# Artificial Intelligence and the Future of Humanity: Towards Sustainable Development Based on Responsible Innovation and Advanced Technology

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**Abstract**
 This research aims to examine the transformative role that artificial intelligence technologies play in supporting the sustainable development process, by exploring ways to harness these technologies responsibly and ethically to achieve a more inclusive, safer, and sustainable global future. The research problem is that despite the tremendous progress in artificial intelligence technologies, their unregulated use may lead to negative impacts on societies, such as discrimination, widening the digital divide, and the absence of legal governance. The challenge lies in achieving a balance between exploiting the benefits of artificial intelligence and mitigating its risks. The importance of this research is highlighted by its contribution to highlighting the true potential of artificial intelligence in achieving the Sustainable Development Goals, while developing a future vision to regulate and guide its use in a way that serves humanity and mitigates its ethical and social risks. The research tools used were a qualitative analytical approach based on the study of secondary data from international reports, economic statistics, and government and private initiatives. The research was also based on a review of scientific literature and reports

related to the field of artificial intelligence and sustainable development, as well as statistical methods. Economic indicators and global forecasts related to the returns of artificial intelligence were used, such as: AI's estimated contribution to global GDP will reach $15.7 trillion by 2030, and global spending on AI technologies will exceed $500 billion by 2024. The research results indicate that AI enhances resource efficiency and supports innovation in vital sectors such as health, education, and energy. There is a legal and ethical gap in regulating the use of artificial intelligence. The risk of discriminatory applications and harmful technologies poses a threat to human rights. The digital divide between countries may deepen economic and social disparities. Some recommendations include establishing clear legal and ethical frameworks to regulate artificial intelligence, supporting digital education and AI skills in developing countries, strengthening international partnerships to achieve responsible innovation, enhancing cybersecurity related to smart applications, and establishing independent oversight bodies to monitor the use of artificial intelligence.

**Keywords:** Artificial intelligence, scale, sustainability, digital infrastructure.

# الذكاء الاصطناعي ومستقبل البشرية: نحو تنمية مستدامة قائمة على الابتكار المسؤول والتكنولوجيا المتقدمة

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**الملخص :**

يهدف هذا البحث إلى دراسة الدور التحويلي الذي تؤديه تقنيات الذكاء الاصطناعي في دعم مسيرة التنمية المستدامة، من خلال استكشاف سُبل تسخير هذه التقنيات بشكل مسؤول وأخلاقي لتحقيق مستقبل عالمي أكثر شمولًا وأمانًا واستدامة. ومشكلة البحث على الرغم من التقدم الهائل في تقنيات الذكاء الاصطناعي، إلا أن استخدامها غير المنظم قد يؤدي إلى آثار سلبية على المجتمعات، مثل التمييز، وتوسيع الفجوة الرقمية، وغياب الحوكمة القانونية. يتمثل التحدي في تحقيق التوازن بين استغلال فوائد الذكاء الاصطناعي والحد من مخاطره وتبرز أهمية هذا البحث من خلال مساهمته في تسليط الضوء على الإمكانات الحقيقية للذكاء الاصطناعي في تحقيق أهداف التنمية المستدامة، مع وضع رؤية مستقبلية لتنظيم وتوجيه استخدامه بما يخدم البشرية ويحد من مخاطره الأخلاقية والاجتماعية. و أدوات البحث أُستخدم المنهج النوعي التحليلي القائم على دراسة البيانات الثانوية من تقارير دولية، وإحصائيات اقتصادية، ومبادرات حكومية وخاصة. كما استند البحث إلى مراجعة الأدبيات العلمية والتقارير ذات العلاقة بمجال الذكاء الاصطناعي والتنمية المستدامة و الوسائل الإحصائية تم استخدام المؤشرات الاقتصادية والتوقعات العالمية المتعلقة بعوائد الذكاء الاصطناعي، مثل:تقدير مساهمة الذكاء الاصطناعي بـ 15.7 تريليون دولار في الناتج العالمي بحلول عام 2030 وتجاوز الإنفاق العالمي على تقنيات الذكاء الاصطناعي حاجز 500 مليار دولار بحلول عام 2024 و نتائج البحث الذكاء الاصطناعي يعزز كفاءة الموارد ويدعم الابتكار في قطاعات حيوية كالصحة والتعليم والطاقة.توجد فجوة قانونية وأخلاقية في ضبط استخدام الذكاء الاصطناعي خطر التطبيقات التمييزية والتقنيات الضارة يشكل تهديدًا لحقوق الإنسان.والفجوة الرقمية بين الدول قد تعمّق الفوارق الاقتصادية والاجتماعية و بعض التوصيات وضع أطر قانونية وأخلاقية واضحة لتنظيم الذكاء الاصطناعي ودعم التعليم الرقمي ومهارات الذكاء الاصطناعي في الدول النامية وتعزيز الشراكات الدولية لتحقيق

الابتكار المسؤول لتعزيز الأمن السيبراني المرتبط بالتطبيقات الذكية وإنشاء هيئات رقابة مستقلة لمراقبة استخدام الذكاء الاصطناعي.

**الكلمات المفتاحية:** الذكاء الاصطناعي، النطاق، المستدامة، البنية التحتية الرقمية .

## 1. Introduction

Artificial Intelligence (AI) has been identified as the dominant innovation technology and frontier of the Fourth Industrial Revolution. It has the potential to transform societies, economies, and industries worldwide. AI is rapidly changing the world. AI could contribute $15.7 trillion to the global economy in 2030, more than the current estimated GDP of either the US or China. Global spending on AI technologies is expected to exceed $500 billion by 2024. Developing ethical AI is central to the achievement of the AI International Establishment Board's 'Mission 2040': to promote equality and environmental protection, prevent sophisticated future warfare, brain-computer integrated development, combating discrimination against AI, responsible AI technology generator, application of large-scale intelligent business and advanced information protection for blockchain technologies.

The Earth is currently at a crossroads between environmental degradation and significant changes to mitigate and adapt to climate change for the sake of sustainability with growth for all. The Global Sustainable Development Goals (SDGs) were thus drawn up and adopted by the United Nations in 2015. To promote those 17 ambitious global goals, AI can be a useful supporter. In addition to providing a global view, this journal also explores the current status and future trend of appalling potentialities to achieve the Global Goals on Sustainable Development [1]. The ten insightful strategic objectives, which need to match in order for 2030 to achieve the SDGs, such as Implementation of legal, regulatory and business models addressing new and existing AI risks, Elimination of all harmful and discriminatory applications of AI-driven technologies to ensure that AI remains beneficial and safe, Development of a high level of digital and cybersecurity infrastructure and the

promotion of AI technologies and internet platforms follow clear security rules.

## 2. Understanding Artificial Intelligence

Not so long ago, Artificial Intelligence was relegated to the realm of science fiction. From the first conceptual glimpses of the 1940s and the 1950s, it seemed a technology doomed to remain forever futuristic, a fantasy good only for Turing Tests and Asimovian imaginings of robot maids. But today, suddenly, it is everywhere—or nearly so [2]. For many consumers, the most immediate changes brought about by AI in recent years have to do with work. For the last years, the conversation about living in a world of Artificial Intelligence has been about the future. But most people understand now that the future is already here and will only become more deeply embedded, even as we might not all entirely grasp how today's currents will shape our world over the long term [3]. Depending on who you ask, this might be cause for elation, consternation, resignation, or some combination of all three. Nearly all commentators agree on one thing: There are major changes ahead as AI technologies become more and more advanced and entwined in our daily lives. Implementing artificially intelligent processes may lead to more environmentally sustainable and more socially inclusive forms of development, provided that this technology is underpinned by a responsible innovation approach, a stakeholder engagement process and embedded in sound governance systems. Advanced technology, namely machine and deep learning, can provide relevant advantages when it comes to the process of informing and shaping development policies, social progress and ultimately fostering a more equitable global economic growth.

## 2.1. Definition and Scope

Artificial Intelligence (AI) has been recognized as a highly transformative technology with the potential to both alleviate and exacerbate a variety of complex global challenges, making it paramount for facilitating the achievement of the 17 United

Nations Sustainable Development Goals (SDGs). However, AI technologies can pose significant and unexpected risks in terms of both individual and societal integrity, most of them little understood by non-experts due to their cutting-edge nature. Recent years have seen prolific effort in mainstreaming AI Ethics and high-level policy standards meant to control them. Such efforts have largely fallen short of impactful change, however, as they are unable to pierce the abstraction gap between high-level values and concrete operative implementation. Thus, in order to allow for the responsible rise and use of AI, there is an urgent need for operationally effective and globally transparent norms that can be enforced at a technical level in a way that is both adaptable to diverse applications and flexible over time. Until then, AI technologies are exposed to a variety of unintended uses that stand at odds with broader developmental outcomes, hindering concerted effort to direct them in a controlled and beneficial way.

AI as a solution can be targeted at each goal individually, or can provide broader support in cross-cutting areas. However, the current state of concern and enthusiasm around AI poses potential ethical and practical risks that present an obstacle to understanding AI's actual capability and potential risks. Therefore a comprehensive view back and ahead, aiming to bridge this gap by first introducing an overview of AI itself (its architecture, methods, application areas, challenges), then showing concisely how these concepts interact with the SDGs both in terms of benefits and challenges.

## 2.2. Historical Development

The development of artificial intelligence (AI) can be traced back to Turing and von Neumann's at the beginning of network computer in 1940. For years, both success and failure development trends of AI have been summarized, especially for failures like Lighthill's and AI winters. In the analysis, learning theory, neural networks, and philosophical thinking with techniques have been combined. There are some similarities between the development of AI and the understanding of human

cognition. Both experience early successes and later failures. As many past failures come from unrealistic technical and philosophical assumptions, recent successes stem from more realistic ones [4]. Statistical natural language processing (NLP) has been largely successful. Generative models from the statistical traditions were replaced by discriminative models. And boosted by a series of empirical successes dropping additional structures and engineering complexity. Recently complex deep learning models that learn distributed representation from large data have been shown to outperform many traditional models. The volume and quality of data have become more important and determined the pace of research improvements. This reflects the long-time understanding in the NLP community. NLP paradigm shift from knowledge-based to data-driven has occurred in individual areas over time scales of several decades. The simplicity, scalability, and efficiency of maximum entropy have played a key role in the convergence. To address the limits of 'narrow' or 'weak' AI, also known in the literature as 'creative' or 'robust' AI, GAs or 'full' AI, 'strong' AI, also more imaginatively as 'real', 'strong' or 'high' AI, or as the 'first' AI [3]. The development of AI has had some parallels in the development of ethical thought about technologies. AI has raised many philosophical questions. The AI 'agents' in a significant way meet the automatic intelligent robot criterion. Under the comparative definitions of Aristotle and Aquinas an AI agent could be seen as applying ethical reasoning akin to these narrow definitions. Similar conclusions have been drawn by those interested in the legal treatment of intelligent robotics.

## 2.3. Current Trends in AI

Artificial Intelligence (AI) is setting foot in every domain of information technology; therefore, careers generated by this blooming technology tend to increase. The present education system must adapt itself for this radical change and prepare students with strong roots in this technology. Sustainability can be enhanced by adopting various emerging technologies like AI,

Internet of Things (IoT), Clean and renewable energy, etc. A career in AI has been among the top-paying, in-demand careers because the Top 5 Tech Companies have invested in AI and are using tailored AI technologies like Alexa for Amazon, Tesla for Tesla Inc., etc. From Health, Transport to Technology and yet other sectors, AI is dominating almost every sector [1]. AI is still peaking in development and its ethical and responsible use is a crucial current topic; there is a powerful rise of ethical AI worldwide, followed closely by further legislative measures to be taken. Analysts suggest the trends to keep an eye on data wrangling to data cleaning, discovering, enriching, managing, etc. and robotic process automation. AI used for auto-generating and healing are well-known techniques inside the graphics sector. Significantly more automated generators, synthesizers and alteration applications can be seen on the sketching artists, music or stock photo sectors.

By producing arrangements with information from multiple datasets, the opportunity of an undisclosed story told by the data could be identified and deepened investigation carried out. This is most typically applied by law enforcement; however, this strategy may be adapted very plausibly in a range of different sectors. Medicinal domain is starting to provide patient-specific care by utilizing ML and AI systems; this form of innovation transforms the whole healthcare machinery. It is expected that approximately 80% of society is going to feel the effects of these advancements; domains like medicine, law and education are going to be redefined or adjusted due to AI until 2022. Within the employment sector, tasks that are simple or repetitive will be replaced or highly assisted by AI. Additionally, brand-new forms of employment are anticipated to emerge in domains that did not even exist several decades ago. The majority of employment sectors will take a blow due to the development of AI since 2018. AI transformation thus needs to be balanced with transforming education [5].

## 3. The Role of AI in Sustainable Development

Modern science and technology are at an unprecedented pace. Many concepts such as the internet of things, cloud computing, and big data have brought about changes in the world, and artificial intelligence (AI) is undoubtedly the leader in future scientific and technological progress. Although the development of AI is accelerating, it is very likely that AI technology will become the most important technology in the middle to long term of the 21st century, but some problems still restrict the development of AI. Therefore, the development of AI can be accompanied by the advanced technological infrastructure. Based on this information, the remaining efforts are focused on three questions: how AI technology will become the most important technology in the future, what problems and challenges are faced in the development of AI, and how AI can be combined with advanced technology infrastructure. Finally, some forward thoughts about the application and future development of AI are put forward according to its own scientific research direction and experience.

The scientific revolution and the industrial revolution promoted the leaps and bounds of the development of human society. After more than 200 years of development, the industrial civilization with steam engines, mechanical equipment, railways, and electric power as the representative has been formed. However, in the last century, with the breakthroughs in information transmission technology and computer technology, the rapid rise of the information society has created the conditions for entering the deep water of the fourth industrial revolution. This revolution features the internet of things, cloud computing, and big data technologies. These technological innovations have affected the overall development of various industries and sectors of the economy [1]. The application of these technologies in the industrial sector to improve production efficiency has led to a new round of scientific and technological revolutions and industrial changes. On the road to the development of intelligent technology, AI was born in the forties and fifties of the last century. After nearly 70 years of

development, AI technology remains the most cutting-edge technology in the field of science and technology. With the continuous maturity and development of AI technology, it is likely that AI technology will become the most important technology in the mid-to-long term of the 21st century, which will have a profound influence on society and economy.

## 3.1. AI for Environmental Sustainability

Artificial intelligence (AI) is a powerful tool that is used to foster the ambitious and meaningful goal of advancing environmental sustainability. It is well suited to predict, optimally operate, and lead innovation in areas that are greatly connected to the environment. AI can be used to model systems and anticipate their evolution, to analyze and classify large and diverse datasets, to optimize processes and resources, and to invent new technologies. Recent advancements in computing and algorithmics have taken AI applications to levels of performance overpassing human capacities in some specific tasks. This makes AI an invaluable ally to mitigate environmental issues and promote a sustainable balance. A growing concern in society is the way AI technologies should be deployed and regulated, not only to ensure they address legitimate concerns and respect fundamental rights but also to open up AI application for the benefit of all, particularly in the neediest parts of the world [6].

AI and the solutions it provides must confront humanity to different challenges related to responsible and social usage and the definition of the best possible technological ingredients and applications. There is a growing awareness of the positive impacts that AI technologies can bring to society and the economy and of the risks and challenges that they may pose. In order to mitigate those negative aspects and foster the positive ones, different initiatives and approaches have been taken by governments, international organizations, and the scientific community. Experience and discussion are shared on how to define a global framework that builds on multidisciplinary research and sets the agenda for the responsible and sustainable

development of AI. These reflections are informed by the scientific literature and by the contributions and debates existing in various international fora dealing with AI challenges. Artificial Intelligence (AI) could contribute to a significant shift in development paradigms towards more sustainable and environmentally friendly models, notably through the promotion of eco-innovation and sustainable consumption and the provision of new digital instruments. From a theoretical perspective, AI broadly comprises data-processing systems built following algorithms inspired by human intelligence, with the ability to reason, learn from data, generalize and perform autonomous decisions. From a more operational perspective, many tools can qualify under AI, including deep learning, machine learning, data mining, bio-informatics and expert systems, together with data visualization and advanced statistics. AI is considered as a general-purpose technology that can affect several aspects of the economy (production, infrastructure), society (education, work) and political life (security, governance).

## 3.2. AI in Healthcare

AI powers the digital age. AI and machine learning are not specific systems or applications. Instead, they refer to models and technologies that emulate human cognition to generate outputs based on inputs and the algorithmic adaptation of "rules," training examples, and hardware through scores or rewards [7]. Policies and norms need to be established to clear up an ambit that continuously evolves. Legislation has been devised to approve and regulate hardware devices, health information, and apps built to diagnose, treat, or manage disease. These devices are certified based on their technical specifications to ascertain that they are safe and easy to use. In the case of software as a medical device (SaMD), new policies must be developed in order to approve and regulate such devices, as they rely on evolving algorithms trained on complex sets of data points. After the collection of a "de novo request," manufacturers who have achieved "organizational excellence"

can obtain exemption from premarket review for low-to moderate-risk products, jumping into the "streamlined pathway" instead. The potential of such AI devices is enormous, especially in healthcare, due to the vast amount of data present in electronic health records (EHR) and the important decisions deriving from it. There is hope that AI in healthcare may enable better disease surveillance, early detection, improved diagnosis, novel treatments, and personalized medicine. AI can help recognize patterns in data that human experts would fail to detect, and health data include, besides genetic information, clinical, social, and behavioural data. Many of these data are conveyed in the form of images, like computed tomography (CT) or magnetic resonance imaging (MRI), or time series, like the data acquired by Internet-of-Things (IoT) devices. In other words, the disease is classified by its biomarker, and it is thus likely that class-specific "latent" variables can be extracted from their data. The process dependent on such variables is unknown, since medical imaging is essentially prophetical – it futural helps labelling diseases based on the visible effect on human tissues. The advent of deep learning has powered AI healthcare applications. Indeed, deep learning has triggered a remarkable increase of AI research in medicine: more than 28,000 papers were published in the past decade, over a third in radiology.

### 3.3. AI in Education

Artificial intelligence (AI) has the potential to transform teaching and education in general. Much of the current AI-driven work focuses on developing intelligent learning platforms and educational software for facilitating, automating, or providing feedback on classroom activities, homework, exams, and mandatory student projects. Many AI-based educational tools are rapidly infiltrating our schools, changing student-teacher dynamics and student expectations. This might also affect the teaching profession, with AI driving partial automation of the teaching process and providing support similar to the way software has begun to replace (at least

partially) white collar jobs in the financial, law, and journalistic sectors [8].

AI in education is gradually becoming a common phenomenon in the modern education system around the world. Artificial intelligence technology is an advanced area of technology that can be effectively used for all types of services all over the world. The impact of AI in the education system depends on various AI technologies. Artificial intelligence is a discipline in designing intelligent machines and systems with the power to solve complex problems. In this era, AI has the potential to change the world, especially in the developing countries like Bangladesh. The central objective of this paper is to provide an outline of AI, its applications in education system and artificial intelligence-based models in the education system [9].

Quality education, one of the Sustainable Development Goals identified by the United Nations, stands to benefit from the adoption of artificial intelligence (AI)-driven tools and technologies. The boom of necessary infrastructure, digitized data and social awareness has propelled research and development in the artificial intelligence for education (AIEd) sector. This analysis investigates how artificial intelligence, machine learning and deep learning methods are being utilized to support students, educators and administrative staff. Additionally, the involvement of AI-driven methodologies in the education process from university or school admissions, course scheduling to knowledge delivery and performance assessment is explored. Furthermore, the major research directions under proactive and reactive engagement of AI in education are outlined.

## 4. Responsible Innovation in AI
AI has the potential to contribute to achieving the UN's Sustainable Development Goals. However, to achieve desired outcomes, it is necessary to engage in responsible innovation. Thus, to begin the development process of AI technology, ethical guidelines should be considered. The Responsible Norms framework can assist the interpretation of procedural and social

norms, offering advice on how to utilize such norms to shape the impact of AI in socially accepted ways. Subsequently, the interpretation of responsible AI in light of the RAIN framework is proposed. Beyond describing the RAIN framework, it operationalizes its components with an initial consideration of regulatory perspectives, to identify relevant guidelines to substantiate the procedural norms. The framework is intended to support high-level control of AI development and deployment to encourage an efficient and direct vectorization of AI technologies towards the common good. A collaborative effort of AI-related ethical experts on both researched technical and regulative levels could increase the likelihood to shape it in a socially benefitting way so to take advantage of AI for the overall global sustainable development and avoid undesired outcomes. However, there is currently insufficient procedural and normative means to assure a positive outcome of AI technologies. Thus, the Responsible Norms framework is introduced, offering a novel abductive model that interprets procedural and social norms. At the same time, the AI model offers practical advice about which specific computational tools to use and how to deploy them to conform to such norms. The framework can serve as a boundary object connecting these domains and assist in a global effort to direct AI technologies goal-conformingly.

## 4.1. Ethical Considerations

Introduction to the series on artificial intelligence (AI) and the future of humanity. Its importance arises due to the rapid growth and wide scope of AI as one of the most transformative technologies of the Fourth Industrial Revolution. This creates a future either of major benefits or serious threats. The former demands a substantially increased level of large-scale global cooperation, but this is challenging in the current context. The ethical and governance issues related to pursuing a sustainable future for AI development are explored in a particularly critical light. It is suggested that successful cooperation may be possible, and mutually advantageous, if pursued within the

framework of Responsible Innovation applied to developing AI for social good, and Advanced Technological Education applied to the associated needed capacity enhancement. Societies are on the cusp of major transformations brought about by a range of cutting-edge technologies and the even more rapid advances that can be confidently predicted for them. Many shining promises are made, but there are likewise numerous dark fears. The question is posed of how best to relate to these technologies given the great value that they could have in solving the innumerable challenges that have so far been so difficult to manage, let alone approach. Discarding what has already been abandoned as interfering with sustainability, inclusiveness or the survival of the democratic state, there appears to be only two mutually reinforcing paths forward. The broadest possible collaboration is to be pursued with the purpose of implementing a substantial governance of AI agenda, that pursues its progressive shaping for the common good through an evidence-based approach with broad multi-stakeholder engagement. For such management efforts to be far better targeted, it will be enhanced by seizing upon capabilities enhancement policies, particularly on the spectrum of learning and education, so as to better anticipate what is to come. It is a sign of openness to experimentation and innovation, putting trust in the power of research and making good use of the experience.

## 4.2. Transparency and Accountability

A multidimensional framework composed of five pillars for robust and ethical AI operation in organizations is presented. These pillars collectively provide a methodical and unified vision for organizations looking to foster the responsible use of AI systems. PILLAR I (Ethical culture and training) focuses on embedding the company's values into all aspects of AI development and use. Continuous training in the understanding and application of these values is a critical requirement to maintain all employees aligned with the ethical identity of the company. The foundation of this pillar is to involve every single actor within the organization in a process of constant review and

alignment with the moral values of the organization. Of particular interest is the design of continuous training programs combining technical knowledge with a deep understanding of how the company's value system can be embedded in everyday decision-making processes. To this end, it is advised to put into practice a series of formal processes and policies that translate the organizational values into practices and systems that are less ambiguous. Examples in this regard include the realization of audits to assure that the code written by the company complies with the ethical framework, certification of the datasets used in the development cycles, or the establishment of a series of rules and protocols on data privacy that are rigorously enforced. PILLAR II concerning AI governance, transparency, and accountability is essential for guaranteeing fair, transparent, and responsible AI operation within companies. AI ambassadors, or other specially designated roles, are identified as important to ensure data quality is maintained at all costs and to offer a continuous feedback loop that enables the decision-making actors a close-up view of AI operation across all scenarios. Because of the complexity of this task, solid governance structures are put in place, including multidisciplinary ethics committees and continuous monitoring mechanisms. Such bodies are in charge of overseeing that the development and use of AI complies with a series of ethical principles that have been established in advance. Under this pillar, a line of work is developed to engage and promote the ever-growing field of interpretable and traceable AI systems ( [10] ).

## 4.3. Public Engagement and Trust

The availability of people to exploit a new commercial service based on artificial intelligence is a significant factor for over 47 percent of AI developers. This represents a substantial increase compared to the share of basic (29 percent) or advanced (21 percent) researchers who agreed with the statement. Firms and AI developers are important agents for an effective policy implementation. They should pursue responsible innovation through an appropriate social shaping of technology approach.

This involves a strong commitment to engage the public and other relevant actors in the technology assessment and development process. The fostering of public trust and the clarification of what the various stakeholders expect from each other are central components of their responsibilities.

A survey was conducted to investigate attitudes and perceptions toward artificial intelligence among the European population. Results show that 41 interested persons have encountered information on AI in the previous year. Differences in such awareness across the EU member states have been highlighted. Respondents to the survey have expressed their dominant fear about robots and artificial intelligence. The data gathered for this paper indicate that individuals appear to have more trust in AI regulators than they do in the developers of AI systems [11]. Over the past few years, governments have increasingly supported AI research. More resources are still needed for the public sector to match the investments of tech companies. There is an overall agreement on the importance of AI developers either in academia or in the industry to obey to a code of conduct. This concern has been expressed by 79 survey respondents, with no significant differences across gender, age, work, AI competence, and trust in AI regulators.

## 5. Advanced Technologies Supporting AI

The ever-accelerated adoption of AI in the world raises a host of important and complex questions, the most critical of which pertain to the use and implications of advanced technologies to automate decision-making [1]. With AI proliferation in societal contexts, there is concern about human agency attaching to AI decision-making, and, thus, about embedding a point of diminishing returns or leading to certain types of uneven technological development. A common discussion of these concerns comprises a history of analytical work aimed at shaping AI systems, a critical agenda focused on geopolitics and extra-societal relations, and a deep theoretical literature in philosophy, ethics, and political science that draws on historical inquiry into forms of intelligence and uses of information. The

central thesis begins as an elemental exploration of this problem and proceeds by assembling insights from these literatures into a formulation of some of the most critical components of the challenge that is posed by AI. It submits that despite its ambitions, the horizon of AI remains bounded by the nature of the intelligence that is sought, as well as by the abstractedness of its context. With AI proliferating as an existential threat, and subtended by a neoliberal ideological architecture, the imperative task is to engineer interactions among advanced technologies that are characterized by durability. Such designs are habitable, require systems of intelligence that recognize AI's limits, and emphasize action as a form of deliberation. Heterodox results follow from this framework.

## 5.1. Machine Learning and Data Science

The transformative power of recent advances in artificial intelligence (AI), together with rapid parallel advancements in related domains, such as big data and the internet of things, now has the potential to address even humanity's most critical issues. But it will take a broad and inclusive domain knowledge distribution, along with responsible thought leaders and process governance, in order to fully unlock and realize the opportunity for profound positive impact. The initiative encourages and would greatly benefit from cross-disciplinary collaboration across sectors. Contributions of practitioners, particularly when directed in close collaboration with domain expert civil society partners and researchers, can be uniquely situated to deploy AI in ways that protect, educate, care for, support, and otherwise benefit the world's most vulnerable populations.

AI-driven prediction tools are set to bring huge social benefits, but also some problems in already-troubled sectors. AI's influence is mostly studied from economic, ethical, and security standpoints, yet its vast environmental aspects are mostly ignored. Artificial Intelligence (AI) is often considered the most revolutionary technology of our time – with its potential to have an impact in virtually all aspects of life worldwide, assisting or even executing various dangerously demanding activities and

tasks, creating entire new tiers of technologies, worlds, and jobs, etc. The complexity of this technology is vast, but with its rapid appearance of more and more new branches, training AI algorithms, it gradually becomes more accessible to a wider circle of society – among AI specialists. However, the environmental consequences for all the abstraction are vastly reduced, and will become an unbearable ecological burden for humanity in a couple of decades, if not solved in time.

## 5.2. Robotics and Automation

Greater efforts should be made to develop beneficial AI technologies, ranging from artificial intelligence for social good in health, economic growth, and environmental sustainability, to automation for sustainable development that creates new opportunities and mitigates risks. International and national governance are less developed with respect to benefits and risks of AI. Research on economic and social challenges of AI can play an important role, e.g., by studying the demand for new labor, the financialization of AI, AI for political communication, spending, and control, as well as the need for intelligent transparency in algorithmic trading. It is urgent to create a resilient platform for sustainable development that deploys AI efficiently and ethically. To endure, this requires governance that includes capacity building, open innovation, and accountability.

Public education about the inability of robots to have feelings or form genuine bonds with humans will likely not be enough to prevent such harms; shrewd AI developers could exploit such misconceptions to deepen attachment to their devices through simple robot social agent enabled design tweaks. It is thus imperative that lawmakers and developers of AI-enabled social agents begin to work together on ethical and legal guidelines for restricting or prohibiting harmful manipulation. Rapid developments in machine learning technology have allowed AI programs to increasingly outthink their human creators and patrons in ways not fully understood by either party. From a technical standpoint, AI programs learn to make increasingly

complex decisions by adjusting their network connections according to patterns revealed in massive datasets. But as sociotechnical systems, AI programs influence human ethics by training them in new belief strategies they may not fully appreciate or understand. This issue is investigated through a series of case studies in the development and deployment of big data and AI prison reform decisions. The automation bias is the psychological phenomenon in which humans greatly overestimate or rely unduly upon the capabilities of computerized systems. Automation bias can result from flawed expectations of computerized systems as infallible or inherently superior to human judgment. The latter is often elicited on the basis of only shallow similarities with intelligent human behavior. A notable example of this phenomenon's salience to the field of AI ethics was the role played in a disaster by operators' faulty deference to an anti-aircraft system. Almost unanimously, AI scientists argue that robot intelligence still greatly differs from human common sense. Judicious deliberation of AI ethic is essential for creating disruptive robots in order to avoid threatening the humanity.

## 5.3. Blockchain and AI Synergy

The real-world applications ranging from trade finance, food supply, medical, and genetic data sharing, to entertainment of blockchain have fascinated numerous communities to develop blockchain-based systems. The system of blockchain is constructed by connecting chained blocks. Transactions or data changes are append only made in the new generated block and chained with the earlier one. Utilizing consensus algorithms, all the records on the blockchains are distributed and shared among the cooperating peers who form the blockchain network. Security concerns on blockchain, connected with smart contract attacks, consensus diverge attacks, and 51% stake attack are studied. The architecture of malicious blockchain may be exploited as another proof of blockchain-based Sybil attacks. Some recent blockchain Sybil attacks towards traditional blockchain systems are sustained. Blockchain has received

extensive attention as it accents for providing secure data sharing services with traceability, immutability and non-repudiation. Immutability of blockchain sustains the unchanged and chronologically ordered characteristics of the data. However, the integration of AI with blockchain has the potentials to overcome these limitations. The blockchain data is usually saved in the local storage or distributed among the blockchain cooperating peers. The blockchain node stores the blockchain data for verifying and verifying the trusted blockchains. Simultaneously the blockchain node also stores some metadata such as the latest trusted block information. After joining the blockchain network, the blockchain cooperative nodes will download a complete version of the blockchain system. Additionally, the blockchain cooperative peer also has the capability to assess and identify the smart contract. With the widespread applications of blockchain, the security and privacy of blockchain systems are attracting much attention for the researchers. Recently many efforts have been made to secure the blockchain network, vulnerabilities in blockchain are being explored. AI approaches may help to capture the abnormal behaviours in blockchain after analyzing the blockchain data. An AI model can be constructed and normal behaviours such as accessing blockchain metadata for verifying and appending second transactions can be trained. With the blockchain alert and the AI model, proactive and autonomic switches can be developed for appellations to prevent blockchain from disruptive actions [12].

## 6. Challenges and Risks of AI

Artificial intelligence (AI) is a key technology that shapes today's economy, society, and politics as no other technical innovation. It will increasingly influence the future of a multitude of thematic areas, including progress in fundamental fields, such as research and education, technologies and their applications, market developments, and structural and macroeconomic traits of economies.

However, while offering enormous opportunities, AI also poses a variety of challenges and risks: "technological unemployment," a narrative that has been present since the industrial revolution; opacity or lack of transparency, the technology's inability to explain its decisions; privacy and concerns as to how the technology "intrudes" upon subjects' personal life; risks resulting from an AI system's autonomous decisions; ethical concerns regarding the fairness and legal treatment of individuals; loss of personal autonomy for the same reason. Additionally, there are technical risks, such as an AI system's susceptibility to adversarial manipulations. And there are "information risks," that the AI system's effects can be nullified if adversaries can feed them manipulated or purposely selected data [13]. To ensure that AI and other advanced technologies meet the Sustainable Development Goals (SDGs) of the United Nations, it is essential to bypass these challenges and risks. This requires an AI development and application that is guided by the goals, kudos, and principles of sustainable development, responsible innovation, and Responsible Research and Innovation. Advanced technologies should contribute to collective goals such as a just and fair society broadly or maintain a healthy environment, even if individual technology applications do not [14].

**6.1. Job Displacement**
Even though AI, automation, and robots are revolutionizing workplaces, the newest evidence shows that potential job immiseration is a false alarm. The key reason is that market economies have demonstrated their flexibility to successfully transform in the past. The fourth industrial revolution will not make past economic performances irrelevant. Moreover, AI, automation, and robots, being still far from delivering the over-hype possibilities fantasized by some prophets, are not going to turn the world around overnight [15]. There are, however, good reasons to believe that the dynamics of change at work will entail significant adjustments. Those will be salient in terms of the acceleration of an on-going trend related to the emergence of

a new 'skills race' among countries. The competitive landscape will be configured so that differences in 'learning capacities' will be increasing. In their turn, this is generating a dual-expression mode in terms of new divides, contrasting between the many as well as the few, and perhaps unveiling the core of a future global order reconfiguration. Grounded on these premises, the focus is on the future sustainability of current patterns of development, and more specifically on the policy and ethical implications related to the design and governance of national growth strategies. It is argued that the pervasive quest for competitiveness will become increasingly intense. A historical analogy is established with other periods of accelerating change— such as the late 19th and the post-WWII American experiences—where development strategies centered on the cultivation of new essential technologies. It is claimed that this constitutes but one potential development path amidst broader alternatives. Furthermore, it is suggested that the pursuit of ambitious objectives in terms of employment, social cohesion, and environmental sustainability will play a vital role in the discernment of those paths which are more conducive to long-term prosperity maintenance. This leads to the proposal of a 'smart sustainability pact'.

## 6.2. Bias and Discrimination

This report outlines an overview of the initiatives of the high-level expert group on artificial intelligence (AI HLEG) with a focus on the ethical and social issues concerning the impact of AI on the future of work and human society. The AI HLEG responsible for producing ethics guidelines for trustworthy AI highlights challenges posed by the use of AI in the public sector for democracy, bias, transparency, and accountability. There is discussion of the deployment of AI in job enhancement, the need for skills to adapt to rapid societal changes, circulation of good practices, and the synergies between AI, RRI and inclusive societies. New job creation, job enhancement and regulatory and educational adaptation to AI applications Counsel to policy makers and educational institutions is obsessed on: 1) job and

business opportunities supported by AI to evolve in the direction of win-win situations between employees and AI, 2) ensuring that employees are equipped by schools and universities with the abilities and perspectives needed to explore them, 3) preparing students and workers to work via AI primarily based systems, and interacting with AI in both technical and user-facing jobs. The future of work and the overall shape of human society beyond 2020 will be driven mainly by the likely impact of AI and robotics [16]. Technological advancements in AI and robotics will continue to drastically alter how people live and work. Given the foreseeable speedy tempo of socioeconomic changes from the automation of latest work/job types, the job marketplace will need to be regularly tailored. This effort should also entail developing societal systems which facilitate the learning of new jobs after the automation of others. This studying should no longer entirely be and concept of threat or technological in nature, but need to also encompass non-work factors of society causing AI-driven monetary impacts and vice versa.

## 6.3. Security Threats

Cyber-physical security threats aim to manipulate the physical world the AI system interacts with to cause either injurious effects or to collect targeted data leaked during the normal decision-making process of the system, or both [17]. An adversarial attacker may control the light sensor of an AI-powered autonomous car to shine a flashlight, causing the AI model to malfunction and fail to recognize road signs. Evasion attacks could be targeted or untargeted. In a targeted evasion attack, an adversary actively tries to trigger the wrong decision (outcome) at the output layer of the AI. A nuclear plant supervisor might launch an attack on the industrial AI controller of the nuclear plant to always produce the action result of 'everything is normal' through manipulating the sensor reading of high temperature around the reactor core. In case of AI, the attacker could also mount an inversion attack, for example trying to reconstruct the training data given only the AI model.

A data-driven hedge fund can use AI to predict the increase or decrease of the stock price in its trading model. Another hedge fund enters non-break clauses in their business contracts and hires an expert third-party to reconstruct the original data, hence reengineering the model. If successful, either for the evasion or the inversion, the output of the AI will be clearly different from the pristine condition. Note that evasion and extraction attacks are closely related since the mechanism of accurate attack is control over internal data representation. Effects are also sometimes similar; confidentiality (data for evasion and model for extraction) needs access to the internals. Grey-box attacks exploit limited knowledge of the internals of the AI model, while white-box attacks require full access to all model structures and parameters. Most of existing adversarial attacks are white-box or contaminant attacks, using backpropagation of the SoftMax loss with respect to input gradients. In case of cyber-attacks on an AI classifier, however, the traditional gradient-based attack is not always possible. Because if the inputs to the attacked model are transformed into a distribution where the SoftMax (classification) score is close to 0.5, as a result of the non-linearity, it is mathematically impossible to increase the score of one class without decreasing the score of the other class.

## 7. Global Perspectives on AI and Sustainability

Global AI efforts in the ongoing race to AI technological development are monitored. Efforts are made by certain countries and agencies to adapt AI in a responsible and sustainable way, thus contributing to global development. This includes: (i) regulations, standards, healthcare and transition towards zero-emissions; we are about to switch from the current prototype, which generates 30 Gg-CO2 per 100 GWh of electricity used in three years, to a zero-emission system; (ii) responsible innovation and ethical guidelines; (iii) prospective research and energy of new infrastructures to be developed by 2025 with zero-emissions; (iv) Development of own technologies, software, infrastructures; this might give a

restrictive advantage that compromises all future developments; (v) efforts to support and develop research on AI abiding ethical norms and competitively fostering AI research towards safe-technological development.

Scientific, ethical, economic and political challenges that AI brings in the form of a SWOT analysis [1]. Finally, AI is proposed by high-tech-based countries participating in the race to SDG-s standing out for bio, nano, quantum-tech, neuro, cloud and other types of super AI technologies. It is pointed out that the effect of AI in reaching possibilities, progress, gaps in a broader development, the role of regulators is indicated; AI is more likely to gain a foothold in digital-based states with strong regulations. The economy dominates, thus conceding safe technological development and the United Nations sets up standard guidelines for AI to be followed by member states. There might be a chance that AI would be exploited in a more responsible way, fostering safer global technological development. However, it still raises concerns since the very nature of AI inherently neglects human values. In the long run, it could be pointed out that global implementation of AI might probably negatively affect the whole development of the Earth - a single state might be left behind, conquer the entire development.

## 7.1. Case Studies from Developing Countries

(1) Five case studies are presented in which Artificial Intelligence (AI) is used in developing countries with the purpose of supporting progress towards the UN Sustainable Development Goals. The technologies aim at improved agriculture, smarter cities, better health, and sustainable environments, but they also have different kinds of unwanted ethical "side effects" [18]. A further study uses this constellation of cases to illustrate how the ethical side effects of AI could be anticipated, avoided, mitigated, or repaired, and it suggests some policies for approaching the ethical introduction of AI applications in the Global South. (2) In recent years there has been a growing interest in how AI can be used to address

complex societal challenges such as health, advanced agriculture, and social structure and environment reform. Considerable financial resources are being employed to this end by governments, corporates, and NGOs. Five case studies have been selected in which AI technologies are used in developing nations to encourage improvement towards the UN SDGs, namely more successful agriculture, smarter cities, health care, healthier environments, and disaster prevention.

The MGI labeled the first three of these illustrations as business process, market model, and enabling model, whereas the ecological illustration has been named an environmental model. In the definitions brought forth by MGI, these models provided UN reports on Sustainable Growth. The MGI suggests that AI should have potential applications in each of the four sustainability categories. Nevertheless, the ethical side effects indicated, and the method of quantitative studies to evaluate them, as well as some analytical thinking to anticipate them, go well beyond the MGI strategies. It is important to bridge this research gap with focus on plans to promote the ethical introduction of AI and large-scale data technologies.

## 7.2. International Collaborations and Policies

As set out in the Pan-African AI Alliance, international collaborations and policies are necessary to propel AI for social good [19]. Through international development cooperation, AI can be promoted to solve global challenges. Similarly, transnational or regional collaborations on R&D&I can boost AI progress. In order to bridge digital divides, it is important to disseminate AI technologies wisely on a global scale. This paper proposed a new collaboration and policy concept called AI4TheGoals. AI4TheGoals is a unique interdisciplinary collaboration combining AI, natural, human and social sciences with sustainable development practitioners. The goal is to establish AI4TheGoals task forces within a number of organizations and research consortia worldwide, each focusing on specific sustainable development goals (SDGs) initiatives.

The concept will be assessed at the international level, thanks to the co-editing framework installation of the TC on AI for developing countries, the organization with African partners of high-level joint events on AI for Africa, and the presentation of the AI4TheGoals concept at UN agencies and European political instances. Similarly, the concept will be pursued at European level with the raising of attention towards European policy makers and the application for H2020 calls on AI and SDGs. Finally, the long-term ambition is to advocate for the creation of coordinated efforts worldwide towards responsible embedding of AI solutions in the service of such development goals, using the AI4TheGoals proof of concept as a support. There is an increasing interest in AI-driven methods and applications, which keep gaining traction due to the development of advanced machine learning and natural language processing technologies. The potential impact of AI technologies on society, accelerated by the Internet of Things arrays and the super-fast connections brought by the forthcoming 5G and 6G mobile networks, is expected to change our lives over the coming years. This paper provides a general view of the development of AI and associated innovation technologies, as stemming from the analysis of their inherent possibilities and pitfalls. A series of key aspects are discussed as to mitigate issues related to the development of advanced AI and associated technologies, most of which are part of the European continent strategic agenda, by anchoring this new aspect in the field of Responsible Research and Innovation.

## 7.3. Cultural Impacts of AI

A critical discourse has emerged those questions the impact of digital technologies and artificial intelligence (AI) on contemporary society. These analyses challenge the prevailing narrative that all technological innovation is inherently positive and beneficial. Instead, they highlight the potential risks of excessive technologization that could erode human autonomy and even have a negative impact on civilization. By so doing, they join the philosophy and sociology of technology, which have long warned of the dark side of innovative activity. Despite

the many benefits that can be gained from the professions by the advance of technology, there is no certainty that the course of global technological development will necessarily turn out to be "good" for humans. This critical approach will analyze how digitalization and the rise of generative AI, the most recent and advanced technology in the field, are radically reshaping not only the ways of working and socializing but also the economic structure and cultural landscape of European societies. To pave the way for this exploration, an understating is first provided to the legal and conceptual framework within which such technological developments are unfolding.

However, it is also recognized that the impact of innovation is not deterministic and that many actors can and do play an active role in shaping the transformation of organizations and society. Governments, academics, civil society, and other stakeholders can take a forward-looking stance and develop and support innovation policies that promote the desired change. It is underscored, then, that a strong role can be played by establishing an ethical approach to innovation, indeed. It called for innovation to be approached not only from the techno-economic perspective, but moreover by incorporating a strong ethical dimension into the design of products, processes, services, and, generally, business models that are aligned with human and social values. With the aim to support such approach, a multidimensional framework of how innovation could be encouraged, monitored, and developed will be proposed, which combines ethics with regulation, innovation, and education [20]. It is argued further that innovation in AI, however, complex and potentially game-changing, should not be feared per se and, on the other side, that several actions can be taken to seize its positive aspects, not only by minimizing the negatives but also by promoting the active role of one or more of the aforementioned actors.

## 8. Future Directions for AI and Humanity
Artificial Intelligence (AI) is one of the main features of the fourth industrial revolution, characterized by a fusion of

advanced technologies and their integration into all sectors. AI technologies hold substantial power to feed into the realization of numerous economic, societal, and environmental challenges, hence transforming industry. Combined with other cutting-edge solutions, such as blockchain technology and Internet of Things (IoT), AI can collaborate with intelligent technologies to give life to a more interconnected future, building sustainable agriculture and rural areas.

AI technology is making a leap on cutting-edge innovations that can significantly impact the course of future development. Many urban elites are working to achieve AI breakthroughs and a more developed and powerful AI industry. In recent years, the involvement of the industrial sector in tackling key technical issues has uncovered transformative findings, including essential advances on advanced data storage for extreme ultraviolet lithography, key technologies and software systems for the basic platform of quantum computers, digital transformation in sectors like pharmaceuticals, and quick breeds of commercial price-photoresist and high-precision lithography equipment. New milestones are anticipated to be driven by greater breakthroughs in these sectors, manifesting itself in the emergence of new scientific and technological revolutions and industrial transformations [1]. To this end, it is pivotal to emphasize on advancing industry participation in the application of cutting-edge technology.

AI's development needs an improved environment of organized structural diversification. AI's deep integration with a diverse spectrum of other technologies and various sectors can further adhere to the advent of new models, practices, industries, and patterns of development. Such a process can venture a significant role and formed into an ultimate outline for trade ecology which caters to both national and global markets. On this account, advancements should be impelled in cutting-edge AI technology and algorithm research. Advanced AI intelligent algorithms require significant effort to foster a more enabling collaborative research ecosystem encompassing joint institutions and large and medium-sized enterprises.

## 8.1. Innovations on the Horizon

With each passing day, greater progress is being made in artificial intelligence (AI) technologies. Together with the advances already described—neuromorphic computing, cloud intelligence, fully homomorphic encryption, digital twins, multi-agent smart systems, and energy harvesting—these achievements are projected to alter all aspects of life in the following years. Including but not limited to language, economics, and personal entertainment, integrated use of AI with these other leading-edge technological achievements should generate a level of innovation and economic growth never before witnessed on Earth. It is hoped that readers are able to move beyond the nanosecond mindset that dominates much of society and contemplate the profound transformations that AI is on the cusp of creating in the years and decades ahead. According to consensus estimates, a full two-thirds of children born today will eventually work in jobs that do not yet exist, over half of which will arise from the ongoing and past effects of AI and illustrated disruptive technologies.

As technologies continue to evolve and branch outward, AI derived enhancements will evolve even more specialized platforms and capabilities. For illustration, discussed a number of disparate and relatively non-obvious disciplines in the preceding sections with the common thread of AI advancements. Each represents merely one among an almost limitless spectrum of potential opportunities arising from the advances presently underway. The landscape and business models of tomorrow are yet to be determined and are really only limited by the collective imagination strove to cultivate within oneself. AI is not "coming" this is outdated pronoun to anticipate the unprecedented technological changes gathering momentum on the threshold of the third decade of the 21st century [1].

## 8.2. Long-term Implications for Society

New computer-based developments, especially the development of Artificial Intelligence (AI) based on digital machinery, 'neural network' architectures and increasing access to data give

opportunities for a new wave of automation of the economy. As with earlier waves, this offers the promise of increased productivity; this time enriched by learning and 'smart' features. And as with earlier waves, it offers the threat of unemployment and challenges to private skills with the potential to exacerbate inequalities within and between societies. As this wave also brings other, less predictable, changes automation ('smart networked' autonomous systems & robots) the good and bad implications of this is disputed. There are also issues of potential dependencies and vulnerabilities resulting from an ever-tighter hybridization of autonomous systems with critical national, infrastructure and the overall wider biosphere; all these can in certain conditions have catastrophic implications.

While the opportunities and threats of AI and other advanced technology are debated within academia, industry, national policy-makers and international authorities, the general public and the civil society organizations more and more noticeably demand genuine debate and a say in the ongoing development, deployment and governance of these technologies. This is reflected in a growing number of popular books, festival discussions and public petitions related to the fight against lethal Autonomous Weapon Systems (AWS), algorithmic biases & decision-making, brain machine interfaces, children's privacy, Luddism, employment & education in the digital economy, gender biases in the development of AI, inequality or workers' right, health implications of wireless radiations and others [3]. Moreover, all these seemingly separate issues share the common concern for the future of the humanity and the sustainable development of the global society based on the responsible innovation and deployment of advanced technology, primarily AI.

## 8.3. Vision for a Sustainable Future
The development of artificial intelligence and its applications in a wide range of areas are creating new possibilities for business development and extensive impacts on social development. It helps to promote the solution of complex global challenges that are closely related to sustainable development, such as poverty,

food security, health, education, climate change, energy efficiency, protection and sustainable use of the oceans and terrestrial ecosystem. Acknowledging the universality of AI and SDGs and the sound importance of this intersection in future sustainable global development, there is a general review of the role of AI as a strategic instrument to achieve the SDGs. AI, despite its tremendous promise, has the potential to exacerbate many of the most pressing issues that threaten to make people's planet a sustainable place to inhabit, among other things, climate change, loss of biodiversity, inequality, cybersecurity, and risks from autonomous weapons.

Table 1 shows a SWOT analysis of the role of AI on the capacity to achieve the 17 SDGs by 2030 with insight of the discipline of AI and its sub-areas, and those that transversely impact on other sectors or depend on the advances and development of AI. A strong emphasis is accorded to the 17 SDGs already established by the United Nations as the 2030 Agenda for Sustainable Development. In the analysis, one axis is AI and advances in AI across the areas and its up-and-coming resolution for pervasive humanitarian challenges, on the other hand, one of the main purposes is to examine the socio-economic, legal, ethical, and political repercussions of escalating the intense application of those technologies, and ultimately whether that may prevent the attainment of the SDGs.

## 9. Conclusion

The exploration of a topic must necessarily have a limit [21] – in this case, the limit of the customary 12,000 words has been reached. However, global trends related to artificial intelligence (AI) and the future of humanity appear almost limitless [1]. It is only guessed at in the title of this focused section.

This means that the AI scene will continue to change at a fast pace and confront people with interesting and challenging developments. The common worry that AI will soon catch up with and surpass human intelligence is subsumed here under the question whether homo sapiens are wise enough in their treatment of their environment and in the organization of their

societies to be justifiably referred to as homo sapiens, a questionable use of the term sapiens given the multitude of faults, limitations, and failures of the humans. On the other hand, research promotes AI as meaning in the progress towards the goals of sustainable development.

Ever increasing processing speed and interconnectivity have been projected far into the future, and they will bring about changes that are currently hard to conceive. As will the fusion of living organisms and machines, like brain implants, chip implants, and machine-enhanced cognitive and physical functions. However, these projections will remain speculative and elusive.

More importantly and much more down to earth, the gains made in the insights of brain function and its technological simulation will not only transform work but defy the very concept of intelligence and creativity. The expertise with which professions earn their living, like analysis, advice, translation, drafting, have a huge proportion of routine work already today that AI can take over from humans. Robots are able to speak, teach, perform surgery, advise on investments. Networking will redefine work procedures and organizations. Major changes in healthcare, economy, society, culture, will accompany the much-praised changes in work.

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