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2025 TECHNOLOGY REPORT

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IMPRESSUM

PREFACE

M. Bülent Özçengel

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DEAR READERS,

Technology continues to shape human life, driving transformative change at an ever-accelerating pace. This dynamic evolution calls for innovative perspectives not just in the technology sector but across all fields. In today's world, understanding technology is essential to recognizing and shaping future opportunities. With this understanding, we present the Softtech 2025 Technology Report—an inspiring roadmap shaped by insights from diverse disciplines. Now in its eighth edition, it stands as a testament to a shared vision and collaborative effort.

The transformation in technology progressed relentlessly over the past year, ushering in a period where the relationship between artificial intelligence, humanity, nature, and innovation was examined in depth. The year 2024 was marked as one in which the bond between humanity and technology grew even stronger, with artificial intelligence transcending its role as a mere tool and edging closer to replicating the intricacy of the human mind and nature. Following the dramatic rise of generative AI, we observed technology's far-reaching impacts, extending from environmental sustainability to biotechnology.

The ways in which these innovations, often referred to as 'future technologies,' will forge a common bond between humans and machines remain an enigma. How close is artificial intelligence to achieving the so-called 'Technological Singularity' as technology advances at an unprecedented pace? Could humanity grow stronger and more intelligent by forming a symbiotic relationship with AI? Or might artificial intelligence develop empathic solutions to our challenges by fostering an emotional connection with humans? Most importantly, how will these advancements shape future technologies, industries, and, ultimately, our own nature? Together, we will embark on a journey to explore these profound questions.

In preparing the Technology Report, we were guided by the aspiration to create a resource that not only illuminates the future but also serves as a lasting reference for years to come. We extend our heartfelt gratitude to all the authors, experts, designers, and agencies whose invaluable contributions made this vision a reality.

With a steadfast commitment to shaping the future, we strive to create more time for life through a technology approach rooted in responsibility, sustainability, and human values. It is our greatest hope that the Softtech 2025 Technology Report will inspire, guide, and bring meaningful value to your lives. We look forward to meeting again in the years ahead, with the same excitement and unwavering determination.

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PREFACE

M. BÜLENT ÖZÇENGEL

Softtech

General Manager

The year 2024 marked a pivotal point in the accelerating integration of artificial intelligence into daily life, as the profound impact of technology on individuals, businesses, and societies became increasingly evident. This year, we observed more closely than ever that technology has evolved beyond being merely a tool—it has become a true 'partner,' working alongside humanity and evolving in tandem. Inspired by these observations, we selected 'Technological Singularity' as the central theme of our Softtech 2025 Technology Report.

Artificial intelligence has delivered significant advancements across various domains, enabling faster diagnoses in healthcare, personalized learning experiences in education, and enhanced productivity in the business world. This technological transformation has not only expanded humanity's potential but also fostered a deeper understanding of collaboration and the creation of shared value, making life more creative, connected, and accessible.

This transformation has also served as a beacon of hope for addressing inequalities among individuals and societies. AI-driven solutions have enhanced access to healthcare in developing countries and broadened educational opportunities in rural areas. The democratization of technology has empowered more people with access to innovative tools, while underscoring the vital importance of global collaboration.

For instance, the 2024 Nobel Prize in Chemistry was awarded to the developers of AlphaFold, a groundbreaking innovation

in artificial intelligence. Developed by Google DeepMind, this AI model has transformed the field of biology by accurately predicting protein structures. This revolutionary technology has already played a pivotal role in unraveling the mechanisms of complex diseases and advancing drug development, a contribution that is poised to remain transformative in the years to come.

Quantum computing has also seen remarkable progress. Google's Willow, a groundbreaking quantum chip, captured attention with its success in error correction, showcasing its potential to significantly enhance the precision of quantum computations. Capable of completing tasks in mere minutes that would take traditional supercomputers far longer, Willow underscores the transformative power of this technology. Notably, our country also introduced QuanT, its first quantum computer, marking a key milestone in technological advancement. The advantages of quantum computing—particularly its ability to tackle complex problems with unprecedented speed—are poised to play a defining role in future scientific and commercial breakthroughs. Meanwhile, ongoing efforts to address challenges such as qubit stability, error correction, and scalability will shape the trajectory of this cutting-edge field.

The year 2024 saw remarkable advancements not only in science and technology but also in the realm of literature. The Akutagawa Prize, one of Japan's most esteemed literary honors, was awarded to a novel co-authored with artificial intelligence. This achievement highlighted the extraordinary potential of creative collaboration between humans and machines. By skillfully capturing complex human emotions and intricate social relationships—the novel's central themes—artificial intelligence demonstrated its ability to contribute not only in analytical domains but also as a true partner in creative fields.

Of course, the rapid pace of transformation also brings with it significant risks and responsibilities that cannot be overlooked. Artificial intelligence has placed critical issues—such as data privacy, ethical decision-making, and workforce transformation—at the forefront of global discussions. While the acceleration of automation in certain sectors has resulted in job losses, the persistent challenge of the 'digital divide' remains an urgent problem yet to be resolved.

The lack of transparency in deep learning models continues to pose significant challenges, making it difficult to understand how these technologies function and, in many cases, nearly impossible to trace and correct the causes of incorrect decisions. Questions surrounding the accuracy and reliability of AI-generated content remain pressing. The distortion and dissemination of information through these means create substantial risks for both individuals and societies. In the coming years, it seems likely that 'Disinformation Security' will become an essential aspect of corporate job descriptions, transforming organizational structures to address these challenges.

Moreover, global cybersecurity threats are becoming increasingly sophisticated and dangerous. Cyberattacks targeting critical

infrastructures, in particular, represent a significant threat to national security. The advent of quantum computing is set to render traditional encryption methods obsolete, ushering in a new era where the security of data—ranging from financial systems to state secrets—could be at serious risk. To effectively manage these risks, the need for stronger international cooperation, comprehensive regulations, and awareness campaigns promoting the ethical use of technology has become increasingly apparent. Reflecting the reality that “new challenges demand new safeguards,” NIST (National Institute of Standards and Technology) and ENISA (European Union Agency for Cybersecurity) have published valuable studies on establishing post-quantum encryption standards. Meanwhile, the trend of "Harvest now, decrypt later" has gained momentum. Recognizing this, it is essential for companies to keep their cryptography inventories up to date and allocate budgets to implement post-quantum encryption algorithms.

Another critical issue is the ‘digital divide,’ which highlights the disparity between those who can benefit from the digital age and those who cannot. Global reports underscore the potential of this divide to become a significant challenge. According to the 2023-2024 Human Development Report by the United Nations Development Programme (UNDP), internet access exceeds 95% in high-income countries, while in low-income countries, this figure remains at approximately 26%. As a result, around 2.6 billion people worldwide lack internet access and are unable to benefit from the opportunities afforded by digital transformation.

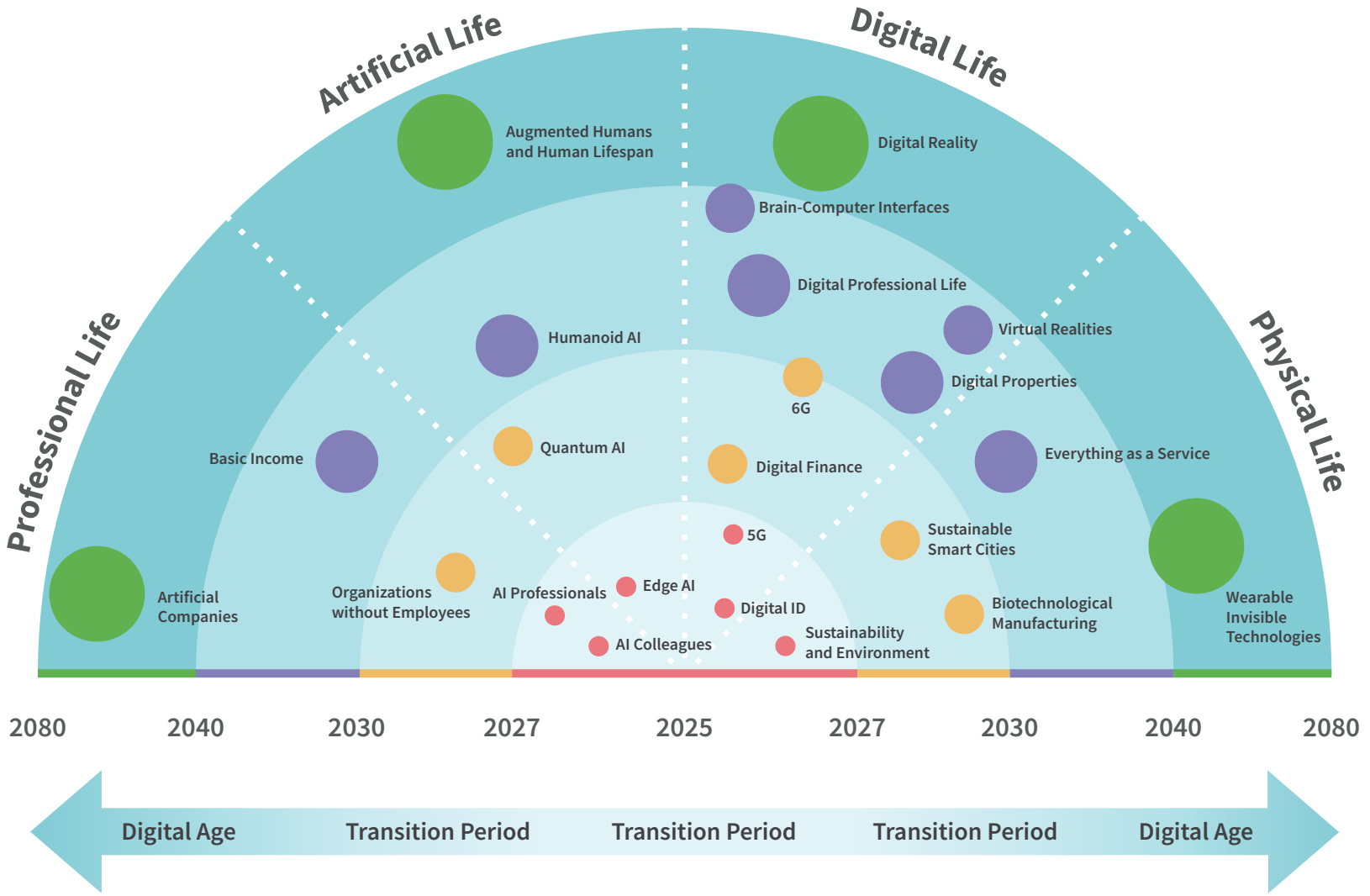
Despite these challenges, 2024 also highlighted encouraging examples of how technology can be harnessed for the benefit of humanity. Notably, global initiatives aimed at bridging the digital divide and promoting more inclusive access to technology garnered significant attention. Projects such as SpaceX's Starlink, Microsoft's Digital Airband Initiative, and Amazon's Kuiper Project focused on delivering internet infrastructure to people in rural and remote areas. In our country, meaningful progress is being made in narrowing the digital divide through initiatives like the ‘Internet for 100 Villages’ project.

In conclusion, the year 2024 reaffirmed that it is possible to harness the transformative power of technology while remaining conscious of its inherent risks. As a group, I would like to emphasize our unwavering commitment to “positioning technology alongside people, not in their place,” and as a company, our enduring mission to “create time for people to realize their full potential.”

I would like to conclude with a quote from Ray Kurzweil, whose visionary concept of ‘Technological Singularity’ inspired the main theme of this report: “Our technology, our machines, are part of our humanity. We created them to extend ourselves, and that is what is unique about human beings.”

I extend my sincere gratitude to our esteemed stakeholders, whose contributions enriched this report with insightful articles and impactful voiceovers, helping us create an exceptional resource in Turkish. I wish you an inspiring and engaging reading experience.

FUTURE OF TECHNOLOGIES


Artificial Life
Digital Life
Professional Life
Physical Life
Augmented Humans and Human Lifespan
Digital Reality
Brain-Computer Interfaces
Digital Professional Life
Humanoid AI
Virtual Realities
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Basic Income
Quantum AI
Digital Finance
Everything as a Service
5G
Sustainable Smart Cities
Artificial Companies
Organizations without Employees
AI Professionals
Edge AI
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Biotechnological Manufacturing
Wearable Invisible Technologies
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Digital Age

TECHNOLOGY RADAR AND 2025 OVERVIEW

KORAY YANGAL

Softtech

Director of Innovation

Since 2018, we have been publishing this annual report without interruption, aiming to highlight the most significant advancements in the field of technology. This year marks our eighth edition, made possible by the contributions of our esteemed guest authors, the dedicated efforts of our report team, and, most importantly, the ongoing support of our valued readers. I extend my heartfelt gratitude to everyone involved and hope this report will serve as an inspiration for those who closely follow the technology landscape.

Our Technology Radar section remains a beacon, shedding light on technological concepts poised to shape our near, medium, and long-term future. In this section, we not only revisit our previous forecasts but also strive to provide you, our loyal readers, with a consistent and insightful perspective. As we navigate the early days of 2025, let us explore together what the future holds, guided by the insights of past Technology Radars.

To maintain continuity with our previous radars, we continue to structure our insights around four key axes: "Professional Life, Artificial Life, Digital Life, and Physical Life". The shifts observed from 2024 to 2025 are summarized as follows:

• "Artificial Intelligence Colleagues" have become an integral part of our daily routines, to the extent that it is increasingly rare to go through a workday without consulting an AI tool. Introduced to our radar in 2021, this concept now holds a central position within our "Professional Life" axis.

• In 2023, Artificial Intelligence Professionals, initially part of our Artificial Life axis, transitioned to the Professional Life axis. Similarly, in our 2023 report, the theme of Artificial Intelligence Colleagues underwent the same axis shift. Does this ongoing shift from the Artificial Life axis to the Professional Life axis hint at a deeper narrative? Let's explore this trend on our radar.

• Each year, we observe that the estimated realization periods for the concepts on our "Artificial Life" axis are consistently brought forward, and this trend continues in this year's report. This pattern provides valuable insight into the accelerating pace of technological advancements associated with these concepts.

• "Brain-Computer Interface (BCI)" makes its debut on our radar under the "Digital Life" axis, aligning with this year's theme of "Technological Singularity".

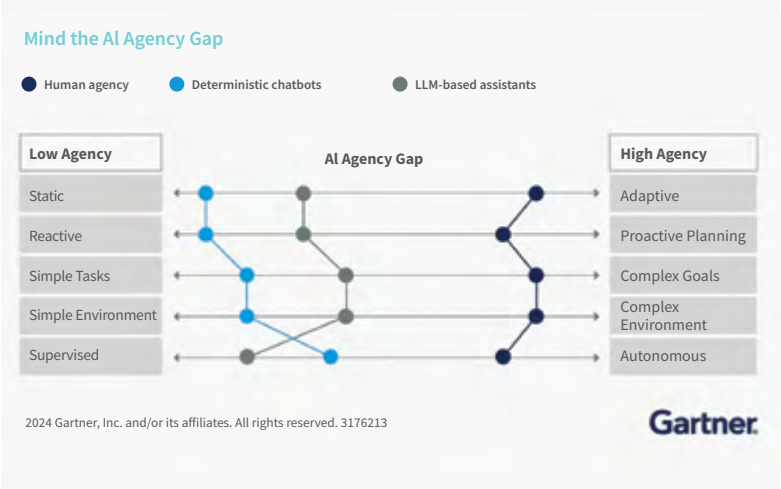
• The concept of 6G has now entered our "Digital Life" axis. You might find yourself thinking, "Wasn't it just yesterday that we were discussing 5G as the future of technology? How quickly we've moved to 6G!" A core motivation behind our Technology Radar is precisely this: To bring the technologies of tomorrow into today's agenda.

• The concept of "Digital Finance", introduced to our radar in 2023, appears to be materializing sooner than expected, driven by technological and regulatory advancements. This report includes insightful articles exploring this topic.

Now, let's delve into the standout concepts on this year's radar.

AI COLLEAGUES & 6G

First, let's establish a shared understanding of the concept of AI Colleagues. This term refers to AI-powered systems or digital assistants designed to help employees perform their tasks more efficiently, quickly, and intelligently. As evident from the definition, the primary goal is to simplify our work processes. According to a Gartner report, by 2028, 33% of enterprise software applications will incorporate AI Colleagues, and at least 15% of daily business decisions will be made autonomously by these virtual assistants.



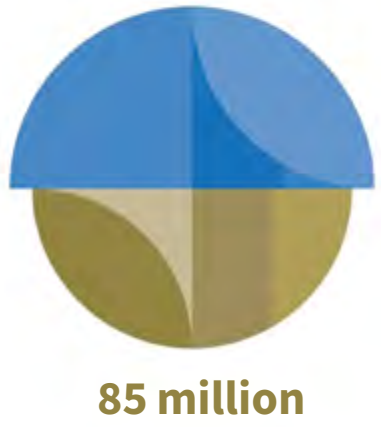
But what does this AI-driven productivity boost imply? Will it truly allow us to spend less time on "Professional Life" and more time on ourselves, or will the concerns about AI replacing human jobs come true? To explore these questions, let's turn to a historical perspective. In 1930, economist John Maynard Keynes introduced the concept of **"Technological Unemployment"** into economic literature. Keynes defined this as the phenomenon where the rate of discovering labor-saving methods surpasses the pace of identifying new applications for labor. In the same article, Keynes famously predicted that by 2030, our weekly working hours would shrink to just 15 hours.

Keynes' prediction was rooted in the belief that advancements in technology would enable people to achieve a higher standard of living while working less, thanks to increased productivity. He envisioned that technology would ease both physical and mental workloads, leading to shorter working hours. As a result, people would have more time for themselves, their families, and their creative pursuits. However, as we approach 2030 with just five years remaining, the extent to which this vision will be realized remains a subject of ongoing debate.

To assess the extent to which Technological Unemployment will manifest in 2025, we can turn to the Jobs of the Future Report, published by the World Economic Forum in 2020. I deliberately chose this report as a reference for retrospective evaluation in our next Technology Report, given its specific predictions for 2025. According to the report, while AI Colleagues may reduce demand in certain job areas, they are expected to generate significantly higher demand for roles in the field of AI Professionals. This trend also explains why certain concepts have transitioned from the Artificial Life axis to the Professional Life axis. Initially considered advanced technology upon their introduction, these concepts evolve into indispensable components of our daily business practices as both technology and skills progress.

Job Landscape

By 2025, new jobs will emerge and others will be displaced by a shift in the division of labour between humans and machines, affecting:



Growing job demand:

1. Data Analysts and Scientists
2. AI and Machine Learning Specialists
3. Big Data Specialists
4. Digital Marketing and Strategy Specialists
5. Process Automation Specialists
6. Business Development Professionals
7. Digital Transformation Specialists
8. Information Security Analysts
9. Software and Applications Developers
10. Internet of Things Specialists

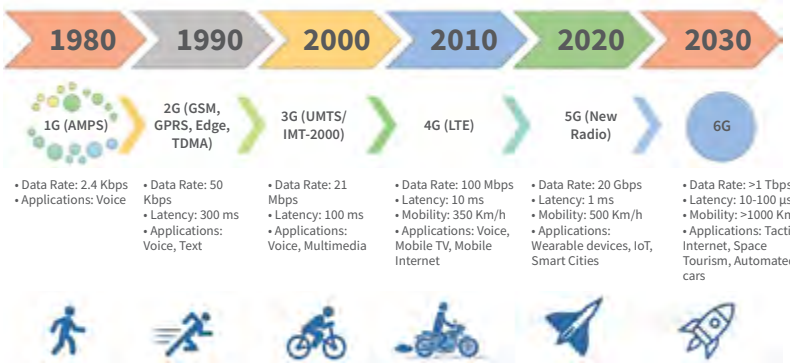
Decreasing job demand:

1. Data Entry Clerks
2. Administrative and Executive Secretaries
3. Accounting, Bookkeeping and Payroll Clerks
4. Accountants and Auditors
5. Assembly and Factory Workers
6. Business Services and Administration Managers
7. Client Information and Customer Service Workers
8. General and Operations Managers
9. Mechanics and Machinery Repairers
10. Material-Recording and Stock-Keeping Clerks

Source: Future of Jobs Report 2020, World Economic Forum.

Now, let's briefly discuss **6G**, a concept that has entered our radar from the Digital Life axis this year. Even the connection speeds provided by 4.5G, introduced in Turkey on 1 April 2016, have significantly transformed our user habits. Who among us hasn't said, "My connection seems unstable; let me switch to my phone," during an online meeting? As Turkey discusses transitioning to 5G/5.5G in 2026, 6G research continues unabated on a global scale.

Unlike its predecessors, 6G, the communication infrastructure of the future, will do more than merely boost connection speeds. It will redefine how smart devices and networks interact with their surroundings. This technology will leverage the Terahertz (THz) spectrum in wireless communications, enabling unprecedented speeds and ultra-low latency in data transfer. However, utilizing this spectrum comes with challenges. The short range of terahertz waves and their susceptibility to atmospheric absorption necessitate innovations in next-generation antenna designs, advanced modulation techniques, and cutting-edge materials to ensure efficient communication at these frequencies. Additionally, frequency allocation and global spectrum management demand international coordination and collaboration among countries. Despite these challenges, 6G is projected to become commercially operational by 2030.



So, how will 6G transform our lives? With ultra-high data transfer rates, latency times measured in milliseconds, and self-optimizing networks powered by artificial intelligence, this technology will stand apart. Achieving speeds of up to 1 terabit per second, 6G will redefine standards in industrial automation, holographic communication, and real-time health applications.

6G will also revolutionize the Internet of Things (IoT) ecosystem, enabling billions of devices to connect seamlessly and simultaneously. Beyond its technological advancements, 6G holds tremendous economic potential. According to forecasts by Kings Research, the global 6G market size is expected to grow from $9.18 billion in 2024 to $59.44 billion by 2031, reflecting a compound annual growth rate of 33.54%.

WHAT AWAITS US IN 2025?

Each article in our Technology Report is designed to build a cohesive narrative by delving deeply into the concepts featured in our Technology Radar, guiding you, our readers, through a step-by-step journey. In this section, we will explore how these concepts are expected to evolve and transform in 2025. Drawing from extensive research, this data-rich segment provides a comprehensive summary of the key concepts.

In earlier paragraphs, we noted that the commercial launch of 6G is anticipated by 2030. By 2025, however, the widespread adoption of 5G networks will enable ultra-fast mobile connections and foster thriving IoT ecosystems. According to Ericsson's Mobility Report, over 4.4 billion 5G subscriptions are projected to be active by 2025, accounting for 60% of global mobile traffic.

Generative AI tools are poised to drive significant advancements across content creation, healthcare, and education. It is estimated that generative AI will account for 10% of all global data, reflecting its growing influence. Furthermore, AI is anticipated to become deeply embedded in consumer electronics, delivering highly personalized experiences. By 2025, the number of AI-enabled devices is projected to rise by 30%, underscoring the rapid integration of AI into everyday life.

The IoT market is projected to grow to include over 75 billion connected devices, driving advancements in real-time monitoring and automation across various industries. Smart cities will leverage IoT-based solutions for traffic management, waste disposal, and energy optimization, transforming urban infrastructure and operations.

In the field of renewable energy, advancements in solid-state batteries are expected to enhance energy storage capabilities and improve the performance of electric vehicles. Additionally, battery costs are forecasted to decline by 40%, making these technologies more accessible. Carbon capture technologies and sustainable production processes are also set to gain significant traction. According to the International Energy Agency (IEA, 2024), global investments in green technologies are projected to rise by 15% in 2025.

The adoption of technological products in the healthcare sector is set to grow substantially, driven by the expansion of mobile healthcare services and wearable technologies. Mobile health usage is projected to increase by approximately 20% this year. Additionally, the integration of genomic data with artificial intelligence will pave the way for precision treatments, revolutionizing personalized healthcare.

Meanwhile, blockchain and decentralized technologies will continue reshaping industries. The market for decentralized finance (DeFi) solutions is expected to reach $20 billion, while Web3 is projected to account for 30% of global internet traffic.

Additionally, quantum computing is anticipated to significantly advance the ability to solve complex problems. According to IBM's Quantum Report (2024), quantum computing capacity is forecasted to increase tenfold, marking a transformative leap in computational power.

Cybersecurity is set to advance significantly, with zero-trust architectures emerging as a key approach to counter increasingly complex cyber threats. The global cybersecurity market is projected to reach $300 billion by 2025, underscoring its growing importance. Additionally, AI-powered tools will play a pivotal role in enhancing threat detection and response, driving more robust and adaptive security solutions.

TECHNOLOGICAL SINGULARITY: THE SHARED FUTURE OF HUMANS AND MACHINES

This year, our primary focus remained on artificial intelligence, which also serves as the foundation of our main theme. Current developments indicate that this focus will continue to dominate for years to come. Reflect on the events you've attended or the reports you've read recently—has any of them excluded a mention of artificial intelligence?In this report, you'll find numerous articles exploring why AI remains such a pivotal topic

and its growing significance. To encapsulate the magnitude of this subject, let me reference a statement by Google's CEO Sundar Pichai from 2018: **"Artificial intelligence is one of the most important things humanity is working on. I don't know, it's deeper than electricity or fire."** This succinctly underscores the profound impact of AI on our world.

Therefore, let us shift our discussion from our focus on artificial intelligence to the concept of Technological Singularity, which forms the core of our main theme. This term was introduced by John von Neumann, widely regarded as the inventor of the computer architecture we use today—an architecture we anticipate will evolve with the advent of quantum computing. Von Neumann brought this concept into our lives in the mid-20th century, envisioning a future shaped by unprecedented technological advancements.

So, what exactly is "Technological Singularity"? In theoretical discussions, "Technological Singularity'—or simply 'singularity'—

is defined as a hypothetical future point where technological growth becomes uncontrollable and irreversible, resulting in unpredictable consequences for human civilization." To better grasp this concept, we can refer to Stanislaw Ulam's reflections from his 1958 article, compiled from conversations with John von Neumann: **"One conversation centered on the ever-accelerating progress of technology and changes in the mode of human life, which gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue."** This profound observation was made during a period when technological advancements were still in their early stages—the 1950s, an era marked by the invention of the first general-purpose computer, ENIAC, the advent of color televisions, and the publication of Alan Turing's Turing Test theory. It is remarkable that the seeds of this concept were planted during what we might now consider the infancy of modern technology.

By the 1990s, Vernor Vinge, a mathematician, computer scientist, and science fiction writer, expanded the concept even further. In his paper titled "The Coming Technological Singularity: How to Survive in the Post-Human Era", he predicted that artificial intelligence would surpass human intelligence, leading to an acceleration in technological progress that would fundamentally transform life as we know it.Vinge's contribution wasn't limited to the scientific realm. Drawing on his science fiction background, he also explored the social, ethical, and existential implications of this transformative concept in his literary works.

In 2005, Ray Kurzweil published his influential book, "Humanity 2.0: Towards the Singularity, Human Transcending Biology." In this work, Kurzweil argues that Moore's Law—which observes the exponential growth of computing power—also applies to the acceleration of technological advancements. He predicts that humanity will reach the Singularity by 2045, a point where humans will overcome biological limitations and merge with artificial intelligence and advanced technologies. The book highlights the completion of the Human Genome Project in 2003 as a significant milestone on the path to the Singularity, emphasizing its role in bridging biology and technology.

As we reach the current year, Ray Kurzweil has once again updated his vision with the release of his book, "The Singularity is Nearer: When We Merge with AI," in June 2024. At the time of writing this article, the book's Turkish translation had not yet been published, so I have referred to its original title. In this new work, Kurzweil predicts that human-level artificial intelligence will be achieved by 2029. He further suggests that the Singularity could occur even before 2045, driven by rapid advancements in AI, groundbreaking research in CRISPR-Cas9—the gene-editing technology awarded the 2020 Nobel Prize in Chemistry—and innovations in BCI (Brain-Computer Interfaces).

So, is a symbiotic life between humans and machines truly possible? The first point that caught my attention while exploring this question is the definition of "intelligence" provided by the Turkish Language Association (TDK). According to TDK, intelligence

is described as: **"All human abilities and skills such as thinking, reasoning, learning, visualizing concepts and objects in the mind, perceiving objective facts, judging, drawing conclusions, controlling the body, perceiving emotions correctly, evaluating, inventing, etc."** I would like to draw your attention to the word "human" at the beginning of this definition. Does this truly differentiate us from machines? What about AI-powered systems capable of passing the Turing Test? When interacting with a customer representative from any company, have you never found yourself wondering, “Am I speaking to a human or a machine?”

These questions prompt us to reflect more deeply on the evolving relationship between humans and machines. As I was organizing my thoughts and putting them into words, a line from the film “I, Robot” came to mind. In one scene, Detective Dell Spooner (played by Will Smith) angrily asks Sonny the Robot:

"Tell me, can a robot write a symphony or turn a canvas into a beautiful work of art?"

Sonny the Robot responds with curiosity:

-"Can you?"

The rapid advancement of artificial intelligence capabilities compels us to reconsider the validity of defining intelligence solely from a human-centric perspective. While intelligence is often described as an exclusively human trait, the ability of AI systems to solve complex problems, generate creative content, and even participate in emotion-based interactions highlights the need to redefine and expand this concept.

In this context, the concept of symbiotic life gains a more tangible foundation. The vision of a future where humans and machines complement each other and collaborate is no longer purely theoretical—it is already becoming a reality. For instance, brain-computer interfaces like Neuralink are considered significant milestones in integrating the human mind with digital systems. Similarly, AI-powered tools such as AlphaFold enable scientists to accomplish decades’ worth of research in just a few weeks, exemplifying the transformative potential of this partnership.

In conclusion, the advancement of human and artificial intelligence toward a symbiotic relationship holds the potential to trigger one of the greatest paradigm shifts in history. However,

viewing this transformation solely as a technological milestone would be inadequate. It also brings forth profound ethical, social, and philosophical questions that demand careful consideration. Since I was 14 years old, I have read Charles Dickens' "A Tale of Two Cities" three times, and each time it offered me a new perspective:

"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way."

The current advancement of technology unfolds in an era strikingly similar to this. On one hand, the integration of artificial intelligence and humanity is opening doors to opportunities once thought unimaginable. On the other hand, the potential inequalities and ethical dilemmas arising from this transformation usher in not only the spring of hope but also the winter of despair.

I hope that the conclusion of this technological journey mirrors the hopeful tone of the final paragraph in A Tale of Two Cities. I trust and believe that, as humanity, we will one day utter a similarly profound and uplifting sentiment about artificial intelligence.

"It is a far, far better thing that I do, than I have ever done."

We kindly invite you to continue sharing your valuable feedback this year as well. Wishing you an enjoyable read!

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DIGITAL TWINS: MERGING VIRTUAL AND PHYSICAL WORLDS

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Dijital ve Sürdürülebilir Gelecek Derneği
Founding President

Over the past years, the world of technology has undergone a rapid and continuous transformation. This transformation, which began in the 2000's with the proliferation of the internet and the acceleration of digitalization, reached a new dimension in the 2010s with the advent of mobile technologies and cloud computing. In the 2020s, advanced technologies such as artificial intelligence, the Internet of Things (IoT), and big data analytics have fundamentally reshaped every aspect of our lives. Among these, the concept of the digital twin has emerged prominently, representing the convergence of the virtual and physical worlds.

Digital twins, as virtual representations of real-world entities, have emerged as a transformative technology with applications spanning a wide array of fields, including manufacturing, healthcare, urban planning, and environmental sustainability.

By leveraging real-time data and simulations, digital twins not only enhance the operational efficiency of businesses and organizations but also hold the potential to create a future that is more secure, efficient, and sustainable.

The lessons derived from the Apollo 13 mission stand as one of the most compelling examples highlighting the significance of digital twin technology. The explosion of the oxygen tanks in April 1970, which transformed the mission into a life-or-death struggle, showcased NASA's innovative approach and engineering ingenuity. During the crisis, the ground crew conducted simulations using a physical model of Apollo 13 on Earth, enabling the astronauts to navigate the challenges and return safely. This model is widely regarded as a precursor to modern digital twin technology.

The story of Apollo 13 serves as a historical milestone, demonstrating the transformative power of digital twin technology. Today, this technology extends far beyond space exploration, enabling safer, more sustainable, and innovative solutions across diverse fields, including healthcare, manufacturing, energy, and smart cities.

The term “digital twin” was first coined in 1998 and formally defined in 2002, later gaining recognition as one of the most significant strategic technology trends in 2017. This groundbreaking technology has revolutionized numerous industries, becoming increasingly cost-effective with the rise of the Internet of Things (IoT). By creating virtual representations

of physical assets, digital twins not only enhance operational efficiency but also play a critical role in risk management, innovation, and product development.

Particularly in smart factories, energy management, and the healthcare sector, digital twin technology is rapidly gaining traction, making processes more efficient, reducing costs, and contributing significantly to the achievement of sustainability goals. Globally, companies are leveraging this innovative technology to gain a competitive edge and deliver unique value to their customers. In Turkey, investments in digital twin projects are expanding rapidly, with notable impacts observed in the areas of industry and urbanization.

According to the Gartner Report, the adoption of digital twin technology has been accelerating rapidly in recent years. It is

projected that 75% of global businesses will invest in digital twin strategies by 2024, and by 2027, 40% of large companies are expected to incorporate digital twins into their projects.

Among the innovative solutions brought by digitalization, Simulation Digital Twin (SDT) is rapidly emerging as a leading technology. Its economic impact demonstrates remarkable growth potential, with global revenue projected to reach $35 billion in 2024 and expected to soar to $379 billion by 2034. This growth highlights not only the rapid expansion of the sector but also the critical importance of digitalization in shaping the future of the business world (E. Brown et al., 2024).

Definition and Functions of Digital Twin Technology: Digital twins are defined as digital representations of physical entities, processes, or systems. These representations are continuously updated with sensor data collected from the physical entity, enabling the analysis, modeling, and simulation of the physical system's behavior. The primary functions of digital twins are as follows:

Real-Time Data Integration: Monitoring the performance of physical assets through sensors and IoT devices.

Simulation and Forecasting: Analysing risks and opportunities by testing possible scenarios.

Optimisation: Enhancing production processes and maximizing resource utilization.

Failure and Maintenance Prediction: Creating preventive maintenance plans and minimizing downtime.

APPLICATION AREAS OF DIGITAL TWINS

Digital twin technology offers a customizable structure tailored to sectoral needs. Its main areas of application are as follows:

Industry and Manufacturing: As a core component of Industry 4.0, digital twins are employed to model and optimize production processes in smart factories. For instance, the digital twin of a production line can help identify bottlenecks and enhance overall efficiency.

A Digital Twin is a virtual representation of a physical component or production process. For it to qualify as a true Digital Twin, the virtual model must regularly update itself by receiving data from

the physical system it reflects. This continuous data update is essential for maintaining accuracy and ensuring traceability to real-world conditions.

In additive manufacturing, the role of digital twins becomes even more critical, as the geometric representation of the product to be manufactured serves as the foundation for not only the physical structure but also for manufacturing process instructions, analyses, and quality verifications. Without a unified digital representation of the component geometry, digital twins are limited to representing only specific stages of the process or require complex data flows to transfer information between steps. To address these challenges, digital twin tools specifically designed for additive and hybrid manufacturing processes must accurately capture and process the state of the component at each production stage. This capability provides real-time insights into each step of the manufacturing process and facilitates process optimization. However, the complexity of integrating such systems remains one of the key technical and operational challenges preventing the widespread adoption of digital twins in the industry (Pratt et al., 2025).

Healthcare: Digital twin technology, a driving force behind Industry 4.0 and Industry 5.0, is transforming fields ranging from defense to urban planning. However, its application in the health and medical sectors remains limited. To unlock its full potential, there is a pressing need to showcase the capabilities of digital twins, particularly in advancing precision neuromusculoskeletal healthcare.

In this context, the development of a digital twin framework offers the potential to deliver more personalized and effective solutions in clinical applications. By leveraging existing computational models and frameworks defined by the International Standards Organization (ISO) for production digital twins, the study by Saxby et al. identifies specific use cases, such as Achilles tendon mechanobiology. For instance, modeling the biomechanical processes within the tendon can aid in individualized treatment planning and lead to more precise clinical outcomes.

Similarly, the application of digital twins in neurorehabilitation technology holds significant potential for optimizing the control of human-machine interface systems. For instance, digital twins integrated with prosthetic or robotic devices to enhance a

patient's mobility can accelerate treatment processes and improve efficiency.

However, progress in this area will depend on the establishment of specific standards and the development of appropriate computational representations to facilitate the transfer of digital data. Future efforts should prioritize data management, modeling methods, and measurement systems to enable the widespread integration of digital twin frameworks into precision healthcare. These advancements will not only improve health outcomes but also support a sustainable digital transformation, fostering innovation across the healthcare sector.

City Planning and Infrastructure: In smart cities, digital twins are employed to optimize traffic flow, monitor energy consumption, and plan infrastructure investments.

THE TRANSFORMATIVE POWER OF DIGITAL TWINS IN URBAN DEVELOPMENT

Digital twin technology is conidered as one of the most innovative solutions shaping the future of cities. In this context, research on urban digital twins highlights the fundamental requirements and challenges for transitioning the technology from concept to practical applications. Making a significant contribution to this field, Ferré-Bigorra et al. (2022) offers the following insightful assessment of how digital twin technology can be utilized in urban development:

"Urban digital twins offer a new paradigm in city management. However, effective implementation of this technology depends not only on the right technical infrastructure but also on conceptual clarity. Misunderstandings and incomplete implementations can limit the benefits that digital twins provide. Therefore, developing a common language and methodology between public administrations and researchers is critical."

CURRENT STATUS AND CHALLENGES

There are still uncertainties in the conceptualization of urban digital twins and the definition of their minimum requirements. For instance, the misuse of the term "urban digital twin" to describe only 3D digital models of cities creates confusion about the scope of this technology. While it is evident that 3D models serve as the foundation for a broader urban digital twin, addressing these misconceptions is essential to achieving a clearer understanding of the key benefits and challenges associated with digital twins.

UNLOCKING THE POTENTIAL: A VISION FOR THE FUTURE

Urban digital twins emerge as a pivotal tool for enhanced decision-making, optimized resource allocation, and the achievement of sustainability goals in urban development. Public administrations, as both key supporters and primary users of this technology, play a central role in its adoption. When implemented effectively, urban digital twins have the potential to revolutionize cities in areas such as traffic management, infrastructure development, environmental sustainability, and the creation of smart cities.

Energy Management: Digital twins are essential for integrating renewable energy sources and enhancing the performance of electricity grids.

SHAPING THE FUTURE: ENERGY DIGITAL TWINS AND SUSTAINABILITY

Energy digital twins (EDT) represent a transformative innovation in energy management, revolutionizing modern industrial processes while advancing sustainability goals. This technology delivers a wide range of benefits, from fostering energy-efficient designs to significantly reducing carbon footprints. In this context, Yu et al. highlight the potential of energy digital twins in their study as follows:

"Energy digital twins offer a comprehensive paradigm shift that supports not only energy management and optimization, but also carbon footprint reduction and the integration of renewable energy sources. This technology has the potential to contribute to environmental sustainability at both local and global levels through energy-efficient design and innovative processes."

This assessment underscores the economic and environmental benefits of energy digital twins in modern industries, offering a promising roadmap for the future.

Automotive and Transport: Digital twin technology is extensively utilized in the development of autonomous vehicles and enhancing the safety of transport systems.

In this new era, which demands the integration of complex, multidisciplinary engineering processes, digital twins provide

an effective solution at the intersection of electrical, electronic, software, and mechanical engineering disciplines.

DIGITAL TWIN: SHAPING THE FUTURE OF VEHICLE DEVELOPMENT

Digital Twin, one of the most powerful tools driving digitalization in the automotive sector, accelerates product development processes while addressing the complexities of emerging trends such as electrification, autonomy, and connectivity.

By enabling the modeling and testing of subsystems through an integrated approach, digital twins ensure the highest standards of safety, comfort, and quality are achieved.

In this transformative process, it is highlighted that automotive manufacturers can enhance their competitive advantage by adopting digitalization, while simultaneously developing vehicles that are more sustainable, reliable, and innovative. Beyond meeting current demands, digital twins act as a bridge, shaping the mobility technologies of the future.

Moreover, as this technological approach becomes widespread throughout the industry ecosystem, it is envisioned that the mobility transformation will not only revolutionize the automotive sector but also advance society toward a more sustainable future (Kochhar, 2023).

THE BENEFITS AND CHALLENGES OF DIGITAL TWINS

Digital twins provide revolutionary benefits across a wide range of industries:

Benefits

Productivity Increase: Reduces time and costs by simulating processes.

Predictability: Lowers maintenance costs by predicting failures in advance.

Comprehensive Visibility: Enhances control and understanding of physical systems.

Challenges

Data Management: Requires robust infrastructures to process and interpret large volumes of data.

Security Challenges: Cybersecurity threats to digital systems can hinder the adoption of this technology.

High Cost: The initial investment required for the technology can pose a barrier for small and medium-sized businesses.

THE FUTURE OF DIGITAL TWINS

Digital twins are poised to play a pivotal role in the technological ecosystem of the future. Their potential expands significantly when integrated with other advanced technologies such as artificial intelligence, augmented reality, and blockchain, enabling more complex and effective solutions. Looking ahead, digital twins are anticipated to drive progress toward sustainability goals, mitigate environmental impacts, and become a cornerstone of smart city infrastructure.

Digital twins are revolutionizing data-driven decision-making by seamlessly merging the virtual and physical worlds. This technology goes beyond process optimization, enabling the development of agile and sustainable systems that are equipped to withstand future challenges. The vision of '**Digital Twins: Merging Virtual and Physical Worlds'** holds immense potential to push the boundaries of technology and innovation further.

DIGITAL TWINS: GLOBAL AND TURKEY-SPECIFIC DEVELOPMENTS

Digital Twin Technology Around the World

Digital twins have emerged as a rapidly adopted and evolving technology worldwide. Particularly in sectors such as industry, energy, healthcare, and smart cities, digital twin applications have experienced significant growth. Key developments in this field can be summarized as follows:

Industry and Manufacturing

• Major companies such as Siemens, General Electric, and Dassault Systèmes have enhanced their production processes by integrating digital twin technology into Industry 4.0 applications, achieving greater efficiency and optimization.

• In the automotive industry, Tesla utilizes digital twins of its vehicles to optimize production processes and analyze performance metrics.

• Boeing leverages digital twins to enhance aircraft maintenance processes, ensuring greater efficiency and reliability.

Healthcare

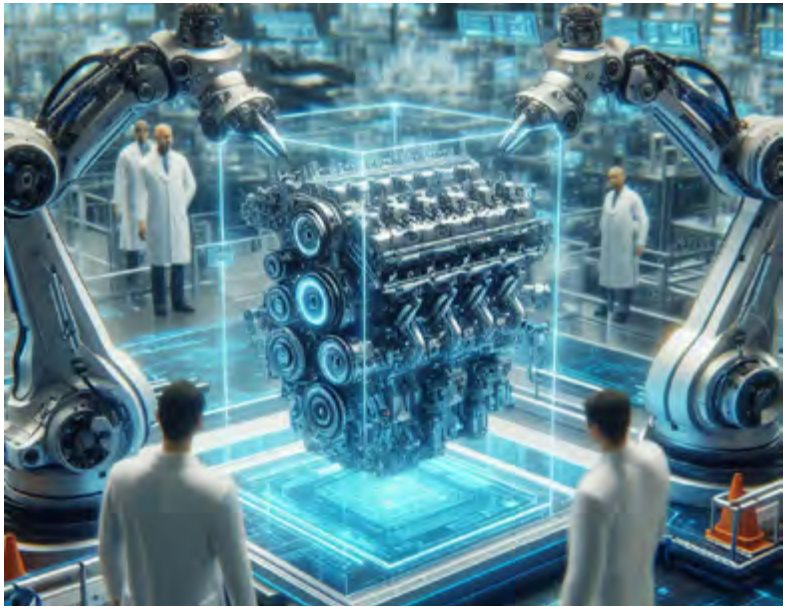
• Digital twin technology has transformed individualized medicine. For instance, Philips and Siemens Healthineers use digital copies of patient organs to optimize surgical planning.

• Healthcare organizations like the Mayo Clinic are utilizing digital twins to analyze patients' medical histories, enabling faster and more accurate diagnoses.

Smart Cities and Infrastructure

• Through the Entire Nation Digital Twin project, Singapore has created a virtual model of the country's entire infrastructure. This platform is used to optimize traffic flow, energy consumption, and urban planning.

• As part of its smart city strategy, Dubai actively employs digital twins in energy management and infrastructure projects.



Energy Management

• Energy giants like BP and Shell utilize digital twin technology to manage oil and gas fields.

• General Electric has developed digital twin applications to enhance the performance of renewable energy systems such as wind turbines.

DIGITAL TWIN TECHNOLOGY IN TURKEY

The development of digital twin technology in Turkey is accelerating within the scope of digital transformation in industry and Industry 4.0 strategies. The adoption of this technology in industrial and public projects is particularly noteworthy:

Industry and Manufacturing

• In Turkey, digital twin technology is utilized to optimize production processes in industrial zones. It is increasingly adopted in sectors such as automotive, white goods, and defense industries.

• Companies like Vestel and Arçelik are investing in digital twin technology to optimize smart production lines and enhance maintenance processes.

Energy

• In Turkey, the creation of digital twins for wind and solar power plants aims to enhance the efficiency of energy generation processes. This technology is actively promoted as part of the digital transformation strategies led by the Ministry of Energy and Natural Resources.

• Electricity distribution companies are implementing digital twin solutions to manage grid infrastructure and predict failures.

Smart Cities

• In major cities like Istanbul and Ankara, digital twin technology is utilized in areas such as traffic management, infrastructure projects, and energy savings.

• In the Konya Smart City Project, municipal services were optimized through the creation of a digital copy of the city.

Research and Education

• Universities and research institutions in Turkey are actively conducting R&D studies on digital twin technology. For instance, projects related to this technology are being developed within TÜBİTAK and technoparks, with young engineers being encouraged to specialize in this field.

Defense Industry

• Defense industry giants like ASELSAN and TUSAŞ actively utilize digital twin technology for aircraft, weapons systems, and logistics management.

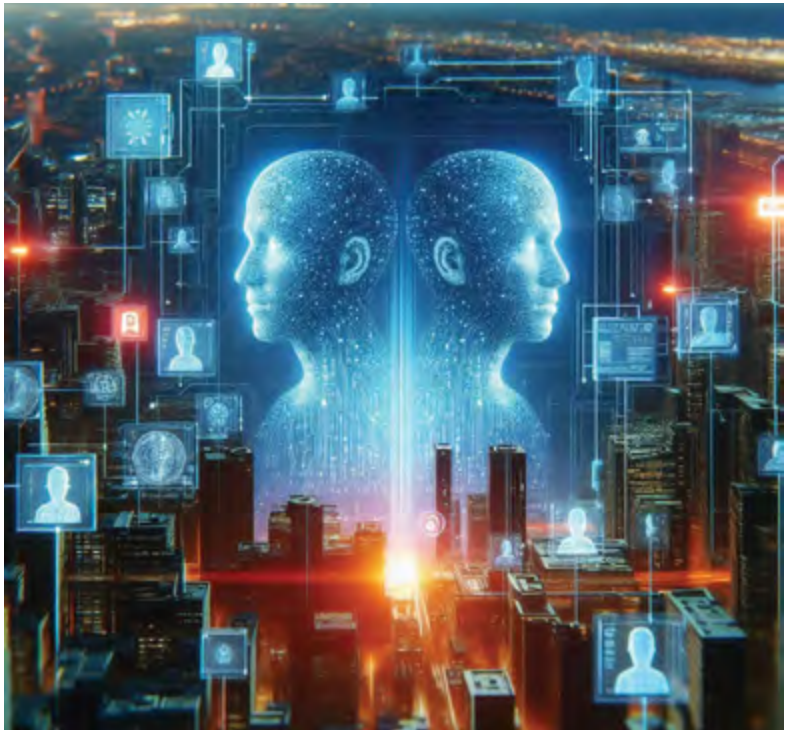
THE FUTURE OF DIGITAL TWINS IN TURKEY

Turkey aspires to achieve world standards in digital twin technology. The investments made by domestic technology companies and the government's digital transformation strategies play a crucial role in reaching this objective. Significant progress is particularly anticipated in the following areas:

• Increasing the number of smart cities and expanding the use of digital twins in urban infrastructures.

• Expanding the use of digital twin technology in Industry 4.0 projects and developing solutions tailored to the needs of small and medium-sized enterprises (SMEs).

• Integrating digital twin technology into a broader range of applications through university-industry collaboration projects.



• Applying digital twin technologies to the management of renewable energy systems.

Digital twin technology has become a crucial component of digital transformation strategies both globally and in Turkey. By implementing the right investments and fostering effective cooperation strategies, Turkey's potential in this field can be significantly enhanced. This technology is poised to contribute to the country's sustainable development goals, not only in areas such as industry and urban planning, but also in critical sectors like energy, health, and the environment.

DIGITAL TWINS AND CYBERSECURITY: IMPORTANCE AND RISKS

Digital twin technology relies on vast amounts of data to create virtual representations of physical assets. This data plays a crucial role in optimizing system performance, predicting potential issues, and enhancing processes. However, ensuring the security of this data is one of the most critical factors for the successful implementation and use of digital twins.

IMPORTANCE OF CYBERSECURITY

In today's world, where digital twins are at the core of operational processes, safeguarding this technology has become a fundamental necessity for ensuring the reliability and continuity of businesses. Cybersecurity plays a pivotal role in maintaining the integrity, confidentiality, and accessibility of the data that digital twins rely on. Protecting digital twins, especially those utilized in industrial processes, energy networks, and the health sector, is crucial not only to prevent economic losses but also to ensure the protection of human life.

RISKS AND THREATS

Data Breaches: Digital twins rely on sensitive data that represents real-world processes and assets. Unauthorized access to this data can lead to significant financial and operational losses for businesses.

Cyber Attacks: The networks connected to digital twins can

become targets for malicious attackers. For instance, an attack on the digital twin of a production facility could result in production stoppages or increased error rates, causing significant disruptions.

Manipulation and Misinformation: If the data powering digital twins is manipulated, it can lead to incorrect outcomes and faulty decisions. This can directly impact the performance of physical assets, potentially causing serious damage.

Weak Security Protocols: Insufficient security measures in the creation and operation of digital twins can make systems vulnerable to targeted attacks.

PROPOSED SOLUTIONS

Encryption and Data Protection: Encrypting all data utilized in digital twins minimizes the risk of unauthorized access.

Cybersecurity Training: Enhancing employees' cybersecurity awareness helps minimize risks associated with human error.

Artificial Intelligence-Based Security Systems: AI-powered solutions can be employed to detect and prevent cyber threats in real time.

Regular Updates and Tests: Ensuring systems are up-to-date and conducting regular security tests helps address potential vulnerabilities.

To fully harness the potential of digital twins, managing cybersecurity risks must be a strategic priority for organizations adopting this technology. A robust cybersecurity strategy not only enhances the reliability of digital twins but also supports businesses in achieving their innovation and sustainability goals.

CONCLUSION

Digital twin technology has emerged as one of the most powerful tools of digital transformation, seamlessly integrating the virtual and physical worlds. Today, digital twins are widely applied across various fields, from industrial production to healthcare, energy management, and urban planning. They enhance the efficiency of operational processes and play a critical role in supporting

sustainability goals. By enabling real-time monitoring, simulation, and optimization at every stage of the product life cycle, this technology reduces costs, minimizes risks, and improves decision-making processes.

However, the success of digital twins depends not only on the technology's capabilities but also on the vision and strategic approach of the organizations implementing it. To use digital twins effectively, organizations must enhance their competencies in data management, cybersecurity, artificial intelligence integration, and human resources development. Furthermore, the evolution of digital twins will accelerate as they are increasingly integrated with other technological components such as the Internet of Things (IoT), big data analytics, and artificial intelligence.

In the future, the potential of digital twins will extend far beyond process optimization, playing a pivotal role in designing smarter, more sustainable, and human-centric systems. This technology, which pushes the boundaries of innovation, will not only enhance the competitive advantage of businesses but also deliver significant environmental and social benefits. The transformative power of digital twins positions them as an indispensable technology for shaping both the present and the future.

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FROM BIG DATA TO BIG POWER: ARTIFICIAL INTELLIGENCE MEETS NUCLEAR POWER

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Artificial intelligence (AI) has revolutionized industries and reshaped how we interact with technology. From autonomous vehicles to virtual assistants, the potential of AI appears boundless. However, this remarkable progress carries a cost that often escapes attention. Beneath the surface lie challenges such as the skyrocketing energy demand, environmental impacts, and widening global inequalities in access to AI resources. In this article, I will explore the energy requirements of AI, its socioeconomic implications, and the potential of Small Modular Reactors (SMRs) as a sustainable solution. Wishing you an engaging read.

THE ROLE OF GPUS AND TPUS IN AI DEVELOPMENT

At the heart of AI's progress are Graphics Processing Units (GPUs) and Tensor Processing Units (TPUs). While TPUs are predominantly utilized within Google technologies, GPUs have broader applications across various platforms. These specialized processors are the unsung heroes of modern AI, driving breakthroughs that would otherwise remain unattainable. But how do they achieve this?

Parallel Processing Power: Unlike Central Processing Units (CPUs), which handle tasks sequentially, GPUs and TPUs excel at parallel processing. This capability enables them to execute thousands of calculations simultaneously, making them essential for AI tasks such as matrix multiplications and linear arithmetic.

What Would Happen If CPUs Were Used? If CPUs were the sole resource for AI training, the time required to train advanced models, such as GPT-4, would become extraordinarily long. A process that

takes weeks or months with GPUs would extend into decades with CPUs, significantly hindering AI innovation. For instance, GPT-3, which was trained in 34 days using GPUs, would have required over 10 years with CPUs due to their inability to efficiently manage such massive workloads.

High Throughput and Efficiency: GPUs provide exceptional throughput for data-intensive tasks by operating thousands of cores in unison. TPUs, specifically designed for AI workloads, further streamline processes like deep learning, reducing latency and boosting efficiency. These innovations are enabling researchers and developers to progress at an unprecedented speed.

Without GPUs and TPUs, the development of AI would remain merely a possibility. These processors underscore their indispensable role in shaping the future of technology.

ENERGY DEMANDS OF AI: TRAINING AND INFERENCE PHASES

As AI models grow more complex, their energy requirements escalate accordingly. The energy consumption of AI can be examined by dividing it into two distinct phases: training and inference.

Training Phase: The development of large AI models, such as GPT-3 and GPT-4, referred to as large language models (LLMs), demands extraordinary computational and energy resources.

GPT-3: Training 175 billion parameters required 34 days and consumed 1,287 megawatt-hours (MWh) of energy. This amount of energy is equivalent to the monthly energy consumption of approximately 1,450 homes in the United States.

GPT-4: With over 1 trillion parameters, training GPT-4 over 100 days consumed between 51,773 – 62,319 MWh of electricity. This energy usage is equivalent to the monthly consumption of approximately 59,000 to 71,000 American households. To put this into perspective, it matches the energy needs of the entire city of Palo Alto, located in Silicon Valley, for one month. This starkly illustrates the enormous resources required for advanced AI training.

Inference Phase: After completing training, AI models enter

the inference phase, where they generate outputs based on the knowledge acquired during training. While individual inference processes consume relatively less energy, their cumulative impact across millions of users is substantial.

A Single Query: A single ChatGPT query consumes 0.0029 kilowatt-hours (kWh) of energy—nearly 10 times the energy required for a Google search.

An Average Dialogue: An average ChatGPT dialogue consisting of approximately 15 queries consumes 0.0435 kWh of energy. This amount of energy is sufficient to power a standard 10-watt LED bulb for more than 4 hours.

Annual Energy Use: ChatGPT's annual energy consumption, estimated at 226.8 GWh, is sufficient to fully charge 3.13 million electric vehicles or meet Finland's energy needs for one day. It is important to note that this is a conservative estimate, based on an estimated 78 billion annual queries in early 2024. With increasing demand since then, this figure has likely doubled.

Cost and Profitability: Unsurprisingly, OpenAI remains far from profitable due to its significant operational costs. Like many high-potential Silicon Valley startups, it relies heavily on venture capital funding, prioritizing long-term growth over immediate profitability. As of November 2024, OpenAI had secured $17.9 billion in investments and reached a valuation of $157 billion following its latest financing round.

Future Energy Outlook: As AI adoption accelerates, energy demand during the inference phase is projected to grow faster than during the training phase. Coupled with an anticipated 85% increase in GPU energy consumption by 2025, this trend points to a 220% rise in global energy consumption by 2027. This dramatic surge over such a short period underscores the urgent need for change in managing AI's energy demands.

Figure 1: Producing this image consumed enough energy to charge an iPhone halfway.

THE GLOBAL RACE FOR AI

The rapid growth of AI has intensified global competition for GPUs, driving innovation but also creating inequalities.

For developed countries, GPU access is relatively easier, but meeting the energy demands of AI remains a significant challenge. Despite advanced infrastructure, energy bottlenecks are becoming an increasingly critical issue, potentially slowing the pace of AI advancements.

In contrast, the situation is more challenging for developing countries, where access to GPUs is becoming progressively more difficult due to a range of factors. Here's why:

High Costs: Advanced GPUs, particularly those produced by market leaders like NVIDIA, are prohibitively expensive for many developing countries.

Supply Constraints: The soaring demand for GPUs has prompted providers to prioritize customers with greater purchasing power, often sidelining developing countries and their companies with relatively smaller economies. In their pursuit of a competitive advantage, companies are striving to secure GPUs earlier to train their AI models. As a result, delivery times for NVIDIA's AI GPUs can extend to as long as five months, further amplifying inequalities. NVIDIA's stock performance reflects this shift, especially after the launch of ChatGPT. While gaming GPUs contributed the lion's share of NVIDIA's revenue over the past decade, its latest balance sheet reveals a significant transformation: approximately 78% of total revenue now comes from Datacenter/AI GPUs, compared to just 17% from gaming GPUs.

Export Restrictions: The volatile global political climate and regulations, such as the U.S. policy restricting advanced chip exports to China, are creating barriers to global AI participation, limiting opportunities for many nations.

The impacts of AI extend far beyond technology, with the potential to significantly reshape the economy. By enhancing Total Factor Productivity (A)—a measure of how efficiently a country utilizes its resources—AI raises both opportunities and concerns about deepening economic inequalities. Total Factor Productivity, along with physical capital (K) (e.g., infrastructure, machines, and technology) and labor (N), are key determinants of a country's Gross Domestic Product (GDP), expressed as: $Y = A \times f(K, N)$.

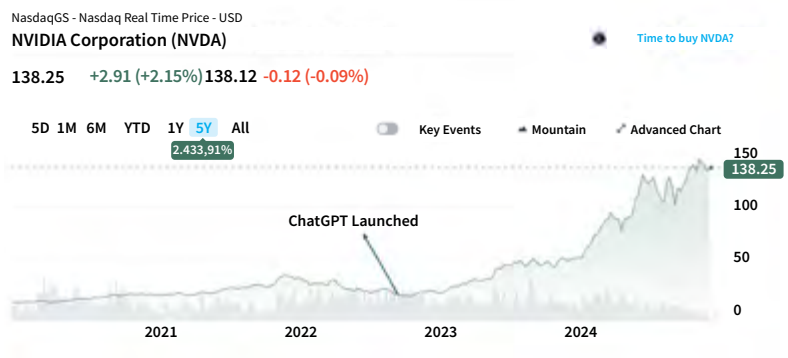

Figure 2: The rise of NVIDIA stock over the last five years.

In developed countries, Total Factor Productivity (A) typically increases at a rate of 1-2% per year, fostering sustainable economic development. However, in many developing nations, including Turkey, A growth remains either stagnant or negligible, which undermines their global competitiveness. As the adoption of AI accelerates, this disparity is likely to widen further, potentially leaving developing countries stuck in a cycle of low competitiveness and slow economic growth.

The age of AI is rapidly becoming a defining force in shaping global inequalities. Access to AI is not merely a technological challenge; it is a critical determinant of economic and geopolitical dynamics,

profoundly influencing the future of nations in the 21st century.

ENVIRONMENTAL COST OF AI

AI's energy-intensive nature presents significant environmental challenges:

Carbon Emissions: Training large AI models generates 626,000 pounds of CO2, equivalent to five times the lifetime emissions of an average car.

Data Center Demands: AI workloads have driven a nearly 50% increase in Google's emissions since 2019, underscoring the environmental cost of technological progress.

As AI's energy demands continue to rise, identifying sustainable solutions is no longer optional but an urgent necessity.

SMALL MODULAR REACTORS: A SUSTAINABLE SOLUTION?

To tackle these challenges, technology companies are exploring Small Modular Reactors (SMRs) as a cleaner and scalable energy solution.

WHAT IS SMR?

Small Modular Reactors (SMRs) are advanced nuclear reactors with the capacity to generate up to 300 megawatts of energy, approximately one-third the capacity of conventional reactors. Their modular design allows components to be manufactured in factories, significantly reducing both costs and installation times. While the installation of conventional reactors typically takes 5-7 years, SMRs can be installed in just 2-3 years.

	Conventional Reactor	Small Modular Reactor
Power	~1,000 MW	300 MW
Production	On-site, complex	In factory
Setup Duration	5–7 years	2–3 years
Scalability	Limited	Highly scalable
Security	Standard	Enhanced Passive Prevention

PARTNERSHIPS OF MAJOR TECHNOLOGY COMPANIES WITH SMR PROVIDERS

Leading technology companies are increasingly adopting Small Modular Reactors (SMRs) to address rising energy demands and support their sustainability goals. These strategic partnerships mark a significant shift towards leveraging advanced nuclear energy solutions for AI-driven operations:

Google: In collaboration with Kairos Power, Google aims to develop a fleet of SMRs capable of generating 500 megawatts (MW) of power by 2035. The first reactor, expected to become operational by 2030, will support Google's ambitions of achieving 24/7 carbon-neutral energy and net-zero emissions across its global data centers. Kairos Power's innovative molten salt cooling system and ceramic pebble-type fuel enhance reactor safety and efficiency

by enabling operation at low pressure. This initiative positions Google as a pioneer in leveraging advanced nuclear solutions to meet the energy demands of its expanding AI infrastructure.

Amazon Web Services (AWS): AWS is collaborating with X-energy and Energy Northwest to deploy SMRs capable of generating over 5 gigawatts (GW) of energy by 2040. The initial projects in Washington state and Virginia will feature four SMRs producing up to 960 MW, enough to power approximately 770,000 homes. These reactors will support AWS's rapidly expanding cloud services and AI operations, while aligning with its carbon neutrality goals. This investment highlights AWS's commitment to adopting sustainable energy solutions for its energy-intensive infrastructure.

Microsoft: In partnership with Constellation Energy, Microsoft is working to revitalize the Three Mile Island Unit 1 reactor and has entered into a 20-year power purchase agreement to supply 835 MW of carbon-neutral electricity for its data centers. The reactor is scheduled to restart in 2028, supporting Microsoft's commitment to becoming carbon-negative by 2030. By utilizing existing nuclear infrastructure, Microsoft reduces its environmental footprint while ensuring a reliable energy source for its expanding AI operations.

These partnerships highlight the growing trend of tech giants turning to nuclear power as a sustainable solution to meet the increasing energy demands of AI technologies. As these initiatives progress, they are poised to play a vital role in reducing carbon footprints, enhancing energy reliability, and serving as a model for clean energy innovation across industries.

AI AND THE FUTURE OF ENERGY

In a nutshell: Artificial intelligence holds immense potential to transform industries and societies, but it also brings significant hidden costs that cannot be overlooked. From the massive energy demands of training and operating AI models to the environmental impacts and growing global inequalities, these challenges underscore the urgent need for sustainable solutions. For developing countries like Turkey, the stakes are especially high. While AI has the potential to boost economic growth by enhancing productivity, unequal access to resources such as advanced GPUs and sustainable energy infrastructure poses a serious risk of falling further behind developed nations.

Figure 3: I used the other half of the iPhone's battery power for this.

In an increasingly competitive global landscape, artificial intelligence is no longer merely a technological tool but a strategic driver shaping the future of nations. By enhancing applications, governance, education, healthcare, and innovation, AI can foster a knowledge-based economy. Nations that strategically embrace AI will lead the next wave of global development, influencing not only their domestic growth but also their geopolitical standing. As a result, AI readiness and resource accessibility must be prioritized as central components of national policy.

Turkey must take proactive measures to fill this gap. Investing in innovative energy solutions like Small Modular Reactors (SMRs) can simultaneously support the country's AI ambitions and advance its sustainability goals. To stay competitive in the 21st century, collaboration with global technology leaders and fostering local innovation in both AI and energy technologies will be crucial.

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THE INNOVATION REVOLUTION IN HEALTHCARE: WEARABLE HEALTHCARE TECHNOLOGIES

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As digital transformation continues to accelerate, new trends, innovations, and business practices are increasingly becoming part of our daily lives. In recent years, wearable technologies have significantly impacted various sectors, including healthcare, sports, entertainment, education, and the business world, enhancing daily life in meaningful ways. Once primarily a concern for middle-aged and older individuals, health monitoring has gained greater importance among younger populations, particularly in the aftermath of the Covid-19 pandemic. In this context, wearable healthcare technologies have redefined innovation capabilities and needs within the healthcare sector.

Wearable health technologies are also transforming lifestyles by helping users counteract the negative effects of a sedentary lifestyle and encouraging increased physical activity. Among these, smart bracelets are one of the most recognized products, widely used by individuals to monitor and adjust their standing and activity times based on their personal routines.By sending notifications, these devices enable users to shape their daily habits, promoting healthier living. In the sports and fitness sector, wearable technologies further enhance user experiences by offering personalized programs. They allow individuals to analyze their performance, optimize their workouts, and achieve more effective results tailored to their needs.

Smart bracelets are not only the first innovative products in this sector but also represent the smallest milestones in its development. In addition to smart bracelets, wearable

technologies enable more efficient healthcare services by collecting and analyzing health data. Smartwatches and devices tailored for athletes significantly contribute to optimizing a healthy lifestyle, gathering various biometric data such as heart rate, sleep patterns, step count, and calorie tracking. Other examples of products that collect health data and serve diverse purposes include smart lenses developed for addressing visual impairments, smart face masks that track changes in the skin and analyze skin aging processes, smart beds that analyze sleep patterns, smart bracelets and necklaces that monitor heart rate, sleep patterns, stress levels, and body temperature, smart shoes integrating pedometers, distance meters, and pressure sensors, and smart t-shirts that monitor muscle activities and provide recommendations for improving form.

The Internet of Things (IoT) applications underpinning these technologies enable consumers to integrate the data collected from their wearable devices with other devices and health services.

Recent efforts have also focused on addressing the negative effects of gender inequality in wearable technologies. For instance, a smart bra developed in England plays a crucial role in facilitating rapid intervention during sudden and life-threatening heart problems in women. Research indicates that women are less likely than men to receive CPR in public during a cardiac arrest. One-third of British respondents report concerns about privacy when administering CPR to a woman, while another one-third of men express fear of being accused of "inappropriate" behavior when performing CPR on a woman experiencing a heart attack in public.

To highlight this issue, the British charity St John Ambulance partnered with Chelsea FC Women's Team captain Millie Bright to introduce the world's first "CPR bra." This innovative bra underscores the importance of rapid intervention to save lives, regardless of gender. Its front side features the message "It's OK to save my life" along with instructions on how to perform CPR effectively.

Artificial intelligence (AI) has increasingly played a pivotal role in the advancement of wearable health technologies, as it has in

many other fields. Wearable health products use AI algorithms to analyze the data they collect, providing in-depth insights into users' health, predicting potential health issues, and offering personalized recommendations. Significant progress has been made in monitoring vital health parameters, including heart health, blood pressure, and glucose levels.

Additionally, new sensors and applications are becoming more prevalent, accelerating innovation and offering fresh perspectives in health technologies. Notably, flexible sensors capable of detecting biomarkers and RF-based remote monitoring technologies are gaining attention. These sensors provide more effective and user-friendly solutions for health monitoring, enhancing the overall experience and efficiency of healthcare processes.

In 2024, wearable technologies are becoming increasingly prominent in areas such as sports and health tracking, chronic disease management, elderly care, and psychological health. These advancements are driving the personalization of healthcare, empowering individuals to make more informed decisions about managing their own health.

Wearable technologies have begun to find new applications as tools for employee engagement and motivation. The rise of remote and flexible working models following the pandemic has highlighted the need to prioritize the physical and mental health of employees. By utilizing anonymized data from wearable devices, companies can implement initiatives to safeguard employee well-being. Many organizations have introduced

new programs by incorporating health professionals into their teams to support the holistic health of their workforce. Wearable devices play a key role in creating a healthier, calmer, and lower-stress workplace by monitoring factors such as stress levels, sleep patterns, and overall fitness. In the field of occupational safety, these technologies can proactively identify risky situations by tracking employees' health conditions, enabling timely implementation of health and safety measures. Consequently, wearable technologies contribute to a safer, more efficient, and happier working environment, enhancing both employee well-being and organizational productivity.

In addition to the advancements mentioned, the fields of education and training have also begun to leverage the opportunities offered by wearable technologies. Virtual reality

(VR) and augmented reality (AR) technologies, in particular, enhance learning processes by providing students with a rich visual experience, making theoretical lessons more interactive and efficient. These devices are especially advantageous for supporting practical knowledge in fields such as medicine, engineering, and rehabilitation, through audiovisual narratives. For example, medical students can improve their learning outcomes by practicing complex concepts in a virtual environment before applying them in real-life scenarios, including rehearsing risky surgical procedures. Additionally, wearable VR technology offers significant benefits in treating psychological disorders such as post-traumatic stress disorder, phobias, and anxiety, as well as in brain injury assessment, rehabilitation, and social skills training for individuals with autism. These applications have the potential to create more effective learning and treatment processes for both students and therapists.

In conclusion, although wearable technologies remain a relatively new field, they are rapidly integrating into our lives, driven by advancements in AI. This evolution is not only transforming the consumer experience but also fostering cross-sector collaborations, new business models, and innovative solutions. The capabilities of wearable devices in health, sports, education, and the business world empower individuals to lead healthier lives, both physically and mentally. In this rapidly evolving sector shaped by innovation, solutions and opportunities that were once unimaginable are coming to the forefront. As the future of technology is increasingly defined by the power of personal data, wearable technologies are transitioning from being mere entertainment tools to becoming indispensable instruments for better understanding life, improving quality of living, and transforming lifestyles.

In summary, wearable health technologies represent a significant milestone in the personalization and enhancement of healthcare services. However, their effectiveness depends on prioritizing user feedback and ensuring data security. This field is expected to experience rapid growth, with continuous innovations in the years ahead. For entrepreneurs and healthcare professionals, leading this transformation with innovative solutions will be essential to remain competitive; otherwise, falling behind in the sector will be inevitable.

THE JOURNEY OF FINANCE AND TECHNOLOGY IN 2025, WITH BLOCKCHAIN IN FOCUS

FATİH GÜNAYDIN

İş Dijital Varlık

General Manager

Around 500 BC, the philosopher Heraclitus observed that change was the most fundamental aspect of nature, famously stating, "There is nothing permanent except change." Centuries later, this timeless wisdom found resonance in the modern business world through Jack Welch, the iconic leader of General Electric and one of the most celebrated CEOs in history. Welch encapsulated his approach to leadership with the principle, "Change before you have to."

The necessity for institutions to adapt to change in order to ensure their survival—an idea recognized by both ancient philosophers and modern leaders—continues to shape the worlds of technology and finance today. In this context, understanding the role that blockchain technology will play in various sectors by 2025 and beyond is becoming increasingly critical. For institutions, it is essential not only to take timely actions to adapt to these evolving conditions but also to recognize the urgency and importance of making such moves.

WHAT DID 2024 LOOK LIKE?

The journey to 2024 for the blockchain ecosystem was far from smooth. The years 2022 and 2023 cast a long shadow over the crypto sector, resembling a harsh winter, with major global exchanges collapsing and regulatory restrictions tightening. Yet, amidst the frost, seeds of transformation were planted, as the sector began to recalibrate and lay the groundwork for broader adoption.

A glimmer of hope emerged with the introduction of Spot Bitcoin

ETFs, a milestone that offered stability and credibility to the industry. This move not only signaled a turning point but also set the stage for a brighter future. At the same time, Bitcoin and the cryptocurrency ecosystem stepped into the global spotlight, becoming a pivotal topic in election campaigns—a clear testament to their growing influence on world politics and the financial landscape. Now, with Bitcoin nearing the 100,000 USD milestone, it is evident that cryptocurrencies are not just a passing trend but a defining force shaping the future of finance and technology.

WHAT WILL 2025 BRING?

First and foremost, I would like to begin by establishing a definition to shape the remainder of this article. Here, I will refer to cryptocurrencies—which many individuals trade solely for financial returns—along with various NFTs acquired either as collectibles or as long-term investment vehicles, consumable or permanent NFTs used in games and virtual universes with emerging applications, and tokenized real-world assets (RWA), such as financial instruments, real estate, carbon credits, and commodities like grain, collectively as "Digital Assets." From this perspective, digital assets have the potential to fundamentally transform numerous sectors.

However, for blockchain technology to be seamlessly integrated into the finance and banking ecosystem, significant efforts are required. This includes the development of innovative solutions and products by technology providers to address the software and hardware needs of this rapidly evolving domain.

To enhance the reliability of digital assets, regulation has become a focal point of global efforts. The MiCA (Markets in Crypto-Assets Regulation) framework, implemented by the European Union, represents a significant milestone in this regard. Similarly, important advancements are taking place in Turkey, positioning the country as a potential leader in this field. The "Law on Amendments to the Capital Markets Law", published in the Official Gazette No. 32590 on July 2, 2024, introduced comprehensive regulations addressing crypto assets. These efforts, reinforced by additional communiqués and guidelines issued by the Capital Markets Board (CMB), seek to create a robust and secure framework for all stakeholders within the digital asset ecosystem. An essential component of these regulations is the definition

of KVHS (Crypto Asset Service Providers), which establishes qualification standards for institutions seeking to operate within the sector. As of this writing, the CMB's temporary operating list includes 77 KVHS, consisting of 7 Custody Institutions and 70 Crypto Asset Trading Platforms.

Ensuring the security of customer assets remains a top priority for regulations worldwide, making custody institutions a cornerstone of the digital asset ecosystem. The future of digital assets fundamentally depends on the competencies, security, and complementary services provided by these custodians. For individuals and institutions investing in cryptocurrencies or tokenized assets for various purposes, the reliability and reputation of the custodian will be paramount. Similarly, developer institutions creating value on the blockchain are likely to prioritize partnerships with custodians capable of ensuring both the technological integrity and regulatory compliance of the assets they produce. To address these market needs, we deliver services that integrate our technical expertise with complementary layers, including strategy, compliance, risk management, control, and operations. Backed by the strength of the Türkiye İşbank ecosystem, which brings a century of history and experience, and a specialized team in the blockchain domain, we provide end-to-end solutions tailored to the evolving digital asset landscape.

When examining the 2025 agenda of the blockchain world, another critical topic likely to be on the radar is CBDC (Central

Bank Digital Currency). In Turkey, we have already seen developments in this area, with some details revealed in the first-phase evaluation report published by the CBRT in 2023. Globally, studies in this field are also expected to accelerate.

Another issue likely to occupy our agenda is the perception of digital assets as strategic reserves by both countries and corporate entities, leading to increased investments in this area, particularly in Bitcoin. It remains to be seen whether the positioning of Bitcoin as a strategic reserve, a topic featured in election campaigns in the USA, and the ambitious goal of owning approximately 5% of the entire Bitcoin supply—equivalent to 1 million BTC over a five-year period—can be realized. Nevertheless, even the rumor

of such a plan has already had a notably positive impact on the markets.

Another blockchain-focused topic on the global banking and finance agenda for 2025 is the development of stablecoins backed by various underlying assets. The issuance of fiat-backed stablecoins and asset-backed stablecoins (e.g., gold) is expected to become widespread.

Another topic that will likely gain prominence from 2025 onwards is the collaboration between blockchain and artificial intelligence (AI). Data privacy, which raises the biggest question marks in artificial intelligence studies, and the fact that artificial intelligence models, which mostly work as a black box, use the unchangeable record-keeping structure of blockchain, full transparency, and accountability features, can lead us to artificial intelligence solutions that reach wider areas of use. Conversely, AI can help overcome some of the efficiency, sustainability, and adaptability challenges faced by blockchain. By optimizing the efficiency of smart contracts, operating energy-saving mechanisms, and conducting preventive security operations, AI could enable more sustainable and effective blockchain solutions, creating a mutually beneficial dynamic between these transformative technologies.

When we consider all of this together, as we look toward the horizon of 2025 and beyond, it becomes clear that blockchain is not merely a trend but the foundation of a new world. In this emerging ecosystem, trust will be established through codes, the boundaries of technology and financial instruments will be redefined, and opportunities will become accessible to all.

IS ARTIFICIAL INTELLIGENCE ESSENTIAL FOR TRANSFORMATION?

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In 2024, artificial intelligence, particularly generative AI, dominated discussions on both the global and local agendas. From Google search trends to reports by independent consulting organizations, various data indicate that generative AI applications, such as OpenAI ChatGPT, Google Gemini, and Microsoft Copilot, are increasingly influencing both the business world and individual use. While this rapid technological ascent generates excitement, it also raises critical questions: Can these technologies truly drive major transformation, or do they merely provide superficial improvements?

With over 30 years of experience in the technology sector, I can confidently state that no technology alone can drive meaningful change in business processes. Technology may ignite the spark of transformation, but for this spark to evolve into a full-fledged fire, business practices and organizational structures must also adapt. If new technologies are merely layered onto outdated processes, their true potential will remain unrealized.

With the advent of new technologies, companies must reassess not only their technological infrastructure but also their business models, organizational structures, and the competencies of their employees. In this context, it is crucial to view technology not merely as a tool but as a strategic business partner.

THE UNIQUE POWER OF GENERATIVE ARTIFICIAL INTELLIGENCE

Generative artificial intelligence is being integrated into the business world at a much faster pace than past transformative

technologies like the internet, cloud computing, and blockchain. A key factor driving this rapid adoption is its ease of use. For instance, OpenAI's ChatGPT can be utilized effortlessly, even by non-technical users. This accessibility has allowed generative AI to surpass 100 million users within just two months, marking an unprecedented milestone in the history of technology adoption.

However, the influence of generative AI extends far beyond its rapid adoption. By supporting both creative and repetitive tasks, these technologies enable a level of productivity and innovation that was previously unattainable. For example, employees can now leverage AI to assist with report writing, data analysis, or quickly responding to customer inquiries. This not only accelerates business processes but also allows individuals to focus on more strategic and value-driven tasks.

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON BUSINESS WORLD

When assessing the impact of artificial intelligence on the business world, it is crucial to recognize that every technology introduces both opportunities and risks. Generative AI provides solutions that support a wide range of professions today. However, current technologies have limitations in creating fully autonomous systems. In particular, for complex, multi-step processes that demand innovation, the success of artificial intelligence remains dependent on human intelligence.

This dependency can be viewed as an advantage for the business

world, as artificial intelligence solutions enhance employees' capabilities rather than replace them entirely. At this stage, companies should focus on enhancing employee competencies by developing training programs that help them adapt to and leverage these new technologies.

In this context, artificial intelligence-supported systems can be said to offer a model that strengthens human-machine cooperation. For instance, a marketing professional can analyze campaign strategies more effectively and create personalized customer experiences with the assistance of artificial intelligence. This harmony enhances not only individual performance but also the overall success of the company.

THE UNITY OF TECHNOLOGY AND HUMAN FACTOR

For companies to achieve sustainable growth, investing solely in technology is not sufficient. Technology generates real value when it accurately identifies opportunities for improvement in business processes and is leveraged to transform these opportunities. In this transformation process, employees also play a critical role.

Improving employees' competencies is just as important as ensuring they work in harmony with artificial intelligence systems. For instance, a customer service representative can provide faster and more effective solutions by collaborating with tools like ChatGPT. However, it is crucial to train employees to adapt to technology while supporting their creativity and critical thinking skills. This is because artificial intelligence still relies on human creativity, empathy, and adaptability to achieve its full potential.

In this context, leaders bear significant responsibility. Beyond promoting the adoption of technology, it is their duty to cultivate a culture where employees can fully embrace and integrate these tools. Such a culture not only enhances technological success but also boosts employee loyalty and motivation.

DYNAMIC LEARNING AND ADAPTABILITY

In an era of rapid advancements in artificial intelligence technologies, it is essential for companies to foster a culture of continuous learning and adaptation to remain competitive and ensure long-term survival. This involves not only enhancing employees' current skills but also equipping them to navigate future technological changes.

To build this culture, companies should invest in reskilling and upskilling programs. These initiatives empower employees to perform their current roles more effectively while preparing them for future changes. This approach enhances organizational flexibility and enables quicker adaptation to evolving market conditions.

BALANCING PEOPLE AND TECHNOLOGY

The rise of transformative technologies like generative artificial intelligence presents immense opportunities for the business world. However, effectively leveraging these opportunities

requires a holistic approach that considers both technological advancements and the human factor. For companies, the key lies in viewing artificial intelligence not as a threat, but as a strategic business partner. This can be achieved through initiatives that empower employees, unlock their potential, and enhance business processes.

In conclusion, the maturation and widespread application of AI technologies depend on the simultaneous transformation of business processes and the enhancement of human competencies. By leveraging technology effectively, the business world can step into a future that is not only more efficient but also creative and human-centered.

POWER OF DIGITAL INTELLIGENCE: TRANSFORMING SOFTWARE WITH AI CODING ASSISTANTS

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Breakthroughs in generative AI have unlocked the potential of large language models (LLMs) to revolutionize a broad spectrum of industries. From text generation and language translation to content creation and customer service, these models' advanced natural language processing capabilities are driving innovation. Nowhere is this impact more transformative than in software development, where AI-driven code assistants are streamlining the coding process, reducing errors, and amplifying developer productivity, ushering in a new era of efficiency and precision.

These assistants empower developers to write, analyze, and manage code with greater ease. Integrating them into your workflow can streamline coding processes, expedite problem-solving, and enable a sharper focus on architectural planning, all while significantly reducing the time spent on routine, repetitive tasks.

AI-powered code assistants are often envisioned as either collaborators for humans or tools that complement other AI systems. Yet, the critical emphasis remains on human ownership of the generated code and the necessity of human oversight before deploying it to live environments.

Developers spend only 9-61%[1] of their total time actually writing code, highlighting a significant opportunity for improvement. AI-powered code assistants are designed to address this specific gap, streamlining and optimizing the coding process where it matters most. Developers dedicate much of their remaining time to meetings, email follow-ups, documentation, web

searches, assisting colleagues, handling administrative tasks, and gathering information necessary for software development.[2] To enhance their productivity, it becomes crucial to leverage artificial intelligence to support these non-coding tasks, allowing developers to focus more on their core responsibilities.

Google CEO Sundar Pichai's statement that over 25% of all new code at Google is now generated by artificial intelligence, later reviewed and approved by engineers, underscores the pivotal role AI plays within the company.[3]

The application areas of artificial intelligence code assistants include:

Code Generation: Code assistants enable developers to automatically generate code for specific functions. For instance, when given a command like, "Write a Python function that returns the even numbers in the given list," the assistant produces the corresponding code to fulfill the request.

Code Refactoring: The process of reorganizing code to enhance its readability, maintainability, and performance without altering its functionality. For example, a complex function can be broken down into smaller, more understandable components.

Unit Test Generation: Code assistants can generate unit tests to ensure that the written code functions as intended. For instance, they can create unit tests for a Python function using pytest.

Code Completion: While writing code, the assistant predicts and completes the partially written code. For example, when you type "pri" in a development editor, the AI code assistant suggests a complete line such as "print(text)".

Explain: Code assistants can provide clear explanations of what a specific piece of code does.

Create Documentation: Code assistants can automatically generate documentation for written code. For instance, they can create docstrings for a Python module or draft a user manual for an API, streamlining the documentation process.

Code Review: Code assistants can analyze written code to identify potential errors, suggest improvements, and ensure compliance

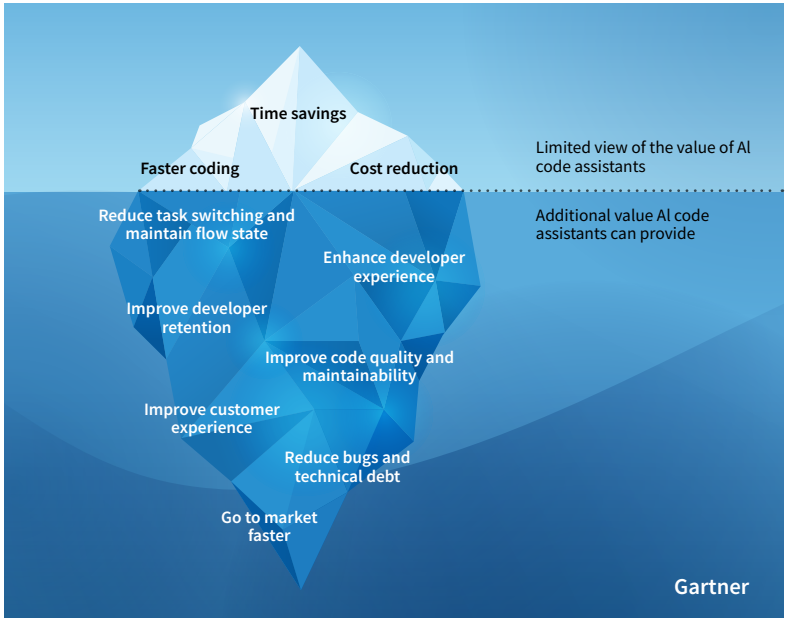
with coding standards. For instance, they can review a pull request (PR) to evaluate code quality and provide actionable recommendations.

Finding Solutions (Issues, Security, Code Quality): Code assistants can identify errors, detect security vulnerabilities, and address code quality concerns during the software development process. For example, they might flag a potential security vulnerability and alert the developer, or pinpoint performance issues while providing optimization suggestions.

HOW WILL AI CODE ASSISTANTS SHAPE THE FUTURE?

AI code assistants are set to revolutionize the software development landscape, not only by enhancing developer productivity but also by driving transformative changes in the field. By automating routine and repetitive tasks, these assistants enable developers to concentrate on more creative and strategic efforts. The result will be faster, more reliable, and sustainable software development processes.

Gartner predicts that by 2028, 75% of enterprise software engineers will use AI code assistants, underscoring their future pervasiveness and indispensability. Often compared to an iceberg, the visible benefits of these assistants represent only a small portion of their true value.[4] The greater impact, hidden below the surface, includes improving code quality, reducing technical debt and findings, and enhancing customer and developer satisfaction.



Code assistants can be categorized based on their usage scenarios. These include plugin-based code assistants, designed for widely used code management tools like Git and code development editors such as VS Code and IntelliJ. Another common application is the ability to generate code through conversational interfaces, which has become one of the most popular use cases.

There are also AI agent-based code assistants, which are systems capable of autonomously managing multi-step tasks and performing specific operations. These assistants can generate their own prompts when needed, make independent decisions, and take steps to achieve defined goals. For instance, an AI agent

might write a unit test, evaluate the test results, and then either fix bugs or create additional tests as required. This capability enables the efficient execution of more complex and dynamic tasks.

A NEW ERA IN CODING: THE EVOLUTION OF PROGRAMMERS WITH AI ASSISTANTS

The evolution of software developers through artificial intelligence is set to progress rapidly, ushering in a new era for the software industry. This transformation, which will fundamentally alter how developers work, will largely depend on how companies adapt to these changes.

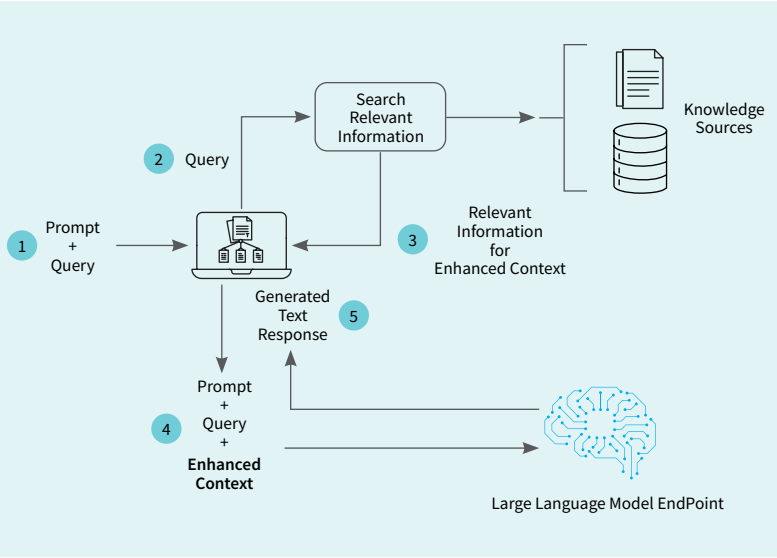
The methods employed to integrate code assistants will vary based on factors such as the size of the development team, the corporate nature of the organization, and the complexity of the codebase.In corporate environments, adaptation is typically driven by deploying products and subsequently monitoring their usage rates and impact on productivity via dashboards. These dashboards are further enriched with feedback from users, ensuring that the tools evolve in alignment with developers' needs and organizational goals.

For a successful AI adaptation, it is essential to begin with a manageable plan, establish clear success metrics, and consistently measure progress. A notable example of effective adoption comes from GitHub Copilot, where approximately 10% of developers adopted the code assistant within the first nine days, and 30% became active users after interacting with it for 28 days—highlighting some of the best metrics for evaluating success in this area.

THE IMPORTANCE OF CODE-BASE AWARENESS

Most development work involves building on existing code bases rather than writing code from scratch. Therefore, it is crucial for code assistants to understand the existing code and generate outputs that align with its style. The better a code assistant comprehends the existing codebase, the more effectively it can produce results consistent with the project's standards. Examples of maintaining the style of existing code include understanding and adhering to a specific framework, handling errors in a manner consistent with previously implemented exception handling, following established patterns of inheritance, and maintaining uniform logging practices.

Each code assistant handles codebase awareness differently, and contexts are generated and sent in various ways. Open code files



This diagram illustrates the conceptual flow of using RAG in LLMs.[5]

in code development editors, selected text, codebase repositories, architectural documents, and related codebase repositories can be used as context. The most commonly used method, however, is performing RAG (Retrieval-Augmented Generation) on the codebase repositories.

First, the codebase repository is saved to the vector database. Without RAG, the LLM generates answers solely based on the information it was trained on or already knows. With RAG, the closest results to the user's input are retrieved from the vector database, and these results, along with the user input, are fed into the LLM. This approach allows the LLM to generate more accurate answers that align with the existing codebase.

Fine-tuning is another method used to enhance codebase awareness. However, it is a costly process, as it requires significant processing power and data, and must be tailored individually for each specific capability. Fine-tuning can improve results in critical use cases, such as defining coding style, increasing reliability in producing desired outputs, addressing edge cases, performing new skills or tasks that are challenging to articulate, and securely handling confidential or internal information.

CONCLUSION

Looking ahead, AI code assistants are anticipated to significantly accelerate software development processes and enhance efficiency. Their adoption will enable developers to offload routine tasks, allowing them to concentrate on more creative and strategic responsibilities. The integration of AI will drive the rapid evolution of developers, marking the beginning of a new era in the software industry. In conclusion, while the adoption of AI-powered code assistants has the potential to make software development processes far more productive, the importance of human review and oversight cannot be overstated.

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ARTIFICIAL INTELLIGENCE BASED AGENTS

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Artificial intelligence technologies have emerged as one of the most transformative tools of the digital age. To ensure the efficient use of this technology, AI-supported agents have taken center stage. These agents are AI units designed to execute specific tasks, interact with users, or learn independently.

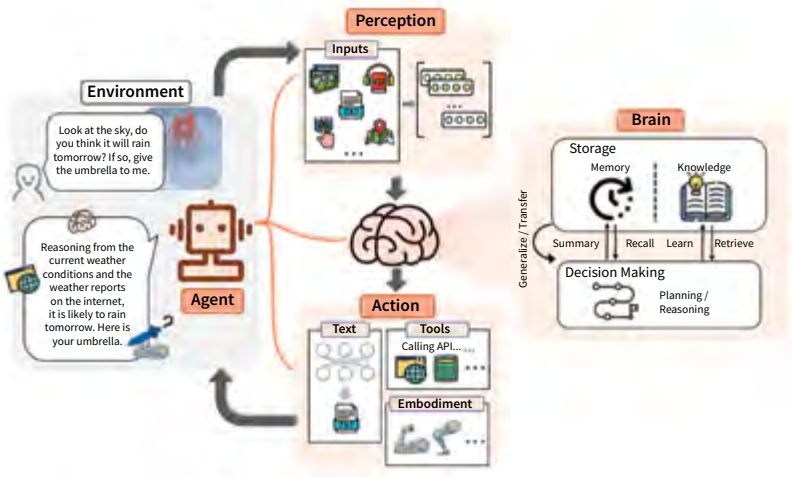
Agents can function autonomously, leveraging various algorithms, data analyses, and decision-making mechanisms. They typically analyze data, learn from it, and make decisions to achieve specific objectives. This capability makes them invaluable across industries such as business, healthcare, education, logistics, and more. Among their most notable attributes is their capacity to specialize in specific tasks. For example, an agent might serve as a customer service assistant, operate as a control unit on a production line, or perform as a data analyst in financial markets. Moreover, their learning ability enables them to enhance their performance and tackle increasingly complex tasks over time.

COMPONENTS REQUIRED IN AGENTS

Brain

Decision Making: The agent processes information from its environment to make decisions and plans actions accordingly. This module encompasses functions such as planning, reasoning, and memory management. Additionally, key processes like information storage, recall, and learning play a vital role in its functionality.

Memory and Knowledge: The agent is capable of storing learned or previously acquired information and retrieving it as needed.



Perception

Receiving Data from the External Environment (Inputs): The agent detects changes in its environment and prepares this information for processing. Functioning similarly to human senses, this module captures multimedia data such as text, sound, and images, converting it into a format that artificial intelligence can interpret.

Extended Perception Capability: The agent is not confined to processing text alone; it possesses a broader perception range by integrating information from visual, auditory, and textual data.

Action

Tool Handling: The agent can utilize tools to interact with and influence its environment, such as sending data to a system through API calls.

Embodiment: The agent can engage with its environment through both software tools and hardware devices capable of interacting with the physical world, such as robotic arms.

Feedback: The agent continuously learns by receiving feedback from its environment, enabling it to make more informed and effective decisions through ongoing interaction.

These three core modules collaborate to empower agents to perceive environmental conditions, make informed decisions, and execute actions aligned with those decisions. By iterating this process, agents foster dynamic interactions with their environment, leading to increasingly effective outcomes.

CONCEPTS OF LLM (LARGE LANGUAGE MODELS) AND SLM (SMALL LANGUAGE MODELS)

One of the key attributes of an agent is its decision-making ability, which is closely linked to the size and capabilities of the language models it employs. Language models are categorized based on their size into two groups: Large Language Models (LLMs) and Small Language Models (SLMs).

LARGE LANGUAGE MODELS (LLM)

LLMs are artificial intelligence models trained on vast datasets, providing them with extensive linguistic and world knowledge. These models excel in performing a wide array of tasks, such as comprehending text, summarizing information, answering questions, and generating creative content.

By leveraging LLMs, agents can engage in more natural and human-like dialogues, extract meaning from complex inputs, and provide answers to intricate questions. These models are widely utilized in applications such as customer service assistants, virtual assistants, and information technology. While their training on extensive datasets makes them highly powerful, it also necessitates significant computational resources and large volumes of data, which can increase operational costs.

SMALL LANGUAGE MODELS (SLM)

SLMs are smaller models trained on less data compared to LLMs. Their lighter and faster architecture makes them more efficient for specific tasks. SLMs are particularly suitable for applications running on devices with limited hardware resources. For instance, an agent operating on a mobile device can effectively handle tasks requiring speed and low energy consumption by utilizing SLMs.

The advantage of SLMs lies in their ability to function with lower computational power and energy requirements. This makes them ideal for resource-constrained environments, such as small devices, IoT (Internet of Things), and edge computing applications. However, their data processing and comprehension capabilities are more limited compared to LLMs, which may render them insufficient for highly complex tasks.

SHIFTING FROM SINGLE AGENTS TO MULTI-AGENT SYSTEMS

The operation logic of Multi-Agent systems closely resembles how we collaborate in our daily lives. To complete projects, individuals with diverse expertise and skills must come together and rely on each other's support to accomplish the task. For example, consider the operations of a financial investment firm. Preparing a detailed report on a company's stock requires the involvement of employees with various specializations, working together to achieve the desired result.

Research Specialist: Collects the latest news articles, press releases, and market analyses related to the stock.

Financier: Performs a detailed analysis of the stock's financial health and market performance. This includes evaluating key financial metrics such as the P/E ratio, earnings per share (EPS) growth, revenue trends, and the debt-to-equity ratio. The analysis also involves comparing the stock's performance with industry peers and broader market trends. Additionally, it focuses on financial statements, insider trading activities, and disclosed risks.

Investment Specialist: Reviews and integrates the analyses provided by the Research Specialist and Finance Expert, consolidating this information to develop a comprehensive investment recommendation.

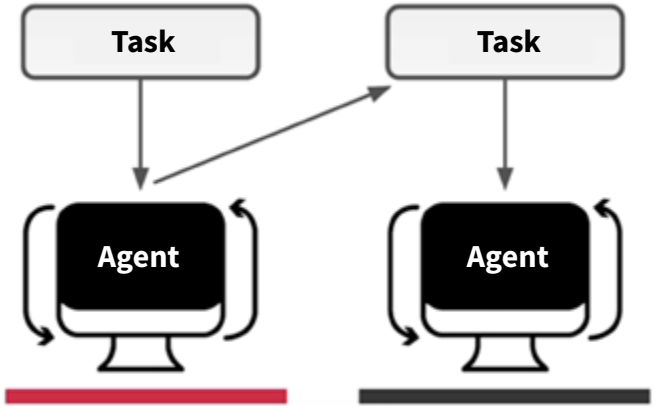
Editor: Creates an engaging blog post about the stock, drawing on the recommendations provided by the Investment Specialist.

As demonstrated in this example, completing the task requires the collaboration of four specialists with distinct areas of expertise.

Multi-Agent systems operate in a similar manner, where each agent can be viewed as a specialist in its respective field.

Multi-Agent systems are infrastructures designed to integrate multiple agents, enabling them to communicate and collaborate effectively to accomplish a task. These systems facilitate mutual feedback among agents and, when necessary, incorporate the human-in-the-loop concept, allowing a human to step in as the controller of the task.

One of the key factors for Multi-Agent systems to successfully complete tasks is ensuring that **each agent focuses solely on tasks within its area of expertise**. This mirrors real-life business scenarios, where an employee's performance tends to decline when they are required to handle tasks outside their specialization.



One of the most notable features of Multi-Agent systems is their flexibility in utilizing different language models. Agents can employ SLMs for simpler tasks and LLMs for more complex ones, resembling the microservice architecture. While performing tasks, agents can operate sequentially or in parallel, depending on the scenario.

In some cases, a supervisor agent is designated to oversee job tracking and task sequencing. This supervisor agent ensures efficient orchestration and assignment of tasks.

To facilitate the adoption of Multi-Agent systems by companies, some technology firms are developing comprehensive software platforms with orchestration capabilities and user-friendly interfaces. These platforms allow users to design systems simply by inputting instructions via drag-and-drop interfaces. By 2025, the introduction of such frameworks into the market is expected to increase significantly.

AGENTS' SECURITY

With the integration of agents into our lives, security has emerged as a critical area of investment. This is particularly vital because agents rely on large language models for decision-making, making them susceptible to manipulation by attackers. These attackers may attempt to extract or disclose sensitive information by exploiting the model, aiming to leak confidential data, access the agent's prompts, or produce responses that breach security policies. To address these risks, OWASP has identified the top 10 vulnerabilities in this area (available at OWASP LLM Top 10). When developing agents, it is crucial to design them with these security risks in mind. As a precaution, a layer of "guardrails" should be implemented before forwarding user requests to the agent, ensuring protection against malicious attempts.

In financial institutions, banking applications are commonly subjected to penetration tests conducted by third-party companies to identify vulnerabilities. Similarly, it is recommended that agents undergo rigorous penetration testing, known as Red Teaming, before being deployed to customers.

USAGE AREAS OF AGENTS

Businesses and Automation

Agents are extensively utilized in enterprises to enhance operational efficiency. By automating routine and repetitive tasks, they help reduce the burden on the human workforce. In customer-facing

roles, such as customer service, agents alleviate the workload of human employees by addressing customer inquiries or resolving complaints.

Additionally, in CRM (Customer Relationship Management) systems, agents monitor and analyze customer interactions, optimizing sales processes through personalized recommendations.

Finance

Agents are widely employed in tasks such as financial data analysis, risk management, and fraud detection. By analyzing large datasets, they can predict stock market movements and market trends, aiding in the optimization of investment strategies. Furthermore, agents used in credit risk analysis and fraud detection enhance security and efficiency within the banking sector.

Learning and Education

Agents are utilized in education to deliver personalized learning experiences. By designing educational programs tailored to students' individual needs and learning pace, they make the learning process more effective. For instance, if a student struggles with a specific subject, agents can analyze the situation and offer additional resources and exercises. Additionally, these agents can serve as virtual teachers and mentors, enhancing the educational process by providing one-on-one support to students.

Information Technologies

Developer agents can actively assist in the coding process by providing suggestions, identifying errors, and proposing solutions. An agent functioning as a code assistant analyzes the developer's code, offers code completion suggestions, and applies corrections based on predefined patterns or best practices. It can even forward the code to another developer agent for review and request feedback. This approach enables potential errors in the software code to be identified and addressed quickly, even before deployment, without requiring human intervention.

AGENTS AND DIGITAL TWINS

Digital Twins are digital replicas of physical systems or processes, applicable across various fields such as finance, clinical trials, manufacturing, recommendation systems, and psychology.

In the digital realm, agents are transitioning from general-purpose applications to user-centered models. Language models and digital twins emerge as critical components of this shift. Digital twins create virtual representations of users by closely tracking their preferences and behaviors, adapting to their needs in real time. Using data derived from these digital twins, agents deliver human-like, emotionally nuanced, and context-aware responses. Consequently, these systems enable more personalized and intuitive user experiences.

Digital twins identify users by leveraging data from social media, CRM systems, and direct user input. This data is integrated with language models to develop agents capable of interacting with users effectively. One of the most significant features of agents in the future will be their ability to deliver personalized experiences.

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WHERE IS SOFTWARE DEVELOPMENT EXPERIENCE HEADED? FROM BASIC AUTOMATION TO SMART APPLICATIONS

SİMGE ULUSOY

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Today, the reluctance to fully acknowledge that software development processes may eventually reach their conclusion reflects a certain sense of comfortable complacency. On the other end of the spectrum lies the belief that artificial intelligence will ultimately take over everything. The reality likely lies somewhere in the middle, and our quest is to bridge these two extremes. In seeking this balance, we approach the situation from the perspective we know best and excel in—software development.

THE NEW SOFTWARE DEVELOPMENT LIFECYCLE

Until 2020, development teams were composed entirely of human contributors. Now, four years later, we are concluding the first phase of a significant transformation. Simple automation has been integrated into software development processes, allowing for some productivity gains. However, none of these advancements have yet reached the level of autonomous decision-making or independent operation. Our objective and strategy for the next 4–5 years should focus on enhancing the artificial intelligence features we've incorporated to empower developers. These features must evolve to collaborate seamlessly with humans, become smarter, gain decision-making capabilities, and, most critically, enable the introduction of disruptive new business models. Looking ahead, it appears plausible that within the next four years, bots could take center stage in software development processes. Developers may step into supporting roles—or even step aside entirely—as bots infer causes and operate autonomously like agents. This trajectory necessitates redefining the software development life

cycle. We must work toward creating innovative workflows that diverge from traditional processes. While these new models may initially seem misaligned with the current ecosystem's DNA, the long-term benefits of this transformation will become evident over time, ushering in a positive and impactful change.

A CONTROLLED, RESPONSIBLE AND FLEXIBLE DEVELOPMENT EXPERIENCE

The core problem that artificial intelligence technology seeks to address is "increasing efficiency," and this principle should guide every solution we deliver. We all encounter rapidly evolving business demands, but this pace of change is particularly pronounced in Turkey. Providing users with platforms that enable seamless adaptation to these changes, while ensuring sustainability, forms the foundation of true efficiency.

To achieve this, rather than offering artificial intelligence features that make users feel controlled, we recognize the need to provide a development experience that aligns with and empowers users. This experience should leverage artificial intelligence technology that allows users to maintain control, ask questions, provide feedback, and enable continuous learning through that feedback. Only by following this approach can we make artificial intelligence technology truly responsible. Users should be able to harness their expertise effectively on the development platforms we provide, transforming their knowledge into valuable contributions. Simultaneously, these platforms must strengthen and enhance their capabilities. We are committed to ensuring that artificial intelligence technology aligns with this strategy, making it not only accessible but also empowering on the platforms we develop.

NATURAL LANGUAGE AND PROGRAMMING LANGUAGES

However, developing a platform that requires coding is not an easy task. This is because it is not possible to represent the entire software development process using natural language. The code blocks written iteratively in software are constrained, and the expressions involved contain limited data. There remains a significant gap between natural language and software development. Natural language is not yet capable of replacing a software development language. Nevertheless, we must adapt to this change.

To transform the application development process into more intelligent structures, we are working to abstract the process to a certain extent using artificial intelligence models. For

the remaining portion, we focus on representing software engineering through an intermediate platform. At this stage, low-code platforms emerge as an essential intermediate layer. These platforms allow us to move forward safely within a defined guideline framework, ensuring artificial intelligence is not left entirely on its own in the application development process. This approach enables anyone with an idea to develop an application. As AI capabilities expand, users are segmented into categories such as expert developers, developers, citizen developers, and even those with no software background. Through these platforms, our aim is to empower business professionals and analysts who have dedicated years to their fields, making them significantly more capable in application development.

Of course, the process is not solely about development. Our long-term experience with our platform, which we have been using and improving over time, has demonstrated that creating an application merely by developing the front-end, service, and data connection provides limited added value in terms of reusability. Beyond development, establishing an accurate data model is also essential.

Only then can we bring the application model to life. Consider it this way: the information in books is static, lifeless knowledge, but as you read them, they come alive through the values you bring. At this stage, the expertise of Softtech's software development teams becomes crucial. We must preserve the data structures within each specialized system as an integral asset of the development platforms. Many smaller low-code development companies lack data and knowledge of this caliber, which limits their progress. Therefore, our primary goal should be to strategically leverage this wealth of information.

As a result, our core strategy should focus on enhancing development platforms—serving as an intermediate layer between these two extremes—with advanced artificial intelligence capabilities. By doing so, we can expand the user profile to include anyone with an idea, enabling a broader range of individuals to engage in the development process. This approach also allows us to redefine the software development process itself. As we advance in these areas, it is essential to present artificial intelligence in a form that empowers users, putting them firmly in control and allowing them to manage the process, rather than confining AI to rigid structures.

I would like to share an approach I came across and found particularly impactful. Artificial intelligence technology is often regarded as having an influence comparable to the invention of the internet. While internet technology dates back further, it was not until 1996 that it became a tangible part of our daily lives. If we consider that artificial intelligence, through tools like ChatGPT, has now begun to touch the lives of people worldwide, we could liken today to 1996 for artificial intelligence. With this perspective, and reflecting on the transformative impact of the internet over the years, it is not difficult to foresee that artificial intelligence will achieve far more, and in a much shorter time frame.

I would like to conclude with a note my daughter left on my desk.

It's never too late for change.

WALL-E

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LARGE LANGUAGE MODELS (LLMS): OPPORTUNITIES AND CHALLENGES IN THEIR USE

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In recent years, revolutionary advancements in Artificial Intelligence have reshaped the landscape, with one of the most notable breakthroughs being the emergence of Large Language Models (LLMs). Models such as ChatGPT, Llama, and Gemini are among the most recognized in this category. These models have propelled the field of Natural Language Processing (NLP) to new heights, unlocking significant opportunities while also presenting notable challenges across various sectors.

HISTORY OF LARGE LANGUAGE MODELS

The origins of Large Language Models can be traced back to the early foundations of artificial intelligence. The journey began in the 1950s when Alan Turing introduced the concept of the "Turing Test" and gained significant traction with advancements in machine learning and artificial neural networks during the 1980s and 1990s. The integration of deep learning algorithms and big data in the 2010s further enhanced the capabilities and effectiveness of LLMs.A defining milestone in this field was the launch of ChatGPT by OpenAI in November 2022. Achieving 1 million users within just five days of its release—a record-breaking feat—it underscored the immense potential and widespread appeal of LLMs.

According to Amara's Law, proposed by American futurist Roy Amara, the short-term impact of a new technological development is often overestimated during its initial two years, while its long-term impact tends to be underestimated. Now, two years into the widespread adoption of LLMs following the launch of ChatGPT,

how might we evaluate the state of generative AI?At the outset, this disruptive technology inspired immense expectations, with some even speculating that these models would achieve human-like intelligence (Artificial General Intelligence, AGI) and revolutionize numerous fields. However, over time, it has become evident that such expectations are not universally realistic and that LLMs have distinct limitations. These limitations often stem from a variety of challenges that complicate the effective use of LLMs.

CHALLENGES IN THE USE OF LLMS

Expensive Resources: Training and operating LLMs demand substantial GPU (Graphics Processing Unit) resources, which can pose a significant financial challenge, particularly for small and medium-sized enterprises. The limited supply, high maintenance costs, and continuously rising prices of GPUs are key obstacles to the widespread adoption of this technology.

Inability to Scale: LLMs rely on large datasets and significant processing power, making them more challenging to scale compared to other technologies. The infrastructure needed to process and store vast amounts of data may not be within reach for all organizations.

Hallucination: LLMs can occasionally generate unrealistic or inaccurate information, undermining their reliability and contributing to the spread of misinformation.

Continuous Emergence of New Models: The field of artificial intelligence is evolving at a relentless pace, with new models being introduced to the market regularly. While this progress requires software developers and researchers to remain current, it also leads to the rapid obsolescence of developed products and written code, posing challenges for long-term sustainability.

New Frameworks: The concepts introduced by LLMs and the associated frameworks are still in the early stages of development. It remains uncertain which frameworks will evolve and gain traction in the future and which will be discontinued. This uncertainty complicates decision-making for developers and researchers, making it challenging to determine which technologies warrant investment.

The Uncertainty of LLMs: The lack of transparency regarding how LLMs operate and the incomplete understanding of their decision-making mechanisms create uncertainty for users. This ambiguity can lead to skepticism about the models' reliability, making it challenging for users to fully trust these technologies.

Biases: LLMs can inherit biases present in the datasets they are trained on, potentially leading to social and ethical challenges. For instance, an LLM may exhibit biases related to gender, race, or other demographic characteristics, which can become evident in the model's outputs.

Generating Up-to-Date Data: LLMs are trained on large datasets, and the responses they generate are shaped by the information within these datasets. However, this reliance on static data raises the issue of models becoming outdated over time, leading to incorrect answers for questions related to events or developments that occurred after the model's training. To ensure LLMs provide accurate and current responses, continuous retraining with new data is essential. Moreover, the quality of the training data plays a critical role in determining the accuracy of the answers. While LLMs are widely used in code development, there is also a risk of declining code quality in outputs generated this way. This underscores the dual importance of training LLMs with up-to-date data and ensuring the data used is accurate and reliable.

Data Security: State regulations emphasize the critical importance of protecting personal data. Laws such as the GDPR (General Data Protection Regulation) and KVKK (Personal Data Protection Law) impose strict restrictions on the collection, processing, and storage of personal information. While these regulations are essential for safeguarding individual privacy, they also present significant limitations in the context of LLMs. Cloud-based LLM solutions, in particular, face restricted use due to these legal constraints, especially in processing certain types of data. Although these measures represent a vital step forward for both security and data privacy, they also hinder large-scale language models from fully realizing their potential.

Large-scale companies often manage vast amounts of data within their systems, encompassing customer information, business processes, financial records, and other critical details. Despite recognizing the immense value of this data, many of these companies lack the necessary infrastructure and human resources to process it effectively. However, they continue to retain this data, as proper processing can offer a significant competitive edge. For enterprises of this scale, the use of data in training or sharing it with third-party cloud solutions poses substantial risks.

OPPORTUNITIES INTRODUCED BY AI AND THE HUMAN FACTOR

Along with the challenges posed by artificial intelligence, the opportunities it brings are equally significant. LLMs have the potential to enhance productivity, optimize business processes, and generate new opportunities across various sectors. However, as these technologies become more widespread, the role and significance of the human factor are also evolving.

A 2023 study conducted by IBM highlighted the skills individuals need in an era where artificial intelligence is increasingly influential. The report underscored that while artificial intelligence cannot replace humans, those who effectively leverage artificial intelligence can replace those who do not. The research identified the following as the most critical skills:

- Time Management and Prioritisation Skills (42%)
- Working Effectively within A Team Environment (40%)
- Effective Communication Skills (38%)
- Flexibility, Agility and Willingness to Adapt to Change (38%)
- Analytical Skills and Business Acumen (35%)
- Ethics and Integrity (33%)

In addition to these skills, grammar and expression abilities have also gained prominence. Developing these competencies is crucial for individuals to fully harness the opportunities presented by artificial intelligence technologies.

The future is evolving at a rapid pace, and today's adults are preparing their children for professions that do not yet exist. Among these uncertainties, it is evident that individuals who enhance their communication skills, embrace change, demonstrate strong self-expression, and excel in prioritization will remain successful, regardless of the circumstances. While artificial intelligence and LLMs are driving substantial transformation in the business world, they do not render the human factor obsolete. On the contrary, the value of individuals who can collaborate with artificial intelligence and utilize these technologies effectively is set to increase even further.

Large Language Models represent a groundbreaking advancement in the world of technology. They have the potential to transform numerous industries by simplifying access to information, expediting complex data analyses, and delivering personalized services.

The opportunities introduced by AI and LLMs are giving rise to new roles and responsibilities within the business world. These emerging roles prioritize skills such as creative thinking, problem-solving, ethical judgment, and human relations. To ensure future success, it is essential to cultivate and continuously update these skills. Furthermore, education and lifelong learning play a crucial role in achieving sustained success in the evolving business landscape.

Source

• Augmented work for an automated, AI-driven world

ARTIFICIAL INTELLIGENCE AND ROBOTIC INTEGRATION

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WHAT IS ROBOTIC AUTOMATION?

The impact of technology on professional life is growing with each passing day. Particularly with the advent of the Fourth Industrial Revolution, **Industry 4.0**, the enhanced communication between machines, systems, and people, as well as the digitization of production processes, is influencing everyone within this ecosystem—be it a small business or a global enterprise.

Businesses that incorporate digital transformation into their processes gain numerous advantages, including value-added production at lower costs, improved efficiency, and reduced time to market. The efficient use of energy and other resources enables sustainable production and contributes to environmental conservation. Additionally, improving quality by eliminating error margins in manual tasks enhances customer loyalty and satisfaction to the highest levels. By automating

repetitive, monotonous, and hazardous tasks, employees are freed to engage in more productive and meaningful work. This shift not only boosts employee satisfaction but also strengthens their loyalty to the company.

Industry 4.0 encompasses a wide range of concepts, from the Internet of Things to big data, cloud computing, and automation. In this article, we will focus on robotic automation, artificial intelligence, and the human factor, which together offer a competitive edge in production processes. Companies that modernize their production lines and other business processes through robotic automation are better positioned to adapt quickly to the demands of the new era, enabling them to succeed and compete effectively in the global market.

NOT EVERY MACHINE IS A ROBOT!

A robot is an autonomous or pre-programmed device capable of interacting with its environment to perform specific tasks. However, not every machine qualifies as a robot. Robots, composed of electronic and mechanical components, possess the ability to perceive, learn, plan, and take action. They utilize sensors to perceive their surroundings, collect data, make decisions, and execute movements.

TRADITIONAL INDUSTRIAL ROBOTS SERVE A SINGLE PURPOSE

Robots perform repetitive, routine tasks within the production process. They are designed, planned, installed, and operated for a single purpose. Although they come in various sizes, they typically occupy a large area and remain stationary due to their considerable dimensions. The working principles of these robots differ significantly from those of humans, as they often handle tasks that are physically challenging or impossible for people to perform. They are commonly used for operations such as part production, assembly, and transporting heavy loads. However, their speed and operational principles necessitate placement within safety cages, as failure to do so could pose risks to employee health and safety.

NEXT-GEN ROBOTS: COLLABORATIVE ROBOTS BECOMES A PART OF OUR LIVES

In recent years, shifts in life processes, climate and environmental conditions, energy resource accessibility, sustainability concerns, human habits, consumer behavior, and e-commerce applications have rapidly transformed our daily lives. Alongside these developments, advancements in robotics and environmental technologies have accelerated the sector's growth rate. Automation and robotics are now extensively utilized not only in traditional industries such as automotive, metalworking, and machinery but also across agriculture, service, e-commerce, and retail sectors, as well as various other application areas. Among these changes, a new generation of robotic technologies—collaborative robots, or cobots—has emerged, enabling automation to become more accessible to all. Characterized by quick installation, intuitive programming, flexible usage, and the capability to operate safely

alongside humans in a collaborative manner, these technologies have seamlessly integrated into our lives. Furthermore, the integration of artificial intelligence has amplified the evolution of robotic technologies, driving their impact to unprecedented levels.

With these advancements, the global installation of robotic systems and the robot density—the number of robots per 10,000 employees—continues to grow rapidly with each passing day.

A MAJOR TRANSFORMATION IN ROBOT TECHNOLOGY THROUGH ARTIFICIAL INTELLIGENCE

Augmented reality and voice command applications have seamlessly integrated into various aspects of daily life. Groundbreaking advancements in artificial intelligence—designed to replicate human intelligence and sensory capabilities—are paving the way for a significant transformation in industrial processes. Artificial intelligence drives a diverse range of applications within robotic technologies. Both conventional robots and next-generation robotic systems enhance productivity in production through AI models that collaborate effectively with humans. AI technologies empower robots to perceive the physical world and respond to real-time needs, enabling companies to optimize robotic tasks and elevate their performance.

COMPLEX TASKS AND APPLICATIONS MADE POSSIBLE WITH AI

Artificial intelligence-based software and hardware, along with robot peripherals such as cameras, grippers, and sensors, as

well as application-specific work elements like welding, painting, screwing, laser cutting, gluing, testing, quality control, assembly, and more, simplify human-technology interaction, making technology accessible to everyone. By integrating artificial intelligence into a collaborative robot designed for basic tasks like picking up and relocating a part, far more complex tasks and applications can be achieved. For instance, in a box with randomly positioned parts of various sizes, camera systems integrated into collaborative robots can identify predetermined parts, while Force/Torque sensors can detect parts of different sizes and shapes. These features, when used simultaneously, enable the realization of a variety of production purposes.

ROBOTS ENHANCES THE PRODUCTION PROCESS WITH AI

Continuity in improving the production process is a fundamental aspect of any operation. What is done well today can always be enhanced tomorrow. In such environments, robots equipped with artificial intelligence make substantial contributions to process improvement from the moment they are deployed. Through AI-based systems that can be seamlessly integrated into collaborative robots, robotic systems offer far more than traditional machines, particularly in performing hazardous and monotonous tasks.

AI IS REVOLUTIONIZING PRODUCTION

While a significant portion of society holds an optimistic view of artificial intelligence technology, which has recently gained attention for its potential, some maintain a more cautious perspective.

The emergence of technologies like ChatGPT has intensified the call for deeper discussions on artificial intelligence in today's context. The notable advancements in computer processing power and the exponential growth of data volume in recent years are key drivers behind the global discourse on AI. Today, we possess the capability to process the vast amount of data and information necessary for the advancement of artificial intelligence technologies. Innovations like ChatGPT have played a pivotal role in shaping the development of AI within this evolving landscape.

Although AI technologies are still in their nascent stages, they are already creating a significant impact. Below are examples of how AI is currently transforming industrial automation and how it stands to benefit manufacturers worldwide by simplifying complex and varied tasks:

Human-like Perception

Selecting unstructured objects from a box has traditionally been regarded as a difficult challenge. However, artificial intelligence is transforming this reality. This technology disrupts the status quo by providing 'human-like perception' to both traditional and next-generation collaborative robots (cobots), enabling faster and more efficient performance, particularly in bin picking applications. Utilizing scanners and cameras, '4D Vision' can identify the most accessible parts and guide the robot on the safest and fastest methods to pick them up.

Handling Variations Without Programming

Artificial intelligence is a dynamic, decision-making technology that operates autonomously, without the need for prior training or guidance. While this is not always the case, camera-based AI technology, when combined with various hardware, enables robots to select, pick up, handle, and process different objects—regardless of shape or size—tailoring their actions to the specific application. Programming robots in next-generation robotic technologies is significantly easier than with traditional robots, but the real advantage lies in the ability to avoid time spent on programming, offering enhanced flexibility, adaptability to rapid changes, and long-term sustainability.

Precise Movement of Moving Parts

Rather than relying on pre-programmed measurements, the robot can execute its movements in real time. This enables the robot to perform tasks that involve dynamic machines or objects, such as assembly, gripping, screwdriving, or testing. Additionally, AI can be utilized to teach robots tactile interactions.

Ever Improving Automation Solutions

The continuously evolving and increasingly sophisticated nature of artificial intelligence offers a significant advantage for industrial automation. The more a robot works, the more data the AI application gathers. This data enables the underlying algorithm to continually adjust, optimize, and enhance the robot's performance. This advanced learning capability ensures that the automation solution becomes progressively more efficient with each passing day.

DRIVING FLEXIBILITY AND SIMPLICITY TO NEW HEIGHTS WITH AI

The benefits of collaboration between robots and artificial intelligence are undeniable. Manufacturers can turn to traditional or next-generation robotic technologies (cobots) to address challenges such as resolving labor shortages, enhancing quality and efficiency, or improving employee well-being. AI solutions also boost quality and reliability while offering manufacturers greater agility and flexibility. The impact of artificial intelligence on automation is remarkably evident. The best part of this transformation is that we are only at the beginning.

CONSCIOUS LEADERSHIP IN AI AND TECHNOLOGY

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For companies, fostering technology hubs and developing unique technological expertise has become increasingly crucial in today's tech-driven world. However, it is not sufficient for organizations to solely enhance their technological capabilities to ensure business and financial sustainability and maintain steady growth in the digital economy. This is because technology permeates virtually every aspect of life. Since the onset of the Web 2.0 era, often referred to as the golden age of technological business, communities and their constantly evolving demands—the driving force behind the on-demand economy—expect 'value' from organizations offering products and services in a manner that vastly differs from traditional models.

This evolving 'value mathematics' introduces a new dimension for decision-makers within organizations: The decision-making algorithm itself is undergoing transformation. Multiple factors influence the shift in the decision-making algorithm:

- In the technology realm, operations extend beyond traditional business practices. We are now part of businesses that adopt a platform company mindset, where multiple disciplines are integrated, operating within cohesive systems and infrastructures. The value of these businesses is not solely defined by the strength of their products and services but also by the ecosystem they cultivate, the connections they foster with their communities, and the value they generate.
- The composition of employees driving these innovations has also evolved. In the tech culture, the traditional team structure

has been replaced by groups composed of individuals with more specialized skills, differing perspectives and inquiries about their work, hybrid capabilities, and the ability to collaborate with artificial intelligence. Furthermore, the nature of leadership, particularly when engaging with Generation Z and subsequent generations—whose relationship with technology differs significantly—also reshapes the decision-making algorithms of leaders.

• We find ourselves in a new, digitally-driven economic landscape, where uncertainty is the defining characteristic. Leaders accustomed to managing vertical functional structures with traditional policies—measuring efficiency, productivity, performance in skills, and ROI through standard deviations and calculations—now face a different reality. In the realm of technology investments, particularly in artificial intelligence, traditional ROI metrics no longer apply. We are entering an era where the focus is on output and process, rather than solely on business results. As the intelligence and dynamics of technology continue to evolve, the nature of work will naturally undergo continuous transformation.

The table illustrates that the traditional composition of leaders and their teams has already been disrupted. Leaders must now shape their professional and economic growth by focusing on what they do not know, rather than relying solely on what they already know.

When it comes to artificial intelligence technologies, leaders encounter another critical threshold. On one hand, the benefits

of technology with limitless potential are widely acknowledged, but if not consciously utilized and managed, artificial intelligence has the power to disrupt humanity, jobs, and life within uncontrolled systems.

Artificial intelligence is not a new concept; it has undergone cycles of development—sometimes silent, sometimes stagnant, and at other times disruptive—since World War II. With the rise of generative artificial intelligence, we are currently in one of its most disruptive phases. This is because technology has transcended the realm of mere technique, data sets, and infrastructure. We are now confronted with a machine form that learns from our humanity, increasingly resembles us physically, has far surpassed the initial promises of automation in basic tasks, and exhibits an undeniable drive toward becoming "human-like." In our haste to stay aligned with the evolving agenda, we often forget that it is humanity that has coded and designed this form. This has led to a growing divide between ourselves and artificial intelligence, leaving us

questioning how to define its value within our work and lives.

In the face of such a paradox, leaders are striving to become the decision-makers shaping the new economic value to be generated by artificial intelligence technologies. Our leadership teams must navigate this complexity by conducting ethical, social, cultural, and moral inquiries into the broader implications of AI—beyond the benefits, convenience, and new financial gain models it offers. This calls for a higher level of consciousness in evaluating technology, work, and life, requiring decisions that go beyond the traditional leadership frameworks we have relied on thus far.

Sam Altman, CEO of OpenAI, refers to the current era as 'The Age of Artificial Intelligence' and proposes that it has the potential to usher in an unprecedented period of economic prosperity and human talent.[1]

• Altman envisions artificial intelligence equipping humanity with powerful tools to address complex problems, accelerating progress at a pace previously unimaginable. **He foresees the emergence of personal AI teams capable of creating almost anything,** with these virtual experts delivering revolutionary capabilities across a wide range of fields.

• Potential future applications include **personalized AI tutors, groundbreaking advancements in healthcare, and on-demand software production.** Altman highlights that ushering in this new '**Age of Intelligence**,' which promises prosperity and scientific breakthroughs for humanity, will require immense computing power and energy.

Sam Altman may hold an optimistic view of the future. However, the promise of artificial intelligence underscores the critical need for technology-conscious leadership. This involves "making sense of technology and artificial intelligence by interpreting not only what is visible but also what lies beyond the surface."

• In Altman's proposition that an "unimaginably prosperous" life awaits us through artificial intelligence, what does "unimaginable prosperity" truly mean for us? How do we define the value equivalent of a prosperous life? **What framework should guide the role of technology, including artificial intelligence, in achieving this vision, and how should it operate?** The framework for prosperity extends beyond the sustainability of businesses and organizational structures; it also encompasses the contributions of our institutions to broader social well-being.

• **How will the value proposition of personal AI assistants capable of creating almost anything be determined?** What do we, as humanity, want AI to accomplish? **How do we grant AI the power**

to create for any community? How does our responsibility as humanity and our "will" factor into this equation?

• What is the role of "will" in the use of technology? **What does "will" represent for our leadership teams in an uncertain economy?**

• Given the premise that artificial intelligence will enable us to enhance our abilities more than ever before, are we fully utilizing and honoring our existing human capabilities?

• Are we prepared for artificial intelligence to enhance our abilities in unprecedented ways? How equipped are our psychological, sociological, and economic frameworks to support this transformation?

"It's not the technology that matters; it's how it is used" perfectly encapsulates the perspective of Robert Former, Chief Information Security Officer (CISO) of Acquia, who emphasizes the pivotal role of policymakers in shaping how technology is applied. In fact, **the "keywords" in Anthropic CEO Dario Amodei's vision, shared within the context of longevity, politics, business, and the economy, regarding how artificial intelligence could transform society within 5–10 years of reaching human-level capabilities,** raise similar questions.[2]

• Amodei predicts that by 2026, "powerful artificial intelligence" will emerge—an intelligence surpassing that of a Nobel Prize winner across all fields, equipped with agent-based and multi-modal capabilities.

• They predict that artificial intelligence could condense 100 years of scientific progress into just 10 years, cure most diseases, and potentially double human lifespan.

• They highlight that artificial intelligence has the potential to strengthen democracy by combating misinformation and offering tools to challenge authoritarian regimes.

The Anthropic CEO's perspective on key issues such as the **"human-level capabilities of artificial intelligence," "longevity and artificial intelligence," and "the impact of AI on politics"** underscores how artificial intelligence has the potential to reshape **"the scope of our practical lives."** This encompasses not only work across every discipline that life touches but also every form and field connected to it. Amodei's insights serve as both a roadmap for leaders to navigate the social and economic opportunities AI will offer and a call to action to ensure its development is pursued responsibly and ethically.

The convergence of biology and artificial intelligence must be examined not only through the lens of expanding medical data sets and their processing with technological intelligence but also by considering the entirety of the physical, spiritual, and mental systems that define human existence. This is because **our physical body carries a record of information accumulated over years, shaping perceptions and influencing decision-making processes. Artificial intelligence is attempting to establish a new framework for emotional systems—reasoning, inferring, and predicting** based on how humans make decisions and perceive the world—and it is improving rapidly in this endeavor.

Perhaps this underscores the importance of mastering our personal bodily systems and physical technology before collaborating with or leading artificial intelligence.

As Microsoft's artificial intelligence leader Mustafa Süleyman introduces the new **features of Copilot, an important topic requiring conscious evaluation emerges for leaders.** According to Süleyman, the latest version of Copilot, with enhanced voice, visual, and search capabilities, will become smarter and more user-friendly. This advancement will enable users to interact more intuitively with computers, thereby boosting productivity in the business world.[3]

It may be valuable to look beyond the phrase "the space for users to interact more intuitively with computers," one of the promises of Copilot's newly added features. Intuitiveness requires a depth of communication wisdom that extends far beyond face-to-face interactions and measurable, visible parameters.

How can machine intelligence develop the wisdom to communicate by forming connections with incoming information that extend beyond what is visible?

The reference point for artificial intelligence in its learning processes and performance is humanity itself. Artificial intelligence is currently conducting R&D across numerous parameters, including cognition and consciousness, and delving even deeper into understanding human emotions—why and how we feel the way we do, how these emotions translate into behavior, and how they generate emotional responses. The foundation of emotions is not solely our feelings but also our perceptions, past experiences, and behavioral habits—essentially, the patterns within our personal algorithm. These patterns underpin the identities we create in both our personal and professional lives. These identities play a pivotal role, influencing many aspects of our professional existence, from how we define ourselves to how effectively we deliver on the economic value we promise. From this foundation, there emerges a dynamic flow where artificial intelligence works to understand and model the decision-making frameworks underlying business processes.

The deep science behind human behavior has also served as inspiration for the development of artificial intelligence. **This makes it essential for individuals collaborating with AI to understand the science of their own behavior. The better team members understand one another, the stronger the synergy they can achieve.** Consequently, leaders' knowledge of behavioral sciences has become a strategic imperative for establishing, managing, and

scaling AI-driven organizations in the technology landscape.

Research indicates that **76% of leaders are struggling to implement AI.[4] For years, leaders have framed their technology investments and business decisions around the question, "Which technology?" They aligned growth, planning, organizational structure, and impact with the value derived from answering this question. Now, the question has shifted to: "Why technology?"**

In the technology universe, there is no single answer to a single question. If there were, innovation—which thrives on questioning and thinking beyond conventional boundaries—would not be one of the defining cultural codes of our modern technology landscape.

Therefore, the answer to the question "Why technology?" involves multiple lines of communication:

- Work-related line
- Human-related line

When our organizations ask the question "Why technology?", they must consider factors such as the ethics of the business, its moral implications, the benefits it provides, its contribution to social welfare and growth, its role in advancing technological development, and the holistic renewal of its value proposition.

When we individually ask the question "Why technology?", we bring into consideration our cognition, consciousness, and the way we relate to ourselves, others, and everything around us through our natural intelligence and human algorithm.

Anyone aspiring to lead artificial intelligence and the roles emerging from its technologies must now incorporate into their skill value propositions not only experience but also the ability to perceive beyond the visible, conduct deep field analysis, engage in profound observation, and demonstrate personal mastery alongside intellectual depth. Achieving personal mastery requires connecting with the ancient knowledge sources of our humanity, cultivating intuitive, conscious, and holistic perception skills, and truly understanding our human algorithm—our operating and relational style—before engaging with machine algorithms. This calls for a deep journey of self-discipline and introspection within ourselves.

Answering the question of "Why technology?" signifies the emergence of a new consciousness as we navigate these thresholds. Approaching technology with awareness enhances the professional quality of communities in the digital world across all roles and levels. For professionals in decision-making positions, managing artificial intelligence and technology without the foundation of "conscious leadership" will increasingly carry critical risks.

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QUANTUM COMPUTING AND AI: COMMERCIAL ENGAGEMENT AND RECENT DEVELOPMENTS

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Quantum computing is anticipated to play a pivotal role in enhancing the effectiveness of artificial intelligence in commercial applications. Conversely, artificial intelligence serves a crucial function in analyzing the complexity of quantum systems and optimizing the data for processing. This dynamic interaction unlocks significant opportunities, fostering innovative applications and advancements in both artificial intelligence and quantum computing.

QUANTUM EMPOWERED ARTIFICIAL INTELLIGENCE

Quantum-empowered artificial intelligence refers to the use of quantum computers to enhance the performance and capabilities of artificial intelligence and associated machine learning algorithms. By utilizing the principles of superposition and entanglement from quantum mechanics, researchers aim to address some of the limitations of classical AI and unlock new possibilities in commercial applications or improve existing ones.

Traditional AI algorithms demand substantial computational resources and time to process large data sets in machine learning and optimization. To address this challenge, researchers are developing quantum algorithms based on classical algorithms, designed to run on quantum processors. This approach aims to shift resource-intensive and time-consuming calculations to quantum computers, enabling more efficient and accurate results. Examples of these approaches, categorized under *quantum machine learning* (QML) algorithms, include *quantum*

support vector machines (QSVM), *quantum neural networks* (QNN), and *quantum natural language processing* (QNLP).

In classical machine learning, increasing the size of parameters often presents significant challenges, as the computational resources required to process and analyze the data grow exponentially with the number of dimensions. The primary advantage of quantum machine learning algorithms lies in their ability to handle high-dimensional data more efficiently than classical computers. *Quantum support vector machines* (QSVM), a quantum adaptation of the classical *support vector machine* (SVM) algorithm, exemplify this capability. By leveraging quantum principles, QSVM can classify data more efficiently and effectively. Another noteworthy algorithm is *Quantum Principal Component Analysis* (QPCA), which can perform dimensionality reduction in large data sets more efficiently than its classical counterpart. Quantum neural networks are a subset of quantum machine learning algorithms. Classical neural networks consist of interconnected nodes (neurons) modeled on the operating principles of biological neural networks, such as those in the human brain. In these networks, the weights assigned to each connection determine the importance of each input. Adjusting these weights impacts the model's ability to learn complex relationships, making proper weight optimization critical to improving performance. Quantum-supported neural networks aim to enhance this optimization process by leveraging the principles of superposition and entanglement. These features enable the creation of quantum neurons capable of processing and storing information more compactly and efficiently. Quantum computing is predicted to potentially accelerate the training of deep learning models. Quantum natural language processing (QNLP) is an emerging research field that integrates the principles of quantum computing with natural language processing (NLP). This discipline explores solving NLP-related problems through quantum computing techniques, focusing on modeling more complex language structures and relationships. By doing so, QNLP aims to enable a deeper understanding and analysis of the subtleties and nuances of natural language.

Given the limitations preventing quantum computers from fully processing big data, companies and researchers are exploring ways to develop new hybrid algorithms by combining classical and quantum approaches through collaboration. Hybrid quantum computing algorithms aim to deliver more effective and efficient solutions by offloading the data-intensive computational tasks of classical machine learning algorithms to quantum computers. In this context, advancements and research in the commercial field highlight the significant potential of hybrid algorithms.

In the field of finance, Deloitte, one of the world's leading consulting firms, is conducting research at its Italian office on how quantum machine learning technology can enhance fraud detection in digital payments. Announced in July 2024, this initiative aims to strengthen financial security and improve the detection of fraudulent activities in digital transactions. As e-commerce continues to experience rapid growth, the demand for adaptable detection mechanisms to address the increasing volume of fraudulent activity has become ever more critical. Traditional machine learning algorithms have already played a significant role in analyzing large datasets in real time to identify suspicious activities swiftly. Quantum computing is anticipated to elevate these capabilities to an entirely new level, offering unprecedented efficiency and effectiveness. Researchers have observed that hybrid modeling can deliver more accurate results while requiring less data compared to classical models.

In May 2023, HSBC and Quantinuum, a quantum technology company under the US-based conglomerate Honeywell, announced a partnership to explore the applications of quantum technologies in areas such as cybersecurity and fraud detection. As part of this collaboration, HSBC and Quantinuum plan to integrate machine learning and quantum technologies across multiple domains, with a primary emphasis on enhancing fraud detection. In addition, they are advancing research on quantum natural language processing (QNLP), a novel form of language-based artificial intelligence that employs an explainable model, unlike the "black box" methods used in traditional classical large language models. This approach aims to enhance natural language processing tasks valuable to various markets, such as providing more accurate answers to customer inquiries or detecting text similarities.

In the healthcare sector, Swiss-based quantum technology company Terra Quantum announced in a study published in

March 2024 that it has developed a hybrid quantum neural network designed to improve the detection of healthy livers for use in liver transplants (Lusnig et al., 2024). Non-alcoholic fatty liver disease, a key factor in liver transplants, affects an estimated 32% of adults worldwide. Using real clinical data, Terra Quantum aimed to classify livers into two categories: those healthy enough for transplantation and those likely to fail if transplanted. With the hybrid algorithm they developed, researchers achieved a classification accuracy of 97%, surpassing conventional methods by 1.8%.Terra Quantum's algorithm not only demonstrates high accuracy in determining the transplantability of a liver but also helps prevent complications by reducing the risk of misdiagnosis, which could otherwise result in a diseased liver being transplanted into a healthy patient. With this study, Terra Quantum has taken a significant step toward improving donor liver selection through the use of quantum neural networks, potentially revolutionizing liver transplantation by increasing transplantation rates.

Also in March 2024, a collaborative research effort by Carnegie Mellon University, the University of Maryland, and the Indian Institute of Technology explored the potential of classical, quantum, and hybrid methods to deliver faster and more accurate results in pneumonia diagnoses (Guddanti et al., 2024). Pneumonia, a lung infection that causes breathing difficulties, is typically diagnosed through chest x-rays. These X-rays are typically reviewed by radiologists; however, labor shortages are expected to pose challenges for timely diagnoses in the future. According to the World Health Organization, pneumonia

is one of the leading causes of death among children under five worldwide. For the diagnosis of common diseases like pneumonia, it is believed that quantum technologies, combined with machine learning, could significantly enhance disease detection. The universities' research approaches this challenge as an "optimization problem," utilizing support vector machines to address it. To solve the problem, annealing methods operating across classical, quantum, and hybrid systems have garnered significant attention. In the quantum annealing method, the problem is appropriately defined, and the system is guided to its lowest energy state to find the solution. Researchers, utilizing machines from Canada-based D-Wave, a pioneer in quantum computing, compared results obtained through classical analysis software and quantum annealing methods. Using a dataset

of 2,000 X-ray images—1,000 each of pneumonia and healthy cases—they applied the SVM method for pneumonia diagnosis. In accuracy measurements, classical solutions achieved 92% accuracy, while the simulated annealing method produced similar or slightly better results. Quantum annealing also delivered high-quality results, although the processing time was slower. This indicates that advancements will continue as quantum devices achieve greater processing capacity.

A noteworthy development in the pharmaceutical industry is Japan Tobacco's (JT) announcement in October 2024 of a new research initiative in collaboration with D-Wave, focusing on drug discovery. To remain competitive, pharmaceutical companies must address challenges such as complexity, uncertainty, and lengthy timelines in the drug development process. This necessity drives the demand for increased speed and quality in AI-assisted drug discovery. As part of this project, which aims to accelerate the discovery of small molecules, JT will leverage D-Wave's annealing-based quantum computing solutions to enhance the speed and quality of AI-assisted analysis systems.

In a paper published in October 2023, Terra Quantum introduced a novel hybrid neural network solution that combines quantum and classical algorithms to model gas emissions in waste incineration and power generation plants (Kordzanganeh et al., 2023). These plants must carefully regulate the flow rate and temperature of emissions from the incineration process. However, predicting emissions is challenging, as they do not exhibit clear correlations with measurable parameters such as airflow or waste input. The researchers discovered that by integrating a quantum neural network layer into an existing classical model, the error rate of the model was reduced to one-third of what it would have been without quantum computing. This model has the potential to alert plant operators to potential issues in advance, enabling them to take corrective actions without shutting down the entire operation, thereby avoiding costly and inefficient disruptions. The researchers highlight that this new hybrid machine learning approach is particularly valuable when addressing atypical or complex problems.

AI-POWERED QUANTUM COMPUTERS

In addition to the contributions of quantum algorithms to artificial intelligence, enhancing the efficiency of quantum computers through the use of classical machine learning represents a significant advancement in the interaction between these two technologies.

One of the most significant engineering challenges in advancing quantum computers to the level where they can solve commercial problems is scaling their processors. The smallest unit of quantum processors, qubits (quantum bits, which are the quantum equivalent of bits in classical computers), are highly sensitive to external factors. As a result, ensuring consistent outcomes during calculations requires error correction in qubits affected by such factors. Error correction can be achieved by

either increasing the number of qubits or detecting errors without disrupting the superposition properties of the qubits—a process known as syndrome measurement. Quantum error correction is inherently more complex than classical error correction due to the nature of quantum information processing, where measurement can lead to information loss. To address these challenges, researchers are increasingly employing artificial intelligence to develop innovative solutions.

In a study published in July 2024, the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO), a scientific institution under the Australian Government, achieved significant progress in detecting and correcting errors in quantum processors by developing an artificial intelligence-supported signal coding solution (Hall et al., 2024). This method, tested on IBM quantum processors, allowed for the direct processing of syndrome measurements obtained from the system and proposed suitable corrections despite the highly complex nature of the noise.

In May 2024, researchers from the University of Innsbruck, Austria, published a paper (Fürrutter et al., 2024) detailing a machine learning-based method for generating the sequence of quantum gates required to prepare specific quantum states or execute algorithms on quantum computers. This method harnesses the power of generative artificial intelligence models, which can be developed using text annotations. The study demonstrates how these models can be utilized to construct quantum circuits tailored to the unique characteristics of quantum computers. In tandem with efforts to improve the scalability of quantum computers, this research marks a significant step toward unlocking their potential, even with a limited number of qubits.

CONCLUSION

Quantum computing is expected to play a pivotal role in enhancing the effectiveness of artificial intelligence in commercial applications. Conversely, artificial intelligence assumes a critical role in analyzing the complexity of quantum systems and optimizing the data to be processed. The integration of AI into error correction processes enhances the reliability of quantum computers, leading to more consistent and accurate results. This synergy creates significant opportunities, fostering innovative applications and advancements in both artificial intelligence and quantum computing.

Despite the promising potential of quantum-assisted artificial intelligence, significant challenges remain. Quantum computers are still in the early stages of development, and practical applications of quantum machine learning algorithms require coherent computations and scalable quantum hardware. Additionally, the development of quantum algorithms capable of outperforming classical algorithms for specific tasks is an ongoing area of research. Nonetheless, as quantum computing technologies advance, they hold the potential to revolutionize machine learning by enabling faster and more accurate data analysis.

Detailed research reports and applications on quantum technologies and artificial intelligence are available through Maxitech's innovation platform, entrapeer.

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HUMANS AND ENVIRONMENT

SMART CITIES: SUSTAINABLE LIVING SPACES FOR THE FUTURE

ASSOC. PROF. DR. ALPER ÖZPINAR

Humans have evolved into one of the world's most intelligent and dominant species by steadily enhancing their cognitive capabilities throughout the evolutionary process, enabling them to live in communities, collaborate in production, and share in consumption. Our species, Homo sapiens, first emerged in Africa before migrating to various regions across the globe. Through interactions with other human species, such as Neanderthals and Denisovans, and through the capacity to construct complex social structures, it established itself as the planet's dominant species.

In this evolutionary journey, our capacity to collectively generate and share knowledge emerged as one of the most crucial factors in our survival. The animal drawings discovered in the Leang Tedongnge cave on Sulawesi Island, dating back approximately 45,500 years, the 40,800-year-old red discs and hand prints in Spain's El Castillo cave, and the paintings in France's Chauvet

cave and the later discovered Lascaux caves stand as the earliest documented evidence of humanity's transformation into a society.

With the advent of agriculture during the Neolithic Period, humanity transitioned to a settled lifestyle, leading to more intricate social structures. In this regard, our Anatolian lands hold a remarkable heritage. The presence of monumental and complex structures such as Göbeklitepe and Karahantepe, alongside evidence of people living in houses, raising animals, and engaging in agriculture in Çatalhöyük, serve as clear markers of this progress. The fact that these ancient settlements can still be visited today as testaments to an advanced artistic and social life is, I believe, a tremendous privilege for us.

The Sumerian civilization, which later emerged in Mesopotamia, founded one of the world's earliest cities,distinguished by its advanced irrigation systems and cuneiform script. The Hanging Gardens of Babylon, regarded as one of the Seven Wonders of the World, exemplify this legacy. During the Roman Empire, urbanization witnessed significant momentum, driven by the expansion of civic activities and trade routes.

Throughout history, the concept of the city has consistently been a central focus of humanity. Today, however, cities are grappling with global challenges such as population growth, climate change, and limited resources. With the advent of the first industrial revolutions—the precursors to digital transformation and Industry 4.0—cities became hubs of industrial activity, triggering large-scale migrations from rural areas. Urbanization, driven by economic dynamics and societal changes, has accelerated the overconsumption of natural resources, environmental pollution, and the intensification of climate change impacts. This situation compels us to seek innovative solutions for a sustainable world and the future of humanity. At this juncture, the concept of **"smart cities"** has emerged, leveraging the power of technology to address these pressing challenges.

Today, smart cities strive to create more sustainable, livable, and efficient urban environments by integrating technological infrastructure, data analytics, and citizen engagement. Designed to leverage technologies such as the Internet of Things (IoT), artificial intelligence, and big data—indispensable pillars of the business world and social media—these cities aim to make significant strides in areas like reducing energy consumption, optimizing transportation, enhancing waste management, mitigating the impacts of climate change, and improving citizens' quality of life.

So, what exactly are smart cities, and why do they hold such significance for both us and the world?

Let us explore the answers to these questions together and gain deeper insights into the sustainable living spaces of the future.

First, let us begin with official definitions. In 2014, the British Standards Institute (BSI) PAS 180 standards document defined a "Smart City" as "the effective integration of physical, digital, and human systems within a structured environment to provide a sustainable, prosperous, and inclusive future for ecosystem

assets." That same year, the European Parliament described a Smart City as "a city that adopts an approach to solving public issues through ICT-based solutions within the framework of a multi-stakeholder, municipality-oriented partnership." ISO, taking a technological perspective, defined it as "a new concept and model where next-generation information communication technologies such as the Internet of Things, cloud computing, big data, and integrated geographic information systems are applied to facilitate city planning, management, construction, and smart services." In 2016, ITU, another standards organization, defined a Smart and Sustainable City as "an innovative city that leverages information and communication technologies and other tools to enhance the quality of life, the efficiency of urban service delivery, and competitiveness, while addressing the economic, social, environmental, and cultural needs of current and future generations."

In our country, the Ministry of Environment and Urbanization, established in 2011, was renamed the Ministry of Environment, Urbanization, and Climate Change in 2021, reflecting growing awareness and targets related to sustainability and climate change, particularly in recent years. The Ministry defines smart cities as "more livable and sustainable cities developed through stakeholder collaboration, leveraging new technologies and innovative approaches, justified by data and expertise, and offering solutions that add value to life by anticipating future challenges and needs." Additionally, the Reference and National Smart City Architecture (RUMI) was published in 2021.

As evident from these definitions, **the initial emphasis on technological infrastructure,** city management, and service efficiency has gradually shifted to include concepts such as **sustainability, participation, and human-centric approaches**. Cities are now viewed not only through an economic lens but also in terms of their social and environmental dimensions. Today, a smart city is defined as an integrated system managed through a multi-stakeholder approach, combining technological innovations with social benefits to develop forward-looking solutions.

In 2024, 57% of the world's population resided in cities, marking a significant shift towards urban living and the onset of a digital transformation in metropolises. By 2050, this figure is projected to rise to 68%, with notable regional disparities: 83% of the population in North America, 75% in Europe, 51% in Asia, and 44% in Africa are expected to live in urban areas. As in many other domains, this field also reflects global imbalances. With trade and economic activities concentrated in densely populated urban regions, cities have evolved into open-air laboratories, featuring advancements such as artificial intelligence-powered traffic systems and sensor networks that monitor carbon emissions in real time.

In fact, last year, smart city investments in the Asia-Pacific region alone surpassed USD 400 billion, highlighting the growing urgency of this transformation. The global climate crisis and challenges in resource management have rendered this shift not a luxury but a necessity. Real-world examples underscore this reality: Singapore

Songdo City - South Korea

achieved a 20% reduction in vehicle waiting times through artificial intelligence-powered traffic systems, Tokyo decreased electricity consumption by 15% using smart energy grids, and Copenhagen reduced carbon emissions by 90,000 tonnes annually by optimizing bicycle traffic with IoT sensors. These advancements are no longer science fiction—they are the reality of our time.

So, will this digital revolution truly deliver on its promises, or will it merely result in a garbage dump of poorly planned projects and narratives that can only be displayed on billboards as part of promotional campaigns?

I'd like to share a few examples to shed light on this. Take Songdo in South Korea—a smart city project built entirely from scratch. Despite its advanced technological infrastructure, the city aimed for a population of 300,000 by 2015 but, by 2024, it only reached around 200,000 and struggled to capture the social energy it had envisioned. Many residents described it as cold and lifeless. That said, it's still worth highlighting that, for a city designed and built entirely for this purpose, it represents an impressive feat of technology and urban planning.

In the Masdar City zero-carbon emission project in the United Arab Emirates, the city was expected to be completed by 2016 and accommodate 50,000 people. It was also designed to operate entirely on renewable energy and achieve zero carbon emissions. However, it fell significantly short of its ambitious goals due to financial challenges and technological limitations.

Sidewalk Toronto in Canada was envisioned as an ambitious urban development project in the Quayside area by Sidewalk Labs, a subsidiary of Google's parent company, Alphabet Inc. Launched in 2017, the project aimed to build an innovative smart city on Toronto's eastern waterfront. However, it was ultimately abandoned due to data privacy concerns and public opposition. On 7 May 2020, Sidewalk Labs CEO Dan Doctoroff announced the cancellation of the project, citing economic uncertainties caused by the Covid-19 pandemic.

These examples offer a glimpse into how different cultures, geographies, and societies interpret smart cities and adopt new approaches. Yet, when it comes to our own examples, which lean heavily on urban transformation and rent-driven projects, I feel it's best to steer clear of that discussion altogether.

Global examples remind us that smart city projects are about far more than just technological infrastructure—they must weave

together social, economic, and environmental threads. Without this balance, even the most ambitious ideas can fall short, leading to disappointment and eroding trust in the "smart city" concept. As I'll delve into later, the true essence of smart cities lies in embracing them as not just a technological shift but a social, economic, and environmental revolution—and ensuring they are designed with sustainability at their core is what will truly shape a better future.

Japan's vision of Society 5.0 introduces a groundbreaking perspective on the future of smart cities, emphasizing the importance of balancing the diverse expectations and needs of multiple generations within this new societal framework. This concept of a "super-smart society" envisions a human-centered future where cyberspace and the physical world merge seamlessly. The digital fluency of Generation Z, the innovative spirit of Generation Y, and the seasoned experience of Generation X combine to form a unique synergy—one that both enriches and occasionally challenges the evolution of Society 5.0.

At this point, it's crucial to recognize that smart **cities are not just a technological transformation** but also **a delicate balance of social dynamics.** The divide between Generation Z's digital fluency, their affinity for cryptocurrency and blockchain technologies, and Generation X's wealth of experience represents both a point of synergy and tension shaping the future of smart cities. Yet, these differences hold the potential to become a powerful source of innovation rather than conflict. I believe that Generation Y's

New Generation Jetsons with Dall-E Interpretation

sustainability-driven mindset and sensitivity can serve as a vital bridge in fostering this balance. After all, each generation has grown up in different environments, technologies, and transformations, shaping distinct priorities and perspectives.

Reflecting on the place of technology in my life as a Generation X individual, I recall how it all began with the "magic box" television during my childhood—a central figure of entertainment and wonder. Today, tablets, smartphones, VR glasses, and countless other technological marvels have taken its place. My thoughts wandered to the cartoons of the 1950s and 1960s, particularly those inspired by American culture, like The Flintstones and The Jetsons, which depicted two wildly contrasting eras—the Stone Age and a futuristic world. If you revisit any episode of The

Jetsons, you'll see Orbit City come to life, illustrating how step by step, we're inching closer to that vision of the future and the promise of smart cities.

If we take a closer look at today's most widely used smart city applications, it's clear that they are predominantly technology-driven. Let's take a moment to highlight a few of them.

Smart Transportation Systems: From intelligent traffic signals that optimize flow to real-time tracking of public transport and autonomous vehicle technologies, these innovations are tackling urban transportation challenges head-on. Singapore stands out as a trailblazer in this field. Closer to home, it's worth mentioning that many of our larger cities boast integrated information systems with impressive results. After all, who doesn't check a GPS app for traffic updates before heading out these days?

Smart Lighting: Motion sensor and LED-based lighting systems have become increasingly popular for boosting energy efficiency. Amsterdam stands out as a leading example with its energy-saving lighting projects that continue to draw attention.

Smart Waste Management: Smart bins equipped with sensors can detect occupancy levels and optimize collection routes, significantly reducing waste management costs. South Korea is a notable leader in this field with its advanced practices. However, in our context, the recycling ecosystem and the individuals working within it present unique dynamics. For this reason, I believe that applications like smart bins are unlikely to see widespread adoption anytime soon, apart from a few pilot projects.

Smart Water Management: From sensors that detect water leaks to systems analyzing consumption patterns, smart water management technologies help optimize the use of precious resources. Barcelona stands out as a city with exemplary projects in this area. In our country, SCADA systems have been effectively implemented in major cities, showcasing successful practices in monitoring and tracking water resources.

Smart Security Systems: AI-powered security cameras, facial recognition systems, and crime analysis tools are transforming urban safety measures. China has implemented a comprehensive security network in this area. While it is undoubtedly a technological success, the system's social implications raise questions—perhaps influenced by the country's approach to individual privacy and borders.

e-Government Services: e-Government platforms simplify citizens' access to public services online, enhancing transparency and efficiency. Estonia stands out as a global leader in this area. In recent years, the innovations and services introduced through e-Government in our country have placed us in a much stronger and more widely adopted position—something we can take pride in.

Smart Buildings: High energy efficiency and automatic control systems in buildings play a key role in reducing cities' carbon footprints. New York is making significant strides with its LEED-certified smart buildings. In our country, such structures are most commonly found in newly developed university campuses, technology development zones, and technoparks.

Healthcare Technologies: Sensor-based systems and mobile applications that collect and analyze health data are paving the way for personalized healthcare services. Sweden is a leader in digital health practices, setting an impressive example. In our country, the e-Pulse system has also made remarkable advancements. If you haven't checked it out recently, I highly recommend exploring it to see how far it has come.

The next decade promises to be shaped by transformative technologies under the themes of Sustainability, Technology, and Social Life. Among these, natural language processing has taken a giant leap forward with large language models (LLMs). Models like GPT, with their trillions of parameters, have unlocked groundbreaking abilities to understand and generate human language, pushing us into uncharted territory. It's an evolution that feels as exciting as it is unsettling. With every advance, the once-distant concept of super artificial intelligence inches closer to reality, bringing not just answers but an avalanche of new questions and possibilities. As next-generation AI applications emerge and the rapid developments covered by the esteemed authors of this Technology Report unfold, one thing is clear—this list isn't set in stone and may shift dramatically in the near future.

Handprints in El Castillo cave

SUSTAINABILITY

Zero Carbon Emission: I believe that renewable energy sources, energy-efficient buildings, and carbon capture technologies will pave the way for cities that not only achieve zero-carbon targets but also harmonize environmental sustainability with social welfare.

Green Infrastructure: Practices such as green roofs, rainwater harvesting, and urban agriculture will bring the vision of a sustainable city to life by offering a way of living in harmony with the natural environment. Practices such as urban agriculture will be implemented.

TECHNOLOGY AND INNOVATION

Artificial Intelligence and Machine Learning: The application of super artificial intelligence in data analysis, predictive models, and optimization processes will pave the way for more efficiently managed cities, offering smart solutions that simplify life in the future.

Blockchain Technology: I believe that blockchain applications, which enhance transparency and security, will strengthen cities' data management systems and foster more reliable ecosystems.

Internet of Things (IoT): Connecting devices and infrastructure in the city to each other and sharing data will provide real-time solutions and revolutionise city management.

Virtual and Augmented Reality: By introducing new experiences in urban planning and social interaction, it will revolutionize many areas, from education to cultural events, and further enrich our lives.

PUBLIC LIFE AND CITIZEN ENGAGEMENT

Smart Citizenship: Digital platforms will enable citizens to actively participate in decision-making processes, which, I believe, will pave the way for more democratic cities.

Social Justice: Ensuring equal access to technology for everyone appears to be a promising way to reduce social inequalities and foster a more inclusive society.

Protection of Cultural Heritage: Digitally recording historical buildings and bringing them to life with augmented reality technologies will ensure that cultural heritage is preserved and passed on to future generations.

15-Minute Cities: Cities designed to meet all needs within short distances while promoting walking and cycling will enhance quality of life and support environmental sustainability. In this context, initiatives such as the DUT European Union Project calls, planned to launch in 2026, are noteworthy examples.

Smart Mobility: Autonomous vehicles and micromobility solutions integrated with public transport are poised to transform the dynamic structure of cities by providing faster and more environmentally friendly transportation options. The concept of Mobility as a Service (MaaS) has now become an essential component of all such projects.

Metaverse Cities: Cities where the physical and digital worlds converge, fostering new forms of social interaction, will revolutionize human life in both virtual and real dimensions. In these digital smart cities, many people may even find solutions to the shortcomings of their existing urban environments.

In conclusion, smart cities represent more than just a technological revolution—they embody a transformative process aimed at enhancing quality of life, ensuring sustainability, and delivering innovative solutions to social challenges. The smart cities of the future hold the potential to create more livable, resilient, and inclusive environments by leveraging technology with a human-centered approach. To navigate the challenges of transitioning to smart cities, it is crucial to bridge the digital divide, ensure cybersecurity, strengthen collaboration among stakeholders, and support user adaptation. Yet, these challenges pale in comparison to the immense opportunities that technology brings.

Finally, I believe that smart cities must transcend being merely technological advancements; they should serve as the cornerstone of a sustainable future rooted in human values. Achieving this vision requires a holistic approach that integrates technology, artificial intelligence, environmental stewardship, and human collaboration. It is our shared responsibility to create more livable cities for future generations. Instead of focusing on the next elections, let us prioritize the future of humanity. Let us join hands and accept the hand extended to us fifty thousand years ago, working together to create living spaces for smart and sustainable cities. Let our goal not be about projects, but about sustaining the future of humanity as an inseparable part of the world. Remember, the future begins today.

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GENERATIVE SYNESTHESIA: COLLABORATION BETWEEN HUMANS AND AI

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We are now in the third year of generative artificial intelligence's swift integration into our lives, and the remarkable advancements so far have become almost routine. By the time you read this, countless new developments—beyond those mentioned here—may have already emerged and begun shaping our daily lives.

What are the most discussed, utilized, and developed applications of generative artificial intelligence in the business world? From my experience so far, I can confidently say that its adoption in the business world still lags significantly behind the pace of technological advancements. So, what do we actually know and talk about? ChatGPT is undoubtedly the most talked-about tool, one that has opened the doors to a new era. There are very few who haven't heard of it. Another widely recognized application is chatbots. Many companies are leveraging ChatGPT or similar language model infrastructures to create personalized customer service tools and employee support systems. Content creation is another prominent use case. In fact, marketing and marketing communications stand out as the first and fastest-growing areas for generative AI adoption.

It is undeniable that content production has been democratized, yet truly creative works remain scarce. For instance, in just the past year or two, billions of images have been generated, often in strikingly similar styles.

We surely cannot ignore that we are now surrounded by images, videos, and deepfakes that are virtually indistinguishable from reality. Interestingly, audio and video cloning technologies

seem to be making more waves in the criminal world than in the business world.

On the other hand, some topics, though less discussed, are poised to have a profound impact in the near future. One such area is artificial intelligence agents (action models). A striking example is Claude.ai's capability to operate a computer and cursor autonomously, as seen at the time of this writing. (Perhaps, as you read this, you are remotely observing it prepare a file or project on your computer.) Beyond ChatGPT, there are now more than 450 language models, and in this fast-moving race, everything can change overnight. Created avatars can already attend meetings or presentations on our behalf, language barriers are disappearing at an unprecedented pace, and step by step, we are edging closer to Artificial General Intelligence (AGI).

As these advancements unfold, it's crucial to reflect on where we stand regarding the productivity potential of generative artificial intelligence. We must understand that generative AI earns its name not because it produces on its own, but because it empowers us to create. This makes our position in productivity during this pivotal moment in history critically important. Will we allow artificial intelligence to make decisions on our behalf, or will we guide it responsibly and use it to accelerate the innovation process?

As organizations, we are still in the process of discovering how to maximize the benefits of generative AI while minimizing its potential risks. In many cases, the use of generative AI models is currently prohibited for several valid reasons. However, this is unlikely to persist, as safer methods of implementation are rapidly becoming available. Organizations must move quickly beyond using generative AI solely for tasks like answering employee queries, preparing presentations, creating marketing content, or performing basic analyses and syntheses. A good starting point is to remember that generative AI lives up to its name by empowering us to produce and innovate.

GENERATIVE SYNESTHESIA

Productivity and creativity are no longer exclusive to humans, as generative artificial intelligence has made abundantly clear.

The billions of creative images and videos that have emerged over the past two years are the strongest evidence of this shift. While debates continue around the creative outputs of artificial intelligence, it's undeniable that creative production has become both democratized and unprecedentedly prolific. However, for now, generative AI cannot produce or create entirely on its own. We know that all generative AI models are probabilistic in nature, generating outputs by making connections based on the limited data they have been trained on—and as a result, they inherently carry a margin of error.

Generative artificial intelligence, for all its advancements, still relies heavily on human instruction and guidance to achieve truly innovative results. While it accomplishes feats beyond our capabilities and even stirs fears of human inactivity, there's a reassuring reality—it cannot replicate what we, as humans, can do. It doesn't come close to matching the skills, perception, and connectivity of the human brain. (Of course, this conversation may change entirely once AGI becomes a reality.)

To move forward, we should begin by introducing the concept of 'Generative Synesthesia' into our professional lives. I believe that collaboration between humans and artificial intelligence will become one of the defining requirements of the new era. As we go about our work, we need to position these models not as interns, but as creative partners—partners who can offer fresh perspectives and reveal angles we might overlook. Recognizing that what we possess, they lack, and what they offer, we do not,

is key. By combining these strengths, we can take the first steps toward a partnership that fosters truly innovative creations.

INNOVATION WITH GENERATIVE AI

The ultimate goal of this collaboration should be innovation. However, I believe we are searching for innovation in the wrong places. Today, we are surrounded by AI start-ups, most of which are built around integrated language models. Many of these start-ups, unfortunately, are near-identical copies of each other and are likely destined to fade away. While focusing on AI-integrated processes is undoubtedly important, why aren't we leveraging this powerful tool to drive innovation across all other areas as well?Innovation is the process of creating value by enhancing existing products, services, or processes. The true breakthrough in this process happens when people connect seemingly unrelated ideas. The human brain remains the fundamental source of innovation. By blending past experiences, knowledge, and observations, it forms

connections between disparate concepts, sparking creativity and new ideas. For instance, an artist might design a unique piece of architecture by merging the delicate shape of a flower with the structure of a building.

Artificial intelligence is a powerful enabler of creativity. Just as the human brain generates ideas by linking different regions, AI analyzes massive datasets to uncover unexpected connections. But here's where AI stands out—it operates without the limitations of human preconceptions, often combining elements that seem entirely unrelated. Imagine an AI suggesting that a principle from biology could inspire a groundbreaking fashion design. Intriguing, right?Yet, there's a catch. These suggestions aren't always innovative. Many are fueled by pre-existing patterns, recycling ideas that already exist. What might seem exciting at first often reveals itself as incomplete, requiring our intervention to refine and transform it into something meaningful. Generative AI is a powerful connection machine, but it relies on us to give those connections purpose and direction.

Both human and artificial intelligence will play pivotal roles in the innovation process. The demand for skilled individuals who can guide generative AI to make meaningful connections, ask the right questions, and manage this process effectively will be greater than ever.

Generative artificial intelligence is therefore not merely a matter of technological investment—it's a matter of adaptation. As these advancements continue to progress at lightning speed, the real focus should be on training individuals who can harness these models to accelerate the innovation process within their own fields.

If we expect artificial intelligence to drive business growth and unlock groundbreaking innovations, the priority should go beyond simply integrating it into our processes. Instead, we must view AI as an innovation partner, begin training individuals who will manage this collaboration, and invest rapidly in fostering this cultural shift.

AI AND SUSTAINABILITY IN THE AGE OF TECHNOLOGICAL DETERMINISM

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The concept of technological determinism—the idea that technology evolves independently of social influences and drives societal change—has sparked and will continue to fuel significant debate in this century. At its core, this theory posits that technological innovations are the primary force shaping culture, the economy, politics, and social structures. In essence, it examines the profound impact of technology on the trajectory of human history and society. As we look ahead, this perspective is poised to serve as an umbrella concept for the advancements we now describe as Artificial Intelligence 2.0.

This perspective argues that, alongside internet technology, a more connected and globalized world is being created. At the same time, the rapid advancements in robotics and artificial intelligence suggest that the construction of a new society is inevitable. Though these technologies have not yet reached full maturity, they signal a new evolution in addressing modern challenges such as climate change and digital privacy within the context of a sustainable environment and society.

The potential positive and negative impacts of emerging technologies on data accuracy, personal privacy, transparency, energy consumption, and inclusiveness remain a hot topic. While these issues require more data and insights to fully unpack, the conversation surrounding inclusive and transparent artificial intelligence is already gaining regulatory momentum worldwide. If we focus on the key concepts of social justice, prosperity, and the future, it becomes clear that governments and institutions—

whether large, medium, small, or start-ups—must develop AI strategies that prioritize inclusivity. Transparency, accountability, and minimizing algorithmic bias should be at the forefront of these strategies in order to ensure responsible data use. Additionally, democratizing access to AI-based products, services, and infrastructure will be crucial, particularly in low-welfare countries and underdeveloped economies. Investments in these regions will not only maximize the social benefits of artificial intelligence but also enhance its environmental impact. However, the intentions and strategies of individuals or organizations developing and implementing these technologies alone will not suffice. It is essential to predict that other technologies must be leveraged, and methods should be continuously reviewed and improved—especially when it comes to ensuring data reliability and transparent usage.

The idea of interoperability—where different systems, software, devices, or platforms seamlessly interact, exchange data, and work together—signals an exciting future for the collaboration between artificial intelligence, robotics, and blockchain technologies, each of which places a strong emphasis on transparency. Expanding the application of the interoperability methodology—whose primary goal is to ensure that diverse technological components share data and functionality seamlessly—offers significant benefits, particularly in terms of global networks, data security, and user experience. The integration of AI-driven systems with blockchain networks, along with the ability to receive data from

these networks, holds immense potential. This synergy can enhance security, transparency, data accuracy, and enable more efficient data processing.

Thanks to its decentralized nature, blockchain technology enhances data security by protecting it against manipulation. Each data block is encrypted and linked within a chain structure, making it virtually impossible to alter. This setup records every data transaction, allowing the traceability of the origin and accuracy of data analyzed by artificial intelligence. Such transparency boosts the confidence in AI algorithms, as it enables a clearer understanding of how decisions are made. Moreover,

blockchain networks offer data owners greater control over how their data is used, potentially easing concerns around data privacy. The data processed by AI-based systems can be sourced from these networks with high security and accuracy. Specifically, the use of data in sensitive areas such as financial transactions, health data, or autonomous systems—where security and privacy are paramount—can help mitigate potential negative scenarios in the future.

As we look to the future, the positive impact of artificial intelligence on social sustainability becomes increasingly clear. When developed inclusively, AI has the transformative power to spark innovation, promote sustainability, and foster social equality. No longer just a topic of debate, research now demonstrates that AI can offer rapid solutions to global challenges once deemed too complex to solve. With its immense potential in fields like healthcare, education, and climate action, AI is poised to be a driving force for meaningful change in the world. In nonprofit initiatives, AI is frequently applied to support "Sustainable Development Goals" like promoting good health, ensuring clean energy, and building sustainable cities. It also plays a crucial role in addressing climate-related challenges, with applications such as autonomous systems designed to enhance energy efficiency and reduce emissions. The potential impact in these areas can be further amplified if geographical inclusion is prioritized. Alongside this, the development of gender-neutral and inclusive AI and robotic systems, as well as inclusivity in open systems, are crucial issues that must not be overlooked. It's essential to consistently highlight the responsible use of AI—not just for driving economic value, but for advancing social equality as well. Reducing algorithmic biases and ensuring greater representation in AI education and development are vital steps in creating truly inclusive solutions. Many institutions have already acknowledged the systemic weaknesses in this area and have invested in improvements, as noted by their representatives. At the same time, the negative perspectives on transparency within closed, developer-owned systems are gradually shifting toward a more decentralized AI model, driven by an interoperability approach.

While I am confident that AI will play a pivotal role in building sustainable and inclusive societies, I also recognize the significant challenges that must be overcome for this potential to be fully realized. These challenges extend beyond the technical and ethical realms. One key issue, in my view, is the global shortage of funding, which is closely tied to geopolitical tensions and economic disparities. As a result, many entrepreneurs with groundbreaking ideas struggle to access the necessary resources to develop their products or services. Although significant investments and support have been made in recent years, the ongoing need for resources to drive more efficient and inclusive innovations remains critical. Without these resources, challenges such as financing constraints, geographical disparities, and the prioritization of profit-driven applications could hinder the spread of high-impact, socially beneficial projects. In such a scenario, it

would be inevitable for large technology companies to lead the competition.

Achieving sustainability and inclusiveness, however, is possible through collaboration with external stakeholders, strong ethical governance, and the integration of accessibility features from the design stage. Moreover, these technologies will have a profound impact on the future of work, education, and community interactions. With the upcoming debate on new technological determinism, it is clear that aligning with global regulatory standards and societal expectations will be essential in the long term.

ROADMAP FOR THE FUTURE: INNOVATION WITH A FOCUS ON PEOPLE AND SOCIETY

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"In an era where artificial intelligence is increasingly integrating into every facet of our lives, we stand at a pivotal moment in the relationship between AI and humanity—particularly within the business realm. This exploration delves into the core values that define us as 'human,' distinct from AI, while also considering how we can harness technology to drive environmental sustainability for the future."

We never anticipated that the future would arrive so swiftly. Technology has advanced far more quickly than we expected, bringing innovations once relegated to science fiction and futurist texts into our present reality. What seemed like distant possibilities are now integral parts of our daily lives. Technology and innovation continue to reshape the world, business, and everyday life with remarkable speed. But beyond simply witnessing this transformation, understanding what these rapid developments mean for people—and how they touch every aspect of life—will provide us with clearer insights into the world that lies ahead. When we ignore the human factor, many technological advancements remain an abstract collection of information to most of us. Yet, when they are transformed into tangible value, they seamlessly become part of life, embraced by everyone, from young children to the elderly.

Today, the challenges we encounter in both business and daily life demand far more than viewing technology as simply a tool. We no longer have the luxury of focusing solely on development and growth within business management. It's essential to

create more holistic and effective strategies and policies that prioritize the environmental and social impacts of technology, its sustainability performance, and its contribution to a healthier, more sustainable future.

As technology advances rapidly, it is crucial to understand the driving forces behind these transformative changes. Revolutionary technologies such as artificial intelligence, the Internet of Things, and blockchain are not only reshaping existing business models but also creating entirely new sectors. In a world where data—often referred to as the 'oil of the new world'—is becoming increasingly valuable, society and people-oriented approaches are not only simplifying life but also unlocking the potential to make the world a safer, more equitable place.

Financial technologies (Fintech) have emerged as one of the key drivers of this transformation. By increasing the speed, accessibility, and cost-effectiveness of traditional financial services, the fintech sector is creating a more inclusive financial ecosystem for both individuals and businesses. Innovations like digital wallets, blockchain-based payment systems, microcredit platforms, and AI-powered credit evaluation are fueling rapid growth in industries such as banking, retail, and e-commerce. These technologies not only facilitate access to financial services but also enable faster, more accurate financial decisions. The benefits extend beyond individuals, offering significant advantages to SMEs and large enterprises. Businesses that access funding at lower costs through digital platforms are empowered to grow, innovate, and enhance their competitiveness.

Customer-centric, end-to-end digital systems that prioritize security are set to become the preferred solutions in the future. The evolving expectations of younger generations are shaping the scope and direction of developments in this space. According to Statista's 2023 report, 60% of Gen Z consumers prefer mobile banking over visiting traditional bank branches. This statistic alone underscores the growing significance of mobile banking applications and online financial services. New generations demand financial services that are not only digital but also transparent and ethical. The competition between banks and fintech companies to provide innovative solutions that meet these changing needs is driving rapid advancements in this field. A study conducted in the UK reveals that 46% of Gen

Z uses third-party applications for their money and financial management, in addition to the services provided by traditional banking and financial tools. These findings clearly indicate that people have reached a new level of financial literacy and are increasingly leveraging technology to manage their finances. From personalization to security, and from streamlined payment methods to diverse payment options, there is a growing demand for maximizing the benefits offered by technology in the financial sector.

It would be short-sighted to view the advantages of technology solely through an economic lens. The fintech sector is pivotal in enhancing financial literacy and integrating more people into the global financial system. Cryptocurrencies and decentralized finance (DeFi) are not just reshaping traditional banking; they're making the financial world more transparent, secure, and accessible. As we look ahead, it's clear that the banking and finance sector will soon become fully digital, and this transformation will extend to many other industries, creating an entirely new landscape of opportunities.

One of the sectors most profoundly impacted by digitalization is retail. Developments such as the rise of e-commerce, its democratization through grassroots expansion, and the reshaping of traditional store sales models have been game-changers. Coupled with rapid advancements in artificial intelligence-driven customer experience management, these innovations have significantly boosted productivity across the

sector. Financial technologies have played a pivotal role in driving this transformation. Furthermore, a new era is unfolding in the transport and logistics field—an essential part of retail—driven by autonomous vehicles, electric cars, and drone technologies. These innovations are not only making transportation faster and more environmentally friendly, but they are also revolutionizing logistics processes.

All these transformations signal that we have entered an era where digitalisation is intertwined with sustainability. Today, we are developing business models that prioritise the integration of technology and digitalisation across various areas, including energy consumption, carbon reduction, sustainable business models, and productivity enhancement, all aimed at combating climate change and environmental challenges.

As a result, fields such as artificial intelligence, green technologies,

and biotechnology are emerging as key components of the business landscape of the future. Innovation is becoming essential not only for developing new products but also for addressing social and environmental challenges. Moving forward, technological advancements are expected to fuel not only economic growth but also the sustainable development of societies.

To succeed in this transformative era, businesses must embrace agility, adopt data-driven decision-making, and make sustainability a top priority. For innovation to truly make an impact, harnessing technology to unlock new opportunities will be the key to staying competitive and achieving sustainable growth. Shaping a smart future depends on steering these technological advancements in the right direction. We all have a role to play in this journey, ensuring we leave behind not only a higher standard of living but also a more sustainable world for the generations to come.

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ADAPTING TO AI: NEW CHALLENGES, TRUSTED REMEDIES

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Artificial intelligence has been around for half a century, but with the arrival of its 'generative' version in the hands of everyday users, it quickly took center stage in the 'technology scene,' a space once ruled by revolutionary breakthroughs like electricity and the internet. It looks like AI is here to stay in the media spotlight, dazzling on red carpets for a long time to come. In the near future, it's not just shaping up to be another technology—it's on track to become a fundamental part of human culture. After this breathtaking debut, AI is bound to drive some major social changes. Yet, even as it unlocks new possibilities, it's already stirring uncertainty and unease among people and communities.

So, how do we adapt to this shift? Can our past experiences serve as a guide on the journey to embracing artificial intelligence? Let's take a moment to revisit some moments from history.

GALILEO GALILEI

In the 17th century, when the belief that the Earth was the center of the universe and all celestial bodies revolved around it prevailed, Italian astronomer and physicist Galileo Galilei sparked a major uproar by challenging this notion. He argued, against widespread belief, that the "Earth revolved around the Sun"[1]—a scientific truth that profoundly disrupted established views. Loyal to his ideas even at great personal cost, Galileo faced trial by the Inquisition and endured years of imprisonment for his convictions.

LUDDITES AND SWING REVOLTS

In 19th century England, as mechanisation accelerated, agricultural workers, fearing for their jobs, launched what became known as the *Swing Riots*, while a group of textile workers led the *Luddite Movement*. These anxious protesters attacked windmills, set wool-shearing machines ablaze, and carried out organised efforts to destroy looms.[2] These uprisings ultimately prompted harsh crackdowns by the government.

The reactions to these major transformations, sparked by scientific advances or mechanisation, led to many painful consequences. While these periods can be explored through social, political, or economic lenses, my focus will be on understanding the role our mind's automatic responses to change played in these processes. Before delving into artificial intelligence, let's take a closer look at the organic structure of our original intelligence.

RESPONSES TO CHANGE AND THE HUMAN BRAIN

Our brain is a remarkable organ with intricate structures and functions. At its core, it consists of three main layers: *the reptilian brain (brain stem),* the emotional brain (limbic system), *and the frontal cortex (neocortex)*.[3] Our responses to change stem from the intricate interplay of these layers. The reptilian brain, driven by survival instincts, the *emotional brain*, which excels in learning and social interactions, and the *frontal cortex*, responsible for logic and planning, collaborate to create diverse scenarios when faced with new situations.

With the arrival of a revolutionary technology like artificial intelligence, our brain, true to form, quickly began generating optimistic, pessimistic, and realistic scenarios. Let's explore these scenarios together.

PESSIMISTIC SCENARIOS: ARE WE FACING THE END?

Concerns that artificial intelligence threatens humanity are frequently voiced. Stephen Hawking has expressed the view that 'the development of full artificial intelligence could spell the end of the human race'.[4] Scientists such as Geoffrey Hinton also state that the threat artificial intelligence poses to the world may be 'more urgent than climate change'.[5]

The primary concerns that cannot be overlooked are as follows:

Unemployment and Economic Inequality: Artificial intelligence could result in the loss of certain jobs and contribute to societal imbalances.

Data Security: Artificial intelligence may heighten the risk of personal data misuse.

Malicious Use: Artificial intelligence can be exploited for cyber-attacks or the creation of fake content.

Loss of Control: Artificial intelligence could advance to a point where it surpasses human intervention.

OPTIMISTIC SCENARIOS: AI—THE KEY TO A PERFECT FUTURE!

On the other hand, many believe that artificial intelligence could offer revolutionary benefits to humanity. Demis Hassabis, CEO of DeepMind, has stated, “If we could build AI in the right way, it could be the ultimate tool to help scientists, help us explore the universe around us.”[6] Similarly, futurist author Ray Kurzweil predicts that in the future, “AI will extend human lifespan.”[7]

The most promising expectations about artificial intelligence are as follows:

Revolutionising Healthcare: Artificial intelligence could contribute to the early diagnosis of diseases, enable personalised treatment methods, and enhance quality of life.

Sustainability: Artificial intelligence could provide innovative solutions for energy efficiency and environmental conservation.

Efficiency: Artificial intelligence could drive economic growth by optimising business processes.

Transcending Human Limits: Artificial intelligence could elevate human intelligence to unprecedented levels.

REALISTIC SCENARIOS: THE FUTURE IS IN OUR HANDS!

Others adopt a more cautious perspective, suggesting that the impact of artificial intelligence hinges on our choices. Yuval Noah Harari highlights the need for balance, stating that "Artificial intelligence can improve our lives, but it also has the potential to increase inequality."[8]

The differing perspectives of esteemed scientists on artificial intelligence seem straight out of Hollywood’s dystopian or utopian film plots. “So, what should we do now?” I can almost hear you asking. Fortunately, I have some good news. Here’s the first:

ADAPTATION IS IN OUR DNA!

Humanity has consistently managed to adapt to major transformations, ensuring its survival through the ages. From the hunter-gatherer lifestyle to the agricultural revolution, from the

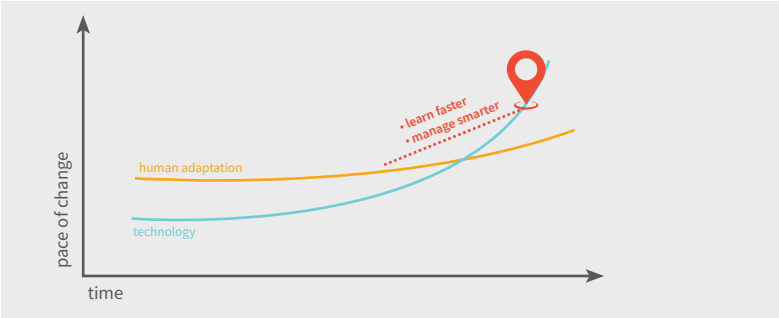
industrial revolution to the digital age, change has always been inevitable, and adaptability has remained the cornerstone of survival.

Now, here's my second piece of good news.

WE DEVELOPED METHODOLOGIES TO MANAGE CHANGE!

As a species that has successfully adapted to countless developments, humanity has devised numerous methodologies for change management, drawing from its accumulated experiences. *Models like Kotter's 8-Step Process, ADKAR, Lewin's Change Model, and the Kübler-Ross Change Curve* are just a few examples. These frameworks have been applied across various geographies and adaptation narratives, inspiring the creation of new approaches along the way.

Approximately 2,600 years have passed since Heraclitus famously declared, "The only constant in life is change." Change was an integral part of human life before Heraclitus and has remained so ever since. However, in the past century, technological advancements have accelerated to such an extent that the pace of change has far exceeded humanity's ability to adapt. Thomas L. Friedman, in his book *Thank You for Being Late*[9], referenced Eric Teller's graph to stress that we must "learn faster and manage smarter" to keep up with the rapid pace of technological progress.



Technological progress and human adaptation, Eric Teller

The business world has been relying on Agile methods for the past quarter-century to "learn faster and manage smarter" in an era dominated by variability, uncertainty, complexity, and ambiguity. While some recent discussions in the media have debated the "death of Agile," the rise of artificial intelligence has made agility more critical than ever. As Kent Beck aptly puts it, with generative artificial intelligence, "90% of our skills have been devalued, while the value of the remaining 10% has increased a thousandfold."[10] If agility is truly "the ability to adapt to changing conditions," then the coming days, shaped by the transformative power of artificial intelligence, will demand it more than ever before.

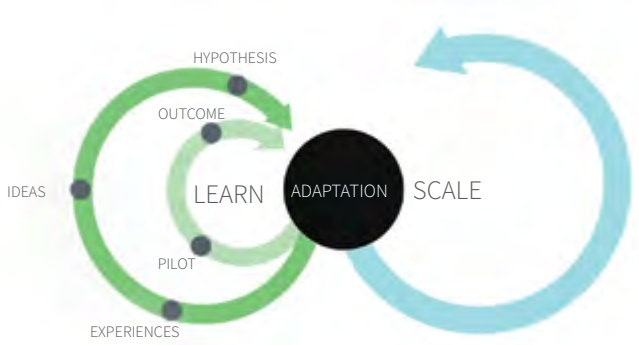
ADAPTING TO AI: A DIFFERENT STORY OF TRANSFORMATION!

Jeff Sutherland, co-founder of Scrum, stated at a conference in Berlin in October 2024 that "By 2030, teams will be 30 to 100 times faster, and teamwork without artificial intelligence will no longer be an option."[11] Achieving such a leap in speed and efficiency is only possible through the healthy integration of artificial intelligence's creative potential into business processes. In this context, adopting a systematic approach to effectively manage the transformation

is crucial. Above all, collaborating with artificial intelligence demands a cultural shift. Organisations should therefore approach the issue with at least these five focus areas in mind:

- Strategy
- Humans
- Products and Services
- Processes and Data
- Communication

In an era where the pace of change is undeniable, it is crucial for organisations to adopt a learn-and-scale approach. This approach is rooted in transitioning from experiences to ideas, from ideas to hypotheses, testing those hypotheses, and scaling them when the results prove successful.



Learn and Scale Approach

I recommend that change leaders navigating the adaptation process adopt the following four-dimensional "circular model"[12] to preserve a value-driven focus and optimise resource efficiency.

Map the Path: The vision and strategy for the change are established, its narrative is defined, and employees are engaged in the transformation process.

Readiness: The organisation's preparedness for change is assessed, and leaders are trained with a focus on the transformation.

Experiment: A trial-friendly environment is created, and pilot projects are carried out.

Evolve: Lessons learned are scaled, and adaptation is made sustainable.

Adaptation Model

Adaptation is a journey. For successful adaptation, it is vital that the structures, employees, and leaders within organisations work in seamless harmony and as a cohesive whole throughout this journey.

EPILOGUE

Now, it's time for my final piece of good news.

For the first time in history, I believe we are facing an innovation that can collaborate with us on the very challenge of adapting to it and even offer its own perspective. Organisations have a unique opportunity to turn this into an advantage and navigate this transformation hand in hand with artificial intelligence.

While artificial intelligence presents remarkable opportunities, it also comes with substantial risks. Even with scientists sounding alarms about these dangers, abandoning AI entirely appears unrealistic. Throughout history, we have navigated similar crossroads, adopting transformative technologies despite their risks and leveraging them to our advantage.

Homo sapiens translates to "wise and intelligent man." Today, we have achieved the remarkable feat of transferring our collective knowledge to machines of our own design. This technology, with its potential to enhance our wisdom and intelligence, seems poised to become an integral part of our culture—despite the costs it entails.

Throughout history, humanity has shaped technology, and technology has, in turn, shaped humanity. Today, as "wise and intelligent" beings, it is our responsibility to ensure the democratic, human rights-compliant, and ethical use of artificial intelligence, striving to minimise its risks and maximise its benefits for all of humanity and our planet. By embracing this responsibility, we can elevate the legacy of human wisdom even further, carrying the intelligence of machines alongside us.

While the challenge of adapting to artificial intelligence is new, the solution is something deeply familiar: our age-old ability to adapt.

And a gentle reminder: This will neither be the first nor the last chapter in humanity's story of change.

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BEING A HUMAN IN AI AGE

ÖMER ERKMEN

Yeni Nesil Kafası

Co-Founder

We are living in a time where the influence of artificial intelligence grows stronger with each passing day. As this technology becomes increasingly integrated into every facet of our lives, it raises a series of profound questions. Will artificial intelligence take over roles traditionally held by humans? What will humanity's place be in this emerging new order? What are the core values that define us and set us apart from artificial intelligence? And how can we harness AI to promote environmental sustainability?

In this article, we will explore the relationship between artificial intelligence and humanity, the values that highlight the essence of being human—particularly in the context of business—and the role of technology in advancing environmental sustainability.

AI AND HUMANS: COEXISTENCE

Artificial intelligence is essentially a collection of systems designed to mimic human intelligence and improve through learning from

experience. Today, AI plays a significant role in automation, data analysis, and decision-making processes. Repetitive tasks, in particular, are increasingly being handed over to AI systems. While this shift may lead to job losses in sectors such as manufacturing, logistics, and customer service, it also opens up new fields like AI development, data analysis, and AI ethics.Rather than outright replacing people, AI is reshaping the workforce by transforming the nature of human roles. Routine tasks are being automated, allowing individuals to focus on more strategic, creative, and human-centered roles. At this juncture, the values that differentiate humans from artificial intelligence become increasingly important.

THE VALUES THAT DEFINE US: CREATIVITY, EMPATHY, AND ETHICS

Artificial intelligence can analyse data to generate new ideas and even produce works of art. However, true creativity remains a uniquely human trait. Fields like art, design, and music are deeply rooted in the human experience, making them difficult for artificial intelligence to genuinely replicate.

Critical thinking involves analysing complex situations, considering multiple perspectives, and making independent decisions—far beyond the programmed tasks of artificial intelligence. This ability stands out as one of the most significant traits that set humans apart from AI.

Empathy and communication rely on emotional intelligence and social skills. Building connections, demonstrating empathy, and communicating effectively are essential components of human interaction, particularly in fields like customer service, healthcare, and education. Moral judgment, on the other hand, involves making the right decisions within the framework of ethical principles and values. While artificial intelligence can be programmed to follow certain ethical guidelines, navigating complex moral dilemmas remains a uniquely human responsibility.

TECHNOLOGY AND ENVIRONMENT: TOWARDS A SUSTAINABLE FUTURE

Artificial intelligence can also play a crucial role in addressing environmental challenges. AI-powered solutions can be leveraged to tackle issues such as climate change, resource depletion, and environmental pollution.

Artificial intelligence can enhance energy efficiency by optimising energy consumption in buildings, transportation, and industry. It can also help reduce waste and prevent environmental pollution by promoting recycling and the reuse of materials. Additionally, AI can contribute to the protection of natural resources by monitoring deforestation, managing water resources, and safeguarding biodiversity.

CONCLUSION: THE COLLABORATION OF HUMANS AND AI

Artificial intelligence will undoubtedly shape the future of the workforce and all aspects of human life. Rather than fearing

this change, we should focus on the values that highlight our humanity and work together with AI to build a better future. By leveraging our creativity, critical thinking, empathy, and moral judgment, we can thrive in this new era and fully harness the potential of artificial intelligence.

Artificial intelligence is also a powerful tool for promoting environmental sustainability. By implementing AI-driven solutions in areas such as energy efficiency, waste management, and conservation of natural resources, we can create a more sustainable world. In conclusion, the essence of being human in the age of artificial intelligence is not to compete with AI, but to align its capabilities with our own values and objectives. Through collaboration with AI, we can enhance both our well-being and the health of the environment, ultimately building a better future for all.

This article seems to be over, but in reality, it's just a beginning. First, a confession: I didn't actually write this article myself—instead, I dictated it using various artificial intelligence tools! It doesn't really matter which ones, but it might be interesting to mention how I went about dictating it.

First, I instructed these tools to create an article template for me by specifying the topic. Then, I asked them to rewrite the outputs in my style, drawing on two of my previously published articles in the Softtech Technology Report. Following two or three repetitions, I was able to reach the above result by editing the final article very little.

Now, let's go through the above topics one by one and discuss them:

The critical question of the first paragraph:
Will artificial intelligence replace humans?

Did you notice while reading? If not, you might think it has replaced me, but the answer is in the following section:

AI AND HUMANS: COEXISTENCE

The impact of artificial intelligence on the workforce is not to replace humans, but to transform their roles. This leads us to an even more important point.

Values that differentiate humans from artificial intelligence! What are they?

CREATIVITY, EMPATHY AND ETHICS

Then, the discussion shifts to technology, the environment, and sustainability. At first glance, this might seem out of place in the flow, but since it is part of the definition in the second chapter of the Softtech Technology Report, it makes sense to include it here.

RESULT: COLLABORATION BETWEEN HUMANS AND AI

I would like to amend this section slightly and finalise it as follows:

I will change the title of the article at the end, after reviewing it.

Instead of "Being a Human in AI Age,"

I found it more fitting to title this journey of Artificial Intelligence technologies towards an uncertain future—one that, much like how human life has been shaped by fire, the wheel, money, machinery, electricity, electronics, wired and wireless communication, radio, television, semiconductors, computers, the internet, and many other past technologies:

"A New Age of Technology, Driven by Creativity, Empathy, and Ethics: Artificial Intelligence"

Note: The developers of Large Language Model (LLM) Artificial Intelligence technology, along with the leading experts in this field for decades, have made various predictions about General Artificial Intelligence (AGI). According to these experts, this technology, which is expected to surpass human intelligence, is anticipated to be deployed within the next 18 to 36 months.

I asked the leading or most well-known tools once again, and the answer I received, which I believe to be the most meaningful, is as follows:

"The answer to the question of when AGI will arrive depends not only on technological advancements but also on how humanity chooses to use this technology."

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ORGANIZATIONS THAT FEARLESSLY EMBRACE THE FUTURE

EVRİM KURAN

Universum

Türkiye Country Manager

In his book The Fourth Industrial Revolution, Klaus Schwab, Founder and President of the World Economic Forum, states: "There has never been a time of greater promise or greater danger." We find ourselves in an era defined by uncertainty, where expectations are entangled with risks and challenges, and promises are closely tied to opportunities and aspirations. Although forecasting the future has become more complex than ever, the role of the human factor remains paramount in navigating the process of transformation.

Digitalisation, sustainability, and evolving work habits—key drivers of industry transformation—are also redefining workforce strategies. Human sustainability is achievable only through an organisational culture that embraces continuous innovation. Such a culture not only attracts and retains top talent but also fosters their ongoing development. In today's business environment, recognising that people are a company's most valuable asset is no longer a mere 'success factor'—it has become an imperative. To build a successful organisation for the future, we must prioritise people, understand their expectations, listen to their needs, and truly internalise their insights.

According to the 2024 results of our WMAE (World's Most Attractive Employers) Research[1], conducted by Universum Global across nine developed countries, the top quality that defines the world's most attractive organisations for young people is Inspiring Purpose. This is followed by Diversity, Equity, and Inclusion, with Innovation ranking third. As debates around

radical flexibility continue, organisations that allow individuals to be themselves, contribute to a purpose they can embrace, and foster psychological safety make it possible for, as Jon McNeill—former President of Tesla and CEO of DVx Ventures—puts it, "every employee to be an innovator." McNeill asserts that innovation is not solely the responsibility of a Chief Innovation Officer. Tesla exemplifies this by turning every employee into an innovator through its Radical Simplification approach. When faced with the threat of bankruptcy, Tesla aimed to increase digital sales of the $100,000 Model S twentyfold. By simplifying the online car purchasing process from 63 clicks to just 10, the company streamlined both its operations and supply chain. What kind of leadership and workforce is required to achieve such transformation? According to McNeill, the key was an organisation-wide mindset of “I don’t know how to do this, but let’s try.” This culture of bold experimentation enabled radical efficiency and innovation.

In Turkey's Most Attractive Employers Survey[2], conducted between November 2023 and March 2024 with 43,322 university students from 61 universities and 15,313 professionals who graduated from these institutions, we uncovered insights that illuminate the attractiveness of sectors and their perception among young people. Currently, the most attractive sector for university students in Turkey is the Computer Software and Technologies sector, with one in five students aspiring to work in this field. However, attributing this solely to the sector's association with innovative thinking creates a misleading perception. As

technological transformation now profoundly influences every industry, employers across all sectors are increasingly positioning themselves as technology hubs. This shift highlights a dual need: while organisations strive to align with workforce expectations, there is an equally critical requirement for a workforce capable of adapting to the evolving demands of organisations.

The growing interest of young people in working for technology companies is largely driven by the strong association of these sectors with innovation and digital transformation. However, this doesn’t necessarily mean that all young people possess the required technological skills. Alarming figures from The Education Commission, aligned with the United Nations Sustainable Development Goals, reveal that 67% of young people aged 15-24 worldwide lack basic digital skills. These skills, which include simple yet essential tasks like copying files, attaching documents to emails, or transferring files between devices, remain a

challenge for half of the young population in Turkey, reflecting a significant gap in digital proficiency.

People often fear the unknown. Deloitte's 2024 Global Human Resources Trends Report[3] surveyed employees to identify their top concerns about talent sustainability. Leading the list, with 53%, was the negative impact of increased work stress on mental health. However, the remaining concerns are all closely tied to technology's role in driving transformation. These include the threat of technology taking over jobs, the rise of new skills and roles required due to technological and business model changes, increased risks to physical safety and well-being in the workplace, the 'always-on' economy enabled by digital technology, employers digitally tracking employees without consent, and the challenges of interacting and connecting in remote and hybrid work environments. According to employees, these are the most significant threats to talent sustainability today.

To what extent will returning to the office and maintaining a conventional working model, while balancing an employer brand that aligns with workforce expectations, influence innovation and, consequently, productivity? According to the 2024 Global CEO Insights Report[4], based on KPMG's survey of 1,325 CEOs worldwide, 83% of CEOs aim to return to the office within the next three years. However, this contrasts with the preferences of employees, who should be regarded as the lifeblood of innovation. Our Turkey survey this year reveals that 63% of students, 71% of young professionals, and 66% of experienced

professionals prefer to work remotely at least two days a week.

So, what is our role as organisations? We will lead the charge, investing more than ever in re-skilling and up-skilling our employees, regardless of their age, experience, or past achievements. We will position ourselves as pioneers, facilitating the seamless adaptation of our teams to the dynamic realities of the modern world. Our working model will tackle the pressing challenges of stress, exhaustion, and burnout through uncertainty, all while relentlessly pursuing excellence. And we will champion the message that technology is not to be feared but embraced as a powerful enabler of a better, more efficient future. The organisations that boldly embrace this vision will be the ones to shatter the chains of bureaucracy and redefine the future. They will rise by rejecting outdated reliance on leaders

confined to past experiences, by fostering collaboration over individual contributions, by encouraging bold ideas, and by celebrating originality and risk-taking. These organisations will attract individuals who thrive as free, empowered agents of change. By adopting a management approach driven by impact, not control—humanocracy over bureaucracy[5]—they won't just adapt to the future; they will shape it. And we intend to be at the forefront of this transformation.

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AI WITH A PEOPLE AND ENVIRONMENT PERSPECTIVE

ASLI ABACI

Softtech

Director of Human Resources

Have you recently attended a seminar where concepts like generative artificial intelligence, ChatGPT, or chatbots weren't even mentioned? Or visited an art event that didn't make use of digital solutions in some way? For most of you, I imagine the answer is a resounding "no".

If you're curious about how artificial intelligence is used in the realm of art, I highly recommend listening to the speech "Creativity in the Age of Artificial Intelligence" by artist Refik Anadol, delivered at İşbank's "Rethinking Atatürk's Pioneer Vision Towards the Second Century of the Turkish Republic". It promises to be a truly inspiring experience—you won't be disappointed.

Artificial intelligence is now at the forefront of our lives, influencing everything from the visual arts to breakthroughs in medicine, from the smartphone apps we depend on to the realm of education.

The same applies to human resources.

Human resources has always stood at the heart of change, consistently one of the first fields to feel the impact of developments and expected to adapt swiftly. This has held true from the industrial revolution to today's technological advancements and will remain so in the future. After all, the core focus of our profession is, as the name implies, **people**—the most valuable and irreplaceable asset of every company, transcending all else.

One of the most dynamic aspects of being a human resources professional is encountering new experiences and challenges

every day. Issues such as pandemics, natural disasters, economic crises, talent scarcity, retention strategies, remote working, employee well-being, and process optimization are just some of the factors that keep the field constantly evolving. Today, the shared focus is on harnessing the potential of generative artificial intelligence and adapting processes to the transformative changes it brings.

Artificial intelligence offers numerous opportunities for enhancing human resources processes. The primary areas where it is currently being applied and actively explored include candidate selection in recruitment, performance management processes, skills assessment, competency development, and making predictions through big data analysis.

According to Mercer's Turkey General Sector Remuneration Survey 2024, 55% of people have already begun integrating generative artificial intelligence into their work. The report highlights that the adoption of AI is progressing at a much faster pace than the historical adoption of the internet, smartphones, or even electricity. Among companies, 75% anticipate adopting AI, 61% report achieving productivity gains through its use, 50% believe it will drive employment growth, while 25% foresee it leading to job losses.

According to Mercer's People Risk 2024 report, the leading transformation tool for 2024 is identified as "increasing productivity". One of the most significant benefits that artificial intelligence brings to our lives is its ability to enable companies to leverage employees' talents in different areas, thereby enhancing overall productivity through the efficiencies it creates in specific fields. Accessing data analyses—traditionally requiring significant time and effort—in a shorter time and with far greater detail, along with saving labor in specific areas through robotic process automation, are among the most valuable solutions we rely on today.

Gartner's human resources predictions for 2025 highlight a focus on AI-powered recruitment, personalised employee experiences, and advanced analytics to support decision-making. The report also notes that remote working solutions and mobile-compatible platforms will enhance accessibility. These trends are expected to drive improvements in efficiency, engagement, and data security within HR operations.

To successfully implement all these initiatives, it is essential to equip employees with diverse skills, provide the necessary

technological infrastructure, and design tailored human resources processes. However, while doing so, it is crucial to maintain transparent communication by considering the employee's perspective and ensuring they feel that technology is being positioned alongside them, not as a replacement. Indeed, we must not forget that only humans can offer the empathy and interaction that artificial intelligence inherently lacks.

Well, when we ask ChatGPT, one of the most prominent tools in this field, 'What is the effect of artificial intelligence on humans?' let's see how it responds:

'Artificial intelligence is a technology that deeply influences human life, offering both opportunities and challenges.'

Generally accurate, and—let us acknowledge—honest enough to admit that it comes with challenges.

Then, under the following main headings, it outlines the dimensions of artificial intelligence's impact, highlighting both its positive and negative aspects:

'Impact on Business and Economy, Impact on Education, Impact on the Healthcare Sector, Social and Ethical Impacts, Emotional and Psychological Impacts.'

'Conclusion: Artificial intelligence has the potential to transform every aspect of human life. However, employing this technology ethically and sustainably is crucial to maximising societal benefits. Striking a healthy balance between humans and artificial intelligence will play a key role in shaping its future impact positively.'

Although it does not delve into the details, it is encouraging to see the word 'sustainable' included in the conclusion.

Let's ask one more question to delve deeper into its views on sustainability and see what it has to add:

'The sustainable use of AI involves designing and implementing it in a manner that addresses current needs while preserving future social, economic, and environmental balance. This concept seeks to ensure that artificial intelligence benefits both humanity and the planet in the long term without causing harm.'

They then elaborate on what they mean by economic, environmental, social, ethical, legal, and technological sustainability, providing a few concrete examples to illustrate their points.

As for environmental sustainability, which is my primary interest, they provide the following example:

'Reducing energy consumption through the optimisation of artificial intelligence-based energy management systems and renewable energy sources.'

Speaking at the Artificial Learning Winter School, held on 9–10 November 2024 in collaboration with Koç University, İşbank, and Softtech, Assoc. Prof. Dr. Alper Özpınar explored this topic in depth. He elaborated on the effects of artificial intelligence on energy and sustainability, providing a fresh perspective at a time when we are increasingly focusing on integrating artificial intelligence into our business processes.

MIT's article titled “Climate Change and Energy” highlights key insights into this issue. It states that the rapid advancement of generative artificial intelligence is driving a significant increase in demand for data centres. When measured by data centre power requirements, the capacity under construction in North America rose from 2,688 MW at the end of 2022 to 5,341 MW by the end of 2023. This growth is in addition to the existing demand for data centres, which is projected to add an astonishing 12,000 MW of co-location capacity—surpassing the energy demand of over 70% of countries. The article also underscores the rising energy consumption of data centres over the years. Projections indicate that global electricity usage by data centres is expected to reach between 620 and 1,050 TWh by 2026.

It appears increasingly vital to prioritize the sustainability of our natural environment while leveraging artificial intelligence. A notable contributor to rising energy consumption is the additional energy required to access accurate data, given that AI does not always deliver precise information. In the context of my questions to ChatGPT, one could argue that this interaction incurred minimal energy consumption, as I received accurate responses on the first attempt. However, advancing toward more sustainable generative artificial intelligence applications demands a comprehensive evaluation of the entire ecosystem. This encompasses everything from the infrastructure of data centres to production processes, as well as waste management, energy, water, and material usage, and the emissions they generate.

Above all, my favorite on this topic still remains the 2002 movie Minority Report.

The day we can make employee assignments with a flick of the wrist like Tom Cruise and become "HR Fairies" that foresee every possibility in advance—that's when I'll say we've truly arrived.

THE NEW PLAYER IN THE HEALTHCARE ECOSYSTEM: GENERATIVE AI

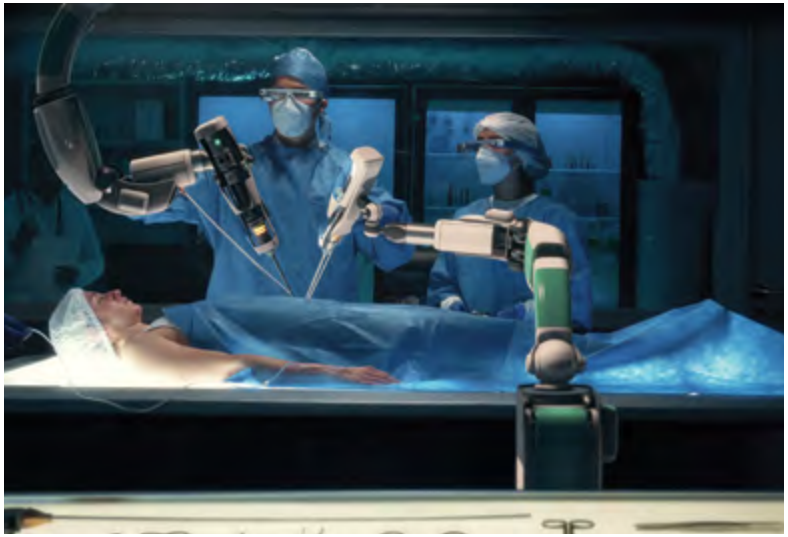
DR. AYŞEGÜL TÖZEREN

Anadolu Sigorta

Health Claims Manager

The health sector's engagement with today's digital culture traces back nearly two decades to 2005. That year, the World Health Assembly adopted a resolution on digital health, urging member states to "consider preparing a long-term strategic plan for the development and implementation of e-Health services, to develop the infrastructure of information and communication technologies for health, and to promote equitable, affordable, and universal access to their benefits." Yet, this progression resembled a measured waltz. In May 2018, the Health Assembly acknowledged the pressing need to accelerate digital health implementation, recommending that member states identify priority areas and establish a global strategy. Consequently, the Global Strategy for Digital Health was launched for the 2020–2025 period.

While comprehensive strategies were being formulated, an unexpected adversary was taking shape. In early 2020, the World Health Organization declared COVID-19 a global pandemic. This declaration fundamentally altered the dynamics between the healthcare sector and digital culture, abruptly changing the rhythm of their dance. Transformations that once seemed destined to unfold over years, entangled in discussions and bureaucracy, were instead achieved within mere days. During the pandemic, the Chinese government shifted 50% of healthcare services online. In the United Kingdom, 11 providers were selected within a 48-hour tender process to deliver video consultations for primary care. Meanwhile, some healthcare providers completed more virtual consultations in a single day than they had throughout the entirety of 2019.



In the second decade of the new millennium, advancements in digital health have not only gained momentum but have also been fueled by the accelerating influence of technology on humanity. According to data from Sensor Tower shared by Reuters, TikTok achieved 100 million users approximately nine months after its global launch, while Instagram reached the same milestone in 2.5 years. By contrast, OpenAI's widely recognized chatbot, ChatGPT, is estimated to have reached 100 million monthly active users by January 2023—just two months after its launch in late 2022—making it the fastest-growing consumer application in history, as reported by UBS research.

The healthcare sector was already grappling with the ethical dilemmas posed by machines capable of mimicking human behavior (AI) when it encountered Generative Artificial Intelligence (AI)—a branch of deep learning that leverages large language models to discern abstract patterns. It was evident that the digital transformation of healthcare would be profoundly disruptive. Generative AI held the promise of enhancing health outcomes by fostering more evidence-based knowledge, skills, and competencies for healthcare professionals through technologies like the Internet of Things, blockchain, smart wearables, and seamless data exchange across the healthcare ecosystem. In response to these rapid and potentially unchecked developments, the World Health Organization issued a guide with 10 recommendations. The guide emphasized that digital health innovations must benefit people in a manner that is ethical, reliable, equitable, and sustainable. It also called for adherence to principles such as transparency, accessibility, scalability, replicability, interoperability, privacy, security, and confidentiality in the development and deployment of digital health solutions.

The latest advancement of digital modernism, generative AI, is generating both excitement and concern among technology experts and healthcare professionals alike. While healthcare organizations worldwide are already leveraging artificial intelligence in areas such as complication prediction and optimizing operating room utilization, generative AI offers an estimated potential value of $1 trillion, according to a McKinsey report. This value stems from its ability to automate repetitive and error-prone operational tasks, provide clinicians with instant access to years of clinical data, and modernize healthcare system infrastructure. However, unlocking this

potential is only the beginning. Healthcare leaders are now focusing on how to seamlessly integrate these models into their existing analytics and AI strategies while addressing potential risks. Given the critical importance of data security in healthcare and the inherent risk of generative AI generating inaccurate outputs, the continued involvement of a human "in the loop" remains essential to ensure that healthcare recommendations truly benefit patients. Although many aspects of the healthcare system rely on human expertise, time-consuming and labor-intensive administrative tasks can still benefit from the support of generative AI technologies, streamlining operations and enhancing efficiency.

McKinsey conducted a Q1 2024 survey of 100 executives in the healthcare and generative AI sectors. Among the respondents, 33% were executives, and 31% represented organizations with revenues exceeding $10 billion. The participants included payers, providers, and health technology companies. Over 70% of respondents indicated they were either pursuing or already implementing generative AI capabilities, with approximately 30% actively in the implementation phase. Half of the respondents reported weighing trade-offs between returns, risks, strategic priorities, governance, maturity, and other factors, while closely monitoring the evidence supporting the benefits of generative AI. Despite the broad interest in AI adoption within the industry, some stakeholders remain hesitant, opting for a wait-and-see approach or having no immediate plans to pursue AI initiatives.

The survey results suggest it remains uncertain whether the healthcare industry will emerge as a partner or a pioneer in generative AI. Among the respondents, 59% of generative AI implementers are collaborating with third-party vendors to develop customized solutions, while 24% intend to build solutions internally. Meanwhile, only 17% anticipate adopting off-the-shelf generative AI products, highlighting a preference for tailored approaches in the sector.

The biggest challenge highlighted by executives surveyed is the risk posed by untested technology and the uncertainty surrounding the necessary investments in this domain. Following this, respondents identified insufficient capacity, inadequate data and technology infrastructure, and uncertainty about proving value as significant obstacles. Among the groups surveyed, payers expressed the highest level of concern, with an average of 60%—and 65% of payers—flagging these issues. The lack of regulatory mechanisms was cited as the primary source of this apprehension. For instance, when a new device or drug is introduced to the U.S. market, the Food and Drug Administration (FDA) typically reviews it for safety and efficacy before approval. This process ensures public protection against unsafe tests and treatments and supports healthcare professionals in making informed decisions. However, this traditional approach is ill-suited to the complexities of generative AI. Addressing these challenges will require a regulatory framework as innovative as generative AI itself, reflecting both the unique demands of the FDA's existing process and the transformative nature of this

emerging technology. The FDA generally requires manufacturers of new drugs and devices to prove their safety and efficacy for specific clinical purposes. To meet this standard, manufacturers conduct rigorous clinical trials, such as demonstrating a drug's ability to lower blood sugar levels in diabetics or detect abnormal heart rhythms in patients with heart disease. Consequently, a drug, substance, test, or software can be approved for treating a particular disease or condition. However, until it is proven effective for another condition, it remains unapproved for that use. What is approved for one disease may not necessarily be approved for another.Thanks to the FDA's global credibility, insurance companies often reimburse for new treatments only after FDA approval is obtained. Clinicians can also rely on FDA approval guidelines and secure informed consent from patients to mitigate liability for adverse side effects. While they may prescribe drugs and devices for off-label purposes, such use carries additional liability risks, and patients' insurance providers may refuse to cover the cost of the drug or device in these cases.

Would this framework apply to the large language models that power generative AI products? A Harvard Business Review article offered a compelling answer: "no." The reasoning is striking—these models are designed to address virtually any question in healthcare and beyond. In other words, rather than having a single use case in healthcare, they encompass tens of thousands, making traditional premarket evaluations of safety and efficacy for each potential application impractical due to the prohibitive cost and time required. The article compared generative AI to a drug with a chemical composition and effects that are in a constant state of flux.

Large language models represent more than just a new device; they embody a new form of intelligence. Similar to how healthcare professionals undergo extensive training and rigorous examinations to earn their licenses, a comparable process could be designed for generative AI. This approach might involve training the models with specific materials and evaluating their proficiency through specialized exams. Additionally, like physicians who are periodically tested during internships, residencies, and fellowships, these models could require ongoing reassessment to ensure sustained mastery of the materials after initial certification. Notably, generative AI has already been integrated into certain testing frameworks.

Generative AI processes require human oversight, but its potential value to the healthcare system is immense. As individuals increasingly demand more personalized and relevant services, the healthcare sector faces mounting competitive pressures and escalating costs. For payers, generative AI offers a dual benefit: enabling private insurance companies to operate more efficiently while enhancing service quality for policyholders. Generative AI can instantly summarize vast amounts of data, regardless of scale, freeing up time for professionals to focus on addressing more complex needs. By analyzing data from multiple sources, such as electronic health records and wearable devices, generative AI empowers insurers to create personalized insurance plans tailored

to each customer. For instance, a plan could include regular checkups and tests to monitor blood sugar levels for individuals managing diabetes. This level of personalization allows customers to access plans aligned with their unique needs and lifestyles, ultimately improving satisfaction and retention rates.

Generative AI has the potential to significantly enhance the risk assessment process in several ways. First, it can be trained on demographic data to more accurately predict and evaluate potential risks, enabling insurance companies to make more informed decisions regarding premium coverage for individuals. Additionally, generative AI can assist coders in building statistical models by reviewing and identifying errors in code, ensuring greater accuracy and efficiency. Beyond risk assessment, generative AI can streamline insurance provisioning and claims operations, improve customer service, and identify opportunities for cross-selling. It can also play a critical role in fraud detection by analyzing historical healthcare claims to identify anomalies or deviations. Moreover, generative AI can simplify the complexities of forecasting by generating simulations of various healthcare scenarios, aiding insurers in making data-driven predictions about future risks and opportunities.

As healthcare costs increasingly constitute a substantial portion of global expenditures, the challenge of providing sustainable care has become more pressing. To address the sector's rising costs, various payment mechanisms are being proposed and tested to encourage prudent resource planning by healthcare providers and foster risk-sharing between payers and providers. Under prospective value-based payment models, cost monitoring and management are critical not only for providers to maintain financial competitiveness but also to ensure the delivery of high-quality care. Simultaneously, accurate cost data derived from patient information can enhance payer efficiency and support the development and implementation of innovative payment models.

Studies examining future healthcare claim average costs based on U.S. healthcare data are reportedly advancing through diagnosis-based clustering, utilizing machine learning and deep learning models—the precursors of generative AI. Diagnosis-related groupings have been developed using clinical text mining powered by a deep learning-based natural language processing model.

While the deep learning-based natural language processing model has shown particular success in addressing circulatory system diseases, it has been observed to be prone to errors when handling dense and complex data.

For example, in cardiovascular surgery cases where the diagnosis and treatment were clear, the model was able to accurately predict the need for coronary angiography and stent placement for a heart attack by interpreting the text. However, it faced challenges in diagnosing an infection that began as pneumonia but progressed to sepsis, spreading throughout the body. In such cases, the model relied solely on the initial diagnosis of pneumonia and failed to recognize its diagnostic relationship to more complex conditions like sepsis.

As productive AI trials in healthcare progress, it is crucial to recognize that one of the greatest obstacles to digital transformation is "change management." Even when new innovations empirically optimize workloads and enhance well-being, adoption can be challenging due to resistance from users. This phenomenon, often referred to as "baby duck syndrome," describes a tendency to cling to the first solution encountered and struggle to move on from outdated technologies, even when superior alternatives are available. For instance, it is common to see individuals waiting in line at the airport for manual check-in, even when a convenient automated check-in machine is readily accessible. This illustrates how ingrained habits influence behavior, leading people to compromise on quality, efficiency, and time simply to stick with familiar technologies.

It is likely that we allocate a disproportionate amount of time to technology development while dedicating far less attention to digital literacy training and addressing adoption challenges with intended end users. The balance between advancing technology and engaging with people must shift. As Freeman aptly noted, "...about 5% of projects are technology and 95%are change management." This principle should not be overlooked when implementing productive AI solutions.

THE FUTURE OF THE CORPORATE CULTURE: ADAPTING WITH AI

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As humanity, we have witnessed numerous historical shifts in recent years, from the advent of personal computers in our homes to the invention of the mobile phone, from the fall of the Berlin Wall to global economic crises. More recently, we have experienced the turn of a millennium and a pandemic. Yet, none of these events have reshaped our lives as profoundly as the Internet Revolution of the 1990s. The Internet Revolution transformed a world once limited to small circles and reachable connections into one of boundless possibilities and immense potential by uniting the globe.

Now, an even more powerful and potentially faster revolution lies ahead: Artificial Intelligence. We are watching the initial, incremental advancements of this groundbreaking technology with both great anticipation and a measure of apprehension. It is now almost certain that artificial intelligence will become a lasting fixture in our lives. As it continues to transform the way we live, it would be no surprise if AI also reshapes corporate cultures and, in some cases, redefines them entirely.

Contrary to popular belief, corporate culture is not solely about values and the behaviors shaped by them. At its core, it is a complex system of interconnected elements, including the company's purpose or value proposition. While culture manifests through beliefs, a sense of belonging, and behaviors, any changes to an organization’s structure, strategy, or processes inevitably impact this system, either positively or negatively.

Since we define corporate culture as a large system, existing

theories on how systems function can serve as valuable guides for understanding it. One such theory is systems thinking. Systems thinking is built on three main elements: the different parts that make up the system, the relationships between those parts, and the system's purpose (or functionality). This theory posits that while the individual parts of a system are interconnected and influence one another, their combined effect on the whole is greater than the sum of their individual impacts.

In his latest book, Nexus, Yuval Noah Harari defines knowledge as a concept that creates new realities by connecting different parts, akin to systems theory. Following this perspective, we anticipate that a "cluster of knowledge" as vast as AI will exert a far greater influence on the entire system than the sum of its individual components. Therefore, when assessing the impact of AI on corporate culture, it would be more effective to adopt a holistic approach to the system rather than focusing solely on its individual parts and their interrelationships.

DRAWING THE PATH FIRST: STRATEGY

First and foremost, it is essential to establish a comprehensive AI strategy. This strategy must clearly articulate how it aligns with the company's purpose, vision, and goals. In developing such a strategy, it is crucial to stay informed about the latest trends in AI technologies and applications, monitor competitors' activities in this field, assess market threats and opportunities, and consider the legal regulations set by relevant authorities.

When taking all these criteria into account, it is essential to recognize that we live in an agile world where conditions can shift rapidly. In an environment marked by high uncertainty and limited predictability, a strategy must inherently be flexible to adapt to changing circumstances.

WHAT WE HAVE: PRODUCTS AND SERVICES

While new opportunities created by artificial intelligence in the market add innovative products and solutions to the product catalog, optimizing existing products and services is another issue that needs to be evaluated. Which products and services will no longer be in demand as much as before in the new world? Which of these will maintain or increase their customer base with some adjustments?

Another area that can be evaluated to maintain and increase the target audience is customer experience. Today, many companies enhance the experience they offer to customers by leveraging artificial intelligence technology. So, what features can be utilized to improve the customer experience of products and services?

OUR HABITS: PROCESSES AND DATA

One of the biggest benefits we envision from AI is increased efficiency. How can business processes be improved or even fully automated using AI? Making decision-making data-driven and utilizing data to enhance the employee experience could serve as a powerful first step in accelerating AI adoption within the company.

OUR STORY: BRANDING

Today, branding plays a significant role in corporate success by fostering customer loyalty, driving increased sales, and providing a competitive advantage in the market. Additionally, it has positive effects such as attracting the desired competencies to the company and enhancing employee loyalty.

It is crucial for the company to swiftly adapt to artificial intelligence and establish itself as an innovative and visionary brand in the market. Effectively communicating an AI-driven narrative that resonates with all employees, both within and outside the company, will enhance and solidify the company's brand image in the future.

WHAT WILL I BECOME?: HUMAN

And finally, the biggest question on our minds is, "Will artificial intelligence take my job?" Leading experts on artificial intelligence who have addressed this issue agree that AI itself will not take people's jobs, but rather, someone who effectively utilizes artificial intelligence may take your job from you.

Transforming all employees into proficient AI users will be one of the top priorities for companies. Including every employee in the adaptation process and managing potential resistance are also critical aspects to address in this transformation.

At the beginning of my article, I highlighted the profound impact of the Internet Revolution on our lives. When the children who witness today's changes reflect on this era in the future, they will likely speak of the Artificial Intelligence Revolution as the transformative force of their time. Just as the internet reshaped every facet of our lives, artificial intelligence will also redefine us psychologically, sociologically, and culturally. It is inconceivable that our way of conducting business will remain unchanged through this transformation. Just as we must accept the world as a vast, interconnected system and approach it from a systemic perspective, we must similarly embrace artificial intelligence—now an inseparable part of that system—in order to adapt seamlessly to the future.

FUTURE OF INDUSTRIES AND INNOVATION

THE NEW NORMS IN BANKING: SEAMLESS EXPERIENCES, SECURITY AND SUSTAINABILITY

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The banking sector, as one of the most technology-intensive industries, continues to enhance accessibility and speed in service delivery with each new innovation. The rapid pace of digitalization is constantly redefining the boundaries between traditional and next-generation banking. While traditional banking was once limited to branch-based services, even mobile banking now falls within this category. This evolution raises an intriguing question: what approaches will define "next-generation banking" in the near future? Although long-term predictions span revolutionary advancements—such as superhuman-level artificial intelligence and the singularity—this article will focus on the more immediate trends set to shape the banking agenda.

TRANSITION FROM THE CUSTOMER EXPERIENCE TO THE HUMAN EXPERIENCE

The primary objective of innovations in banking is to enhance the customer experience. Today, this concept has evolved into a critical factor shaping not only the banking industry but also numerous other sectors. However, a broader, more human-centric perspective has emerged, reframing "customer experience" as "human experience." Human experience represents a holistic approach, integrating banking services seamlessly into the daily lives of customers. Banks that successfully transition from Customer Experience (CX) to Human Experience (HX) achieve three key outcomes: superior products, a more engaged workforce, and heightened customer loyalty. This, in turn, strengthens customer retention, improves operational efficiency, and drives profitability.

Here's a refined version of your text:In this context, service-oriented and invisible banking approaches take center stage. Banks are introducing innovative service models designed to seamlessly integrate their offerings into customers' daily routines. This concept, referred to as invisible banking, enables effortless financial transactions by operating discreetly in the background, ensuring convenience and accessibility without disrupting the customer experience.

In this transformation, the current role and future potential of fintechs have gained significant importance. Traditional banks are compelled to accelerate their digitalization efforts under the influence of fintechs, while fintechs are poised to emerge not only as providers of innovative digital solutions but also as strategic partners driving human-centric approaches. With their user-friendly and efficient solutions, fintechs have become trailblazers in delivering innovative services to the banking sector. As collaborations between banks and fintechs grow, banking services will become increasingly personalized and accessible, seamlessly integrating into customers' daily lives.

Banks must rethink their business models and embrace more flexible, experimental approaches to achieve continuous improvement with a focus on the human experience. Delivering a seamless human experience requires banks to look beyond their own industry, drawing inspiration from the experiences people encounter in their daily lives and across various sectors. In this context, networked organizations, where professionals from diverse fields collaborate, will play a pivotal role. Through these cooperative models, banks can adopt a broader perspective to develop innovative solutions that address customers' evolving needs. Additionally, experimental organizational structures will foster innovation by enabling the testing and refinement of products and services based on customer feedback. This new approach represents a significant step toward creating deeper, more human-centered experiences within the banking sector.

FUTURE OF FINANCE

As banks and fintechs strive to enhance and accelerate their interactions with customers, the financial world's infrastructure is undergoing a significant transformation. A notable development in this context is a concept introduced by the Bank for International Settlements (BIS) in April 2024: Finternet. This

innovative system envisions a future where all financial assets can be securely, quickly, and seamlessly transferred through digitally tokenized assets. At its core, Finternet relies on unified ledgers, which consolidate and verify all transactions on a single platform. By recording every transaction at a single point, unified ledgers enhance security and establish a financial ecosystem resilient to cyberattacks. Beyond security, Finternet promises to revolutionize the user experience, laying the groundwork for an advanced financial infrastructure. As this system evolves, it could drive radical changes in the current banking landscape.

The Central Bank Digital Currency (CBDC) initiative, currently being explored by central banks worldwide, has the potential to bring transformative changes to the banking system. While already implemented in three countries and in pilot phases across many others, the success of CBDC depends heavily on its design and implementation. A well-crafted structure can deliver significant benefits to the financial system; however, a rushed transition or insufficient infrastructure could have adverse effects on the sector. To ensure a successful rollout, it is crucial for central banks and regulators to strike a careful balance, safeguarding the interests of both banks and users during the implementation process.

At this juncture, the words of Daron Acemoğlu offer valuable insight: “Inclusive economic and political institutions increase the well-being of societies, while exclusive institutions deepen poverty and inequality.” Embracing innovations like the Finternet and CBDC with an inclusive approach can establish a robust foundation for enhancing prosperity in the financial world.

SECURITY REDEFINED: NAVIGATING THE QUANTUM APOCALYPSE AND BEYOND

Security remains a top priority in financial technologies as advancements in technology accelerate. Recently, researchers from Shanghai University introduced the term "Quantum Apocalypse," signaling a new era of cybersecurity challenges. This concept describes a scenario where current encryption systems could become obsolete in the face of quantum computers. The ability of quantum computers to rapidly solve complex encryption algorithms poses a significant threat to the integrity of existing financial security systems.

Emerging risks, such as security breaches via synthetic media

generated by advanced artificial intelligence and a rise in phishing attacks, are further intensifying the focus on security. To counter these threats, post-quantum cryptography has been developed, introducing new encryption algorithms designed to resist quantum computing's potential to crack traditional systems. Another significant advancement in security paradigms is cognitive biometrics. This innovative approach leverages an individual's cognitive traits and behavioral patterns for authentication, surpassing the capabilities of traditional biometric methods. By strengthening algorithms and redefining security protocols, cognitive biometrics may pave the way for a future without passwords, enhancing security while streamlining user experiences.

Developing quantum-resistant algorithms and integrating these advanced solutions into existing systems will be a key priority for banks in the near term.

SUSTAINABILITY: REDEFINING PRIORITIES IN BANKING

So far, I have explored the future of individuals and banks, the initiatives led by central financial authorities, and the actions needed to create more secure financial infrastructures powered by technology. However, as we embrace these advancements, we must not overlook the future of our planet—a concern of paramount importance. The technologies driving these innovations come with significant energy demands. To address this, sustainability must take center stage in the strategic plans of both individuals and industries, ensuring a balanced approach to energy consumption and environmental stewardship.

In Turkey and across the globe, sustainable banking is evolving rapidly to broaden the environmental and social responsibilities of the financial sector. In Turkey, the Banking Regulation and Supervision Agency (BRSA) is actively working on aligning the industry with sustainability principles, encouraging banks to prepare sustainability reports and finance environmentally friendly projects. As part of these efforts, tax advantages and incentives are being introduced to support banks that prioritize green financing. Additionally, the sustainability guidelines published by the Banks Association of Turkey provide a framework for fostering greater transparency and accountability within the sector.

Globally, sustainable banking is advancing on a broader and more impactful scale. Initiatives like the United Nations' Net-Zero Banking Alliance are driving banks to commit to achieving carbon neutrality by 2050. Similarly, the European Union's Green Deal has introduced a range of regulations aimed at evaluating environmental risks and promoting sustainable investments. Through instruments such as green bonds, banks are financing environmentally friendly projects and aiding companies in reducing their carbon footprint by creating carbon credit platforms. These global and local initiatives are not only guiding the financial sector toward a sustainable future but also reinforcing the social responsibilities of banks.

STEERING TOWARDS THE FUTURE

As institutions at the forefront of financial technologies, we play a pivotal role in shaping the transformation of the banking sector. The transition from customer experience to human experience, advancements in security, and sustainability-focused approaches have emerged as cornerstone elements defining the future of financial services. Our mission is to leverage the full potential of technology to deliver secure and sustainable solutions that simplify and enhance our customers' lives. Through fintech collaborations, innovative service models, and eco-friendly financing methods, we aim to transform banking into more than a service—into a value that contributes to societal well-being. By staying attuned to the evolving dynamics of the sector and taking proactive steps, we will shape the future of financial technologies together, driving meaningful progress for individuals and communities alike.

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AI-POWERED HUMANITY AND SUSTAINABILITY

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Living in the age of technology, we are experiencing the blurring of boundaries between the virtual and physical worlds. As a generation shaped by the 80s and films like Back to the Future, we once envisioned the technologies of tomorrow with boundless excitement. Scenes of Marty McFly traveling through time, hoverboards zipping through streets, and smart devices seamlessly integrated into daily life sparked vivid imaginations about what the future could hold. Today, we find ourselves in a reality that has not only surpassed those dreams but redefined them entirely. Innovations like artificial intelligence, augmented reality (AR), and virtual reality (VR) have outpaced our once-fanciful predictions, creating a world where the virtual and the real coexist in ways we never imagined.

In today's rapidly evolving technological landscape, artificial intelligence is increasingly permeating every facet of life. It has sparked revolutionary transformations across diverse sectors, including finance, healthcare, agriculture, retail, education, and the arts. However, alongside these advancements, critical questions have emerged regarding the sustainable role of humans in this new paradigm.

COLLABORATION AND STRATEGIC ALIGNMENT WITH AI

Automation has enabled machines to take over repetitive and simple tasks, leading to the decline of certain jobs and a rise in unemployment in some areas. However, it also holds the potential to create new opportunities and foster more creative roles, emphasizing the growing importance of continuous learning. To

In the next 10 years, demand for workers with social and technological skills will increase

	Basic skills Basic literacy, numeracy, and communication	Physical skills Motor skills and strength General equipment repair and mechanical skills	Higher cognitive skills Creativity Complex information interpretation Project management Critical thinking and decision making	Social skills Entrepreneurship Interpersonal skills and empathy Advanced communication Adaptability and continuous learning	Technological skills Basic digital skills Scientific research Technology design and engineering Advanced data analysis
2030 baseline employment Million	**5.2**	**15.5**	**5.8**	**4.5**	**2.4**
2030 workforce, projected[1] Million	**4.7**	**14.3**	**6.2**	**5.5**	**3.9**
Change Million	**-10%**	**-8%**	**7%**	**22%**	**63%**

1. Projection with average automation level of 20–25%, does not include 1.8 million entirely new jobs.

Figure 1. McKinsey Turkey's Talent Transformation in the Digital Era

thrive in this evolving landscape, individuals must not only acquire new technical skills but also cultivate essential competencies like communication, critical thinking, adaptability, and ethical decision-making. While the possibility of artificial intelligence gaining consciousness remains a topic of debate, the unique human domain may increasingly focus on areas such as complex problem-solving, creativity, ethics, empathy, and sustainability.

In the banking sector, artificial intelligence is being leveraged across various domains, including risk management, fraud detection, credit evaluation, customer relationship management, and personal finance management, significantly enhancing banks' competitive edge. According to research by the McKinsey Global Institute, the adoption of generative artificial intelligence in financial services has the potential to boost operational efficiency by approximately 30%.

While this increase in efficiency accelerates business processes, it also introduces risks if the technology is misused. Concerns such as data security and ethical implications are at the forefront. Ensuring transparency in how AI-driven decision support systems operate is crucial. Customers increasingly demand clarity on the rationale behind a system's decisions. Biased datasets can result in biased outcomes, and a lack of transparency risks eroding customer trust, potentially leading to legal challenges.

For these reasons, adopting strategies that integrate technology with a human-centered approach while adhering to ethical principles is of paramount importance.

While artificial intelligence relies on data and algorithms to make decisions, human decision-making operates on an entirely different plane. Equipped with emotional intelligence, humans can understand and empathize with the emotions of others, allowing them to respond in ways that reflect these insights. Furthermore, ethical and moral values play a fundamental role in shaping human decisions. These qualities enable humans to transcend individual interests, pursue the greater social good, and place a strong emphasis on fulfilling their environmental responsibilities.

This value-driven approach not only addresses current challenges but also paves the way for long-term, sustainable, and human-centered solutions for the future. Understanding the depth of the difference between human and artificial intelligence is crucial for leveraging technology for the benefit of humanity. As technology advances, preserving human values and integrating them into decision-making processes will serve as a guiding principle for our future.

While artificial intelligence can analyze environmental challenges and generate optimized solutions for resource management, the implementation of these solutions and the assessment of their long-term impacts require human strategic guidance. For instance, in combating climate change, AI can develop technologies to reduce carbon emissions, while human leadership decides where and how to apply these technologies and facilitates community adaptation to this transformation.

The social and legal implications of errors or unforeseen circumstances arising from artificial intelligence systems can be effectively managed under human leadership.

To prevent artificial intelligence from becoming a threat to humanity, establishing committees, audit mechanisms, and global collaborations, as well as developing and implementing policies within the frameworks of transparency, justice, and accountability, will be humanity's most crucial role as a leader and ethical guide in shaping AI.

Managing the impact of artificial intelligence on automation and the workforce, preventing widespread unemployment, and ensuring a fair transition process are critical responsibilities for building a sustainable future.

HUMAN EXPERIENCE AT THE INTERSECTION OF PHYSICAL AND VIRTUAL WORLDS

In today’s business world, while concerns about artificial intelligence continue to grow, another frontier of uncertainty is the transition between artificial and physical life. Technologies like augmented reality (AR), virtual reality (VR), and the metaverse are redefining human experiences, transcending physical boundaries and creating virtual worlds that are as captivating and lifelike as reality itself.

The metaverse has redefined the boundaries of virtual worlds, transforming how individuals work, socialize, and find entertainment. VR and AR-supported work environments enable virtual meetings and create spaces where employees can remain productive, regardless of their physical location.

However, this shift raises questions about how people perceive their identities and roles. Spending more time in virtual environments can distance individuals from real-world interactions, potentially weakening social connections. Furthermore, the boundless opportunities provided by virtual worlds may lead people to reassess their real-life goals and motivations, blurring the lines between physical and virtual life. Navigating these technological advancements while balancing the benefits of both worlds presents a significant challenge for individuals and the business world alike.

Leaders are now taking on a more multifaceted role, striving to understand the psychological impact of this ongoing transformation on employees and to manage these effects effectively.

SUSTAINABLE LEADERSHIP STRATEGIES FOR THE FUTURE

In the pre-AI era, leadership revolved around strong vision, fostering innovation, strategic planning, and incorporating technology into business operations. With the advent of artificial intelligence, the scope of leadership has expanded significantly. Leaders now blend the efficiency and innovation potential of AI with human values, make data-driven decisions, optimize business processes through effective AI utilization, and prioritize human and environmental sustainability in every aspect of their approach.

Future leaders must ensure the objectivity and diversity of datasets used by AI to eliminate potential biases. They should also foster transparency by creating environments where AI-driven decision-making mechanisms are clearly explained, including the data they rely on and the potential outcomes they may produce.

The collaboration between artificial intelligence technologies and human capabilities, which enhances our lives in countless ways, holds the key to achieving sustainable success. As technology becomes an integral part of modern leadership, human qualities such as empathy, ethical values, creativity, and social intelligence provide a meaningful complement to AI's processing power and speed. This partnership elevates humans from mere users of technology to guides who shape and direct its application. Future leaders must inspire their teams and prioritize the social good while leveraging AI as a strategic tool for progress.

By achieving this balance, we can maximize both individual and societal benefits, leveraging AI as a powerful tool to drive environmental sustainability and foster social progress.

THE STORY OF THE AGE OF DISRUPTION

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The journey from the invention of the first transistor at Bell Laboratories in 1947 has brought us to an era where large language models are now at our fingertips. Like an airplane taxiing on the runway, the advent of the internet lifted technology off the ground, propelling it to new heights. The 2000s, in particular, reshaped the world irreversibly with a cascade of transformative innovations.

Giants ascend by standing on each other's shoulders. The flow of information enabled by the internet has introduced one breakthrough after another into our lives, and this momentum shows no sign of slowing. Breakthroughs spark new breakthroughs, while the relentless pace of competition drives innovations to market before society is fully prepared. What we perceive as breakthroughs are merely the visible surface of change. Meanwhile, significant advancements in fields like education, healthcare, energy, logistics, and transportation often remain out of sight in the realm beyond daily life.

Let us not forget that within just three weeks of the emergence of the extraordinary Covid-19 crisis, the virus's genetic map was made available through open sources. Remarkably, the first vaccines were developed in just eight months. Furthermore, video conferencing tools like Zoom enabled us to carry on with daily life almost seamlessly from the comfort of our homes.

The rapid technological advancements of the 2010s shifted the once-optimistic view of technology toward growing scepticism. This change became even more pronounced after the emergence of ChatGPT, as the lightning-fast progress of artificial intelligence

brought sceptical perspectives—championed by pioneers of large language models like Stuart Russell, Yoshua Bengio, and Geoffrey Hinton—into sharper focus.

The term "disruption", translated into Turkish as "kırılım" (breakdown), was popularized by Harvard University's Clayton Christensen in the mid-1990s. Its roots, however, trace back to Joseph Schumpeter, an Austrian economist and the pioneer of the term disruptive innovation, also associated with Harvard. According to the Cambridge Dictionary, disruption is defined as "the act of preventing something, especially a system, process, or event, from continuing in the usual or expected way."

Transformative, life-altering breakthroughs—those that completely overhaul systems—have a remarkable ability to bypass the control mechanisms that govern society. Social media has upended hierarchical media structures and even challenged press laws. Uber, as a representative of the sharing economy, disrupted the traditional taxi industry. Cryptocurrency has revolutionized the financial system, while smart contracts seem poised to redefine the legal landscape. Meanwhile, on smartphones, the once-primary "talking on the phone" function has been overshadowed by texting, photography, music streaming, and gaming. And then there are the large language models—the "mother of all disruptions." For now, they have primarily disrupted the coding industry, a domain we, as a country, believe will drive economic contributions. For now. Because these models are very likely to spark a profound transformation in the foundations of the classical education system as well.

State and local authorities derive revenue through various control mechanisms. Tax systems, diplomas, licenses, driving permits, and number plates theoretically form the foundation of these revenue streams, designed to deliver public services and maintain order. However, when one revenue mechanism after another is disrupted, the control frameworks of these authorities begin to erode. Beyond that, the fear of losing control often drives authorities to enforce their remaining systems with even greater rigidity and repression.

Moreover, the hastily introduced breakthroughs often reveal their unexplored dark sides over time, emerging as new sources of danger. Cybercrime, once associated with hooded teenagers, has now escalated into a key facet of international organized crime.

On the horizon lies a new transformative category born from large language models. In the next year or two, we will likely witness the emergence of artificial intelligence agents. And when quantum computers enter the scene, it will be as if our aircraft has ascended from the stratosphere to the mesosphere.

Aviation introduces a new paradigm. Traffic rules, pedestrian crossings, streetlights, and roads hold no relevance for airplanes navigating the stratosphere. Similarly, the future demands a reimagined framework—a new compass to guide it. This calls for structures that are far more global, equipped to tackle the challenges of the future, considerate of environmental conditions, and far surpassing the governance models shaped by the industrial era.

We must not forget that time is running out. As Antonio Gramsci aptly observed, "The old is dying, and the new cannot be born; in this interregnum, a great variety of morbid symptoms appear." For the current system to adapt with flexibility rather than fracture, it is crucial for academia and young people to act swiftly to lay the foundation for a new narrative. While we all recognize that starting with a clean slate is no easy task, we are equally aware that the mindful use of technology serves as a powerful lever for ensuring the planet's sustainability.

Currently, 1.6% of the world's energy consumption is dedicated to artificial intelligence—a significant figure that is projected to rise to 3.6% by 2030. The global annual energy consumption stands at 450 EJ (exajoules), while the sun delivers an astounding 3.4 million EJ each year—7,500 times more. If increasing the energy usage of artificial intelligence to 5% could enhance solar energy efficiency, it seems like a worthwhile trade-off with minimal loss.

AI IN HEALTHCARE: CHALLENGES AND OPPORTUNITIES

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Advances in medicine and technology have brought about significant transformations, from developing treatments for deadly diseases to preventing genetic disorders, improving surgical techniques, and advancing vaccine research—all contributing to an increase in human life expectancy. Additionally, global improvements in nutrition and hygiene have played a crucial role in extending lifespans. According to a United Nations report, by 2050, the population aged 65 and over is projected to double to 1.6 billion, accounting for 16% of the global population.[1] While the rise in life expectancy is undoubtedly positive, the rapidly growing elderly population is placing immense pressure on healthcare systems. The demand for healthcare services is surging, but the growth in the number of healthcare workers needed to meet this demand is not keeping pace. The World Health Organization projects a global shortage of 10 million healthcare workers by 2030.[2] Addressing this critical challenge in healthcare access lies in leveraging advancements in technology. Digitalisation is driving transformative changes in healthcare through innovations such as the widespread adoption of electronic health records, the expansion of teleconsultation services, and enhanced tools for tracking chronic diseases and managing medications. These developments are improving both the quality and efficiency of healthcare services.[3] In Turkey, digital platforms like e-Nabız and the electronic storage of patient data, including radiological imaging, provide a significant advantage, positioning the country as a leader in healthcare digitalisation.[4]

Rapid digitalisation and its accompanying positive transformation

are not yet enough to bridge the gap in the healthcare workforce. At this stage, the integration of advanced technologies, particularly artificial intelligence, into healthcare services is becoming indispensable for the future of healthcare systems. Artificial intelligence provides a vast array of applications in medicine, ranging from automated image analysis and early diagnosis systems to drug development and personalised treatment plans. However, the global integration of AI into the healthcare sector remains at a relatively limited stage of progress. But can artificial intelligence truly transform healthcare systems? Can it ease the workload of healthcare professionals, enabling fewer physicians to deliver higher-quality care to more patients? Could it even take a step further and make the “artificial physicians” of the future a reality? In this article, we will explore these questions, examining the opportunities artificial intelligence offers in medicine and healthcare alongside the challenges it presents.

To deepen the discussion, let us begin with a striking prediction about the future of artificial intelligence in healthcare. Geoffrey Hinton, recipient of the 2024 Nobel Prize in Physics for his groundbreaking work on artificial neural networks, made a bold statement in a 2016 speech: “People should stop training as radiologists. It’s clear that in five years, deep learning will outperform radiologists.” Now, eight years later, this prediction has yet to materialize. Let’s explore why this anticipated shift has not occurred and why artificial intelligence has not yet brought the concept of "artificial radiologists" to fruition. Is deep learning technology truly incapable of taking on the roles of radiologists or physicians? Or are the main obstacles slowing progress in this field rooted in technological limitations, ethical concerns, and the deeply ingrained traditional structures of the healthcare sector? After delving into these questions, let us explore the transformative potential of artificial intelligence in medicine and healthcare—an impact that remains significant even if “artificial radiologists” or “artificial physicians” have yet to become a reality.

To address these questions, it’s essential to first understand how the systems we call artificial intelligence—essentially mathematical models—function and become “smart.” This technology, which gained widespread attention following the release of ChatGPT in November 2022, typically refers to artificial neural networks, a concept that dates back to the 1950s. To

simplify and make this topic more relatable, let's revisit your high school math classes. You may recall that a linear relationship involving a single variable, x, can be represented using a simple two-parameter linear function: f(x) = mx + c. By adjusting the m and c parameters, different lines—and therefore different relationships—can be defined. In this straightforward scenario, the learning process of artificial neural networks involves identifying the optimal m and c parameters through an iterative optimization algorithm. This process seeks to best capture the assumed linear relationship, represented by the function f of x, between the input data (x) and their corresponding outputs (y). In other words, the goal is to determine the values of the parameters m and c that minimize the difference between the values predicted by the function f(x) for the x inputs in the training dataset and the actual y outputs corresponding to these inputs. In essence, it seeks to learn these parameters and, consequently, the model defined by them. Of course, the simple linear function example provided is often inadequate for modeling real-life problems. Solving such problems requires the use of much more complex, non-linear models with a significantly larger number of parameters. However, the process of learning these complex models follows a very similar approach to the one outlined earlier, involving the optimization of the model parameters based on the given dataset.

Depending on the problem being addressed, the nature of the input and output, the complexity of the function needed to describe the relationship between them, and the number of parameters in this function can vary. As models become more complex and the number of parameters increases, more training data and additional optimization processes are needed to effectively learn these models. Moreover, larger models require greater computational power for training. For instance, in language models like ChatGPT, the input is a sequence of words, and the output is the most likely word that will follow that sequence. To determine the output word, a complex nonlinear function with billions of parameters must be defined, and these parameters need to be learned simultaneously, requiring hundreds of billions of data points. Training these large models necessitates substantial budgets; according to the Stanford University 2024 AI Index Report, it is estimated that $78 million was spent on training the GPT-4 model.[5] In essence, large models

draw their power not only from their sophisticated designs but also from the size of the complex functions they are based on, the vast amounts of data used to learn their parameters, and the high computational power required during the training process.

CHALLENGES

Let's continue with another example to frame the discussion meaningfully and directly relate it to the healthcare field. Consider the problem of detecting lung nodules through computerized tomography (CT). In this case, the input consists of a series of consecutive images of a person (with these images containing millions of pixels), and the output represents the locations of any lung nodules in the individual. To derive this output from a series of CT images, a function with millions of parameters must be defined. These parameter values are then learned by optimizing them based on the available data. On the other hand, unlike our previous example, the availability of accessible data in the healthcare sector can be quite limited. The scarcity of cases, particularly for rare diseases, challenges with data sharing between institutions due to patient privacy concerns, and the difficulties in obtaining labeled health data all contribute to reducing the amount of data available for model training. Furthermore, as is the case in many countries, there are restrictions in our country on transferring health data to foreign cloud services, which limits the ability to fully leverage high computing power when needed.

Another key issue is that, due to the diversity of medical data and the broad spectrum of health problems, it is not feasible to create a single artificial intelligence model that can be used across a wide range of healthcare problems. For instance, while both lung nodule detection and Covid-19 diagnosis rely on CT images, they are based on different visual criteria, even though they affect the same organ. In CT and MR images, or in different MR imaging sequences, distinct tissue characteristics emerge, leading to differences in interpretation. Radiology and pathology images are entirely different from each other, requiring distinct expertise for interpretation. Furthermore, the interpretation of pathology images can vary depending on the tissue type being studied and the specific type of cancer involved. Additionally, signals produced in procedures such as ECG are completely different from the aforementioned images and require separate approaches for analysis. These examples could certainly be extended further. However, the key point I want to emphasize is that, due to the vast range of diseases and the diversity of data in the healthcare field, many problems require the design of problem-specific artificial intelligence models. In other words, the function f(x) must be defined for the specific problem at hand, and the parameters of this model must be optimized using problem-focused datasets. In recent years, 'foundation' models trained[6] on relatively large medical datasets have been developed, demonstrating their potential to serve as a basis for solving various problems. However, due to the diversity and complexity we have discussed, even these large models often still require problem-specific data to be adapted to particular issues.

Another crucial point to highlight is that decision-making

processes in healthcare often require a holistic approach. For instance, a radiologist should not base their interpretation solely on reading images; in many cases, they must integrate these images with the patient's clinical information for a more accurate evaluation. Therefore, if the goal is to create fully autonomous "artificial physicians," the focus must shift from systems designed for single tasks to those that can behave more like a physician—systems capable of conducting comprehensive analyses by synthesizing information from various sources. However, with current technology and the limited data available, artificial intelligence models are not yet advanced enough to take on such a holistic role.

Beyond technical challenges, there are additional factors that complicate the use of fully autonomous artificial intelligence models in healthcare. The extremely low tolerance for error in healthcare and the need for explainability make doctors and healthcare organizations wary of relying on AI systems. Furthermore, the legal and regulatory framework imposes significant limitations on the use of AI applications. For instance, according to current legislation, the legal responsibility for a diagnosis lies with the physician who signs the report. This raises the unresolved question of who will be responsible when artificial intelligence algorithms are used. Similarly, health insurance systems require that the diagnosis be made according to established protocols before treatment begins; however, current regulations do not recognize AI algorithms as an official decision-maker.

OPPORTUNITIES

While these challenges make the emergence of fully autonomous "artificial physicians" difficult, the potential of artificial intelligence to transform medical practice and drive new discoveries in the field is an undeniable reality. The use of AI-powered intelligent systems in routine clinical processes holds the promise of improving the efficiency of healthcare services by reducing errors, speeding up decision-making, and allowing for more effective use of physician time. AI's impact extends beyond clinical applications; it also stimulates scientific research by uncovering new medical relationships and reshaping treatment processes through the systematic analysis of historical health data. It also exerts a transformative effect on areas such as accelerating drug development processes and discovering new molecules. In the final part of my article, I aim to provide you with a concrete perspective on these opportunities by sharing examples of some that are beginning to be implemented, others still in the research phase, and some on which I am actively working with my students at the Koç University–İş Bank Artificial Intelligence Centre.

Accelerated decision support systems: Many routine clinical tasks can be performed by physicians with high accuracy. However, due to their time-consuming and repetitive nature, these tasks take up a significant portion of physicians' time. When AI-enabled systems are trained for such tasks, they can execute them quickly, allowing physicians to focus on more complex and critical decision-making processes. In this context,

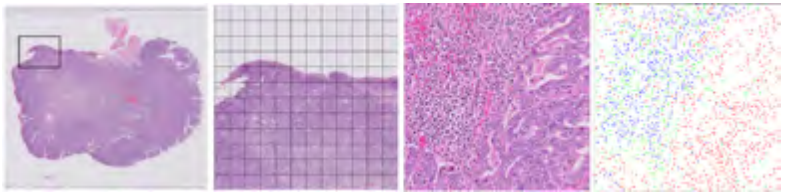


Figure 1: From left to right: Biopsy section prepared on a glass slide for examination under the microscope. The black frame, enlarged and divided into squares. Enlarged image section corresponding to a selected square. Tumor (red), lymphocyte (blue), and other (green) cells marked individually in this image section. The TIL ratio for this image section is expressed as the ratio of lymphocyte cells to tumor cells. Since calculating this ratio across the entire glass slide is a time-consuming process, it is typically estimated by eye as an approximate number.

I would like to present two concrete examples. The first example is the examination of tissue samples on glass slides under a microscope by pathologists, which is the gold standard in cancer diagnosis. This visual examination is not only conducted to detect the presence of cancer but also serves a treatment-guiding function by predicting the cancer's prognosis and its response to treatment. Although each type of cancer has its own specific criteria, for instance, in breast cancer, the proportion of lymphocytes infiltrating the tumour holds significant prognostic value. To determine this ratio, pathologists count tumour cells and lymphocytes in the tumour areas of tissue samples and calculate an approximate ratio. While this is a manageable task for pathologists, counting hundreds of thousands of cells across large tissue areas on a glass slide, as shown in Figure 1, can be very time-consuming. As an alternative to this meticulous cell counting, another method used in pathology involves estimating,

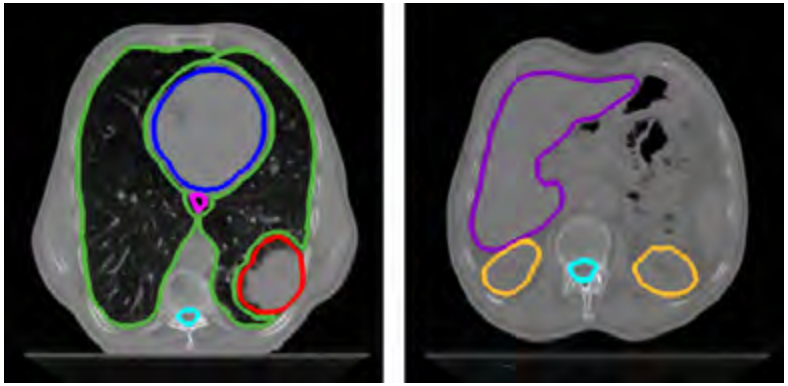
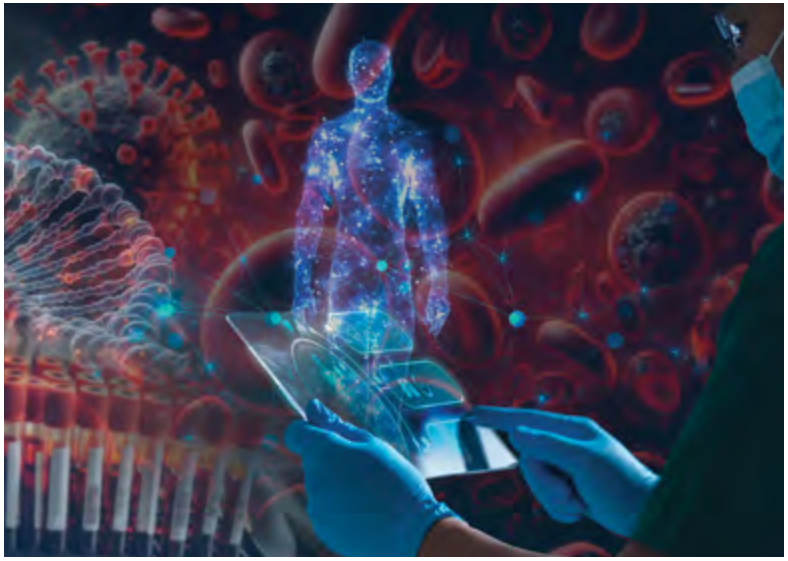


Figure 2: Organ contouring in two different CT slice images. The boundaries of the lung tumor are outlined in red, and the boundaries of each surrounding organ are highlighted in different colors.

by eye, the number of cells in a given area and then generalizing this estimate across the entire slide. Although the approach known as "eyeballing" speeds up the process, it introduces subjectivity among physicians. Here, artificial intelligence models offer the advantage of enabling both rapid and objective cell detection and classification. In the second example I will provide, radiotherapy planning, it is crucial to calculate the dose and angle that will effectively kill cancer cells while minimizing damage to healthy surrounding tissues. Radiation beams are then directed accordingly. For this calculation, the tumour area and surrounding organs must be contoured individually, as shown in Figure 2. Although physicians can perform contouring with high accuracy, doing so across hundreds of CT images for multiple organs is a very time-consuming process. AI-assisted contouring tools, which are already available as products, have the potential



to save physicians significant time. In both examples I provided, AI models do not aim to deliver a final diagnosis; rather, they are decision support systems designed to focus on a single task within a framework where the physician ultimately makes the final decision.

Opportunistic diagnosis and screening systems: Early-stage diagnosis of diseases not only reduces treatment costs but also significantly improves success rates. Therefore, detecting diseases before symptoms appear or at an early stage is of paramount importance. However, one of the main barriers to implementing early diagnosis screening programs is the shortage of physicians. Here, the deployment of artificial intelligence models tailored to the specific imaging modality and disease being screened presents a significant opportunity. I would like to explain this with two examples. The first example is age-related macular degeneration, commonly known as yellow spot disease, which occurs in the macular region of the retina responsible for high-quality vision and has no definitive treatment. This disease, prevalent among aging populations, typically does not show symptoms until it reaches advanced stages. However, if detected in its early or intermediate stages, its progression can be slowed through simple measures like lifestyle changes and vitamin supplementation. Age-related macular degeneration, characterized by fluid accumulation and hemorrhages in the retina, can be visualized using optical coherence tomography (OCT) and can be detected even in the early stages. OCT is a low-cost imaging technique that can be performed by technicians. However, the main reason it is not widely used as a screening test is the insufficient number of ophthalmologists available to analyze the images. A potential solution to this problem involves the automatic segmentation of fluid and hemorrhage regions in OCT images using deep neural networks—a topic I am actively working on in a project. This would enable the implementation of AI-supported screening systems based on the characterization of these regions. Secondly, I would like to provide an example of what we can refer to as opportunistic diagnosis. For individuals over middle age who seek medical help for common complaints of back pain, lumbar MRI is frequently performed to visualize the vertebrae and discs. Although lumbar MRI is performed to visualize the spine region, some internal organs may be partially captured in the scan. However, if the examination focuses only

on the areas related to the complaint due to time constraints, abnormalities in organs that are not directly connected to the complaint but incidentally appear in the image may be overlooked. This is where artificial intelligence-supported systems become crucial, enabling additional analysis of organs unrelated to the complaint. This approach allows the patient to be referred to the relevant specialist, and if necessary, the early detection of health issues unrelated to the complaint could be possible through further testing.

Intelligent systems designed for triage: In healthcare, where resources are limited, it is crucial to allocate these resources effectively, considering the urgency of each case. This approach not only improves the overall quality of healthcare but also ensures that physicians can use their time efficiently, focusing on cases that match their expertise. For example, directing patients with easy-to-diagnose, routine conditions to less experienced physicians, while referring more complex cases to specialists, is critical for optimizing physician time. In this context, artificial intelligence-supported systems have the potential to play a key role in triage processes. For example, patients admitted to the emergency department can be assessed by artificial intelligence algorithms based on the urgency of their condition, and the resulting prioritization can be presented to triage officers as an alternative. In another scenario, the CT image of a patient suspected of head trauma due to a fall, who arrives at the emergency department at night, can be quickly pre-evaluated by the AI-supported system. Based on this preliminary evaluation, the CT image can be sent to the emergency physician, or if the situation is classified as more critical, the radiology specialist who is off-duty can be alerted and activated for further examination. An example of triage can also be found in the field of pathology. Typically, the pathologist to whom biopsy samples taken during gastric and intestinal endoscopy are directed is chosen randomly. However, the vast majority of these samples consist of simple, non-malignant cases, while more serious cases, such as cancer, are relatively rare. An AI-supported digital pathology system could automatically examine these biopsy samples and generate a preliminary diagnosis. Based on this preliminary diagnosis, simple and routine samples could be directed to less experienced pathologists, while complex and critical cases could be sent to more experienced pathologists. In this approach, less experienced physicians can always seek the opinion of a more expert physician when necessary. Additionally, by avoiding random assignments, the expertise and experience of pathologists can be utilized more effectively.

Discovering new relationships and medical breakthroughs: I would like to conclude my article by sharing two examples of how artificial intelligence is used to uncover new medical information and contribute to drug discovery, which excites me scientifically beyond its role in facilitating routine medical practice. My first example is a project I am leading in the field of digital pathology within my research group. This project explores whether pathological examination can provide clues regarding the loss of homologous recombination (HRD) in high-grade ovarian serous carcinoma. Detecting the HRD mutation, which has an effective

treatment protocol when identified, is currently only possible through costly genetic sequencing. However, estimating clues about this mutation through low-cost pathological examination, followed by sequencing when necessary for the relevant patients, offers a more cost-effective approach. In this project, we aim to uncover the potential relationship between immune cell distribution and the presence of the mutation by using deep learning models on pathology slides we have collected in the past, where we already know the HRD status. My final example is an artificial intelligence program called AlphaFold, developed by DeepMind, which predicts the three-dimensional structure of proteins. The three-dimensional structures of proteins provide valuable insights into their functions, aiding in the understanding of how new drug candidates might interact with biological targets. While it typically takes years for humans to comprehend these interactions, AlphaFold can make such predictions within seconds, thanks to artificial intelligence. This capability is revolutionary for drug development research.

In the final part of my article, I have provided examples of how artificial intelligence can be used in various scenarios. Undoubtedly, the areas and problem solutions where artificial intelligence will find a place in the field of medicine and healthcare—an area with a vast array of challenges—are not limited to the examples I have shared. I believe that, in the future, artificial intelligence solutions developed for different problems will become increasingly widespread, with some of these solutions being integrated into healthcare systems. Moreover, I believe that especially complex and challenging problems will drive the development of new AI methods and approaches, making significant technical contributions to the field of artificial intelligence. At Koç University–İş Bank Artificial Intelligence Centre, we are thrilled to be part of and contribute to these research efforts.

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BREEDING THE BEAST: AI AND THE TITANS OF BIG TECH

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In August 2015, when eight Google engineers published their groundbreaking paper in the field of artificial neural networks, no one in the information technology industry could have predicted where this new technology would take us.

The paper introduced a new algorithmic approach to neural networks that significantly enhanced the efficiency of text-to-text translation. With this new algorithm, it became possible to predict the next word more effectively by considering the entire sentence. Shortly after the publication of the paper, a team of 11 individuals, including former Google employees, quietly founded OpenAI. In 2022, OpenAI would launch ChatGPT, the first chatbot to operate on a large language model (LLM).

DISRUPTIVE INNOVATION ANXIETY

What happened next left individual users first, and then the business world, in awe. ChatGPT revolutionized computer-human interaction by using natural language. The business world quickly rushed to integrate this groundbreaking technology into existing solutions, offering entirely new added value to users. In fact, less than a year after its launch, nearly every industry had begun designing new business models around artificial intelligence. Thought leaders in the innovation space argued that any innovation not integrating big language models stood no chance in the market.

Competition in any industry is driven by the added value offered to customers. For instance, in the telecommunications

sector, competition hinges on uninterrupted service and data speed. In line with their ongoing business activities, companies strive to develop technologies that can instantly elevate the value they provide. When successful, these innovations lead to radical advancements in the solutions they offer. To illustrate, the transition from 3G to 4G technology is a prime example of radical innovation, boosting data speed from 14.4 Mbps to 100 Mbps almost overnight. Similarly, the shift from physical buttons to touchscreens in smartphones was a radical innovation that significantly enhanced ease of use and took mobile devices to a whole new level.

With the emergence of big language models, many sectors, from e-commerce to maritime, from human resources to logistics, were swept up in the wave of this radical innovation. However, the real unease was felt in the boardrooms of the world's largest information technology companies such as Google, Microsoft, Meta, and Amazon. This radical innovation, coming from within their own ranks, could lead to unforeseen consequences for them.

RESETTING THE GAME

Beyond driving a leap in user-focused added value, radical innovations are also distinguished by their ability to generate sudden turbulence within their industries.

In sectors demanding substantial investments, such as high technology, the dominance of a few companies is often evident. For instance, in the telecommunications equipment market, Ericsson, Huawei, and Nokia have established control over a significant portion of the market, forming an oligopoly. In industries where oligopolies prevail, the competitive advantages of leading companies are so pronounced that their loss of power or the successful entry of new competitors is generally deemed unlikely—until a radical innovation disrupts the competitive equilibrium.

The advent of large language models as a groundbreaking radical innovation in computer-human interaction has directed all attention to OpenAI. In a remarkably short time, OpenAI emerged as a magnet for investors, elevating its valuation to the billion-dollar level and establishing itself in the public's perception as a leader in the field of artificial intelligence.

ESCALATING THE COMPETITION

From that moment, the previously unshakable leadership of information technology giants Google, Microsoft, Amazon, and Meta began to be called into question. How would these companies respond to OpenAI's breakthrough? Did they possess the artificial intelligence capabilities needed to rival this transformative development?

What unfolded next largely remained behind the scenes for end users. Let's delve into what transpired.

MICROSOFT

Microsoft was arguably the most foresighted in anticipating OpenAI's rise, effectively shutting the door to technology leadership opportunities for other competitors through early investment. In 2019, with a one-billion-dollar investment in OpenAI, Microsoft secured exclusive licensing rights to the large language models

OpenAI would develop and established a significant revenue stream by mandating the use of its cloud infrastructure.

Microsoft already possessed a robust infrastructure in language technologies, supported by the spell-checking and translation features embedded in products like Office. Leveraging this foundation, Microsoft became the first and most effective company to integrate large language models into its products. Today, Copilot is widely used worldwide to generate summaries of MS Teams meetings. Additionally, the growing adoption of the Bing search engine, which incorporates large language models into search functionalities, is viewed by analysts as an opportunity for Microsoft to redeem itself from the shadow of the Internet Explorer setback.

GOOGLE

Although Google began its artificial intelligence endeavors later than Microsoft, it still achieved notable success in end-user applications. It first simplified the user experience by predicting search queries based on the initial words entered. Then, it challenged Microsoft's dominance in translation with Google Translate. Moreover, Google pioneered advancements in large language modeling with its groundbreaking Transformer technology.

In fact, Google possessed all the essential resources to lead in this field. Two primary components are necessary to power large language modeling: text-based data and computational power.

Since the early 2000s, Google had been transferring vast amounts of internet text to its own database for its search engine and had established high-performance server farms to deliver rapid search results. Despite these advantages, the launch of ChatGPT left Google striving to catch up with OpenAI in the race for dominance in large language models.

Under high expectations, Google introduced its chatbot, Bard, in 2023. Following the issues encountered during Bard's launch, Google made a second major move to surpass ChatGPT by releasing the Gemini chatbot. Gemini was designed to operate on a large language model aimed at eliminating gender and race-based biases found in ChatGPT, positioning it to overshadow OpenAI's leadership. However, in its attempt to correct biases, Gemini faced backlash for historical inaccuracies, such as generating a depiction of a Black Pope, drawing sharp criticism from technology circles. Google was compelled to issue multiple apologies for these missteps.

AMAZON

Lacking the extensive text-based data required to develop large language models, Amazon concentrated on its strength in computational power to remain competitive. Through Amazon Web Services (AWS), it had already secured a leadership position in cloud technology. Initially, Amazon opened this infrastructure to companies developing large language models, followed by those integrating these models into their own products. Later, it pursued licensing large language models, such as GPT, through its cloud infrastructure.

This approach solidified its position as the preferred cloud service provider for its customers while driving growth in the cloud services sector, where it maintained its leadership.

META

Meta, the parent company of social media platforms like Facebook, Instagram, and WhatsApp, was well-positioned to

	OpenAI	Google	Microsoft	Amazon	Meta
Chatbot	ChatGPT	Bard & Gemini	Copilot	-	Meta AI
Large Language Modelling Strategy	In-house R&D	In-house R&D	Strategic Partnership and In-House R&D	Platform Strategy and In-House R&D	Ecosystem Strategy and In-House R&D
Business Model	Subscription	Advertisement	Licence	Access-Consumption	Open Source

Table 1. Strategy choices in the large language modelling domain

develop powerful large language models, thanks to its vast access to text-based data and robust server infrastructure.

However, Meta faced a significant challenge regarding large language models. Since its products are free for end users, developing a business model to monetize these models seemed impractical. Any steps toward revenue generation risked undermining its existing advertising-based model—a move that could have been tantamount to signing its own death warrant. In response, Meta devised a strategy that disrupted the competitive landscape: it released its developed large language models as open source for artificial intelligence developers. Through this approach, Meta aimed to establish itself as a hub of innovation in the AI sector, secure a central role in the development of large language models, and ensure that the best models were first deployed on its own social media platforms. Additionally, by making similar models freely available as open source, Meta effectively curtailed the ability of companies like OpenAI and Google to generate substantial profits from their proprietary implementations of large language models.

THE RACE FOR DOMINANCE AMONG TECH TITANS

As 2024 draws to a close, the powerful ripples created by large language models in the IT industry show no signs of settling. OpenAI continues to release new and improved versions of its GPT language model at short intervals to maintain its edge in developing the best models. While its subscription model for end users appears sustainable for now, the widespread accessibility of applications like Microsoft's Copilot, provided through workplace integrations, poses a notable challenge to OpenAI's growth trajectory.

Amazon's approach of expanding and solidifying its cloud-based services in between the ongoing artificial intelligence storm has proven a prudent short-term move. However, whether this relatively narrow strategy will suffice for Amazon remains uncertain. Notably, the company has developed its own large language model, Titan, and made it available on its cloud platform. The extent and manner of returns on this investment are yet to be seen.

Meanwhile, Meta earned industry acclaim with its open-source strategy, marking a strong step toward establishing its own artificial

intelligence ecosystem. However, recent developments suggest a shift away from this approach, as Meta appears to be introducing restrictions on the free usage of its open-source models.

As these developments unfold, new players in the sector are emerging as contenders for the leadership throne. Anthropic, founded by two data scientists who departed from OpenAI, has begun challenging GPT's dominance with its large language model, Claude. Notably, by developing Claude within the framework of ethical artificial intelligence norms, Anthropic could gain a significant competitive edge over OpenAI.

WHAT LIES AHEAD FOR OTHER INDUSTRIES?

As IT giants grapple with the waves of radical innovation they've unleashed, companies across other industries are striving to navigate these turbulent waters. How, then, can this competitive analysis shed light on their path forward?

The only certainty revealed by this analysis is, paradoxically, uncertainty itself. We do not know which large language model will emerge as the best. Nor do we know which business models will most effectively deliver these models to users.

In situations of uncertainty, one of the most effective strategies is the real options strategy. This concept is borrowed from option-based products in the financial sector. In finance, options are offered to companies seeking to secure a position against uncertainty in a particular commodity. For a relatively low fee, financial options grant the right to purchase a commodity at a predetermined price on a future date. When the time comes, the option holder exercises the right to buy if the transaction is profitable or relinquishes it if it would result in a loss. This approach provides an opportunity to cap the potential damage of uncertainty at the cost of the option itself.

A real options strategy entails making small, incremental investments under conditions of significant uncertainty about the future, allowing a company to prepare for periods when clarity increases. In the context of large language models, this approach advocates for gradual integration of the technology with minimal investment. For instance, instead of incurring high licensing costs, companies could opt for open-source models. Rather than committing heavily to a single model, they can experiment with various options and design infrastructures capable of supporting any model. The key is to avoid taking binding steps that are challenging to reverse—both financially and operationally—until the uncertainty diminishes.

FUTURE AND AI: KEY FORCES AND THE BLUEPRINT FOR TOMORROW

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Co-Founder

Over the past two years, we have extensively explored and sought to understand themes such as the accelerating pace of change, the emergence of game-changing artificial intelligence technologies, the adaptation of corporate organizations to future demands, and agility in technology innovation. We have delved into processes like anticipating potential disruptions, challenging conventional wisdom, and integrating and developing data-driven products. So, how can we effectively track the recent advancements in artificial intelligence and its future potential?

The quest to answer this question forms the cornerstone of this article. During a recent conversation with Mr. Adnan Bali, Chairman of İş Bank's Board of Directors, a few insights stood out to me. He emphasized the importance of adopting a rational, measurable, and traceable methodology to form a well-founded perspective on any subject. Drawing inspiration from this, I approached this article not just as an academic and the founder of several initiatives, but also as a representative of pivotal organizations like the Informatics Foundation of Turkey and the Artificial Intelligence Platform of Turkey (AITR), both of which proudly mark their 30th anniversary this year. With artificial intelligence being an expansive domain, I aim to outline key areas to watch and share my perspective on tracking emerging trends in this transformative field.

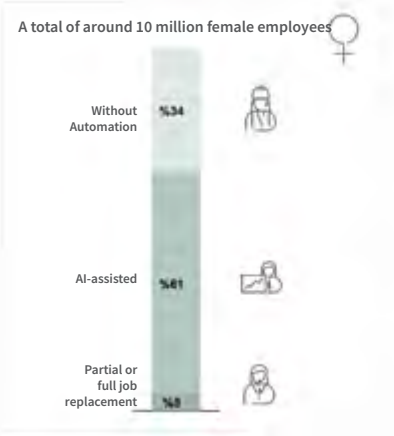
The monitoring of artificial intelligence technologies can traditionally be analyzed across eight key headings. By centering our focus on these areas, I believe we can derive valuable insights specific to each one:

Sector Reports and Research Papers: Numerous international consultancy firms transform current developments into statistical reports based on feedback from industry representatives. One notable study[1], prepared by Google for Turkey and recently supported by AITR, highlights the extensive impact of generative artificial intelligence on business through its automation technologies. According to the study, approximately 41% of jobs—such as those in construction, cleaning, outdoor work, and human-interactive roles—are predicted to remain unaffected by automation. However, 55% of jobs, encompassing 11 million men and 6 million women, are expected to evolve and improve with the support of artificial intelligence. On the other hand, around 4% of jobs are anticipated to undergo complete or partial changes, with office and communication center workers being particularly vulnerable to job displacement driven by AI advancements.

With the right strategic decisions made today, artificial intelligence technologies are projected to contribute an additional 5% to our country's GDP, with the potential to increase this to 7% within the next 12-13 years. However, failing to ensure proper positioning and strategic alignment risks reducing this additional contribution to as low as 1%. While our country is not significantly behind in terms of operational environment and strategy for AI application dynamics, it is evident that we may lag globally in AI innovation dynamics, particularly in areas such as infrastructure, talent management, research, commercialization, and development.

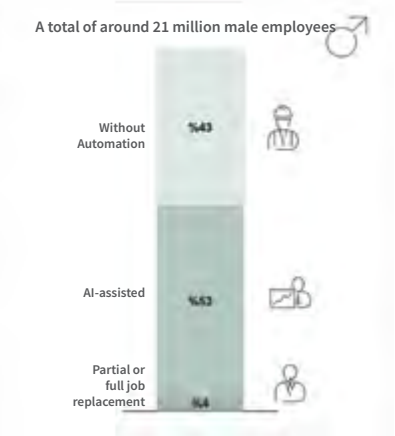
The ratio of jobs held by women expected to be impacted by AI-driven automation.

Compared to total female employment (per cent)



The ratio of jobs held by men expected to be impacted by AI-driven automation.

Compared to total male employment (per cent)



Note: Based on 2023 employment data. Following the classification in Brigas and Kodnani (2023), jobs with an AI impact below 10% are categorized as "non-automated," those with an AI impact between 10-49% as "AI-assisted," and those with an AI impact of 50% or more as "partial or full job replacement." Percentages and figures have been rounded.
Source: Implement Economics, based on Eurostat, O*Net, and Briggs and Kodnani (2023).

Turkey's AI capacity according to Tortoise Global AI Index

Global AI Index, ranking

Note: The Global AI Index assesses the capabilities of nations in artificial intelligence based on seven comprehensive criteria: operational environment (including legal regulations and cybersecurity measures), strategy (such as national budget allocation for AI, defined AI objectives, and the presence of a dedicated national AI institution), infrastructure (encompassing factors like internet speed and supercomputing capacity), skills (measured by the availability of specialists in AI-related fields, including IT and STEM graduates, data scientists, and AI experts), research (evaluated through the volume and impact of AI-related publications and citations), and commercial initiatives (criteria not elaborated in the original text).
Source: Implement Economics from Tortoise Media.

Technology News and Columns: OpenAI CEO Sam Altman consistently highlights the potential of generative AI, often tying advancements—such as OpenAI's o1 model—to broader progress in the AI field. Whether one admires him personally or not, Altman symbolizes the introduction and democratization of AI technology as a product in our daily lives, offering valuable insights into how this evolving process might unfold. He categorizes the current stage into areas like chatbots, reasoners, and AI agents, emphasizing that innovation will drive acceleration through diverse applications—ranging from integration into operational processes within enterprises to transformation and redefinition. The model we currently have demonstrates significant progress in enhancing problem-solving capabilities, such as code debugging and complex decision-making, by prioritizing reasoning over prediction. It also showcases its ability to operate in a singular, reasoning-focused manner across multimodal domains—such as image, audio, and text processing. However, Altman acknowledges that the high computational demands—including hardware, energy consumption, and costs—pose challenges to scalability and efficiency. These issues have led to delays in product deployment, a challenge inherent to the nature of AI tools and their operational requirements. To address these limitations and reduce its reliance on other companies, OpenAI is actively working on developing custom AI chips, akin to those by Google, NVIDIA, and AWS (TPU, GPU, Inferentia, etc.), with a goal of achieving significantly greater computational efficiency by 2026-2027. As a result, it is not difficult to foresee the competitive landscape taking shape in the coming years.

OpenAI, competing with major players like Google, AWS, Microsoft, and Tesla/SpaceX, and strategically aligning its investors, is expected to adopt highly aggressive development and product deployment strategies in this domain. However, as we all recognize, understanding advancements in artificial intelligence cannot be confined to the contributions of OpenAI or Google alone; key players within the startup ecosystem are also delivering significant innovations. Even so, it is anticipated that major cloud computing companies, which control critical technology infrastructure, and companies like NVIDIA, holding a monopoly in the GPU sector—the backbone of the AI industry—will retain their influential positions for at least the next 5-10 years.

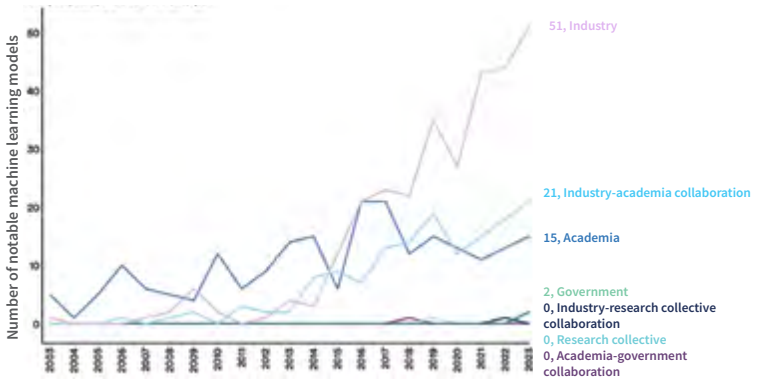
Meanwhile, Yuval Noah Harari, in his latest book Nexus, highlights the societal risks posed by unchecked AI development, offering global examples and developmental patterns to underline these concerns. It argues that artificial intelligence disrupts the fundamental structures of human civilization, threatens social stability and human autonomy, and strongly advocates for the implementation of strict regulations and responsible development policies to prevent the erosion of democratic institutions and social norms. The imperative for modern parliaments to shift their traditional perspectives on the advancement of these technologies, safeguard rights within the framework of a human-centered rule of law, and proactively prepare for these changes becomes increasingly prominent.

Global concerns underscore the urgent need to address the ethical and philosophical dimensions of artificial intelligence's rapid evolution, emphasizing the necessity of taking swift action to establish human-centered policies alongside technological advancements.

Academic and Open Source Research: Until 2014, academia played a leading role in developing machine learning models, which were pivotal in advancing artificial intelligence. However, from that point onward, leadership transitioned to the industry, which has gained significant momentum since 2017.[2] By 2023, the industry had developed 51 noteworthy machine learning models, while academia managed to produce only 15, with these efforts largely guided by world-leading countries. Another striking point is the collaboration between industry and academia, resulting in the development of 21 significant models, particularly large language models, in 2023. Unfortunately, our country has remained outside this process. This figure represents the highest level ever recorded, underscoring the importance of companies' support and collaboration with academia in this context moving forward.

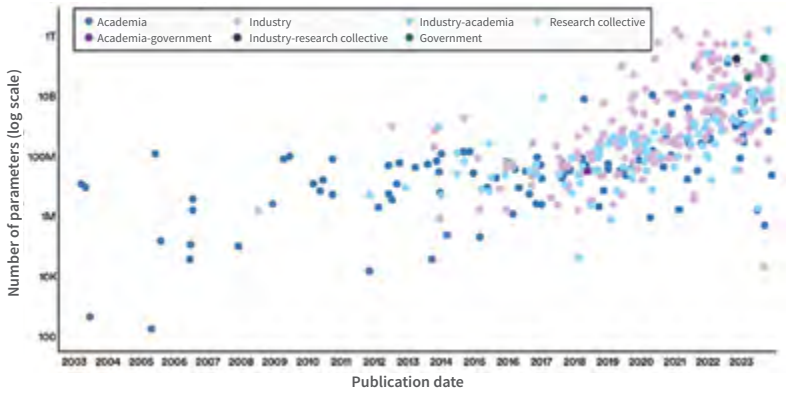
Developing advanced artificial intelligence models demands vast amounts of data, robust computational capacity, and substantial financial resources—requirements that academia struggles to fulfill, a challenge observed globally. This shift has resulted in the growing dominance of industry in developing advanced AI models, a trend first emphasized in last year's AI Index report[2]. While the gap has narrowed slightly this year, the trend of industrial superiority remains largely intact, with academic research institutions

Number of parameters of notable machine learning models by sector, 2003-23
Source: Epoch, 2023 | Chart: 2024 AI Index report

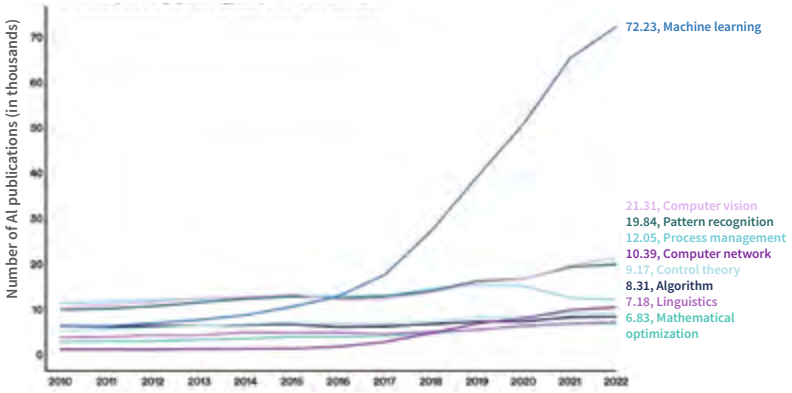


Note: The Global AI Index assesses the capabilities of nations in artificial intelligence based on seven comprehensive criteria: operational environment (including legal regulations and cybersecurity measures), strategy (such as national budget allocation for AI, defined AI objectives, and the presence of a dedicated national AI institution), infrastructure (encompassing factors like internet speed and supercomputing capacity), skills (measured by the availability of specialists in AI-related fields, including IT and STEM graduates, data scientists, and AI experts), research (evaluated through the volume and impact of AI-related publications and citations), and commercial initiatives (criteria not elaborated in the original text).
Source: Implement Economics from Tortoise Media.

Number of parameters of noteworthy machine learning models by industry, 2003-23
Source: Epoch, 2023 | Chart: 2024 AI Index Report



Number of AI publications by field of study (excluding Other AI), 2010-22
Source: Center for Security and Emerging Technology, 2023 | Chart: 2024 AI Index report



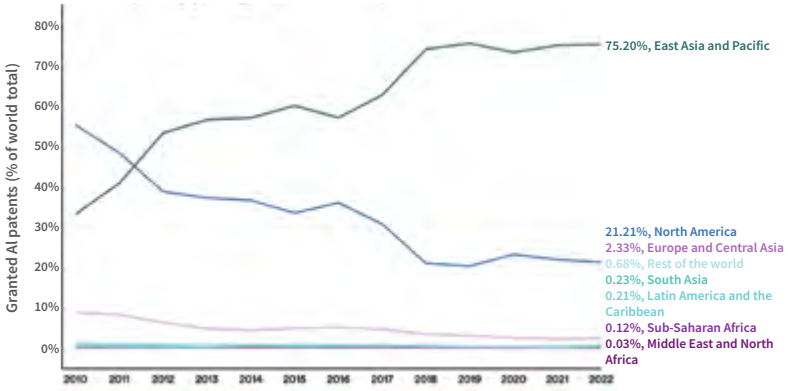
appearing to weaken in this area. This continues to stand as a critical and pressing issue for our country.

In open-source publications, as anticipated, the release of Google's "Attention is All You Need" paper[3] marked a significant increase in the number of articles focusing on generative artificial intelligence models, and consequently, total machine learning research.

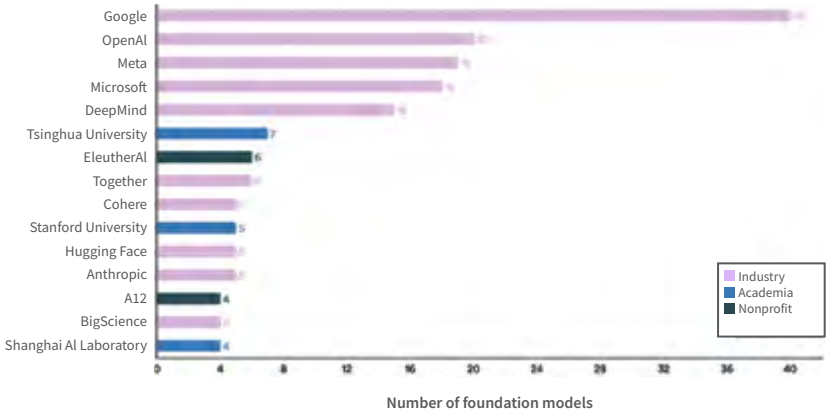
Today, diverse computing applications are converging through multimodal implementations. While there has been a noticeable rise in open-source scientific academic research, the processes of productization, licensing, and commercialization remain more guarded, reflecting a more closed approach within the business world. The complexity of algorithms and the traceability of decision-making systems highlight that the issue of "explainability" involves highly challenging processes, inherent to the nature of the technology. Furthermore, questioning legal obligations and decisions centered on human judgment is becoming increasingly difficult. As a result, open-source science, data, and algorithm processes are expected to become critical topics, to be collectively addressed and examined by non-governmental organizations and governments in the future.

Patents and Innovations: Examining trends in global AI patents over time is crucial for understanding future trajectories and identifying potential breakthrough technologies. Monitoring the evolution of innovation, research, and development in AI, alongside analyzing patent data, offers valuable insights into how these technological advancements are distributed worldwide. However, similar to licensing and publication processes, there is a notable delay in the availability of AI patent data, with the most recent data dating back to 2022. This is partly due to the lengthy nature of patent processes, as well as the fact that software-based patenting is not as widespread globally as it is in the US and China. The data

Granted AI patents (% of world total) by region, 2010-22
Source: Center for Security and Emerging Technology, 2023 | Chart: 2024 AI Index report



Number of foundation models by organization, 2019-23 (sum)
Source: Bommasani et al., 2023 | Chart: 2024 AI Index report



presented in this section, provided by the Centre for Strategic and International Studies (CSET) as part of the AI Index 2024[2] report, highlights clear leadership by North America and China.

It also shows the significant contributions from Europe, led by the former EU and now the UK, particularly when measured by the number of AI-based startups and unicorns. Significant advancements are observed not only in software but also in hardware and middleware related to chip technologies across China, South Korea, Singapore, Japan, and Taiwan. Similarly, the United States continues to generate substantial outputs independently, with a noticeable rise in the number of commercialized patents. While these patents span a wide range of fields, notable growth is anticipated in areas such as large language models and, from this year onward, large multimodal models (image and language processing). Additionally, an increase in patents and commercial products stemming from applied AI processes is expected across all verticals, encompassing a diverse array of field-specific applications.

Social Media and Forums: Social media and forums, offering a distinct perspective from technology news and columns, play an important role in the dissemination of information through dispersed and often informal processes. They are valuable for forecasting trends and sometimes reflecting the collective intelligence's perspective on potential developments. It is well-known that global communities closely follow technology leaders such as Sam Altman, Elon Musk, Jensen Huang, Sundar Pichai, and Bill Gates, among others. Artificial intelligence (AI) discussions on social media and forums provide valuable insights into public perceptions of the technology, ethical considerations, and societal impacts. While a generally positive attitude towards AI is evident, concerns raised by artists and similar groups over the unauthorized use of their works, along with potential risks such as job losses, ethical dilemmas, and privacy violations, appear to amplify societal anxieties surrounding AI. With AI integrating into various aspects of life, new challenges such as content moderation and misinformation are emerging. Platforms like Reddit are struggling to regulate AI-generated content, while rumors and unfounded claims about AI proliferate rapidly on social media. The growing use of AI-powered therapist bots in mental health support offers improved accessibility; however, experts caution that these bots cannot replace human therapists—at least for now. These discussions highlight the need to address AI

not only from a technical standpoint but also through its ethical, social, and cultural dimensions. Studies have categorized the effects of social media into five main areas: **public perception and sentiment, ethical and societal concerns, mental health support, content moderation and its challenges, and the dissemination of misinformation and AI-related rumors.**

Venture Ecosystem and Investments: In recent years, over 400 large and small investment funds have become operational in our country, including those under GSYF. While this growth is a positive indicator of a revitalized venture ecosystem, the number of investment funds specializing in artificial intelligence remains quite limited compared to global counterparts. The Artificial Intelligence Factory, established by İş Bank's next-generation investment fund, addresses this critical gap, taking on significant responsibilities to inform and foster the development of the AI-focused venture ecosystem. However, academia, the public sector, and companies bear significant responsibilities in fostering qualified initiatives, given the fluctuations in infrastructure, education, and skilled workforce—critical areas identified as top priorities for our country. In recent years, the rise of software and AI-based software companies achieving ‘unicorn’ status across various verticals suggests that this trend will continue to grow internationally. However, it is essential to adopt and follow a robust strategic approach to ensure sustained progress in this domain. Transforming academia and education, coordinating data sharing between the public sector and companies, and advancing field-oriented design processes with AI are critically important.

Artificial Intelligence Roadmaps, Internal Initiatives, and Product Launches of Companies: In our country, globally significant companies operate in sectors such as finance, manufacturing, e-commerce, software, and construction. These companies closely monitor global trends, enhance their operations by integrating artificial intelligence into internal processes, and actively support internal initiatives, commonly referred to as "spin-offs." At the same time, large conglomerates that have ventured into different specializations and verticals (e.g., smart agriculture in the energy sector, finance in the pharmaceutical sector, software in the production sector, etc.) are diversifying their profit streams. To accurately identify trends in potential breakthrough technologies, they first collaborate with world-renowned consulting firms to refine their learning,

integration, and implementation processes. For this reason, AI-based data governance, data infrastructure efforts, generative AI-driven services and products (B2B or B2C), and their impact on potential revenue, profitability, and growth should be regarded as critical components for companies managing applications across diverse fields. The evolution of internal initiatives and the quality of product launches will provide significant insights into the general framework and technologies of future potential products.

Government and Policy Updates: To maximize the potential of AI, it is crucial to emphasize the importance of trust while recognizing that building trust in new technologies takes time. Regulatory bodies must adopt a careful and balanced approach to AI, ensuring that trust grows alongside the preservation of investment incentives, thereby accelerating advancements in the field of artificial intelligence. The 2021 National Artificial Intelligence Strategy Document (updated this year) must be continuously refined and developed to inclusively address all segments of society and achieve coherence. Five steps are proposed as part of our country's technology and innovation policy: **Enable Innovation:** Investments should be made in artificial intelligence research and development initiatives: **Establish a Universal Regulatory Framework:** Ensure transparency and clarity to prevent developers and users from facing uncertainty about future regulations. **Promote Widespread Adoption and Universal Accessibility:** Encourage the adoption of artificial intelligence across all industries and businesses of all sizes. **Develop a Workforce Supported by Human Capital and Artificial Intelligence:** Employee capabilities should be enhanced through artificial intelligence, equipping them to effectively work with new technologies. Academia, education, and research processes must be restructured and aligned with contemporary standards. **Invest in AI Infrastructure and Processing Power:** Public institutions and the private sector should be encouraged to invest in the essential AI infrastructure needed to operationalize AI models, including graphics/image processing and supercomputers.

In recent years, artificial intelligence (AI) has emerged as a strategically vital field in technology and business. The rapid advancement of AI is pushing the boundaries of automation and innovation, generating profound impacts on businesses, academia, governments, and societal structures. Industry reports, research studies, and technology news highlight AI's transformative effects on the labor market, where it is expected to create new job opportunities while placing certain professions at risk. According to Google-backed research, with the implementation of the right strategies, AI has the potential to contribute up to 7% additional growth to Turkey’s GDP. However, fundamental challenges such as inadequate infrastructure, a shortage of skilled human resources, and limited patent production continue to hinder global competitiveness.

Academic and industrial collaborations are driving the rapid

advancement of large language models and multimodal AI systems, while public perception and ethical debates surrounding AI echo prominently across social media and forums. The diverse perspectives of technology leaders offer a comprehensive analysis of the opportunities and risks tied to technological progress. On one hand, they underscore AI's potential to foster innovation and economic growth; on the other, they raise concerns about societal disruption and ethical violations. For Turkey, bolstering the AI startup ecosystem, updating government policies, and swiftly adapting regulatory frameworks are essential to sustain technological progress and fully harness the benefits of AI advancements.

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STEP INTO THE ARENA: FROM SPECTATORS TO GAME CHANGERS

TİMUR AKKURT

Tekno Safari
Editor-in-Chief

Patika Digital

A few years ago, answering the question, “What’s next in the world of technology?” felt like a simple exercise. A new smartphone, computer, or television would emerge, and the innovations would flow steadily along familiar lines. But today, everything has changed. The game is no longer about the gradual march of ‘technology’—it’s about artificial intelligence, a force that has exploded into our lives and is evolving at breakneck speed. Predicting even the next few hours feels like a gamble. At the epicenter of this whirlwind stands artificial intelligence, relentlessly reshaping the technology landscape with every passing moment.

The waning enthusiasm for purchasing traditional consumer electronics can be attributed to several factors: uncertainties in the global economy, the similarity of features across products, and the lack of significant innovation. Artificial intelligence, however, stands apart as a groundbreaking new phase—one that captivates the world with its potential. It’s a force we approach with curiosity, strive to understand, occasionally fear, but also deeply anticipate. The pivotal question now is: How can we comprehend this technology, adapt to it, and unlock its benefits?

ARTIFICIAL INTELLIGENCE FOR OURSELVES

Artificial intelligence is far more than just a technology trend; it is a transformative force that has already begun rendering many professions obsolete. This shift is set to accelerate in the coming years. For instance, projections by the McKinsey Global Institute suggest that by 2030, 375 million employees worldwide may need

to transition to new roles due to automation. This data underscores the profound and inevitable nature of the changes reshaping the business world.

How can we navigate this challenge? The first step is to explore how your profession can integrate artificial intelligence. In this new era, every role will either be enhanced by AI or replaced by it. If your role doesn't align with AI, it may be necessary to consider alternative paths or develop new skills. However, incorporating AI into your workflow—as an assistant, accelerator, or driver of efficiency—can provide a critical edge in this rapidly evolving landscape.

The World Economic Forum predicts that new job roles will rise to 13.5% by 2025, highlighting the opportunities created by AI disruptions. From musicians and designers to educators and scientists, professionals can leverage AI to make their work faster, more efficient, and more creative. Early signs of this shift include Hollywood studios partnering with AI firms and brands like Disney establishing their own AI divisions. While these advancements raise legal and ethical questions, they also pave the way for new norms and standards.

In Turkey, digitalisation is expected to generate 3.1 million net new jobs by 2030. This growth depends on how quickly individuals and organisations adopt AI technologies. To stay relevant, we must ask: "How can I update my skills to align with the AI revolution?" These answers will play a pivotal role in shaping our careers.

ARTIFICIAL INTELLIGENCE FOR ORGANIZATIONS

Organizations must adapt to the rise of artificial intelligence. Companies that resist technological transformation risk falling behind as competitors use AI to cut costs and improve offerings. The global electric vehicle industry exemplifies this shift, with Asia-based manufacturers outpacing Western counterparts through AI-driven automation and production optimization. This changing dynamic extends beyond automotive to sectors like finance, healthcare, retail, and education.

According to McKinsey Turkey's report, advancements in automation and digitalisation could transform 7.6 million jobs across the country. This statistic underscores the urgency for organizations to invest in artificial intelligence to bolster their competitiveness. Companies must prioritize hiring experts to implement AI projects, retraining their workforce, increasing

R&D investments, and crafting strategies aligned with industry dynamics. In this new era, managers will not only need to assess profit and loss but also evaluate how swiftly they are adapting to technological transformation.

GLOBAL POWER DYNAMICS AND ARTIFICIAL INTELLIGENCE

By 2025, global investments in artificial intelligence are projected to reach $300 billion, signaling that a substantial portion of the global economy will revolve around AI. As technological competition between Asia and the West heats up, economically vulnerable countries must closely observe this race and take strategic action. Failure to do so risks leaving them lagging behind the global power players—a consequence that could prove particularly dire.

On the other hand, the influence of political leaders and technology visionaries is pivotal. For instance, Elon Musk's initiatives in artificial intelligence, autonomous driving, robotics, and Neuralink are reshaping the roles of individuals and states in the emerging world order. In the face of this rapid transformation, it is essential to step forward as an active participant—not merely a spectator but a player shaping the future.

CONCLUSION: STEP INTO THE ARENA - FROM SPECTATORS TO GAME CHANGERS

Adapting to artificial intelligence demands a calm yet decisive and strategic approach. It's about more than just keeping up—it's about staying ahead. This transition calls for individuals to upgrade their skill sets, organizations to rethink management strategies, and governments to overhaul education and infrastructure policies. Without strong financial resources, a skilled workforce, smart regulations, and dynamic institutions, securing a powerful position in the AI era will be an uphill battle.

Failing to seize the momentum of artificial intelligence today could leave us at a significant disadvantage in the future. The World Economic Forum's warnings make it clear: further delay is not an option. Developing countries like Turkey must act decisively to position themselves at the forefront of this transformation. Rapid investments, education initiatives, innovation hubs, and robust R&D efforts are essential. Artificial intelligence is more than a technological leap—it's a transformative force reshaping the economic, social, and political dynamics of tomorrow. The opportunity to shape this future lies firmly in our hands.

THE FUTURE OF TECHNOLOGY: WHERE REALITY AND VIRTUALITY WALTZ TOGETHER

RIZA EGEHAN ASAD

NOVUS

Co-Founder

Throughout the ages, humanity hasn't just embraced new technologies—it has transformed them into the essence of progress. From the invention of writing to the dawn of steam power, from electrifying the world to connecting it through the internet, each breakthrough has reshaped how we see and live in reality. Yet one truth has always held firm: technologies endure only when they enrich and elevate human existence. That's why the fusion of the artificial and the real is not the destination—it's the tool. The real question is how these tools serve to uplift humanity.

EFFICIENCY AND VALUE: THE DOUBLE-EDGED SWORD OF TECHNOLOGY

In the 18th century, the Industrial Revolution brought efficiency by replacing human labor with machines. Yet, a world made entirely of machines would be lifeless—cold, mechanical, and devoid of meaning. Today, we stand at a similar turning point with the digital revolution. Artificial intelligence and virtual reality are not just tools for accelerating processes; they are opportunities to forge deeper connections and purpose. At Novus, we are dedicated to enhancing these connections through the tools we create. Because technology that doesn't place humanity at its core remains merely an 'innovation'—it cannot become a 'transformative force.'

THE BLURRED BOUNDARY BETWEEN VIRTUAL AND REAL

Think of Plato's Allegory of the Cave: people once believed the shadows they saw were the only reality. Today, the blending

of virtual and real worlds mirrors this allegory, but with a key difference—we now have the power to control the light rather than be confined by the shadows. This "blurred boundary" between the virtual and the real holds profound significance: if managed wisely, it has the potential to enrich and simplify life. The key lies in positioning these technologies to create genuine value.

THE FUEL OF ARTIFICIAL INTELLIGENCE: NEXT-GENERATION GPUS AND AI TECHNOLOGIES

The future of artificial intelligence will be defined not just by the abundance of big data but by the lightning-fast, powerful technologies capable of processing it. Innovations in GPUs, led by pioneers like NVIDIA, are at the heart of this transformation. A historical parallel: in the 20th century, the invention of transistors laid the foundation for the computing revolution. Today, AI accelerators are redefining the limits of artificial intelligence. These formidable tools enable AI systems to tackle complex tasks in mere seconds, pushing the boundaries of what's possible.

BEYOND TRANSFORMERS: NEW APPROACHES FOR SMARTER MODELS

Transformer models marked a major milestone in the world of artificial intelligence, achieving remarkable progress with their ability to process complex data and learn contextually. Yet, these models are not without limitations. Transformers demand substantial computational power and consume significant energy. Additionally, they can fall short in scenarios that require context-independent reasoning or highly specific information. For instance, the demand for fast and accurate results using only the necessary information calls for innovative approaches that transcend transformer architecture.

In the future, the development of more specialized and efficient models capable of overcoming these limitations will usher in a new era of artificial intelligence. Lighter, smarter, and more tailored models are set to revolutionize the field. Just as the programmable computers of the 1950s laid the groundwork for today's cloud-based systems, a new AI paradigm is now taking shape. These emerging models aim not only for speed and precision but also for a sustainable future, consuming less energy while delivering greater impact.

AI ON DEVICES: NEXT-GENERATION SPECIALIZED LANGUAGE MODELS (SLMS)

Future AI systems will operate seamlessly, not just in massive data centers but everywhere. The next generation of "Just Necessary Learning Models" (SLMs) is set to revolutionize fields ranging from autonomous vehicles to smart devices. Much like the rise of personal computers in the 1980s democratized access to information, these models will bring artificial intelligence to every corner of society. For instance, equipping an autonomous vehicle with just the essential data for faster and more accurate decision-making promises groundbreaking advancements in both safety and efficiency.

ECHOES OF THE PAST: CRAFTING AN ETHICAL COMPASS FOR TECHNOLOGY

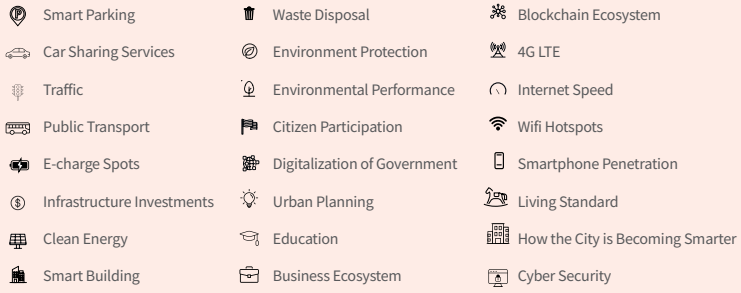
In the 20th century, nuclear energy showcased its dual nature: a promise of cheap, abundant electricity on one hand, and a harrowing force of destruction on the other. This paradox underscores a critical lesson—ethics and responsibility must remain at the forefront of technological progress. Over the next two years, the dialogue around using nuclear energy to fuel artificial intelligence development is set to intensify, an inevitability as model development costs align with ambitious targets. Much like the acceleration in digital transformation spurred by the Covid-19 pandemic, we may soon witness a similar catalytic impact of AI on nuclear energy's role in shaping the future.

CONCLUSION: SHAPING THE FUTURE

The future of technology hinges on the story humanity chooses to craft with these tools. In the interplay between the digital and physical worlds, the ultimate goal is to achieve a harmony between efficiency and meaning. This balance will not only make us "faster" but also profoundly more "human."

Past reports indicate that artificial intelligence has boosted productivity by 66 percent. With the advent of artificial intelligence agents and cumulative advancements, this surge in efficiency is poisedto drive exponential growth in both computational power and real-world impact.

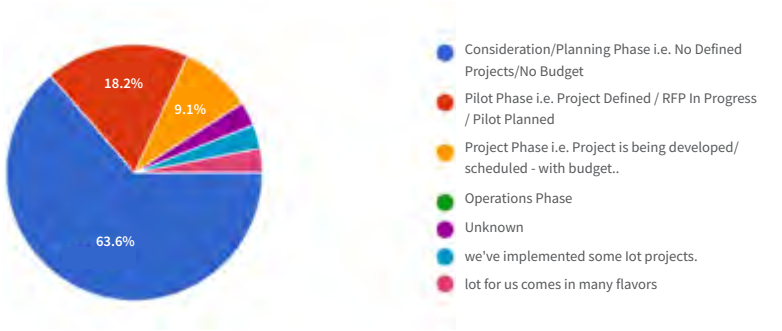
In the coming years, AI-powered systems will become increasingly integrated into all facets of life. In education, for example, virtual reality classrooms will transport students into the heart of historical events, offering immersive and transformative learning



Swedish company EasyPark lists 24 factors that define a smart city.
Source: https://blogs.nvidia.com/blog/what-is-a-smart-city/

experiences. In the healthcare sector, personalized diagnosis and treatment processes are set to become the norm. Yet, this transformation must go beyond being merely a tool; it should be guided by a human-centered approach and rooted in a strong ethical framework.

In the future business landscape, individuals will assume more creative and strategic roles, while routine tasks are delegated to artificial intelligence. Crucially, this shift should focus on enhancing human potential rather than replacing it, fostering a collaborative synergy between people and technology. The symbiotic relationship between business and people will thrive under a model where technology acts as a true "assistant." This is precisely where Novus' vision takes center stage: empowering people to achieve more.



According to a study by NIST, most smart cities are still under construction.

Source: https://blogs.nvidia.com/blog/what-is-a-smart-city/

Ultimately, the lines between physical and digital life will continue to blur, with robots emerging as a potential bridge to seamlessly connect the two realms. As NVIDIA CEO Jensen Huang noted, advancements in AI and GPU technologies over the next five years will bring truly intelligent robots into our homes, integrating into our lives as companions rather than mere automatons.

Smart cities will leverage AI-powered infrastructures to deliver real-time solutions, while digital identities will evolve to hold personal significance beyond mere data. This emerging world promises an era where technology and life progress in harmony. The key lies in ensuring humanity remains at the heart of this transformation.

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ARTIFICIAL INTELLIGENCE: SELF-TAUGHT OR SCHOOLED?

KEREM ÖZDEMİR

Nasıl Bir Ekonomi Gazetesi

Columnist

The journey of artificial intelligence, evolving from machine learning to generative capabilities, seems poised to shape the next chapter of its story with a profound impact across industries. While its reflections will vary from one country to another, the clearest shift in the normal course of life will come with the retirement of professionals from the telecommunications-driven innovation era. As these seasoned experts exit the workforce, companies face the dual challenge of losing their accumulated knowledge and the depth of their institutional memory.

From the mid-1990s onward, the widespread adoption of personal computers and mobile communication has left a lasting mark on the business world and numerous industries. Now, we are nearing the end of the 30-35-year careers of those who led this transformation. In many companies, these individuals are still seen as pillars of expertise. However, their departure—even with successors in place—will mean the loss of a significant body of knowledge and experience.

Especially for family businesses, this shift is expected to serve as a significant motivator for digital transformation, and we're only beginning to understand the role artificial intelligence will play in this process. Having been a part of the media industry since the early 1990s, I can foresee a transformation akin to the seismic changes we experienced in the mid-90s. Back then, articles painstakingly typed on typewriters and rigorously reviewed by trusted institutions were the gold standard of reliable content. Today, those institutions have largely been replaced by influencers, broadcasting videos shot on their smartphones directly to their social media audiences.

This transformation unfolded even though those who lived and grew within these institutional structures found it difficult to adapt. Their inability to grasp the reasons behind these changes highlighted systemic flaws—or "bugs"—within the organizations themselves. The process of producing a single news story often took up to 48 hours, encompassing editorial discussions, data collection, article drafting, printing, and distribution. If you trace this timeline further back, especially in Anatolia, you encounter the concept of the "newspaper read when it arrived in town" rather than a daily publication. At the time, gaining access to a daily newspaper was considered a significant advancement. Yet, as the demand for real-time news grew, it became clear that newspapers alone were insufficient for daily communication. Websites stepped in to fill this gap, followed by mobile applications. All of this stemmed from the inability of print publications and television to establish a competitive foothold against the immediacy and accessibility of digital platforms.

Today, while search engines like Google are exploring models to serve personalized news content based on your search preferences, media organizations seem far from adopting such an approach. Television channels aim to capture viewers' attention around the clock with 24/7 news streams, while print publications are trying to compete in the same space through notifications from their digital platforms.

In pursuing these approaches, we often overlook the fundamental economic principle of balancing supply and demand—delivering quality to meet demand, allowing for higher pricing and profitability. As a result, we've created a market where nearly everyone adopts either similar or contradictory strategies. This market is increasingly defined by commoditized, low-margin products, leading to a resource-constrained trajectory. This journey encompasses every domain, from human resources to financial power.

Let me draw attention to a favorite saying of mine: "Kızım sana söylüyorum, gelinim sen anla"—a Turkish idiom akin to speaking indirectly to convey a larger point. The story I've told here about the press can and should be applied across all industries. It's a vital lesson in adapting to the age of artificial intelligence, ensuring survival not as one of the fallen in this disruptive process, but as one of the transformed.The transformation in the press will not end with the influencer effect. The lack of distinction between a reporter's story written without firsthand knowledge and a video shot by an influencer at the same location highlights a shift in power. Influencers, with their direct and personalized channels to their audience, hold the advantage of one-to-one engagement. However, when citizen journalists step

in—people present at the scene of an event, equipped with real situational knowledge—the traditional tools of both sides lose their edge. From this perspective, we can imagine a new world where institutional structures combine their field expertise with their unique capabilities to forge fresh competitive strengths. In this scenario, the collaboration between humans and artificial intelligence becomes a critical tool for creating a new form of "real intelligence."

AI LAPTOPS VS. LLMS: A BATTLE FOR THE FUTURE

As this new "real intelligence" takes shape, I can't help but draw a parallel to the Jedi in Star Wars—learning to harness and refine their inner strength. Right now, AI laptops are rapidly entering the market—mobile computer systems designed to use specially developed GPUs and their graphic processing capacity (GPU) to train artificial intelligence through personal data and experience. These systems are set to create a significant transformation.

If we consider AI systems built by training large language models (LLMs) as highly educated professionals—akin to academics—then we might liken these self-developing personal systems to self-taught experts. While the former may appear more prestigious, the latter will play a far more critical role in terms of competitive edge and field performance. The potential for remarkable outcomes emerges when these two approaches work together in harmony.

Meanwhile, we'll also witness the emergence of a new language. As an early example, get ready to encounter the term TOPS, which refers to trillions of operations per second. This term defines the power of AI laptops. Currently, we're at around 40 TOPS on average, but one manufacturer recently announced a capacity of 45 TOPS. This represents a robust and sufficient infrastructure for utilizing AI without needing to connect to an LLM-based model over the internet.

AI systems developed through this approach will also be exempt from a major issue emerging in the world of LLMs. As companies become increasingly reluctant to share their data, LLMs are starting to suffer from a lack of training material—a scenario reminiscent of the intellectual void that followed the burning of the Library of Alexandria. While synthetic data generation is being explored as a solution, it's clear that the outcome risks resembling an attempt to grow a forest in a flowerpot.

After outlining the playing field from an engineer's perspective, I turned to my wife for support in exploring how artificial intelligence might impact various industries. Or rather, she volunteered her help with, "Let me ask AI for you." I accepted this offer because I understood the importance of field insights. A CIO I spoke with recently shared an intriguing observation: "We don't

use AI on the IT side at our company, but individual departments are using it in their own areas." Considering this trend—driven by the rise of low-code/no-code systems—I was open to the results my wife Ayfer, a journalist, brought back from her inquiry.

AI'S HIT LIST: INDUSTRIES SET FOR TRANSFORMATION

While I accepted these findings, as you'll soon read, I prefer to base my analysis on the insights gathered at the 6th Digital CEO and Leaders Summit hosted by Vision 100 in October 2024. This event identified 10 key industries and examined how they might be impacted.[4] Here's the list:

Healthcare: Artificial intelligence is making a significant impact in the healthcare sector, particularly in areas like diagnosis, treatment, and drug discovery. The combination of medical imaging and AI enables earlier detection, especially for cancer and cardiovascular diseases. AI-based systems are being used to identify these conditions, while in drug discovery, AI accelerates the testing of new drug candidates. As a result, the duration and cost of clinical trials are significantly reduced.

Finance and Banking: Artificial intelligence, particularly in fraud prevention and enhancing customer service, is also being leveraged to improve investment management through robo-advisors.

Payment Systems: Artificial intelligence is serving a wide range of purposes, from preventing fraud to improving customer service, by making payment systems more secure, faster, and personalized.

Industry and Manufacturing: Artificial intelligence accelerates automation processes and, alongside robotics, supports predictive maintenance systems, enhancing both efficiency and uninterrupted production capacity.

Retail: In the retail sector, artificial intelligence is used in areas such as personalized customer experiences, demand forecasting, inventory management, and pricing. Artificial intelligence, by analyzing customer preferences and providing personalized product recommendations, drives sales while reducing costs and preventing inventory issues through optimized supply chain and inventory management processes.

E-commerce

Transportation and Logistics

Education

Agriculture

Recreation

Choosing not to elaborate after the fifth item is a deliberate decision. Closing the book after providing just enough examples to bring clarity is a preference that creates value by fostering experiences that push us forward—a choice I frequently make.

When my wife asked AI about the trends it will create for companies in 2025, Copilot's responses were as follows:

Generative Artificial Intelligence: AI-powered tools will achieve significant advancements not only in art and content creation but also in fields like scientific research and engineering.

Healthcare Services: Artificial intelligence will enable doctors to

make more accurate diagnoses and personalize treatments for patients[1-2].

Environmental Sustainability: Artificial intelligence will assist in combating climate change by improving energy efficiency and reducing carbon emissions[1-2].

Digital Marketing: Artificial intelligence will play a pivotal role in digital marketing strategies, making brand campaigns more effective[3].

Automation and Business Processes: Artificial intelligence will enhance business efficiency by automating and accelerating processes[1-2].

Here's what ChatGPT told us:

Advanced Natural Language Processing (NLP): Human-like language comprehension and generation capabilities will continue to advance, with particular improvements in multilingual AI applications and contextual understanding.

Zero-Shot Learning: Artificial intelligence systems will be able to deliver better results based on data they have never encountered before. This will provide a significant advantage in scenarios where training data is limited.

Complex Data Analytics and AI Governance: The integration of big data analytics with artificial intelligence will deepen further. Additionally, standards will be developed for the governance and ethical use of AI systems.

Proliferation of Autonomous Systems: The use of autonomous

vehicles, drones, and other autonomous systems will expand, revolutionizing logistics, agriculture, and transportation.

Personalized AI Applications: Artificial intelligence systems tailored to individual needs and preferences (in education, healthcare, e-commerce, etc.) will become more widespread.

AI and IoT Integration: The fusion of artificial intelligence with the Internet of Things (IoT) will take significant steps toward creating smarter cities, homes, and industries.

AI Security and Ethics: The security and ethical use of artificial intelligence will garner increased attention in societal and legal contexts. Oversight and transparency in AI systems will play a key role in boosting public trust and acceptance.

AI-Powered Healthcare Services: The use of artificial intelligence in areas such as diagnosis, treatment recommendations, and patient monitoring will increase. Solutions based on personal health data will become more widespread.

Robotic Process Automation (RPA): With the growing adoption of process automation, RPA applications will enhance company efficiency.

Sustainability and Low Energy Consumption: Energy efficiency will take center stage in the development and implementation of artificial intelligence systems. The pursuit of solutions that consume fewer resources will gain momentum.

The ChatGPT that provided this list to my wife also added a note at the end: "Considering the continuous evolution of artificial intelligence and its ability to respond to societal needs, these trends could have significant impacts by 2025."

THE POWER LIES IN PEOPLE

All of this shows that artificial intelligence, as exemplified by ChatGPT, isn't just superior at creating lists—it's now capable of drawing insightful conclusions. Yet ultimately, success depends on humans and AI working together, finding the right balance to navigate toward our goals. While theoretically, this journey appears as a straight line, the reality—shaped by the complexities of the world—often bends that path into a curve.

Ultimately, the real influence of artificial intelligence on our lives will depend on the smart moves we make within our own realities. There's an old adage that suggests everything follows a clear order, but life often feels less like a precise game of chess and more like the unpredictable roll of dice in backgammon. Balancing the academic AI of LLMs with the self-taught, hands-on AI that evolves alongside us is a challenge left to us. As for me, I cast my lot with the self-taught kind. Let me end with a story that illustrates why.

In the Istanbul of yesteryears, a refined gentleman boards a small boat to cross the Golden Horn. Seeking conversation, he asks the boatman, "Do you know Nedim?" The boatman replies, "No." The gentleman sighs, "Ah, then half your life is wasted." A moment later, he asks, "Well, do you know Voltaire?" Again, the boatman shakes his head. The gentleman lets out another sigh of pity. The boatman pauses, then asks, "Sir, do you know how to swim?" The gentleman looks puzzled. With a slight grin, the boatman replies, "The boat is taking on water, so all your life might be wasted."

My so-called self-taught AI is like this boatman, who not only knows how to row but also ensures the boat gets the necessary maintenance to keep it from sinking. Developing this is a responsibility that falls squarely on the leaders of every sector without exception.

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FUTURE LEADERSHIP: HARNESSING HUMAN SYNERGY WITH AI AS THE STRATEGIC C-SUITE ALLY

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President

Artificial intelligence is ushering in a profound transformation across the business landscape, reshaping not only operational workflows but also the fundamental principles of strategic thinking and decision-making. Cultivating expertise in artificial intelligence among employees and leaders has become an imperative. This evolution signifies that technology has transcended its role as a mere tool, taking center stage in shaping the future visions of organizations. At the highest levels of leadership—spanning CEOs, CXOs, and boards of directors—artificial intelligence now serves as a strategic partner. With advanced capabilities in planning, memory management, and self-reflection, AI is redefining the way organizations navigate their most critical strategic decisions. These technologies not only enhance operational efficiency but also redefine the governance paradigms of the business world by introducing innovative and competitive advantages. However, the notion of AI assuming a direct role as a CEO or board member remains a complex and multifaceted topic of debate. Leveraging the predictive power, advanced data analytics, and decision support mechanisms enabled by AI, senior executives can adopt more proactive and results-driven approaches. Directly or indirectly, AI's contributions to modern boards have already begun to leave a lasting imprint, reshaping the strategic outlooks of key leadership roles such as CEOs, CFOs, and COOs over the past few years.

Agendas for C-Level executives have grown more demanding and multifaceted than ever. As the world order shifts, technological advancements accelerate, and global politics and geopolitical dynamics continuously evolve, each week feels as consequential

as an entire quarter. Today's business leaders must navigate beyond traditional agendas, adopting a comprehensive perspective that encompasses everything from technological innovation to political developments and economic volatility. Yet, within this expansive scope, delving deeply into every issue and managing it with optimal efficiency has become an increasingly formidable challenge. This is where artificial intelligence steps in, revolutionizing the decision-making processes of senior management. By integrating AI into the system with a "beside, not instead" approach, boards of directors can make more informed and agile strategic decisions. Artificial intelligence serves as a distinctive support mechanism, capable of analyzing complex agendas, prioritizing effectively, and offering insights across diverse domains—lightening the load for leaders.

Gartner projected that by 2025, 75% of boards will be leveraging AI tools for decision-making and operational guidance. This forecast underscores AI's emergence as a vital element in governance and risk management. Once regarded as an abstract concept, AI is now evolving into an indispensable resource for forward-thinking boards. Its role has the potential to fundamentally reshape decision-making, risk management, and strategic planning.

DATA: THE NEW CORNERSTONE

Senior management meetings have traditionally been composed of seasoned professionals with deep expertise in finance, operations, law, and strategy. For the past 50–60 years, this governance model has set the standard, with companies often relying on the "intuitive" judgment of experienced leaders to steer their decisions.

Yet, the landscape is shifting at an extraordinary pace. AI assumes its place at the table as a data-driven strategist, offering profound insights. Its capacity to process vast datasets with remarkable speed and distill actionable conclusions is redefining how senior management approaches strategy—streamlining decision-making while inspiring new dimensions of thought.

Emerging leaders increasingly underscore that AI's role transcends automation and efficiency, providing a deeper, more precise comprehension of market dynamics. AI's capability to thoroughly analyse customer data, market trends, and competitor

strategies provides executives with invaluable insights into strategic direction and investment priorities. This empowers companies to navigate a future defined by constant change and disruptive technological advancements with greater agility. For instance, **Amazon** has leveraged AI-driven recommendation systems to personalise customer experiences, boosting sales and enhancing customer satisfaction to secure a competitive edge. Similarly, **Netflix** has strengthened user loyalty through AI algorithms that analyse viewing habits, delivering tailored content recommendations.

RISK PREDICTION WITHOUT AI: A RISKY PROPOSITION

Traditional risk assessment methods have become inadequate in today's fast-paced and complex business environment. Artificial intelligence, with its advanced algorithms and big data analytics capabilities, can identify potential threats before they materialize into tangible outcomes. By continuously monitoring a wide range of areas—from cybersecurity vulnerabilities and financial fraud indicators to geopolitical dynamics and supply chain disruptions—AI empowers boards of directors to embrace a more strategic and proactive approach to risk management.

Artificial intelligence, with its real-time data processing capabilities, can analyze massive volumes of transactional, financial, and operational data, delivering early warnings about potential risks. By moving beyond traditional reactive approaches, AI enables the identification and management of risks before they escalate into crises. Offering a proactive risk management framework,

AI not only mitigates risks but also ensures the continuity of business operations while empowering decision-makers to craft data-driven and forward-looking strategies. **Tesla's** autonomous driving technology exemplifies AI's capability to analyze complex data sets, simultaneously enhancing safety and elevating the driving experience.

This evolution redefines risk management, shifting it from a defensive mechanism to a strategic asset that offers companies a competitive edge. Artificial intelligence is becoming an integral component of modern boards, spearheading this transformation and reshaping the decision-making frameworks of the future.

THE NEW PARADIGM OF DIGITAL TRANSFORMATION: AI AGENTS

Artificial intelligence agents represent the future of AI, emerging as the foremost trend of 2025. As AI technology continues to evolve, these agents transcend the boundaries of traditional models, offering a fresh perspective and gaining widespread prominence. While conventional AI models typically focus on specific tasks and perform limited analyses based on predefined data, AI agents break these confines. They transform data-driven insights into real-time decision support systems, continuously learn, and adapt with exceptional agility. With these capabilities, AI agents stand out as indispensable tools for navigating the complexities of the modern business landscape and shaping strategic decision-making.

One of the most groundbreaking applications of AI agents lies in "digital twin" models. Digital twins simulate a company's operational processes or market behaviors, enabling the assessment of risks and opportunities associated with various strategies. Through these simulations, companies can analyze scenarios such as the market impact of a new product launch or the potential effects of supply chain disruptions. This empowers CEOs to make complex decisions with greater insight and precision.

For instance, Siemens AG's AI-driven digital twin strategy serves as a notable example of optimizing intricate production processes. By simulating production lines before their physical implementation, this approach allows boards of directors to leverage artificial intelligence to unlock a range of strategic advantages, including:

Predicting Maintenance Needs: Artificial intelligence forecasts the maintenance requirements of machinery and equipment, preventing malfunctions.

Optimizing Resource Allocation: Artificial intelligence-powered analyses ensure the most efficient utilization of resources in production processes.

Reducing Operational Costs: This strategy has enabled Siemens to reduce its operational costs by 15-20%.

This approach not only facilitates more data-driven and effective strategic decision-making but also enhances the flexibility and sustainability of production processes.

The strength of AI agents lies in their ability to complement human intelligence. While strategic vision, ethical principles, and decisions rooted in emotional intelligence remain uniquely human capabilities that a CEO brings to the table, AI agents enhance these decisions through powerful data analytics and scenario modelling. By easing the workload of CEOs, this collaboration demonstrates the potential of human-AI synergy in the business world, fostering faster and more accurate decisions, minimizing operational errors, and driving long-term sustainable growth.

Microsoft, leveraging AI-powered performance management systems, focuses on:

- Talent gap analysis,
- Personalized employee development plans,
- Diversity and inclusion initiatives.

The board of directors leverages AI-driven insights to inform strategic recruitment and talent management decisions.

This partnership reveals the potential of human-AI synergy in business, facilitating faster and more precise decision-making, minimizing operational errors, and fostering long-term sustainable growth.

AS A RESULT...

At first glance, the notion of AI replacing a CEO may seem as unlikely as appointing a young analyst to lead a board of directors. After all, AI is susceptible to significant errors, such as “hallucinations” (producing false or misleading information) and a tendency to lose focus during tasks. These traits are seldom associated with effective leadership, particularly in roles that demand balancing the interests of multiple stakeholders, analyzing historical trends, detecting subtle market shifts, and making strategic decisions that shape the company's future.

While the “artificial CEO” concept may have the potential to transform traditional strategy consulting and internal strategy units, its true value lies in collaboration with human leaders. With tools such as generative AI, digital twin simulations, and learning systems, AI enables CEOs to make faster, more accurate decisions, reducing operational errors and fostering sustainable growth. This hybrid leadership model harnesses the synergy between human intelligence and artificial intelligence, making leadership more effective and future-focused. The fusion of human vision and AI-driven insights provides organisations with:

- Competitive advantage
- Faster decision-making
- Sustainable growth.

The leaders of the future will be those who view AI as a strategic partner rather than a rival.

By integrating the vision and values of human leadership with AI’s data-driven capabilities, this approach allows companies to maintain their competitive edge and lead transformation in an increasingly complex business landscape. Artificial intelligence

is not here to replace the CEO; it is here to stand alongside them, reshaping leadership for a new era.

RECOMMENDATIONS FOR BOARDS OF DIRECTORS

Human-AI Collaboration: Positioning AI as a strategic partner.

Ethical AI Framework: Establishing ethical guidelines for transparent and responsible use of artificial intelligence.

Continuous Learning: Ensuring the leadership team regularly enhances its AI technology expertise.

Data-Driven Decision Making: Balancing insights from AI with human intuition.

Adaptive Strategy: Embracing a flexible and innovative approach to technological integration.

The synergy between AI and human intelligence will enhance leadership effectiveness and resilience for the future. Leveraging the opportunities that AI provides, companies can fortify their strategic decision-making, adopt a more proactive approach to risk management, and foster sustainable growth.

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HUMANITY AT THE CROSSROADS OF TECHNOLOGY, TRANSFORMATION, AND PARADIGM SHIFTS

SERDAR TURAN

HBR Türkiye

Editor-in-Chief

During the height of the pandemic, when lockdowns swept across nearly every country in the world, Harvard Business School hosted a Zoom meeting. Executives from all corners of the globe, grappling with a mix of panic and uncertainty, eagerly awaited the insights of three senior professors. The chatbox quickly filled with one urgent question after another: “What should we do?” “How do we navigate this period?”

The professors took the floor and gave a startlingly honest response: “We don’t know. We’ve never experienced a pandemic either.” Then one of them offered a profound observation: “We’re thinking about this all wrong. We assume stability is the norm, and uncertainty or change is the anomaly. But in truth, uncertainty and change are the norms, while stability is the anomaly. And one thing is certain—nothing will ever be the same again.”

Yes, nothing will ever be the same again—especially in a world where technology is advancing and evolving at an unprecedented pace. A glance at the radar reveals a reality unlike any other moment in history: a multitude of technologies simultaneously

emerging, maturing, and embedding themselves deeply into our lives. Artificial intelligence, data-driven analytics, digital twins, quantum computing... Each of these has the potential to transform industries—and even the world—on its own. Now imagine the profound impact of all these innovations maturing at the same time. Such sweeping windows of transformation have historically only been opened by extraordinary events—wars, climate crises, or perhaps even asteroid impact events. Today, however, humanity stands at a unique crossroads, holding the opportunity to transform ourselves, our work, and our planet. And in doing so, we have the chance to adopt a value-driven perspective that prioritizes meaningful impact.

This is where I want to shine a spotlight. Navigating the transformative wave of technology isn't just about the technology itself—it's about something far deeper. Transformation is a journey, and at its core, it must center on humanity and serve humanity. Losing sight of this fundamental truth could mean the difference between success and failure in this pivotal era.

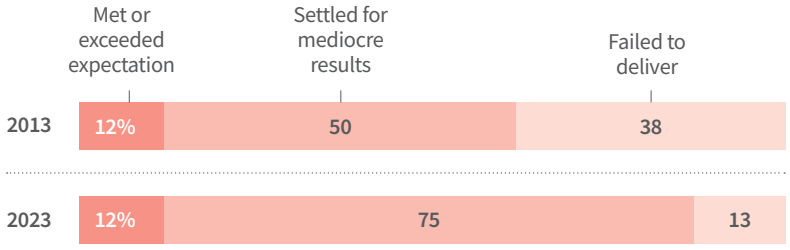
THE AVERAGE TRANSFORMATION TRAP

Whether it's driven by technology, society, or individual choices, transformation is never an easy process—especially in an environment buzzing with lofty value propositions. Artificial intelligence will reshape the world. Fair enough. Factories will run without lights. Sounds impressive. Virtual agents will manage our lives on our behalf. Wonderful. As individuals, organizations, and societies, we speak boldly and confidently about monumental transformations. Yet, when it comes to executing these transformations, our track record is flashing warning signs.

Michael Makins and Patrick Litre from Bain & Company highlight a striking study in their Harvard Business Review article, Transformations That Work. This research, conducted twice—once in 2013 and again in 2023—analyzes the state of transformations in the business world, and the findings are nothing short of eye-opening.In 2013, only 12% of transformations were deemed successful, while 38% were outright failures. The remaining 50% delivered mediocre results. Fast forward to 2023, and the percentage of successful transformations remained stagnant at 12%. Failures, however, dropped to 13%. That's good news, right? But here's the catch: the share of mediocre outcomes ballooned to 75%. Yes, a staggering 75%. We might call this the "average

Transformation Efforts Are Still Missing the Mark

In 2013 and 2023, Bain & Company conducted surveys of the transformation initiatives os 300 large companies worldwide. The companies included both Bain clients and nonclients. The results reveal that despite everything companies have learned from research on what derails change programs, very few transformation efforts achieve their goals.



Source: HBR

transformation trap"—where results fall short of expectations but aren't disastrous enough to spark immediate action. And so, we carry on, limping forward, content with "good enough."

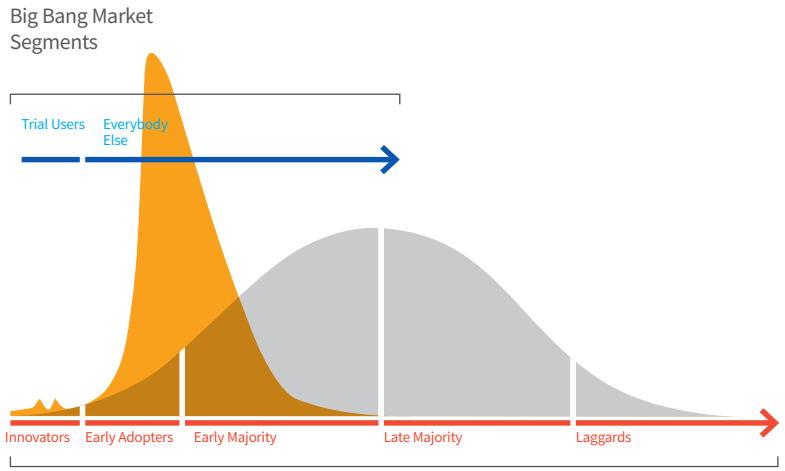
So, why do we seem to struggle with achieving the desired outcomes in transformations? The answer to this question becomes even more critical and meaningful in an era dominated by transformative technologies, particularly artificial intelligence.

THE QUESTION OF SPONTANEITY IN TECHNOLOGICAL TRANSFORMATIONS

When it comes to technology, there's a tendency to overdramatize its disruptiveness and spontaneity. AI is here—civilization as we know it is doomed. We've reached space—time to abandon Earth. Robots have arrived—humans are officially out of a job. This superficial way of thinking sadly overlooks one of the fundamental dynamics that has shaped our civilization: the ability of different elements to coexist simultaneously. No technology creates a "switch effect." In other words, we don't flip a switch and discard a concept, an era, or an old practice/technology overnight. Transformation is a process—one that requires time to internalize, adapt, and make sense of.

It's true that some transformations and changes strike with the intensity of a lightning bolt—sudden, powerful, and impossible to ignore. For instance, when Google introduced navigation features to its maps application, it swiftly obliterated the standalone GPS device market, reducing it to near irrelevance. On the other hand, some transformations follow the "boiling frog" model: gradual,

Big Bang Market Adoption



Source: Roger's Market Segments

incremental, and so subtle that their impact isn't recognized until it's too late to respond. Structural changes—the ones we often describe with sweeping rhetoric—typically emerge through this slower, quieter process.

From this perspective, managing technology-driven transformations requires a model that balances urgency with a strategic approach—one that combines experimentation with deliberate action. If we're not operating in one of the few industries characterized by impulsive change, we must accept that transformation will unfold over time. During this process, the old and the new will coexist, often with neither delivering optimal performance. The key to success lies in embracing this

journey step by step: acting swiftly but without haste, responding to shifts without losing sight of the vision. And let's not forget, the sweeping S-curves we often sketch to depict change are, in reality, composed of hundreds of smaller S-curves—a collective trend built on incremental progress.

THE SCIENCE AND ART OF TRANSFORMATION

While curves dominate the conversation, let's shift our focus to some straight truths. The path to navigating transformation effectively lies in embracing both the science and the art of change. Strip away the jargon—technology, next-gen innovations, artificial intelligence, and everything else—and you'll find one undeniable truth: it all exists for humanity. Yet, we often reduce transformation to a purely technical and mechanical process, sidelining humanity from the equation. The flawed and biased nature of human existence is treated as an anomaly in the pursuit of perfect transformations. But in reality, it is this existential unpredictability that shapes transformations into an infinite array of outcomes, making them uniquely human.

One of the leading theorists in change management, John Kotter, positioned his famous eight-step approach as a cross-industry standard for many years. This transformation cycle—beginning with a sense of urgency and culminating in embedding change into an organization's DNA—became the cornerstone of our theoretical understanding. Recently, Kotter added four principles to this framework, explaining that the original model was too mechanical and lacked sufficient emphasis on the human factor.

Source: John Kotter

These four principles are: speak to hearts and minds, manage and lead, move forward with desires rather than obligations, and focus on a few key priorities instead of trying to tackle everything.

In technological transformations, it's all too easy to fall for the allure of technology itself, shifting our focus entirely in that direction. It's a common trap—primarily because it's the easier path. Technology is tangible, measurable, and predictable. However, what remains ambiguous, misunderstood, and unpredictable are the sociological, economic, and psychological impacts of technology on humanity. Unless we manage transformations with these dimensions in mind, achieving the expected outcomes will become increasingly difficult.

THE EXTERNALITIES OF TECHNOLOGY

Finally, externalities deserve closer examination. Every innovation, every theoretical shift, and, by extension, every

technology produces externalities to varying degrees. These are the unintended—or sometimes inconvenient—effects that arise simply from their existence. Perhaps it's more fitting to call them "side effects." For instance, the development of artificial intelligence requires enormous amounts of electricity. As we make robots smarter, we must acknowledge that some people will lose their jobs. And as next-generation technologies emerge, we have to accept that not everyone will have access to them, potentially widening the gap of inequality.

Welcome to the world of trade-offs. This is exactly where understanding and managing these compromises becomes crucial. If we cannot address issues like the climate crisis, income inequality, or educational disparities without artificial intelligence, should we, at least in the short term, tolerate its externalities?

I believe a phased perspective can be particularly useful here. Let's consider three fundamental stages: the negative externalities phase, the neutral period, and the opportunity phase. Using artificial intelligence as an example... During its development phase, AI will consume vast amounts of energy, contributing negatively to global warming. In the neutral phase, more efficient systems will emerge, operating with optimized energy consumption and reducing these externalities. This is the critical point, leading to the opportunity phase. If we shape this final stage with a positive, human-centered vision, artificial intelligence could become the architect of solutions—building, discovering, and managing systems to tackle the climate crisis, inching us closer to resolution each day. But if we misstep during the neutral phase, AI risks transforming into a weapon, amplifying inequity and making the world an even riskier place to inhabit.

ON THE BRINK OF GRAND TRANSFORMATIONS

Humanity stands at the edge of a monumental threshold. Next-generation technologies have reached a point where they can transform both our world and ourselves. At this juncture, our guiding star must be humanity itself—anchored in universal values and driven by bold, innovative approaches. We must shape this era's dynamics by remembering that technology, at its core, is a neutral force; its true impact depends on how we use, direct, and frame it. For the first time in a long while, humanity faces a window of opportunity to shift the paradigm. We must seize this chance and seek ways to harness technology for the greater good. The path forward lies in understanding and internalizing transformation, melding functionality with responsibility into a cohesive and purposeful whole.

GENERATIVE AI IN BANKING: REDEFINING IMPACT AND INNOVATION

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Artificial intelligence is continuing to revolutionize a wide range of industries, with the banking sector at the forefront of this transformation. Recent breakthroughs in generative AI have significantly accelerated this shift across various sectors. Unlike traditional data analysis, generative AI harnesses content generation, natural language processing, and deep learning techniques to create text that closely mirrors human language. In banking, the impact of this technology spans from enhancing customer experience to optimizing operational processes, with the sector increasingly leveraging ever-evolving generative AI solutions to drive innovation and efficiency as digitalization advances.

According to a 2024 McKinsey study, 67% of senior banking executives plan to increase their AI investments over the next three years. This growing interest signals that generative AI will play a pivotal role in reshaping how banks operate and will guide

the sector's future. Additionally, a 2023 survey by EY-Parthenon identifies three key areas where generative AI has the potential to transform banking operations:

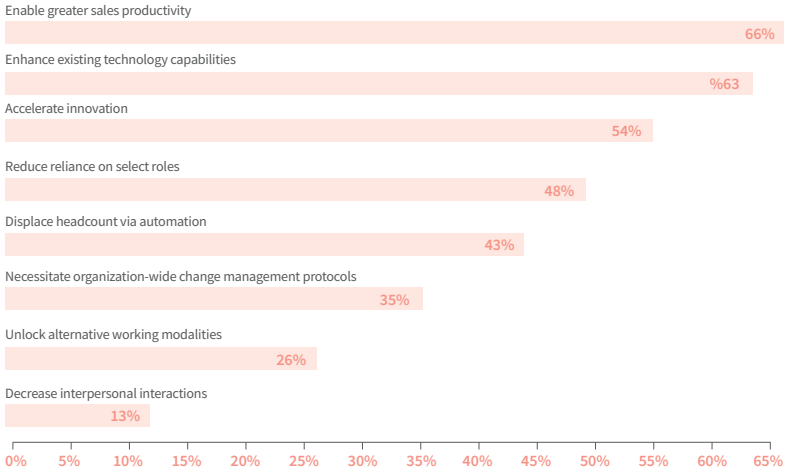
Automation of Sales and Customer Service: 66% of survey participants believe that generative AI will enhance productivity in sales activities, enabling faster and more accurate service delivery to customers. In particular, generative AI-powered virtual assistants make it possible to provide instant responses in customer support processes. This not only boosts customer satisfaction but also helps banks secure a competitive edge.

Enhancing Existing Digital Capabilities: 63% of respondents believe that generative AI will help banks enhance their existing digital competencies. Advances in natural language processing (NLP) and deep learning, for instance, enable banks to deliver more personalized customer service.

Accelerating Innovation: 54% of respondents believe that generative AI will accelerate innovation in banks, unlocking the potential for broader advancements. These innovations include applications like chatbots designed to enhance customer interaction, personal financial advisory tools, and tailored investment solutions.

Considering this information, it is natural to conclude that the areas where banks do not utilize artificial intelligence are steadily diminishing. Banks are employing AI in numerous areas, including enhancing customer experience (through virtual assistants and hyperpersonalization), ensuring high accuracy in operational decisions, and strengthening risk management—all aimed at achieving rapid decision-making, greater efficiency, and increased profitability.

How do you think Generative AI will change your bank's ways of working?



Source: https://www.ey.com/en_se/insights/banking-capital-markets/five-priorities-for-harnessing-the-power-of-gen-ai-in-banking

REVOLUTIONIZING CUSTOMER EXPERIENCE

One of the most striking applications of generative AI is its ability to transform customer experience. By harnessing the analytical power of generative AI, banks can craft more personalized services and offer tailored solutions to their customers. For example, instead of providing generic

investment recommendations based solely on market analysis, banks can now offer customized advice that takes into account a customer's financial goals and transaction history. These personalized recommendations not only boost customer satisfaction but also enhance customer loyalty.

Generative AI is also making a significant impact in the realm of robo-advisory services. Traditionally, robo-advisors offer investment advice based on specific algorithms, but with the advent of generative AI, these recommendations are becoming increasingly sophisticated. By analyzing factors such as clients' risk tolerance, investment goals, and market conditions, generative AI-powered systems can provide more comprehensive and personalized investment advice. This offers a valuable advantage, particularly for individual investors seeking cost-effective and accessible advisory services.

EFFICIENCY INCREASE IN OPERATIONAL PROCESSES

Generative AI holds significant potential to enhance efficiency in banks' operational processes. For instance, repetitive tasks such as automatic document processing, loan application assessments, and employee training planning can be completed faster and more accurately with generative AI-based automation solutions. These automation tools enable banks to redirect their human resources toward more strategic initiatives.

Generative AI plays a crucial role, especially in navigating extensive regulations and compliance processes. Complex tasks,

such as reviewing regulatory texts and preparing compliance reports, can be carried out more efficiently with generative AI-powered analytical tools. This not only helps banks accelerate their compliance efforts but also enables them to avoid potential penalties and reduce operational costs.

FRAUD DETECTION AND SECURITY

Fraud risk has always been a critical concern in the banking sector. Leveraging analysis of large data sets, generative AI-based solutions can detect abnormal transaction patterns and potential fraud in real time. This technology proves to be an invaluable tool for enhancing the security of bank customers and proactively identifying emerging threats. For instance, by monitoring unusual transaction activity, it can flag high-risk instances of fraud, allowing banks to investigate suspicious transactions before they escalate. Additionally, strengthening

defenses against cybersecurity threats is another key application of generative AI in banking. Generative AI-powered systems can predict potential cyber-attack scenarios, enabling banks to proactively prepare for and mitigate these risks.

SHAPING THE FUTURE OF BANKING

Generative artificial intelligence stands out as one of the most transformative technologies with the potential to shape the future of banking. By enhancing customer satisfaction and streamlining operational processes, generative AI-based solutions empower banks to address not only today's needs but also those of tomorrow. For instance, by further personalizing customer experiences, banks can elevate service quality, paving the way for more accessible and effective financial advisory services in the future.

In the coming years, generative AI is set to further enhance human-machine collaboration. Powered by continuously learning and self-improving models, this technology will drive the development of more innovative, customer-centric solutions in the banking sector. As a result, banks will be able to deliver greater value to their customers, while pushing industry competition to new heights.

As a result, the innovations and advantages brought by generative AI to the banking sector will encourage more banks to integrate this technology into their processes in the future. Leveraging the opportunities provided by artificial intelligence, banks will continue to offer more reliable, innovative, and personalized services to their customers. Aligned with its 'Bank of the Future' vision, İş Bank is utilizing generative AI, particularly in the areas of customer experience and operational efficiency, creating value for both its customers and employees.

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AN OVERVIEW OF THE INNOVATION ECOSYSTEMS IN TURKEY AND THE UK

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Innovation is the cornerstone of economic growth and long-term competitiveness for any nation. While Turkey has made promising strides in its innovation ecosystem in recent years, the path to truly sustainable progress requires strategic, continuous efforts. In this journey, relying on one-off innovation projects aimed solely at boosting reputation is unlikely to bring lasting success. Innovation must go beyond the creation of new products and services; it should be a transformative strategy that reshapes an organization's internal culture and ensures long-term sustainability. Without a strategic framework, superficial innovation efforts—such as offering training without measurable outcomes or executing temporary innovation processes—end up being little more than time and money wasted. To catch up with leading innovative countries, Turkey must embrace a comprehensive, strategic approach that drives cohesive decisions and actions across all levels.

TURKEY VS. UNITED KINGDOM: A GLOBAL INNOVATION INDEX COMPARISON

According to the 2024 Global Innovation Index, Turkey ranks 37th globally, while the UK holds the 5th spot. These rankings indicate an improvement in Turkey's innovation capacity, yet there remains a clear need for further strategic growth nationwide. For instance, while the UK invests 2.4% of its GDP in R&D, Turkey's figure is just 1.09%. To truly elevate its innovation landscape, Turkey must increase its R&D investments through a strategy focused on developing groundbreaking solutions that reshape industries,

rather than simply replicating existing models.

In this context, for Turkey to compete with global leaders in innovation, it must first boost its R&D investments and produce more innovative products and services. To make this process successful, technology companies, startups, universities, and institutions need to collaborate closely and work together to develop solutions to key challenges.

INTRAPRENEURSHIP IN TURKEY: STEPS TO STRENGTHENING THE INNOVATION CULTURE

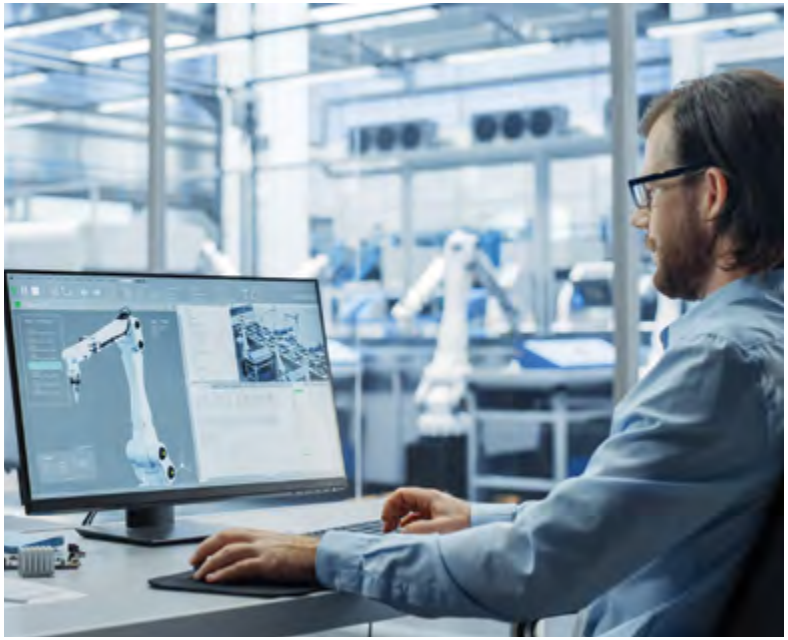
In Turkey, intrapreneurship programs are unlocking the creative potential of employees, thereby enhancing the innovation capacity of institutions. According to the 2024 GOOINN Turkey Innovation Report, 48% of organizations in Turkey have made strides in their internal innovation processes. While this highlights the growth of the corporate innovation culture in the country, it also indicates that its full potential has yet to be realized.

Enterprises are fostering greater diversity in their product development processes by encouraging employees to pursue innovative projects. In-house entrepreneurship programs not only provide employees with opportunities for self-development but also enhance the company's innovation capacity. It's important to recognize that a company can create significant impact by dedicating just one hour per week to planned innovative activities. Such entrepreneurial initiatives will contribute to making Turkey's innovation ecosystem more sustainable.

The UK has a more established framework for intrapreneurship compared to Turkey. In the UK, 70% of companies offer intrapreneurship opportunities to their employees, demonstrating a more effective approach in encouraging employee involvement in innovation processes. Given Turkey's young, dynamic, and open-minded population, it is crucial for the country to draw inspiration from the UK's successful models and ensure that innovation permeates a broader scope within its corporate culture.

THE ENTREPRENEURIAL ECOSYSTEM IN TURKEY

In the first half of 2024, investments in entrepreneurs in Turkey reached 587 million dollars, signaling significant momentum in the country's entrepreneurship ecosystem. However, while



investments in the UK exceed 10 billion dollars, it is striking that Turkey's investments remain at much lower levels. A noticeable gap in capital exists within Turkey's entrepreneurship ecosystem, highlighting the need for increased investment in this sector. One of the key outcomes of intrapreneurship, spin-off investments—joint ventures created by employees who work outside their institutions in collaboration with the companies they were originally employed by—are unfortunately well below expectations.

Technoparks, incubators, and angel investment networks in Turkey are key components of the country's entrepreneurship support mechanisms. By supporting entrepreneurs in technological fields and guiding them towards both local and global markets, Turkey can enhance its competitiveness. The scope of these supports should be expanded to enable entrepreneurs to develop more impactful solutions in the global market.

R&D INVESTMENTS AND TURKEY'S TECHNOLOGY PRODUCTION POTENTIAL

Turkey is making significant strides in areas such as digital transformation, artificial intelligence, and Industry 4.0. However, the annual value of university-industry collaborations in Turkey stands at just USD 1 billion, compared to over USD 4 billion in the UK. Strengthening its technology production capacity through increased R&D investments is a crucial step for Turkey to enhance its competitiveness on the global stage.

At this stage, fostering more university-industry collaborations is essential, and these partnerships should encourage both local and global workforces to develop creative solutions. To fully leverage its potential, Turkey must ensure strong cooperation between universities, the public sector, and private enterprises.

TURKEY'S STRENGTHS AND WEAKNESSES: OPPORTUNITIES FOR INSTITUTIONS

Turkey's strengths include a young and dynamic workforce, strong problem-solving capabilities, and the successful founders of startups that have recently achieved unprecedented valuations. The country ranks 16th globally in creative output but falls to 37th in market maturity. However, challenges such

as weak corporate governance and low ease of doing business remain notable obstacles. Addressing these issues will accelerate the development of Turkey's innovation ecosystem.

To capitalize on growth opportunities within this ecosystem, top executives must genuinely support, embrace, and actively engage with innovation. This commitment is a critical step toward elevating Turkey's position in global innovation rankings.

CONCLUSION: INNOVATION STRATEGY RECOMMENDATIONS FOR TURKEY

Turkey's advancement in the innovation rankings depends on increasing R&D investments, expanding intrapreneurship programs, and strengthening its entrepreneurship ecosystem. With a young population and strategic geographical location, Turkey holds significant potential to build an innovation-driven economy. To unlock this potential, strong collaboration among universities, the public sector, and private enterprises is essential.

In conclusion, Turkey must adopt a sustainable and inclusive strategy to enhance its innovation ecosystem. Such a strategy will help position Turkey as a stronger player in the global innovation landscape.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