Digital Cooperation Organization

GenAI Reshaping the Digital Economy

Understanding Generative AI and unlocking its power for a safe and sustainable Digital Economy.

TABLE OF CONTENTS

Disclaimer

This white paper is a working paper, and hence it represents research in progress. It does not necessarily reflect the official views of the DCO Member States, nor the official position of any staff members. All efforts were made to compile data that is as accurate and as recent as possible based on available international sources. The DCO does not take any responsibility for data that may be inaccurate. The names of companies, entities, products, services, etc. mentioned in this document are not intended as an endorsement or referral to by the DCO, its Member States or staff members. They are sorted alphabetically and not in order of preference.

All images in this white paper are generated by artificial intelligence tools through specific prompts, with manual edits applied afterwards.

EXECUTIVE SUMMARY

Generative Artificial Intelligence (GenAI) is an emerging and groundbreaking area of Artificial Intelligence (AI) that creates and understands quality text, images, audio, videos, 3D models, and other content from training datasets.

Generally, AI is a paradigm-shifting idea that entails the creation of intelligent computers capable of carrying out tasks that ordinarily demand human intelligence. AI includes a variety of technologies and methodologies, like computer vision, deep learning, natural language processing, and machine learning. AI systems use data to identify patterns, make choices, and take action to reach predetermined objectives. AI, including the GenAI, can increase productivity, accuracy, and efficiency, lowering costs and improving customer satisfaction. Virtual assistants, chatbots, recommendation systems, and autonomous vehicles are just a few examples of AI-powered applications that are already impacting the digital economy.

GenAI can generate substantially rational and complex content that mimics human creativity, making it a valuable tool for numerous economic areas, like entertainment including game design, movie making, and product design, etc. GenAI is based on GPT (Generative Pre-trained Transformer), a type of Large Language Model (LLM), and it utilizes deep learning to generate human-like, conversational text. The LLMs are general-purpose technologies, and their versatility allows them to be applied in diverse scenarios.

There are various Generative AI tools apart from OpenAI ChatGPT. The following are the examples of GenAI tools: Chatsonic, Google AI bard, LLM-Augmenter, Microsoft Dynamics 365 Copilot, Microsoft new Bing, Salesforce Einstein GPT, and YouChat. However, this paper mainly concentrates on the GenAI tool ChatGPT. ChatGPT is one of the most popular applications of Generative AI that processes natural language prompts, offers detailed responses, and assists the users in completing the tasks like composing emails, essays, and even programming codes.

The mechanism that powers the GenAI tool 'ChatGPT' includes training, input processing, inference, and response creation, among other steps. It is a conversational agent driven by GenAI that significantly impacts the digital economy by revolutionizing client relationships, enhancing operational effectiveness, and spurring business expansions.

Such GenAI tools improve the customer experience by offering individualized and interactive support twenty-four hours a day with its capacity to comprehend and provide human-like responses.

The GenAI tools, like ChatGPT, for example, serve as virtual assistants or customer support representatives for businesses, providing on-demand assistance, responding to inquiries, and assisting with purchasing decisions. This results in increased consumer involvement, contentment, and loyalty. Such innovative tools improve operational efficiency by automating repetitive operations and offering prompt and accurate responses, saving enterprises time & resources, and increase sale productivity to generate business firms' revenues, and to contribute for the growth of digital economy.

It is important to remember that Generative AI-based applications, like ChatGPT, rely on statistical patterns discovered from training data and cannot always produce flawless or contextually relevant responses. The model's capabilities are currently being improved, and issues with language understanding, interpreting context, and creating high-quality responses are being addressed. Additionally, extra steps are taken during the fine-tuning and deployment stages to customize and optimize GenAI tools, like ChatGPT, for various applications, domains, or use cases. This entails further domain-specific dataset training and iterative advancements based on user input and actual user interactions.

Despite numerous challenges of GenAI tools, including ethical challenges, it is captivating Venture Capital (VC) investors' attention, and they are financing the Generative AI startups. Besides that, all other startups saw a 24% drop in investment. Globally, investments in GenAI are expected to hit USD 42 billion by the end of 2023 [1]. For example, Mistral AI, a Paris-based start-up just a month old, picked up USD 110 million in seed funding to build and train a Generative AI model.

Similarly, Salesforce Ventures announced expanding its Generative AI Fund to USD 500 million, up from USD 250 million in March 2023 [2]. In a recent report on the economic potential of GenAI, it is mentioned that GenAI can deliver a total value in the range of USD 2.6 trillion to USD 4.4 trillion in economic benefits annually when applied across industries. They further added that it would add 15 to 40% to the USD 11.0 trillion to USD17.7 trillion of economic value that they now estimate nongenerative artificial intelligence and analytics could unlock [3]. The governments, business community, and even the creators of such GenAI-based tools want to establish collaboration to formulate a balanced regulatory framework, standards, and principles to manage the challenges of GenAI tools to reap maximum benefits from this novel technology's impact on productivity that could add handsome financial value, in the form of trillions of dollars, to the digital economy [4] [5], [3].

We noted numerous challenges, including ethical challenges, like lack of data security, accountability, transparency, digital literacy, and privacy regarding GenAI tools that could rise inequality, increase copyright infringements, embed biases in training data, reduce reliability, enhance discrimination, and toxicity of issues, lack of holistic regulatory framework, inadequate National Strategy and Policy for GenAI tools, non-availability of complete, and quality data. We explain such challenges in the forthcoming sections of this paper.

We also propose a set of recommendations, including regulatory, and strategy recommendations based on the investigation of literature, through Systematic Literature Review method, and informal interactions of the authors with industry experts. The recommendations that include, but are not limited to the following: formulation of ethical guidelines, and framework for GenAI tools, early AI adoption by the business community, including retail and consumer packaged goods (CPG) industry, health, and education, and banking sectors in various areas for better impact on their business functions, formulation of national GenAI strategy, incentives for GenAI at levels for development, testing, and adoption of such technologies based tools, create awareness, and digital literacy about GenAI tools to tackle misconception about GenAI models, development of suitable standards, and principles to safeguard against side effects of GenAI tools. We have mentioned details about each proposed recommendation in the forthcoming paper sections.[6].

Generative AI, and its tools, like ChatGPT, are at the lips of every Entrepreneur, Venture Capitalist, CEO, Journalists, policymaker, and individual. It is also critical for them to make collaborative efforts to balance innovation and regulatory measures to manage GenAI tools side effects. Moreover, it is equally important not to stifle innovation and the potential impact, including possible economic impacts that GenAI brings to businesses and society.

AI is at the heart of the Digital Cooperation Organization (DCO) agenda. In continuation of existing efforts on AI technologies, the DCO is currently in planning stages for the introduction of several initiatives, such as development of AI toolkit to assist the DCO Member States on the AI readiness and adoption of AI into a Member State business system to improve productivity, quality of services, and efficiency across various government departments.

INTRODUCTION

1.1 Artificial Intelligence (AI) & Generative AI

The advent of Artificial Intelligence (AI) has reformed the fashion businesses operate in the digital economy in different significant ways, namely, automation & efficiency, data-driven decision-making, customer care, intelligent virtual assistants, process optimization, advanced fraud detection & security, etc. AI is the most fundamental transformative emerging technology, and it has the potential to address most of the critical issues we face, like climate change and the digital divide.

AI, including GenAI are the simulation of human intelligence by machines, particularly computer systems using high-level algorithms, to perform tasks that would otherwise require human intelligence [7].

AI has potential to has a positive impact on 79% of the UN SDGs targets [8].

We promote the use of AI as it facilitates delivering high-quality goods and services in various sectors, like health, education, economy, justice, agriculture, etc., to achieve SDGs by 2030 [9], [8]. Figure 1 portrays a relationship between AI and Generative AI.

Natural Language Processing (NLP) is an area within the discipline of AI that empowers machines with the capacity to read, comprehend and extract meaning from human languages. The main goal of NLP is to fill the gap between how humans communicate and how computers understand. Some essential research tasks in NLP include automatic summarization, co-reference resolution, discourse analysis, machine translation, morphological segmentation, named entity recognition, and part-off speech tagging.

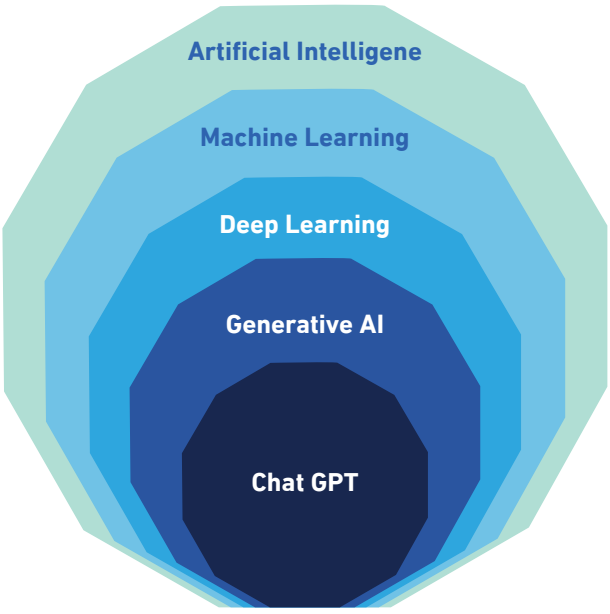


Figure 1: Relationship between AI and Generative AI

NLP can be classified into two sections. The first section is Natural Language Understanding, which empowers machines to understand and analyze natural language by extracting concepts, emotions, keywords, and other elements to facilitate understanding of the context delivered by human language.

The second section is Natural Language Generation (NLG) which involves generating meaningful, rational, and fluent phrases, sentences, and paragraphs, like human-produced content, based on internal representation. The NLG is an important area of Generative AI.

Generative AI (GenAI) is a kind of Artificial Intelligence that can create new content, like text, images, audio, videos, programming code, 3D models, etc. [10], [11]. GenAI is also known as a machine-learning framework [10], a set of algorithms [12], and a deep-learning model [11].

The GenAI algorithms are constructed on top of foundation models trained on a massive amount of raw data in a self-supervised way to discover underlying patterns for a broad range of jobs. GenAI-based systems, like ChatGPT, generate valid text, like human-generated text.

The following are the most notable applications of GenAI:

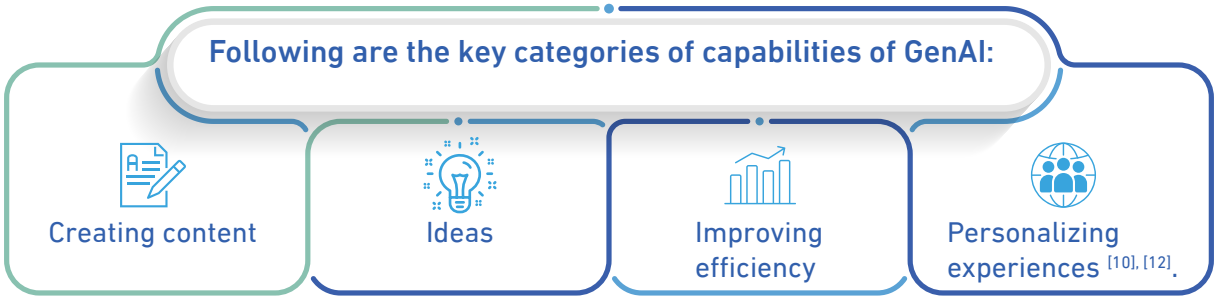
01 ChatGPT

02 DALL-E

ChatGPT is an AI Chatbot that relies on Large Language Models (LLM), like GPT 3.5 and GPT 4, trained on vast volumes of text for the purpose of responding to queries, text summarization, and sentiment analysis.

DALL-E, a multimodal foundation model, can be utilized to create images, expand images beyond their original size, or alter existing paintings. In the recent-past, OpenAI (developer of ChatGPT) also released Dall-E 2, a new version of DALL-E, which is improved on the methods used for its first generation to create more high-end and photorealistic images.

Such kind of Generative AI has the potential to significantly accelerate AI adoption, even in organizations lacking AI expertise.



In AI, and its sub-domains, among the various AI models likewise Supervised, Unsupervised, Reinforcement or Deep learning, Computer vision or Generative models, the ability of language models to analyze and comprehend enormous volumes of textual data has attracted much attention.

For example, Generative Pre-trained Transformer (GPT) and ChatGPT were developed by "OpenAI" which is an American organization focused on advancing Artificial General Intelligence (AGI) safely and beneficially for humans.

AI and other kinds of AI technologies involve learning, reasoning, perception, and decision-making; therefore, such AI tools and technologies have the potential to impact the digital economy in numerous aspects, like provision of improved customer service, increasing efficiency, making trend-based decisions, enhancing user experience, etc. we also explain the applications of GenAI, and such technology-based tool in the public, and private sectors in the forthcoming section of the paper.

1.2 Generative Pre-Trained Transformer (GPT)

The Generative Pre-Trained Transformer (GPT) is a language model developed by OpenAI. It is an advanced artificial intelligence system trained on large amounts of text data to produce human-like text based on a provided prompt or context. The model is "pre-trained" in that it is initially trained on a large corpus of text data and can then be fine-tuned for certain jobs, like contextual understanding in terms of text completion, question answering, and machine translation.

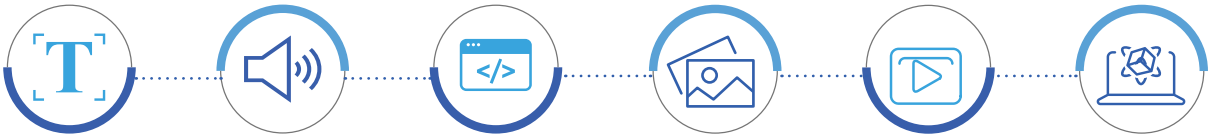
GPT uses a deep learning technique called 'transformer architecture', that allows it to process and understand data sequences such as text [13].

AI's **Large Language Model (LLM)** utilizes deep learning, a model of machine learning, to process and generate natural language text. Such models are trained on massive amounts of text data, allowing them to learn the nuances and complexities of human language [13].

GPT-3 was introduced with the ability to generate high-quality text and perform a wide range of language tasks. On March 14, 2023, OpenAI released GPT-4, a large multimodal model (accepting image and text inputs and emitting text outputs) [14]. Subsequently, GPT5, once again larger than GPT4, is scheduled to come out of training in 2024 [15].

1.3 Generative AI Tools

GenAI-based tools can create new content, such as:



Various tools include OpenAI ChatGPT, Google AI bard, Microsoft Bing, Salesforce Einstein GPT, Microsoft Dynamics 365 Copilot, LLM-Augmenter, Chatsonic, Apple ChatGPT-style product, and YouChat. However, this study mainly focuses on ChatGPT as an example. We also include a brief description of other GenAI-based tools in this segment of the study.

ChatGPT:

The ChatGPT is a Generative AI tool and a cutting-edge OpenAI chatbot technology released on November 30, 2022. ChatGPT is one of the most popular applications of NLP. It is a general-purpose conversational chatbot built on top of OpenAI's GPT-3 family of large language models (LLM) that uses Natural Language Processing (NLP) and machine learning to enable users to have conversational interactions with a virtual assistant [14]. It is trained on diverse text data, including books, articles, and online conversations, to enable it to engage in non-trivial dialogue and provide accurate information on various topics [16]. The GenAI system ChatGPT is designed to be highly intelligent and intuitive, with the ability to understand and respond to complex requests in a natural and human-like way [17].

The development of ChatGPT represents a significant advancement in natural language processing, GenAI, and AI in general, building upon the initial GPT (Generative Pre-trained Transformer) model [18]. It is a Generative Artificial Intelligence agent to perform high-level cognitive tasks and produces indistinguishable text from human-generated text [16] [19]. It is expected to impact every aspect of society, i.e., governments, businesses, and civil society.

While GenAI-based ChatGPT, a variant of the GPT model tailored for conversational answers, has demonstrated promising potential, there are a few limitations to be aware of likewise; lack of consistency, sensitivity, incorrect or redundant information, vulnerability to biases, inability to ask explanation on ambiguous input, increasing ethical concerns, etc. However, OpenAI acknowledges these limitations and is actively working to improve its capabilities and address the mentioned and other relevant drawbacks. It is pertinent to enhance the ability of the GenAI model like ChatGPT; user feedback and active progressive research play a vital role in refining the model's performance and ensuring the responsible and beneficial use of Generative AI language models.

The short briefs on a few other GenAI-based tools are as follows:

Google AI Bard:

It is an artificial intelligence chatbot developed by Google. Bard uses LaMDA, a Language Model for Dialogue Applications. It uses information from the web to provide high-quality responses that are up-to-date and easy for the user to understand. Google Bard uses a combination of machine learning and Natural Language Processing (NLP) to provide these high-quality yet realistic responses to the user [20]. In the recent-past, Google introduced a new version of Google AI bard that can also speak its answer back to the users and respond to prompts that include images. Users can interact with Bard in over 40 languages, including Arabic, Chinese, German, Hindi, and Spanish [2].

Microsoft Dynamics 365 Copilot:

It is the latest version of Microsoft's tool that includes several applications for sales, customer service, and marketing that integrates AI to automate specific tasks like data gathering and analysis or creating an email campaign, among other capabilities. With Dynamics 365 Copilot, organizations can empower their workers with AI tools built for sales, service, marketing, operations, and supply chain roles. These AI capabilities allow everyone to spend more time on the best parts of their jobs and less on mundane tasks [21].

Microsoft's new Bing:

Microsoft (MS) released its new Bing, powered by an upgraded viral AI chatbot ChatGPT model. MS claims the new model is faster and more accurate than ever before. The new Bing also has a Chat mode that pulls in web queries and allows users to ask contextual information based on them. Bing enables users to plan trips, get recipes, seek advice, and much more, like ChatGPT [22].

Salesforce Einstein GPT:

Salesforce Einstein is the first comprehensive AI for Customer Relationship Management (CRM) which is software solution that handles customer relationships. It's an integrated set of AI technologies that makes Salesforce Customer 360 smarter and brings AI to trailblazers everywhere [23].

YouChat:

YouChat acts like a search engine that lists links to indexed web pages relevant to users' queries. Alternatively, the users can get the typical ChatGPT-styled conversational responses for questions. If users are looking for a search engine and a Chabot-like ChatGPT rolled into one product, then YouChat could be a great option [24]. The subsequent Figure 2 presents a few GenAI tools.

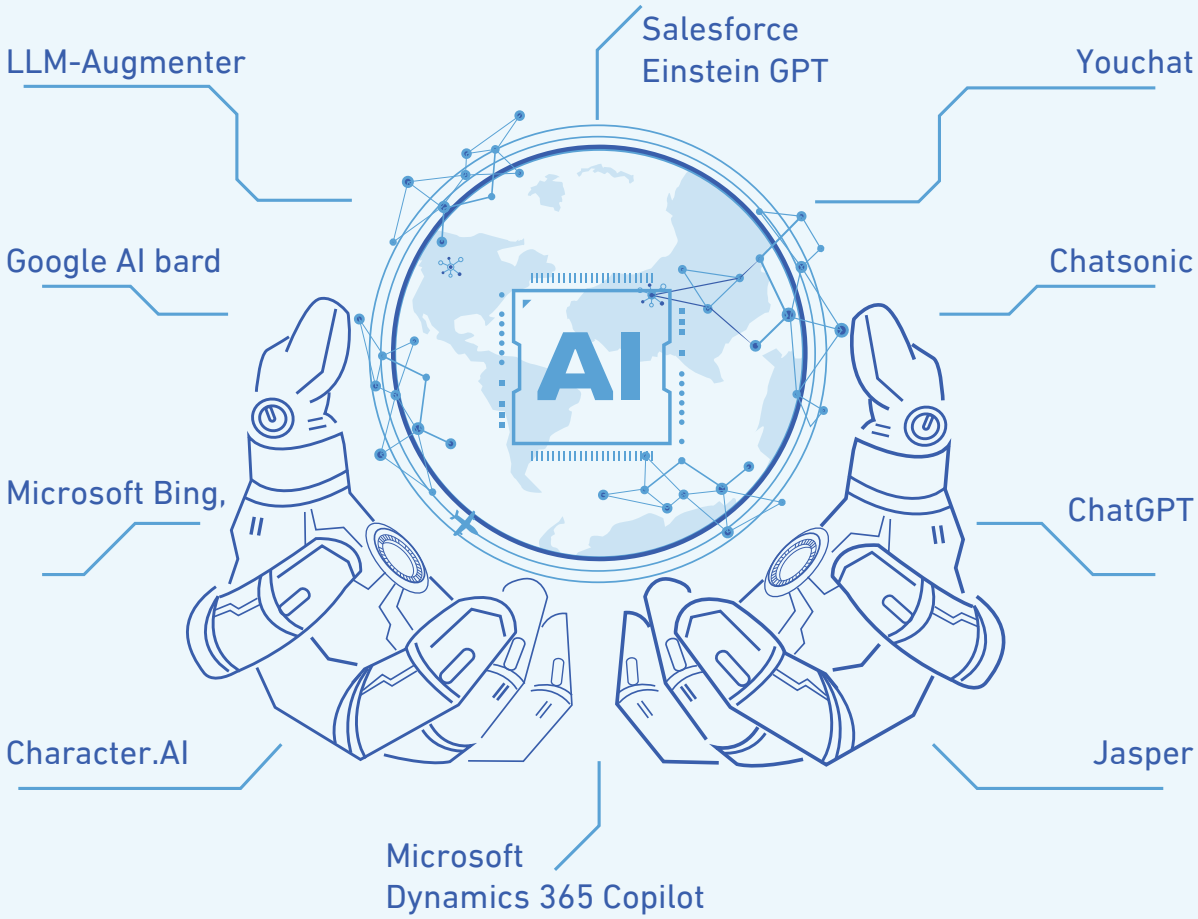


Figure 2: A few Generative AI tools

1.4 GenAI & Digital Economy

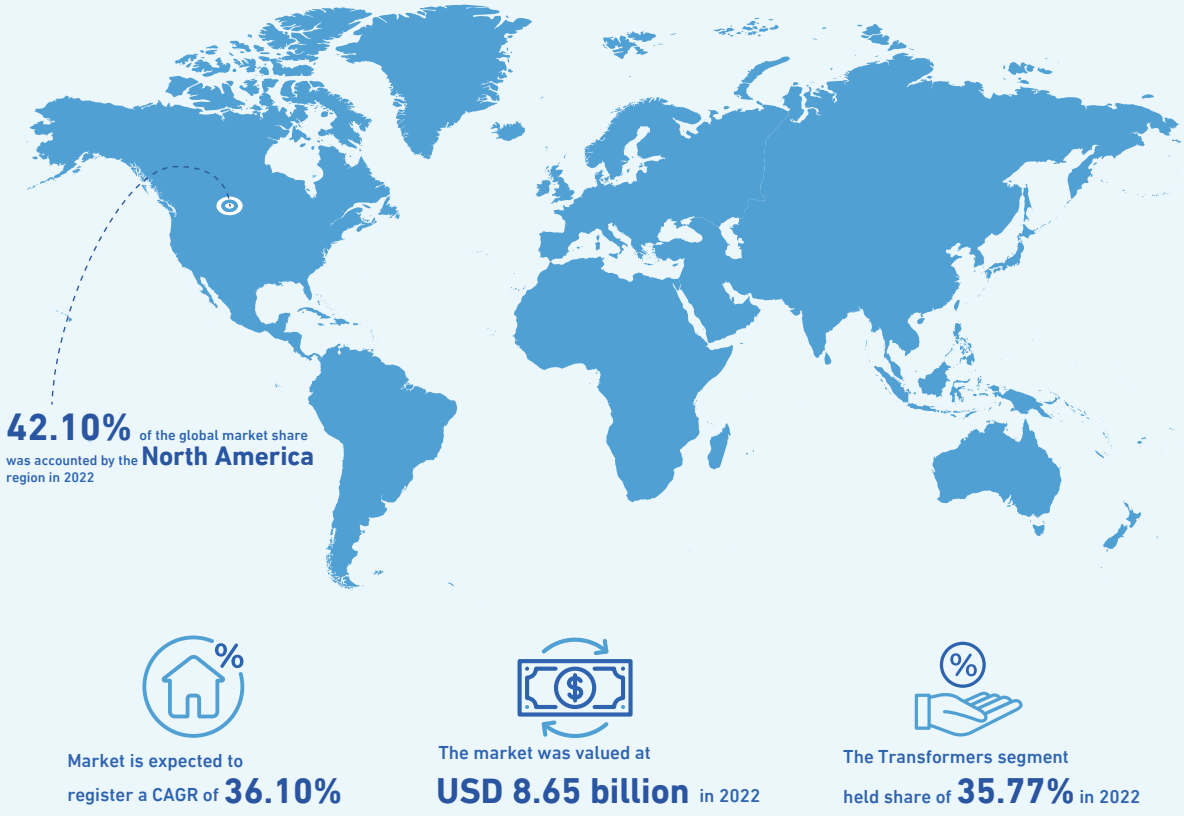
The digital economy encompasses a global network of economic endeavors, business transactions, and professional engagements facilitated by information and communication technologies (ICT). It can be concisely described as an economy that revolves around the utilization of digital technologies. According to the EU, the digital economy refers to digitalization affecting all businesses, albeit to altering degrees. It comprises companies that sell goods and services via the Internet and digital platforms that link spare capacity and demand [25].

A professor from the University of California mentioned that the digital economy includes performing economic actions electronically, based on the electronic processing, storage, use, and communication of information, including activities that offer the enabling physical infrastructure and software [26]. The UNCTAD stated that the digital economy implies using ICT in creating goods and services, their consumption, and marketing [27].

The term "digital economy" denotes mainly the recent and significantly unrealized changes in various segments of the economies by computer-assisted digitization of data [28]. Adopting information and communication technology (ICT) by all business sectors is supporting the growth of the digital economy and boosting its productivity. Conventional beliefs about how firms are organized, how consumers receive goods and services, and how states must adjust to new regulatory issues are changing as the economy undergoes a digital transformation [29].

Adopting human-centric and responsible AI and GenAI-based tools is vital to boost the global digital economy. The global Generative AI market is estimated to

expand from USD 8.65 billion in 2022 to USD 188.62 billion by 2032, at a Compound Annual Growth Rate (CAGR) of 36.10% during the predicted phase 2023-2032. Moreover, the North American region dominated the market in 2022. Figure 3 showcases such vital trends of Generative AI market in 2022 [30].



Disclaimer: The designations employed and the presentation of the material on any map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the Digital Cooperation Organization concerning the legal status of any country, territory, city, or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Figure 3: Generative AI market in 2022

By 2030, it is estimated that AI and GenAI-based decision-making technologies will add more than 20 trillion dollars to the global economy [31], [8]. Moreover, Venture Capital (VC) investors are financing Generative AI startups, despite numerous challenges of GenAI tools, including ethical challenges. Presently, GenAI is captivating investors' attention. While all other startups saw a 24% drop in investment, globally, investments in GenAI are expected to hit USD 42 billion by the end of 2023 [1]. Such investment opportunities are vital to boost the human-centric, inclusive, and sustainable digital economy.

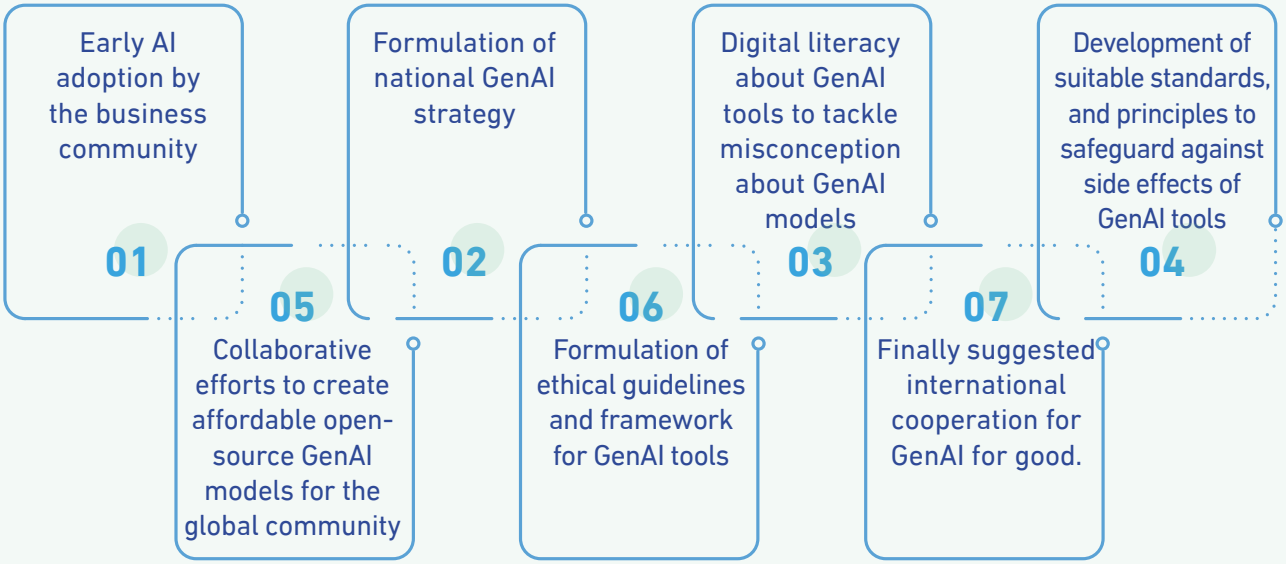
While all other startups saw a 24% drop in investment, globally, investments in GenAI are expected to hit USD 42 billion by the end of 2023

GenAI tools and technologies have numerous impacts on the digital economy: enhanced customer support, personalized marketing, improved user engagement, data collection & streamlined workflows, new business opportunities, enhanced user interface & labor impact, etc. The positive impact of GenAI-based tools, like ChatGPT, on the digital economy depends on its ethical and responsible implementation, protecting data privacy, and ensuring transparency to build trust with users and stakeholders.

Despite several potential rewards for the adoption of AI and GenAI-based technology systems, like ChatGPT, in public, and private sectors, such emerging technologies also raise challenges, including ethical issues, like lack of data privacy, and security, consumer trust deficit, copyrights, biases, reliability, and toxicity issues, lack of AI policies & strategy, like AI governance policy, non-availability of complete, and quality data.

We also propose a set of recommendations, including regulatory and strategy recommendations based on the investigation of literature, through the Systematic Literature Review method and informal interactions of the author(s) with industry experts.

The proposed recommendations include, but are not limited to the following:



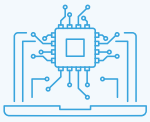
We describe details about each proposed recommendation in the forthcoming paper sections.

The remainder of the white paper is structured as follows: Section 2 mentions the background and history of Generative AI and its tools. Section 3 presents GenAI applications. Section 4 explains GenAI and the digital economy. Section 5 describes the challenges of GenAI tools. Section 6, make recommendations on GenAI. Section 7 lays out GenAI tools limitations. In the last section, we illustrate our conclusions and scope for future work.

BACKGROUND AND HISTORY OF GENERATIVE AI & AND ITS TOOLS

2.1 History

Generative AI (GenAI) has an extensive history that dates back many years. Early generative models appeared in computer science during the 1950s and 1960s. For instance, creating Markov and Hidden Markov Models (HMMs) [17] laid the groundwork for producing data sequences. Researchers started investigating probabilistic models for generative AI in the 1980s and 1990s. Such research-based efforts include methods to create realistic samples by simulating the underlying probability distributions, such as Bayesian networks and Gaussian mixture models. A Restricted Boltzmann Machine (RBM), a generative stochastic artificial neural network, was initially introduced under the title 'Harmonium' by



Early generative models appeared in computer science during the **1950s** and **1960s**

Researchers started investigating probabilistic models for generative AI in the **1980s** and **1990s**

Paul Smolensky in 1986. Subsequently, RBM was expanded by Geoffrey Hinton and other collaborators, and they introduced fast learning algorithms [7].

An innovation in generative AI called Generative Adversarial Network (GAN) was introduced in 2014 by Ian Goodfellow and his coworkers. The GAN is a category of machine learning frameworks and a prominent framework to approach generative AI. A generator and a discriminator are the two neural networks that make up GAN.

Transformers have revolutionized the field due to their extended attention span. The transformers were introduced in 2017 by a team of experts at Google Brain. There are other kinds of transformers, like text, video, and speech Transformers. Natural Language Processing (NLP) revolutionized after Vaswani et al.[18] introduced the Transformer architecture. For example, GPT (Generative Pre-trained Transformer), have shown outstanding ability in producing text that appears human, and they are frequently used for chatbots, text completion, and language translation.

OpenAI introduced the GPT series (Generative Pre-trained Transformer) starting with GPT-1 in 2018. GPT models were trained unsupervised on massive amounts of text data using language modeling objectives [2], [32]. The models achieved state-of-the-art performance in text completion, summarization, and question-answering tasks. OpenAI released ChatGPT as a variant of the GPT model fine-tuned specifically for generating conversational responses. ChatGPT was trained using dialogue interactions to generate more interactive and context-aware responses in a conversational setting [11]. OpenAI continued to refine and iterate on the GPT and ChatGPT models based on user feedback and ongoing research. They released updated versions like GPT-2, introduced in February 2019, and GPT-3, introduced in May 2020, which showcased further advancements in language generation capabilities.

On March 14, 2023, OpenAI officially launched the GPT-4 language model system that allows users to access the Chat GPT-4 with a paid subscription. In general, one of the key differences between GenAI tool ChatGPT with prior models is its ability to follow instructions promptly and offer a detailed response accordingly. This enhanced capability of ChatGPT is based on a model called InstructGPT, which OpenAI quietly unveiled at the beginning of 2022.

Major players in the technology industry, including Microsoft, Google, and OpenAI, have made significant advancements in AI chatbot technology to make it more accessible to the public [33], [34], [35], [36]. It is pertinent to mention that GPT5, once again larger than GPT4, is scheduled to come out of training in 2024 [15]. We showcase the exponential growth of Generative AI development in **Figure 4.**

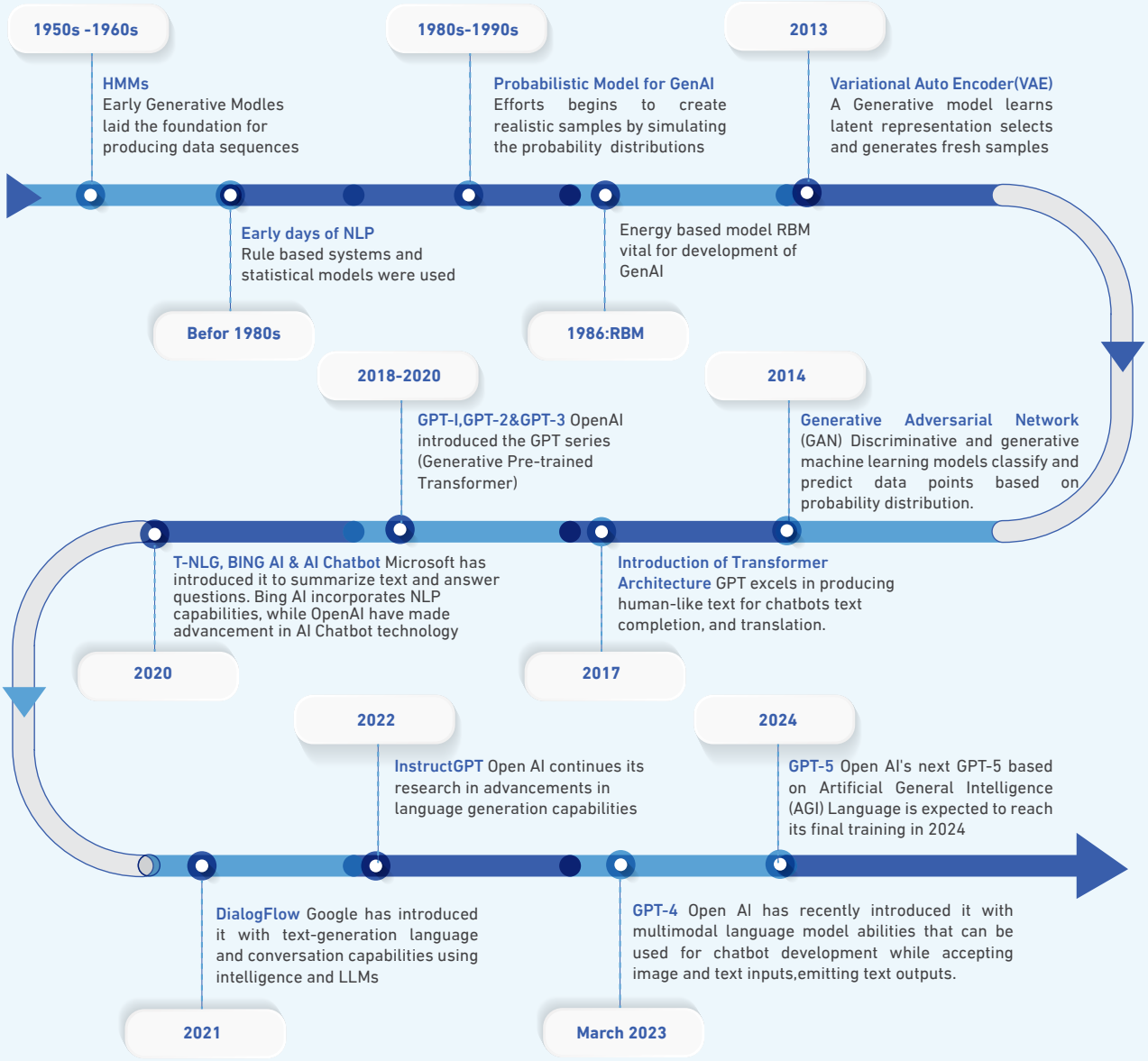


Figure 4: Exponential Growth of Generative AI development

Generally, AI has been deemed suitable for analytical tasks. Creative and generative tasks, however, were thought to be reserved for the beautiful minds of human beings. A study conducted among innovation managers a few months before the barnstorming rise of GPT-3 in the last quarter of 2022 revealed that idea generation, idea evaluation, and prototyping were considered the least important areas for AI application in the innovation process.

Within months, the emergence of transformer language models and generative AIs has changed this perception, and the use of AI in creative tasks such as idea generation has moved to the center of attention of practitioners and academics [37].

2.2 Characteristics of GenAI Tools

The key characteristics of a Generative AI-based tool, i.e., ChatGPT, that include but are not limited to the following:

01 **Pre-training:** Pre-training capability over the vast corpus of text data enables ChatGPT to learn patterns, grammar, vocabulary, and semantic relationships within human language [32].

02 **Contextual:** Based on statistical relationships and patterns found through training data, ChatGPT can recognize the input context and respond appropriately[17].

03 **Transferable:** ChatGPT could generalize knowledge and language understanding from the pre-training phase to new tasks or domains, which helps the model learn general language patterns, semantics, and grammar[11].

04 **Scalable:** ChatGPT can be used for various use cases because it can be run on different hardware configurations, from a single GPU (Graphical Processing Unit) to multiple GPUs and TPUs Tensor Processing Units) [38].

05 **Fine-Tuning:** It can be fine-tuned on specific tasks, such as conversation or language translation, by training on a smaller dataset.

06 **Generative model:** It is a generative model, which means it can generate new text based on the input it receives.

07 **Large Capacity:** With many parameters, it can memorize large amounts of data.

08 **Open Domain:** It can generate text on a wide range of topics.

09 **Personalization:** It can be fine-tuned for different languages and regions to generate text that is more specific to a particular audience.

2.3 GenAI-based Systems Back-End Operations

Here, we briefly explain behind-the-scenes working operations of the Generative AI-based system ChatGPT as an example below:

A Transformer-based Neural Network (TBNN) is the deep learning architecture on which ChatGPT is built. Transformers are renowned for their capacity to process and produce text by paying attention to various input sequence components. It goes through a pre-training stage when it acquires knowledge from a significant body of text data. Numerous sources, including books, articles, websites, and other textual content, can be used to collect information. The model obtains the ability to predict the next word or token based on the context it has already recognized during pre-training. The model also gains language knowledge through the patterns it notices during pre-training. It gives an understanding of syntax, semantics, and syntactic structures and the ability to associate words and phrases with meanings.

After pre-training, ChatGPT undergoes a fine-tuning process on specific datasets or tasks. This fine-tuning allows the model to adapt to specific applications or requirements. It involves training the model on labeled or task-specific data to optimize its performance on the desired tasks, such as generating coherent responses in a conversational setting. Once trained and fine-tuned, the model can be deployed to a production environment to interact with users.

Servers or cloud-based resources that accept user requests or prompts and immediately produce responses comprise most of the back-end architecture. The back-end processes the user's input text and feeds it into the model whenever they send a prompt or message to ChatGPT. The model then responds based on its internal patterns, knowledge of the surrounding context, and the given prompt. The model provides the response by selecting or decoding from the probability distribution of the potential following words or tokens. Based on the input received, it seeks to produce a contextually relevant and coherent response. **Figure 5 presents a brief concept behind the working structure of GenAI based tool ChatGPT as below:**

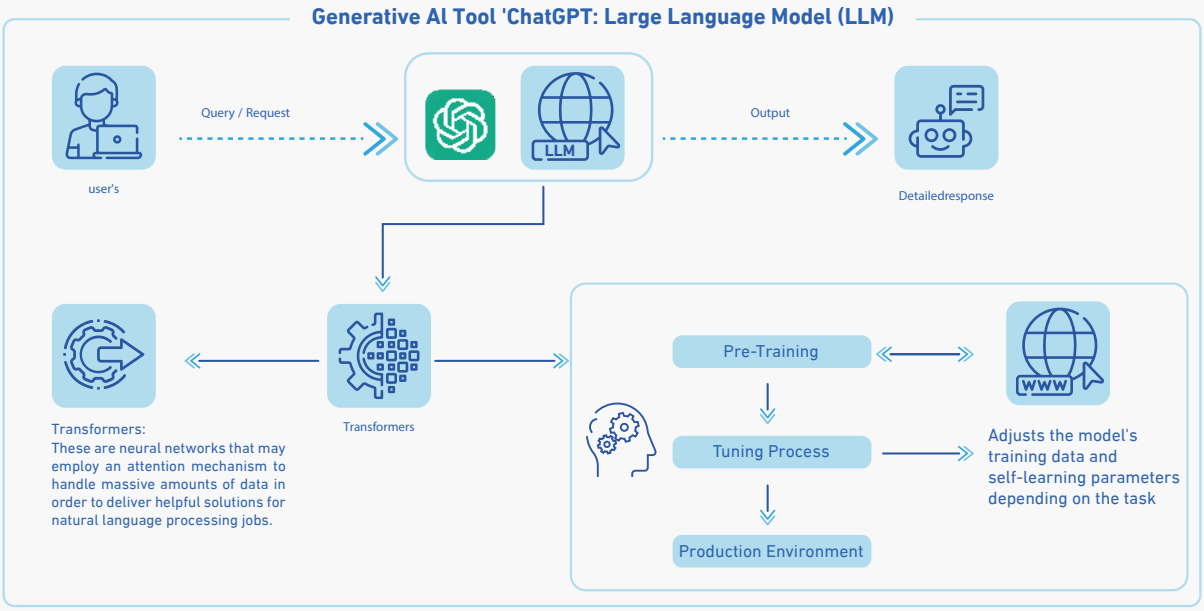


Figure 5: A brief concept behind the working structure of the GenAI-based tool ChatGPT.

2.4 Research Gaps, and Our Contribution

In segment, we describe the following research gaps, and our contribution as below:

Research Gaps: We notice mostly gray literature on the Generative AI, and its tools, like ChatGPT, however, we do not find much research-based studies on the subject topic. Moreover, existing research articles focus on main topics on Generative AI challenges, Generative AI applications in general, etc. However, we hardly find a study that thoroughly examines together the Generative AI, its tools and its impact on digital economy. Such aspects of the Generative AI include the following: applications of GenAI, challenges, including ethical challenges, limitations, and recommendations.

Our Contribution: The concentration of this research-based paper is to address the above-mentioned research gaps covering all the above-mentioned GenAI aspects connected with digital economy, like proposing recommendations, including strategies, policies, and regulations recommendations for the stakeholders to revolutionize digital economy, and to make balance between innovation and governing measures to manage such emerging technologies, and tools side effects.

APPLICATIONS OF GENERATIVE AI AND ITS TOOLS

In this section, we illustrate Generative AI and its tool ChatGPTs' applications in public and private sectors, and communities to promote a sustainable, inclusive digital economy. To obtain benefits in the provision of public services, Public Administrations (PAs) have considerably increased the adoption of GenAI-based systems, like ChatGPT [39], [40]. The United Nations (UN) has given a Classification of Functions of Government (COFOG) that is centered on how governments segment their activities and direct their expenditure and management to socio-economic objectives [41]. Moreover, COFOG offers an understanding to the PAs to maximize the use of AI-based solutions in public organizations. This classification standard has also been adopted by various international organizations, including others likewise OECD, EU, and the International Monetary Fund [42].

AI-based systems, like ChatGPT, would be helpful for the public and private sectors to improve decision-making processes, expedite operations, and improve consumer experiences, as mentioned in the forthcoming paragraphs, to boost the digital economy. However, these sectors must consider the ethics of GenAI and its associated systems and appropriately deal with privacy issues critical for AI's long-term success. The public and private sectors are working on the possible applications and future opportunities of the GenAI to reshape the economy and convert it to a digital economy.

We describe a few such applications and opportunities of GenAI, and its tools, like ChatGPT, as follows:

3.1 Applications of Generative AI and its Tools in the public sector

01 **Public Services Delivery:** GenAI-based ChatGPT can be used by PAs to provide efficient and effective public services delivery, real-time answering common citizens' inquiries, smooth execution, and management of country leadership, like Prime Minister or President, grievance management system and assisting them by offering numerous public services.

02 **Information Dissemination:** Public sector organizations can leverage GenAI-based tools, like ChatGPT, to disseminate effective, accurate, and complete information, particularly during the global, and national disasters. They can answer frequently asked questions, guide the citizens on policies, including economic development policies, regulations, and public services for effective implementation, and upgrade such important policy documents to boost the country's digital economy.

03 **Decision Support Systems:** The GenAI can be applied in decision support systems to assist policymakers and civil servants in analyzing complex data, providing data insights, and recommending appropriate strategic actions at global, regional, and global levels.

3.2 Applications of Generative AI and its Tools in the private sector

01 **Customer Engagement and Support:** The private sector can deploy GenAI-based tools, like ChatGPT, to improve customer engagement and support, addressing customer inquiries, offering product recommendations, and resolving common issues.

02 **Virtual Sales Agents:** ChatGPT can serve as virtual sales agents to engage with customers, understand their preferences, and suggest products or services that match their needs.

03 **Market Research and Development:** Companies can leverage GenAI-based systems to analyze market trends, gather customer feedback, and generate insights for making strategic business decisions.

04 **Content Generation and Personalization:** GenAI can aid in content creation, automating the generation of personalized product descriptions, marketing copy, or news articles based on user preferences and requirements.

05 **Chatbot Integration:** AI-based ChatGPT can be integrated into existing online communication systems to enhance businesses' conversational abilities and enable more natural and context-aware interactions between the marketing resources of firms and their online customers.

06 **Language Translation and Communication:** The GenAI-based ChatGPT's language capabilities can be applied for real-time translation services and to facilitate efficient real-time communication between businesses and their customers from different language backgrounds.

07 **Personalized Customer Interactions:** AI-powered systems, such as ChatGPT, possess the ability to process vast amounts of data and understand customer preferences, behaviors, and past interactions. This enables them to offer highly personalized interactions, thereby enhancing the customer's sense of being understood and valued.

08 **Available around the clock:** Unlike human customer service representatives who are constrained by working hours and capacity, AI-powered interactions offer the advantage of round-the-clock availability. ChatGPT and similar models can provide instant responses to customer queries, even during off-hours. This not only improves customer satisfaction but also helps businesses serve global customers in different time zones without delays.

09 **Scalability and Cost-Effectiveness:** In today's era of competition, by using GenAI, the cost of doing business can be reduced providing businesses an edge of the competition in the digital economy. It becomes important for any organization to adopt and prosper.

We have portrayed the key benefits of Generative AI based chatbot in Figure 6.

Figure 6: Key benefits of Generative AI based chatbot

GENERATIVE AI MODELS AND DIGITAL ECONOMY

GenAI is a step shift in Artificial Intelligence's (AI) evolution. As the public and private sectors rush to adapt and implement GenAI tools, recognizing the technology's potential to deliver value to the economy and society at large will assist in shaping critical decisions.

Generative AI models, like ChatGPT, DALL-E 2, Google Bard, etc., are expected to impact the digital economy significantly, reforming various aspects of business operations and user experiences to increase productivity in multiple sectors to revolutionize the economy. While progress in AI technology continues, it will inevitably affect the digital economy, say tech experts and consultants. There are plenty of discussions between the stakeholders on the State of the Digital Economy and how Gen AI-based models, like ChatGPT, will impact the digital economy.

There is no generally agreed definition of the digital economy; however, researchers, international organizations, and well-reputed IT firms presented digital economy definitions to fulfill their own motives. According to the EU, the digital economy refers to digitalization affecting all businesses, albeit to altering degrees. It consists of businesses that sell goods and services via the Internet and digital platforms that link spare capacity and demand [25].

The digital economy is an economic endeavor in which digital data is the main factor of production. In a generalized form, the digital economy can be presented as a part of economic relations that integrates mobile communications, information communication, and Internet technologies [18].

Using GenAI models, multiple segments of the digital economy, including, smart agriculture, digital industries digital construction, e-healthcare, e-education, e-commerce, and smart transportation, etc., either in public or private sectors, can improve in several ways. Among these sectors, some selected ones are described to understand better the argument behind the impact on the digital economy [26], [18]. There is a positive view that GenAI model-based systems will prove to be an effective instrument for several workers, improving their capacities, productivity, and proficiency while granting a boost to the digital economy. In this way, GenAI can be utilized as a practical tool to extend their knowledge and expertise and provide them with the specialized skills required in areas like health care or education where there are ample employment opportunities; it could revitalize our workforce.

Figure 7, mentioned in the recent McKinsey & Company report [3] ,indicates the potential impact of GenAI in the following business functions: marketing and sales, software engineering, research and development, and customer operations.

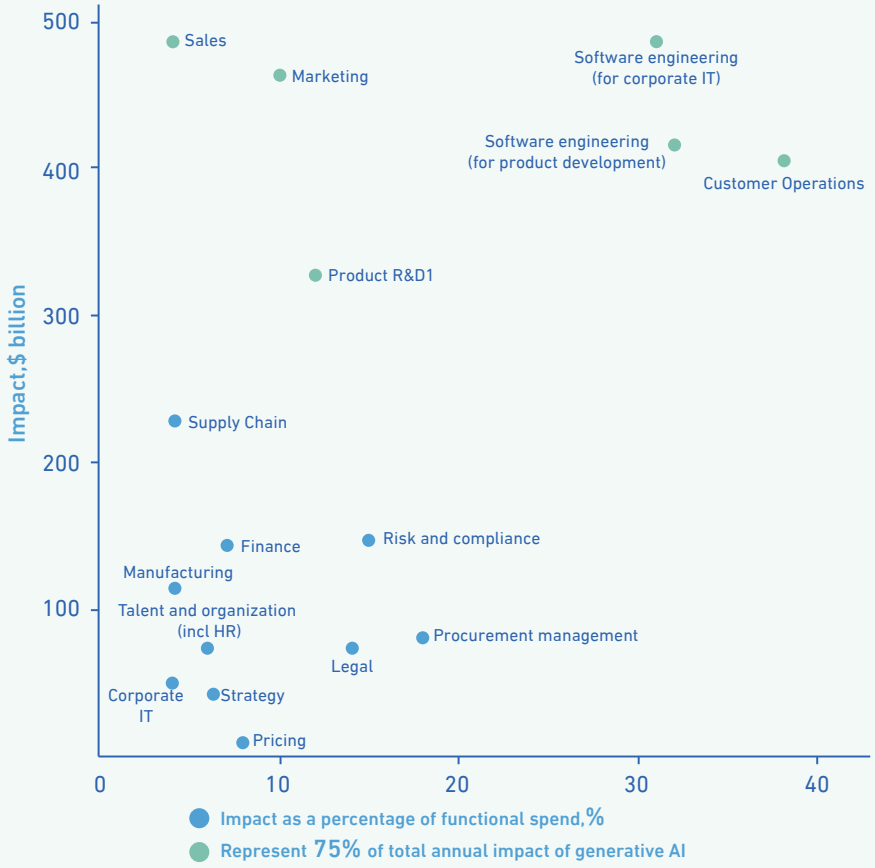


Figure 7: The potential impact of GenAI on the following business functions

Source: Comparative Industry Service (CIS), IHS Markit; Oxford Economics; McKinsey Corporate and Business Functions database; McKinsey Manufacturing and Supply Chain 360; McKinsey Sales Navigator; Ignite, a McKinsey database; McKinsey analysis [108]

The report mentioned that their above-mentioned analysis might reflect approximately 75% of the total annual value from generative AI applications in various business areas highlighted in the report[3].

They explained that GenAI could deliver a total value in the range of $2.6 trillion to $4.4 trillion in economic benefits annually when applied to about sixty-three use cases across different industries. They further added that it would add 15 to 40% to the $11.0 trillion to $17.7 trillion of economic value that they now estimate nongenerative artificial intelligence and analytics could unlock [3]. There are various factors for the impact of GenAI on the business sector, like the importance of different functions, and scale of an industry's revenue, etc.

The GenAI tools significantly affect the health sector, including pharmaceutical and medical-product industries ranging from $60 billion to $110 billion yearly. Such mega potential reflects the resource-intensive process of determining new medication compounds. Health firms, including pharma companies, typically spend approximately 20% of their revenues on R&D, and developing a new drug takes an average of ten to fifteen years. AI could add roughly $310 billion in extra value for the retail industry, including auto dealerships, by enhancing performance in functions like marketing and customer interactions [3].

In the current digital age, we can hear shrieks from corner offices across the globe about how people can make money from using GenAI-based tools. Moreover,

GenAI could deliver a total value in the range of $2.6 trillion to $4.4 trillion in economic benefits annually

It would add 15 to 40% to the $11.0 trillion to $17.7 trillion of economic value

The GenAI tools significantly affect the health sector, including pharmaceutical and medical-product industries ranging from $60 billion to $110 billion yearly.

the technology giants, like app developers, venture-backed startups, and many of the world's largest enterprises, are all aspiring to utilize the GenAI model, like ChatGPT, to generate business revenues and boost the growth of the digital economy. Investors, including Venture capitalists, are pouring billions into firms based on generative AI, and the list of apps and services driven by large language models is growing longer every day, intending to generate more business and finance to contribute to the global digital economy [43].

In the forthcoming segments, we describe GenAI-based tools, like ChatGPT, potential impacts on certain key sectors as a pattern for the stakeholders to expand it to other sectors as well:

4.1 Financial Sector, including Customer Operations.

GenAI has the potential to significantly impact the financial sector by identifying, analyzing, and monitoring financial transactions, including fraudulent transactions, providing efficient customer service to improve the overall Customer Experience (CX), analyzing investment opportunities, managing risks associated with financial instruments and developing trading strategies for marketing patterns by the professionals. There are some pathways in which GenAI, and its tools, like ChatGPT, can contribute to **the Finance sector, including customer operations:**

01 Personalized Customer Support through customer self-service interactions and Virtual Assistance [3], [38], [44] [45]

02 Fraud Detection and Security [46]

03 Financial Research and Development [47]

04 Regulatory Compliance [48]

05 Automated trading and development of algorithmic trading strategies to promote trading efficacy [49]

06 Analysis of financial sector customer data to introduce new financial sector products and services [47]

07 Cost-effective customer support services [50]

08 Useful interaction between customers and agents to boost tailored and real-time information delivery [3]

09 Increased customer satisfaction & Business efficiency [51]

10 Agent self-improvement for personalized coaching [3]

4.2 Health Sector

Generative AI could significantly advance the healthcare sector. For instance, it can boost patient engagement, delivery, and the precision and efficacy of medical diagnosis and treatment. However, it is important to note that Generative AI and tools, like ChatGPT, should not replace human healthcare providers but rather should be used to augment and enhance their work. We mention the following pathways in which GenAI can contribute to the health sector.

01 Patient Triage and Assistance [52], [53]

02 Drug Development and Medical Diagnoses [53]

03 Medical Education, Information [53]

04 Medication Management and Adherence [54]

05 Mental Health Support [55]

06 Personalized Health Care, including Personalized Medicine [53]

07 Healthcare big data collection, filtering, integration, and analysis [54]

08 Health Monitoring and Lifestyle Guidance [56]

08 Language interpretation in the healthcare sector to assist patients in getting a medical report or doctor advice within a limited time, and cost, in their languages [57].

The applications of GenAI, and its tools, like ChatGPT, in healthcare sector as shown in Figure 8.

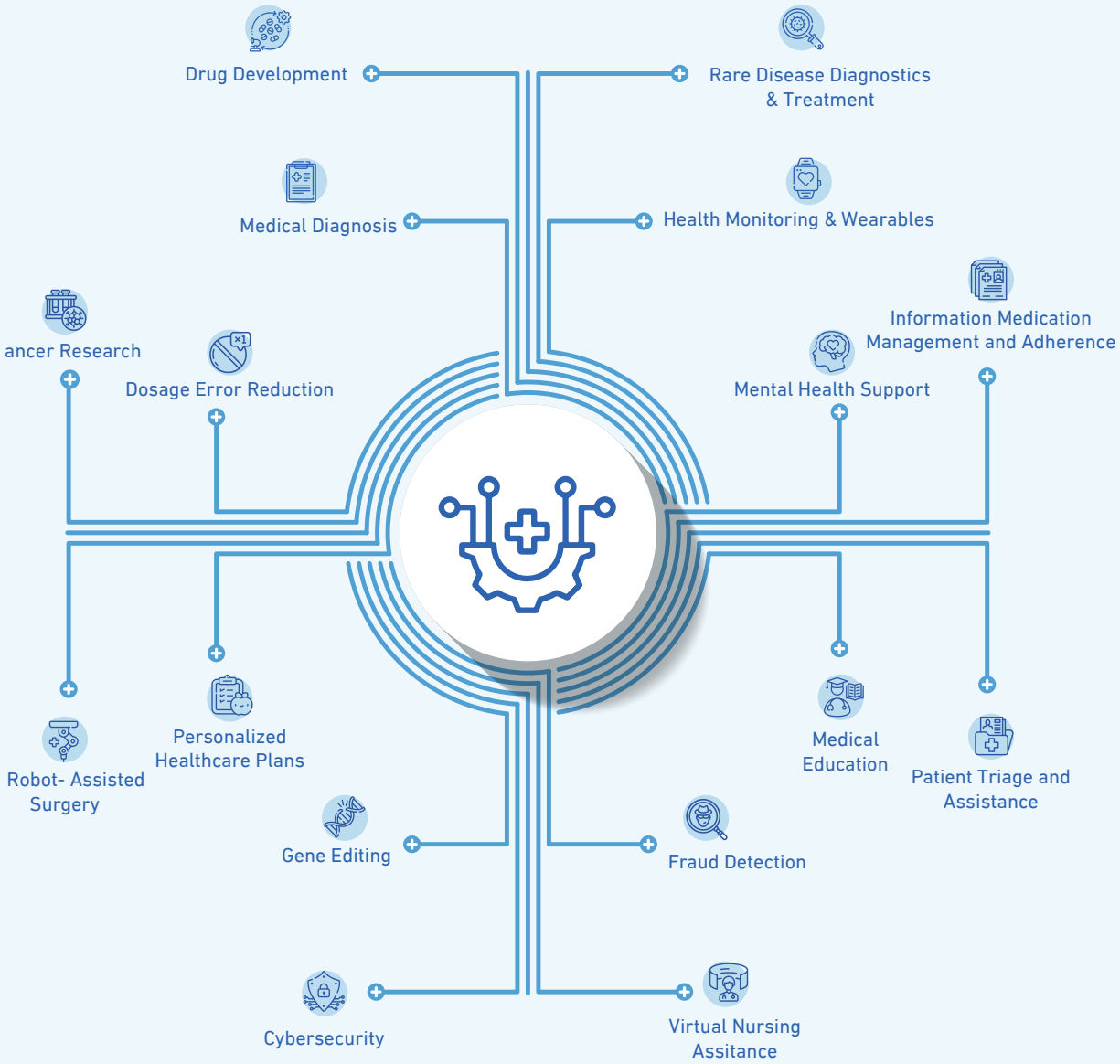


Figure 8: The applications of Generative AI in healthcare

4.3 Education Sector

GenAI, and its models, like ChatGPT, revolutionize teaching, learning, and administrative procedures while offering the education sector a wide range of opportunities to improve learning outcomes, efficiency and providing more personalized instruction. It is estimated that AI, including GenAI technologies is expected to be worth USD 6 billion by 2024 [58]. The following are some important aspects of GenAI models in the education sector.

Moreover, there are other potential applications of GenAI, and its tools, like ChatGPT, in the education domain as shown in figure 9.

01 Personalized and Adaptive Learning [59], [58]

02 Intelligent Tutoring Systems and adaptive learning platforms [60], [58]

03 Intelligent content & Automated & Standard-based Grading in the Educational system [61]

04 Student Retention and Dropout Prevention [62]

05 Learning Analytics & support for teachers [20], [63]

06 GenAI-enabled continuous learning [58]

07 Accessibility & language learning in a cost-effective manner [64], [58]

08 NLP Grounded Effective Engagement with Educational Stakeholders through Instant Feedback and Guidance [20]

09 Innovation-based Transformation in Educational Ecosystems [63]

Figure 9: Potential Applications of GenAI in education domain

4.4 Marketing and Sales

Moreover, the Marketing and sales team of a business entity could be transformed by the GenAI-based tools for the following features [3]:

01 To prepare effective marketing communications by gathering market trends and customer information from various structured and un-structured sources

02 To launch customers' multilingual campaigns for their awareness.

03 To establish conversion with virtual sales agents to imitate human qualities like personalized communication, empathy, and natural language processing to boost customer trust.

04 To promote customer retention through effective messaging, and customer support

The application of GenAI for marketing, and sales activities, include, but are not limited to the following: effective content creation, maintaining consistency, and maximize the use of data that is critical for a business entity marketing strategy, Search Engine Optimization (SEO) optimization, product, and services discovery and search personalization, identify and prioritize sales leads through building comprehensive costumers' profiles, etc. There are several applications of GenAI in marketing and sales and one such application is shown in Figure 10.

Figure 10: Application of GenAI in marketing and sales [65]

4.5 Climate Change

The effectiveness of GenAI models in Climate Change is also critical for the stakeholders. As we know, GenAI models, like ChatGPT, consume a significant amount of energy. As more and more data is being processed and more GenAI models are being developed, the energy consumption of GenAI is only going to increase.

Now, the Inventors of GenAI models, like OpenAI, are working on using renewable energy sources to store and process data in their data centers. They are also trying to reduce the scale of the GenAI model and promote efficient hardware use. GenAI is becoming more integrated into our daily lives, so we must use its tools, like ChatGPT, sustainably [23].

The stakeholders in climate change can utilize GenAI models in various themes but are not limited to the following: to conduct climate change research by investigating carbon dioxide emissions, weather patterns, and environmental impacts for the safety of our planet, to perform analysis of relevant data, that is gathered from different sources to track and predict changes in the air quality, to accomplish time-consuming, repetitive tasks, like reporting, and monitoring environment circumstances, to produce electronic reports, and presentations to mitigate the need for printing, and shipments of copies of such reports, and to generate contents to create awareness about the importance of sustainability for our clean planet.

4.6 Agriculture Sector

In the **agriculture sector**, the GenAI-based models assist in the sector's digital transformation by creating farming-related crowdsourced datasets and their integration with smart tech tools to respond to farmers' queries through smart applications. Yield forecasting can provide us with a better way to plan. Robot farmers with AI can provide us with better yield. AI is also helpful to be used in Irrigation to avoid overwatering, The uses of GenAI in the agricultural field as presented in Figure 11.

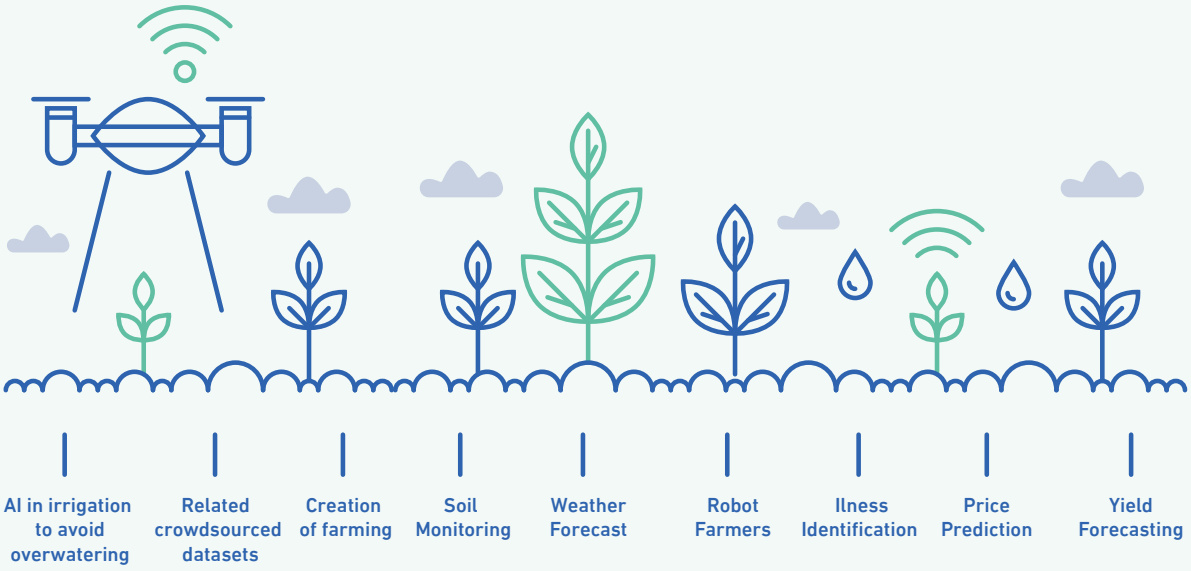
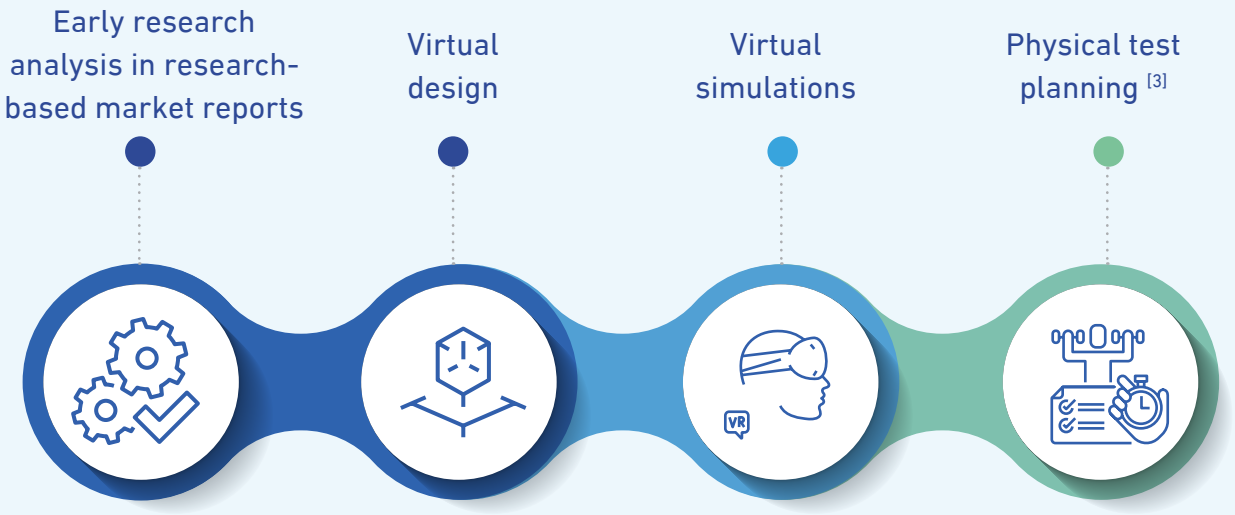


Figure 11: Applications of GenAI in the agricultural field

4.7 Product and Services R&D

GenAI has a critical role in product and services R&D in the following related activities:



4.8 Miscellaneous Spectrum of Generative AI and its Tools

The GenAI models, like ChatGPT, have a diverse spectrum that includes several applications and use cases in various sectors that include but are not limited to the following:

01 An E-Commerce Tool [66]

02 Virtual assistant & Language translation [67]

03 Assist To Businesses to Produce Collaterals [47]

04 A Platform for Digital Transformation [68]

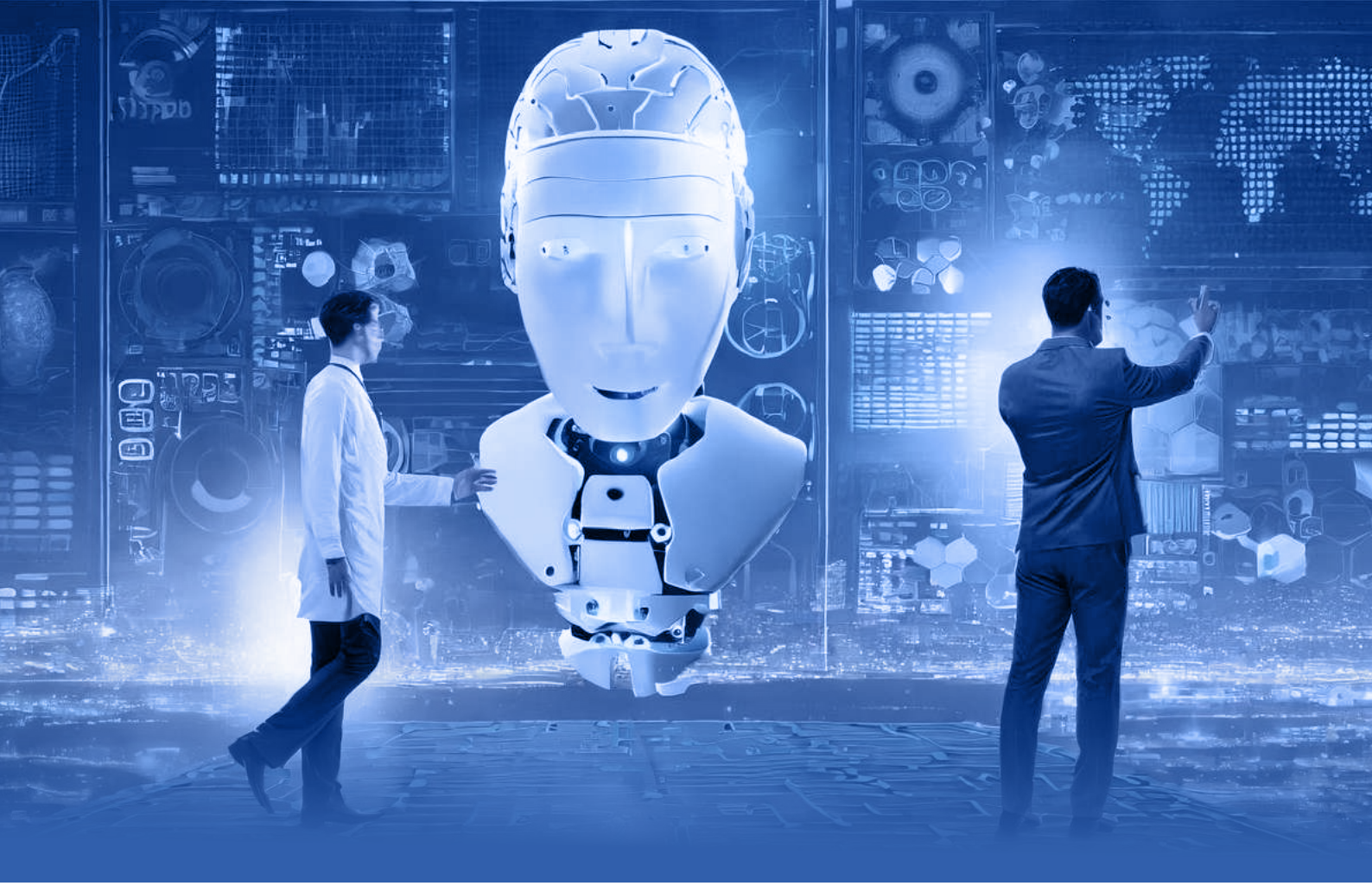
05 An Essential Tool for IT Developers [66]

06 Use of ChatGPT in the Justice Ecosystem to reduce time and efforts for Fair and Equitable Decision making by the court Judges for all Parties

07 An Efficient Alternative for Call Center Professionals [69]

08 Transformation of software engineering processes [3]

It is pertinent to mention that stakeholders, including policymakers, need to think about the combination of GenAI-based tools with other emerging technologies, like knowledge graph, quantum computing, AR/VR, and blockchain technologies, to take full benefits from these technologies in the various domains, such as environment domain, e-identity management, fintech, climate space, or environment domain, and interpretation of data with limited resources, and better quality control.



CHALLENGES OF GENERATIVE AI & ITS TOOLS

While Artificial Intelligence (AI), Generative AI, and its tools, like ChatGPT, offer numerous opportunities to the public and private sectors. GenAI technology has sufficient capacity to process massive amounts of data, find patterns, and offer accurate predictions.

However, there are several challenges of these emerging technologies that hinder AI adoption in both sectors. We categorized such challenges into two main groups, i.e., ethical, and generic. In this study, we focus on the ethical challenges of GenAI, and its tools, like ChatGPT.

We make efforts to create awareness regarding GenAI challenges amongst the stakeholders so that they may establish cooperation to manage such critical issues for full adoption of AI, GenAI, and its tools, like ChatGPT, to ensure progress to achieve SDGs and to boost sustainable and inclusive digital economy [70].

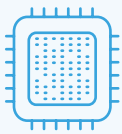
5.1 Ethical Challenges

Concerns and considerations regarding the moral and ethical ramifications of Generative AI and its tools, like ChatGPT, creation, implementation, and use, are called its "ethical challenges". Ethics is about concepts of right or wrong, and ethical issues usually tend to interfere with a society's moral principles. In general, the following are examples of ethical issues: privacy, workplace safety, confidentiality, human rights, accountability, and equity of resources, informed consent, and user anonymity.

Some activities may be legal, but in some individual's opinion, they are not ethical, like; performing a medicine test on animals is legal in numerous countries; however, some people think it is not ethical [71]. Similarly, diverse ethical challenges arise from the potential impact of Generative AI and its tools, like ChatGPT, on various stakeholders and society. We also mention a few key GenAI ethical issues below:

5.1.1 Inequality

First, Generative AI-based tools, like ChatGPT, involving LLMs are not for minor fry. GenAI tool ChatGPT employs about 10,000 Nvidia GPUs operating in tandem to train itself using its related LLM. An estimate is that about 30,000 Nvidia A100 GPUs will be needed to continue ChatGPT in production. Moreover, the immense demand for electricity and cooling water is a prohibitive hurdle to any novel start-ups in the area—an estimated cost of



GenAI tool ChatGPT employs about **10,000** Nvidia GPUs operating in tandem to train itself using its related LLM

An estimate is that about **30,000** Nvidia A100 GPUs will be needed to continue ChatGPT in production

running GPT3, a ChatGPT predecessor, was USD four million per month. Thus, an LLM, by definition, is a vast technology business involving a steady influx of cash to continue operations of such GenAI models, continue to tune the LLMs and return a profit. Typically, monetization is attained through the markets for Search Engine Optimization (SEO), advertising, and subscription services.

Hence, it can be no wonder that OpenAI, the parent company of the ChatGPT's product line, has partnerships with Big Tech and IT firms like Microsoft and Stripe. Stripe is a leading consumer service firm, cooperating with OpenAI to extend individualized subscription services for the OpenAI GenAI-based tools services. Such partnerships are critical for OpenAI to compete, sustain their GenAI-based products, and frame required company business sustainment strategies. However, such raised strategies raise ethical issues, like inequality amongst the communities regarding who can buy high-ranking advertising campaigns based on costly technologies and who underwrites such advertising campaigns.

Second, the current economic system is based on compensation for contribution to the economy, often measured by applying an hourly wage. Mostly companies are still dependent on hourly work when it comes to products and services. However, by using GenAI and its tools, a firm can drastically reduce reliance on the human workforce, which means that revenues will go to fewer individuals. Therefore, people who own AI-driven companies will earn all the income [72].

There will be limited participation of disadvantaged groups to experience the GenAI-based tools and offer feedback as per their needs. Such situations within the global community lead to GenAI ethical issues and inequality, creating hindrances to boosting a sustainable, human-centric, and inclusive digital economy.

5.1.2 Biases in training data

The first stage in a more ethical GenAI-based tool, ChatGPT, is spotting the quality of its training data. Mostly training data is freely available on the internet, and it is cumbersome to guarantee the accuracy of such data. The biases in training data may include discriminatory language, social stereotypes, exclusionary norms, etc. Therefore, there is always doubt in the users' minds that the GenAI-based tool ChatGPT generated responses based on biased data can be incorrect or contain biases and harmful information [73].

Biases may occur in collecting the training data used to train models, leading to biased outcomes. For example, racial biases may be introduced in creating datasets, with minorities being underrepresented, thereby leading to lower-than-expected prediction performance [50].

One form of toxicity that may arise is the presence of offensive language in the training data. This can result in the model generating or understanding offensive or harmful content when interacting with users [74]. For example, there is Gender bias in performance feedback written by ChatGPT [75] as shown in Figure 12.

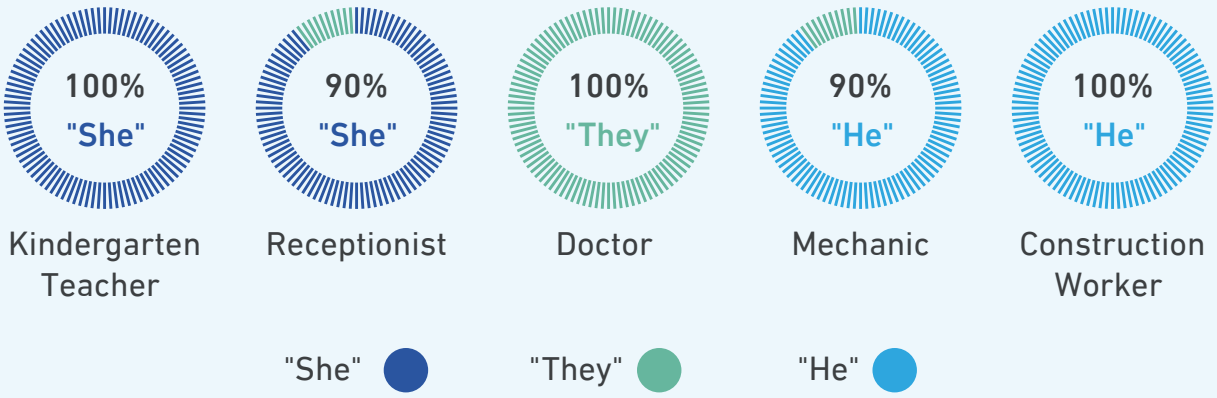


Figure 12: Gender Assumptions by ChatGPT [72].

5.1.3 Copyright

GenAI training datasets and model outputs can generate major IP risks, including infringing on copyrighted, patented, trademarked, or legally protected materials. It is also critical for the beneficiary entities to understand what data is incorporated into training datasets and how it's used in GenAI-based tools outputs while they are using them in their environment [3]. Moreover, international research institutions, like the International Committee of Medical Journal Editors (ICMJE) and the Committee on Publications Ethics, have already started deliberations on GenAI-based tools, like ChatGPT, as an author. Given their ability and versatility, they believed that such GenAI tools, like ChatGPT, posed a challenge to the human-based authorship model and asked ChatGPT to opine on copyright matters. The ICMJE categorically mentioned that ChatGPT considers itself an invalid author [76] [22]. The content generated by GenAI models can be categorized as a "work" under the Copyright Law is also controversial [77]. Since the release of GenAI-based tools, like ChatGPT, their matter of ghostwriting and copyright infringement issues still need to be addressed [76], [20] and require the global community's attention to promote effective technological systems to boost the human-centric digital economy.

5.1.4 Privacy

Data privacy is founded as one of the most critical aspects of AI, GenAI, and their models. The use of AI in numerous sectors, like health and transportation, raises concerns about privacy ethics [23]. In the transportation sector, for example, self-driving cars collect continuous data about their surroundings using advanced sensors. There is no fair expectation of privacy in public spaces where autonomous vehicles operate, and no warning or preference is endowed, creating privacy

concerns. Similarly, the deployment of AI in the health sector also poses a slew of privacy ethics issues.

Such issues include but are not limited to the following: the protection of personal records, the ethical limits of creativity, and the actual effect of technology on doctors and patients [78], [79], [80], [57]. Using GenAI models in the education sector raises concerns about data privacy and security, as education sector data, including student data, is often sensitive and personal. Such problems include concerns about data breaches, unauthorized access to student data, and using student data for purposes other than education [59]. The researcher stresses that if ChatGPT is applied to the financial sector, it needs robust privacy and safety measures and adherence to privacy standards and regulations.

It is critical for business firms to consider the importance of data privacy ethics and adhere to the relevant privacy rules and regulations when creating and offering digital products and services to their valuable customers through the use of GenAI models [81], as their consumers are curious about what kind of data is gathered about them and how advertisers use their data. The GenAI-based tools, like OpenAI ChatGPT, are trained on big data collected from diverse sources, including pages scraped from the internet. However, such data sources also contain personal data about internet users.

Therefore, countries noticed that OpenAI tools, ChatGPT, are using people's personal data to respond to users' queries. For example, the Italian government issued an official communication to OpenAI to stop exposing the Italian community personal data included in the ChatGPT training data [82]. Government actions indicate privacy tensions around creating GenAI models, which are often trained on data, including internet data.

5.1.5 Job displacement

GenAI holds the capacity to mechanize mundane and repetitive responsibilities across diverse sectors, potentially resulting in the replacement of certain occupational positions. Activities that can be readily outlined, measured, and executed through algorithms are particularly prone to automation. The use of ChatGPT may affect the job market, potentially resulting in job displacement throughout the economy.

Addressing this potential challenge and ensuring that the technology is used to augment and enhance existing roles rather than replace them is important for the successful future of ChatGPT [51]. A longstanding concern regarding AI in healthcare is the fear it will replace jobs, thus rendering healthcare workers obsolete [38], [51]. The threat of replacement translates to doubt and displeasure about AI-based interventions. Therefore, it has become utmost import for all the countries to train their workforce in the areas that are not going to obsolete due to AI such as content writing and graphic designing. Rather, they may train their workforce to be AI users or AI makers.

5.1.6 Trust

The use of GenAI models can affect user perceptions and trust, particularly in the context of sensitive information, like financial sector information. People have different reasons for not trusting GenAI-based tools, like ChatGPT. Examples of the following are the key reasons: ChatBot lies, unfair, no clue about the back-end systems of an enterprise, outdated, etc.

Managing customer expectations and ensuring a positive experience with technology is critical to enhancing customer trust in such technical emerging solutions and AI adoption in the financial sector [51]. The OpenAI GenAI-based tools, like ChatGPT, are evolving, and new versions of ChatGPT are under testing and will be released soon.

Therefore, OpenAI and its partners may give focus to adhere to the code of ethics to increase the trust of all the sectors, including the public sector, for smooth growth of technologies to progress towards SDGs and to boost a human-centric, sustainable digital economy [83].

5.1.7 Transparency

A major necessity for GenAI algorithms, like ChatGPT, to be considered just and ethical is transparency [84]. The concept of transparency is diverse. About GenAI-based systems, we are concerned with, for example, how and why the GenAI algorithms reach a response, what stages can be accounted in the decision-making process to prepare the response based on the users' queries, what are the determining key factors that led to the choice, what sources of information utilized to final the response [79] [85]. Presently, there is a lack of effort from the developers of the GenAI algorithms to make them explainable and transparent for the stakeholders, including end users [3].

Transparency is critical in every sector of life, particularly in the health sector, as it affects healthcare decision-making processes that directly affect human lives.

However, in such sectors, there is no mechanism introduced by the creators of the tools, like ChatGPT, for the end users to note and understand the system's details and offer information on how the GenAI tools were trained to ensure explainability aspects. The GenAI also has accountability issues as well [84], [50].

It is pertinent to mention that there are no holistic ethical guidelines to manage the above-mentioned GenAI and its tools, like ChatGPT, ethical issues.

5.2 Generic Challenges

A generic challenge to ChatGPT refers to a common difficulty or obstacle the ChatGPT system faces, irrespective of specific application domains or contexts. These challenges are overarching and can impact ChatGPT's functionality and performance. Some examples of generic challenges include:

01 Sector-oriented limited data availability [80], [86]

02 Incorrect & inconsistency in responses [51]

03 Lateness in GenAI adoption in business sectors [84]

04 Accountability issue [84], [50]

05 Lack of standards and principles for GenAI and its models [51]

06 Reliability problem [3], [87], [88], [59]

07 Robustness bottleneck [57], [89], [90]

08 Large Models are running centrally, and access through the internet imposes data privacy and costing issues [84], [50]

09 Limitation of open source with the current GenAI Models, like ChatGPT, as the OpenAI owns the source code [84]

10 No specific National Strategy for GenAI, and its Tools [84], [51]

11 Inadequate incentives for GenAI for the IT firms, particularly for SMEs to explore GenAI [91]

12 Misconceptions about GenAI Language Models [92]

13 Lack of digital literacy regarding GenAI and its tools within the global community [93]

14 Research on GenAI models is still developing [84]

The ability of ChatGPT to produce misinformation in language that is self-confident and context-sensitive will facilitate manipulators to execute cost-effective cross-platform misinformation campaigns. There is limited international cooperation to take preemptive measures by introducing standards and principles and framing the international regulations of GenAI, and its tools, like ChatGPT.

In addition to the above-mentioned challenges, there are other various challenges, but are not limited to the following:

01 Problem identification and formulation

02 Energy consumption

03 Data issues

04 Cheating and deception

05 Responsibility, Controllability,

06 Predictability

07 Continual learning

08 Storage (limited memory)

09 Semantic and communication

10 Rationality

11 Mind accountability

12 Reproducibility, Evolution

13 Beneficial

14 Exploration and exploitation Balance

15 Verifiability

16 Safety

17 Complexity, etc. [94].

RECOMMENDATIONS ON GENAI TO REVOLUTIONIZE THE DIGITAL ECONOMY

Based on the literature and informal interactions of the authors with industry experts, there is a set of recommendations, including regulatory and strategy recommendations regarding GenAI and its tools, that has the potential to revolutionize the sustainable and human-centric digital economy in several ways, including:

6.1 Formulation of Holistic Ethical Guidelines and Regulatory Frameworks for GenAI-Based Tools

Recommendation for: **All Stakeholders**

The development of holistic ethical guidelines and regulatory frameworks for developing and using GenAI can help address the following GenAI tool-related concerns: accountability, privacy, bias, and potentially harmful consequences. By formulating such ethical artifacts, the global community can benefit from emerging technologies to boost the human-centric digital economy instead of specific region-based AI regulations, like EU AI regulations/Act, likethe EU AI Act [138] it is critical for any new technology, like GenAI, to consider its ethical aspects and ensure that they are deployed responsibly, and it should be value-neutral [95].

Therefore, it is suggested that stakeholders, including international organizations, businesses, and civil society, may collaborate to formulate ethical guidelines for the GenAI models like ChatGPT to use this technology for the good of humanity instead of misusing it. They must investigate the ethical gaps relating to the drastic uprise of NLP-based GenAI tools.

Such regulatory frameworks also ensure that the fundamental human rights, the rule of law, democracy and environmental sustainability should be protected from high-risk AI[138].

The proposed guidelines can be helpful for the stakeholders and offer them a foundation to build specific rules, principles, and policies to ensure the optimization of the GenAI forthcoming models and the validity of its generated contents.

Moreover, such ethical guidance will be centered to cater the following key ethical aspects: un-biasness of training datasets for the GenAI based tools, offer equal chance to use GenAI technologies to all communities of the world, promote equality by creating equal opportunities for the all kind of business entities to contribute to the digital economy instead of a few big IT firms who own such GenAI models, introduction of specific classifier to distinguish between human language, and GenAI tools generated language to tackle the copyrights ethical issue, to consider the role of accountability [50], honesty, integrity and transparency into the ethicality of GenAI based tools, like ChatGPT, consideration of privacy by default while developing, and evolving such emerging technologies based models, like ChatGPT.

The ethical guidelines could also guide how the human controlled GenAI technologies' more considerable impact will be in complementing and augmenting human capabilities, not replacing the workforces to ensure performance from the joint work of GenAI tools and humans. The public and private sector leadership should reassure staff that the implementation of GenAI tools can supplement human efforts, and automate time-consuming and repetitive processes, freeing up people's time for more innovative and strategic work with the potential to create new employment and opportunities that demand specialized skills. The subject guidelines should focus on consumer data privacy through the transparent use of consumers' data and adherence to international standards for data privacy. In this way, they will feel confident that their personal data is secure. Moreover, covering such personal data privacy aspects in the subject guidelines can help the public sector strengthen its relationships with citizens and the business community.

6.2 Early GenAI Adoption By the Business Community

Recommendation for: **Private Sector**

It is recommended that the business community may take full advantage of early GenAI models, like ChatGPT, adoption. This way, businesses can transform their existing conventional technologies and cumbersome processes to grow with GenAI technologies. The business community, particularly business leadership, may initiate AI by formulating AI-friendly technology strategic goals and investigating current OpenAI GenAI-based models, like ChatGPT. AI field has already entered the various domains, like finance, engineering, security, and autonomous systems.

Therefore, we suggest the business community, and other decision makers in other sectors of life for early adoption of AI in the following vital business areas to generate business values and to contribute to a sustainable and inclusive digital economy. It is observed that AI adoption is greatest in the sectors that are already strong digital adopters [96] as shown in Figure 13.

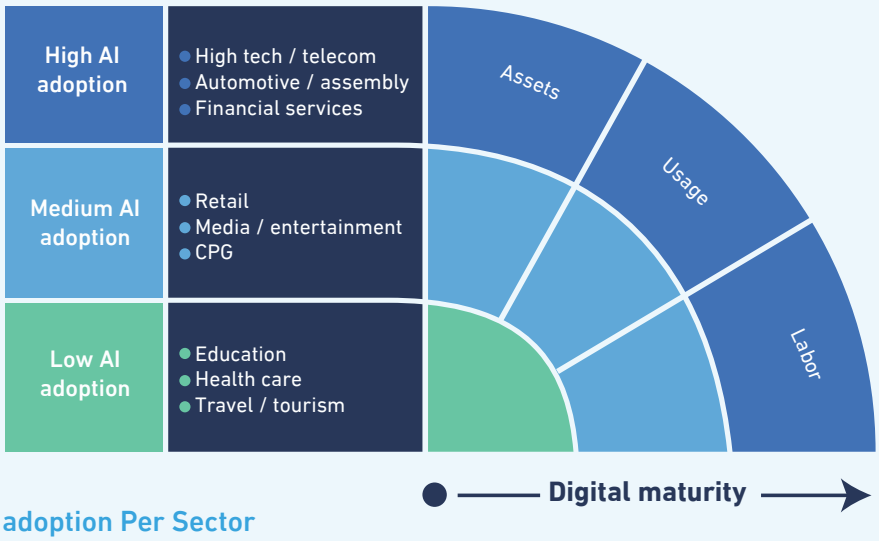


Figure 13: AI adoption Per Sector

6.2.1 Customer care

The GenAI-based models, like ChatGPT, are excellently establishing effective interactions between businesses and customers. Their customers can receive personalized and engaging experiences with GenAI tools, which can also serve as virtual assistants or customer service representatives.

They can provide real-time assistance, respond to questions, and assist with purchasing decisions. In this regard, it is highly recommended that the business community deploy the GenAI model ChatGPT to respond to the customer's frequently asked queries or inform them to use valuable information to boost customer happiness, satisfaction, and engagement.

6.2.2 Automation of repetitive processes

There are limited dependencies on human intervention when repetitive processes are automated via GenAI models, which can also deliver quick and better responses. Because of such automation, via GenAI, businesses may experience improved operational effectiveness and cost savings.

6.2.3 Customer loyalty and retention

GenAI-based models, like ChatGPT, can run around-the-clock, helping and providing services whenever needed. Due to the ability to increase availability and continuously support customers, business entities can increase customer loyalty and retention.

6.2.4 Handling multiple simultaneous interactions

Without experiencing major resource limitations, GenAI technologies can handle numerous simultaneous interactions. Due to its ability to scale, business entities can effectively handle large numbers of customer inquiries or requests, guaranteeing a positive customer experience even during busy times.

6.2.5 Trust of customers

It is suggested that business firms explain the advantages and disadvantages of GenAI technology to their valuable customers and make it clear that they are speaking with a GenAI Language Model. By doing this, such firms will be able to manage and control their expectations about such emerging technologies and foster trust.

6.2.6 Establish a Customer Grievance System

Even with the greatest of intentions, the influx of deliverables produced by GenAI could have mistaken or flaws that affect the clients. Because of this, businesses must have the resources necessary to

comprehend what clients are saying about their goods and services in real time. Organizations can have a complete understanding of how their product is perceived by gathering user reviews from various platforms and channels. With this information, businesses can adjust and correct while ensuring that their products stay current, useful, and consistent with their brands.

Therefore, it is suggested that entities may establish a customer grievance system to listen and understand their valuable feedback about a firm GenAI-based products, and services and to use their feedback for the improvement of the Generative AI based products, and services to build customer trust, and enhance business revenues to contribute to enhance digital economy.

6.2.7 Transform sales and marketing departments

To transform sales and marketing departments by gathering market trends and customer information and drafting proper marketing and sale communications[3].

6.2.8 Optimize Software Engineering

Optimize Software Engineering (SE) processes using GenAI tools in the following SE stages: initiation and planning, system design, programming, testing, implementation, and support and maintenance of the software solutions [3].

6.2.9 Use of GenAI for Product and Services R&D

Boost the use of GenAI for Product and Services R&D for the following related business activities: Early research analysis for market reports, ideation, and solution preparation, virtual design, virtual simulations, and physical test planning [3]. Besides the above-mentioned business areas, as suggested for the early adoption of GenAI, businesses can also adopt it in several other areas. The examples of such areas include but are not limited to the following: production of business reports and summaries by performing analysis of big data for useful insights for the stakeholders, including business leadership; firms can utilize GenAI systems, like ChatGPT, for sales and marketing of their products, and services; and use of GenAI tools to assist the firms in preparing multilingual content, particularly on their official web portal, to expand their businesses in other regions of the world through managing languages barriers there.

6.3 Development of National Generative AI Strategy

Recommendation for: **Public Sector**

The new wave of generative AI, particularly models like ChatGPT, can potentially transform sectors of life and entire industries as well. Governments should develop strategies to become a leading GenAI-enabled government, attract foreign AI and GenAI investment in numerous sectors in this digital world. In this way, governments can ensure efficient, effective public service delivery for the citizens and boost their public administrations' performance at all levels.

Such strategies can also support the states to attract foreign investment in AI, particularly GenAI, in various sectors, like health, tourism, education, and environment, agriculture, to build vital markets with high economic value. Such strategies somehow centered on different pillars, like GenAI literacy, requisite infrastructure for testing and deploying GenAI models, GenAI research and development, the establishment of state-of-the-art ecosystems for GenAI, including GenAI startup ecosystems, national and cross-border cooperation, and governance of GenAI, etc.

Therefore, it is highly recommended that stakeholders, particularly governments, collaborate to formulate a holistic, clear, and compelling national GenAI strategies now. In the recent past, a few countries, like UK, Saudi Arabia, UAE, US, Singapore, Bahrain, etc., have already issued generic national AI strategies. They also need to revisit their existing national strategies to incorporate the GenAI, and its tools, like ChatGPT, or formulate a separate National GenAI strategy while considering the current development of GenAI-based models.

6.4 Incentives for GenAI

Recommendation for: **Public Sector**

The international organizations, governments, and investor community may incentivize financially, at all levels, for the testbed, development, and adoption of GenAI technologies within the state. Such incentives would be helpful for numerous key activities that include but are not limited to the following:

01 to assess whether GenAI initiatives are socially preferable and environmentally friendly.

02 to encourage creativity and promote competition in the development of specific GenAI solutions that are ethically sound and in the interest of the common good.

03 to assist the national GenAI startups in developing GenAI based products through incubator funds, and paid mentorships. For example, AI Singapore's 100 Experiments project to investigate startups, and SMEs specific problem and their possible AI technologies-based solutions cited in [91].

6.5 Disclosure of GenAI, and its Tools, Like ChatGPT, Status as an AI Language Model

Recommendation for: **Private Sector**

AI-Language Models (LMs) are a form of GenAI [92]. AI Language Models are at the heart of widely utilized language applications, ChatGPT. The LMs utilize natural language processing algorithms to interpret and respond to text-based human input. The Language models are the statistical predictors of the next word, or any other language element given a sequence of preceding words. They facilitate machines to process and generate human language.

The GenAI, and its models, like ChatGPT, function as AI-Language Models based on the data it has been trained on and the techniques it employs to respond. There are numerous misconceptions about AI-Language Models. For example, such LMs models are basically large databases. However, they are not huge databases; instead, they are just stored predefined responses. Such responses are usually generated through pattern recognition instead of data retrieval.

This false view that LMs are just large databases can indicate excessive expectations and misinterpretations of their potential. Understanding that LMs generate replies by pattern recognition, not data retrieval, facilitates the users to realize their generative nature and the difficulty of their responses. Other misconceptions about AI LMs include the following: AI LMs are creative, they understand human language and emotions, and AI LMs are accurate.

Therefore, it is recommended that stakeholders may launch appropriate initiatives, like awareness campaigns, to assist the people to understand that they are interacting with an AI Language Model, not a real person. This revelation can assist in establishing the parameters of the discussion and avert the above-mentioned misconceptions within the global community about GenAI-based systems, like ChatGPT.

6.6 GenAI Standards and Principles

Recommendation for: **All Stakeholders**

There is an essence to developing suitable standards and principles that can help the users to utilize GenAI-based tools, like ChatGPT, safely, ethically, and effectively in the same manner like international organizations, regional entities, and states somehow defined the AI standards, and principles, like OECD AI standards, and principles centered on how public sectors and other actors from the private sector, and civil society can shape a human-centric approach to the trustworthy AI.

Therefore, it is suggested that stakeholders, particularly international organizations, may frame a multi-stakeholder working group to discuss and deliberate the GenAI above-mentioned challenges and propose a set of standards, and principles for GenAI, and its tools, like ChatGPT, to promote the adoption of human-controlled, responsible, and trustworthy AI to boost the world progress to achieve the UN SDGs, and to increase the sustainable, and inclusive digital economy [97].

Such AI standards and principles may cover different required aspects that include but are not limited to the following to prevent undesired side effects related to the GenAI models, like ChatGPT:

- 01 Transparency
- 02 Copyrights
- 03 Robustness
- 04 Security
- 05 Accountability
- 06 Safety
- 07 Human-centricity
- 08 Fairness

6.7 Significant Digital Literacy GenAI

Recommendation for: **All Stakeholders**

Generative AI-Language Models, like ChatGPT, are on everyone's lips nowadays and have terrific potential to boost the digital economy. However, such AI technologies need elevated society-wide digital maturity through sufficient digital literacy, as only informed use will benefit consumers. A collective focus on facilitating technological adoption and increasing information and digital literacy paves the way toward more ethical GenAI-based models, like ChatGPT [93].

Moreover, instead of banning such innovative GenAI-based tools, it is recommended that stakeholders, particularly international organizations, regional and national governmental bodies, and academia may, launch digital literacy joint initiatives, like a revision of the educational curriculum of degree programs, educational campaigns at school, college, and university levels, etc., to boost the digital literacy of the GenAI tools users. For example, the UN established an entity titled 'AI for Good' to bring together the best minds and technologies to resolve the world's most critical AI issues [91].

By imparting digital literacy to the users, they will be more informed and technically astute application of the new language models on a broad societal level. The prospects for GenAI literacy for the stakeholders as shown in Figure 14.

Figure 14: Prospect of GenAI Literacy

6.8 Research on GenAI, Including LLMs.

Recommendation for: **International Organizations, Civil Society, and Private Sector**

We do not find many research articles on GenAI, particularly on Large Language Models. It may be due to the recent release of GenAI-based models, like ChatGPT, released in November 2022.

Therefore, it is suggested that research communities, international entities, academia, and research funding agencies may consider it as a key priority area for their current and future research work for further study of different aspects of GenAI-based models, like capabilities, potential, holistic approaches to manage such models' challenges, particularly ethical issues.

The Scientists should consider various relevant research topics, like locally hosted small-size models, frameworks for transparency, consumer trust, affordable solutions, Gen AI models for audio, and video contents, and approaches to boost digital literacy of the global community.

They could also perform joint research in-collaboration with the practitioners about state-of-the-art GenAI tools prompt strategies for better results in the form of responses, and mitigation of black box approach to increase transparency of GenAI models.

The outcome of the collaborative research efforts should be centered on recommendations in the form of guidelines to formulate clear rules for GenAI models to tackle different related key matters. Such matters include the following: accountability for the responses of LLMs, to enhance transparency on the use of AI in the processes in the public sector, tackling of the copyrights challenges over the contents that are generated by the GenAI based systems, and development of GenAI standards, and principles.

6.9 Use Open-Source GenAI Models.

Recommendation for: **Private Sector**

Currently, numerous open-source GenAI models are available for fine-tuning. The open-source models, like HuggingFace, Bloomz, OPT-IML, LLaMA or Streamlit, can be utilized to build institutional GenAI model applications.

Moreover, another research consortium is working to build affordable open-source models for the global community, particularly unserved and underserved communities of the world, to use such GenAI-based systems in their everyday life and provide feedback for the improvements of these models as per their needs. For example, pan-European research consortia are working to improve GenAI models as per European requirements, including advancing multilingualism in training data.

Therefore, stakeholders, particularly international, regional, and national entities, are suggested to fund donors to spare dedicated time, efforts, and funds to build open-source GenAI models that should be grounded from the existing US industry subject models' work.

6.10 Establishment of Cooperative Infrastructure for GenAI Models

Recommendation for: **All stakeholders**

It is suggested that public sector organizations could establish joint infrastructure to use specialized GenAI Language Models in a shared way, like by establishing, and executing a joint cloud data center combined with small hybrid edge models that only periodically access the cloud environment.

They could also mutually procure GenAI models and cloud storage with external cloud service providers while taking appropriate measures for the privacy and safety of data, including personal data, to avoid associated risks, like:

01 Data Secrecy

02 Data Leakage

6.11 Global Cooperation for GenAI for Good

Recommendation for: **All stakeholders**

GenAI-based systems, like ChatGPT, are evolving faster than predicted and such systems are getting very powerful that does need special attention as it has a global impact. Therefore, it also requires global cooperation. The CEO of Open AI delivered the same wording during his high-profile visit to South Korea in June 2023 [98]. The CEO added that AI technologies, including GenAI-based models, are critical and a risk for humanity if left unchecked. He stressed that AI technologies should be given global priority along with other major societal challenges, like pandemics, climate change, and nuclear war, by the stakeholders.

Moreover, governments are also under strain to construct GenAI regulatory framework, standards, and principles to build, train, and deploy LLMs and to manage the copyright and liability aspects for GenAI-based models generated content. At the same time, the global community is facing several misconceptions about GenAI tools, like ChatGPT, as mentioned in the preceding paragraphs.

There are limited GenAI literacy initiatives for the public and private sectors. The GenAI technology actors are mostly self-regulating, with some AI firms coming up with joint initiatives and voluntary pledges. Global cooperation is also critical to develop and enforcing a Code of Conduct to monitor GenAI models and prevent abuses is a step in the right direction, given the potential impact of GenAI tools. Because of the above, a single entity at all levels can't manage all the above GenAI tools' critical aspects alone.

Therefore, it is vital to establish global cooperation of multi-stakeholders (e.g., international organizations, governments, businesses, civil society, and GenAI technological actors) for joint efforts to handle them without further hindering the speed at which AI technologies are being developed and deployed and assist the global community to take full advantage of such emerging technologies to boost the sustainable, human-centric digital economy.

6.12 GenAI Tech Firms' Commitment with the Other Stakeholders, including Governments

Recommendation for: **Private Sector**

It is critical important that GenAI tech firms, like OpenAI, Meta, Google, Microsoft, Apple, etc., should be committed with the stakeholders, particularly with governments to tackle risks posed by the GenAI tools, and technologies to safeguard global community, and values of the countries.

Examples of such commitments may include but are not limited to the following: well testing of GenAI tools by multi-stakeholder group of experts before their release; widely reporting GenAI limitations, and abilities on a regular basis, and take joint research initiatives in-consultation with research institutions on the GenAI risks, like discrimination, bias, copyrights, invasion of privacy, and spreading of misinformation.

6.13 Constitution of an Independent Authority to Monitor and Analyze GenAI Tools Performance

Recommendation for: **All stakeholders**

To spot any problems or biases in ChatGPT's responses by closely monitoring its performance and to make sure ChatGPT is running ethically and successfully, it is suggested that an independent authority at the state level may be established to monitor and analyze GenAI tools, like ChatGPT.

The Authority may also regularly examine GenAI tools responses and any user comments or complaints and suggest remedial actions to the concerned quarters accordingly. This authority may also develop a mechanism for accountability to guarantee that GenAi tools, like ChatGPT, run fairly and openly.

Generative AI tools, like ChatGPT, Limitations

Generative AI models, like ChatGPT, have certain limitations, as mentioned below:

01 **Lack of real-world context understanding:** It lacks a true sense of the world as it relies solely on patterns learned from training data and may not possess deep knowledge or common-sense reasoning abilities [99].

02 **Sensitivity to input phrasing:** The GenAI tools, like ChatGPT, can be sensitive to slight variations in input phrasing, leading to different responses. It may not consistently handle rephrased questions or prompts, and small changes in wording can yield varying results [100] [38].

03 **Tweaks sensitivity:** GenAI tools can sometimes generate nonsensical, repetitive responses or lack coherence. It may struggle with longer conversations and maintaining consistent context throughout the dialogue [14].

04 **Excessive verbose:** The GenAI models are often excessively verbose and overuse certain phrases, such as restating that it's a language model trained by OpenAI. These issues arise from biases in the training data (trainers prefer longer answers that look more comprehensive) and well-known over-optimization issues [14].

05 **Knowledge limitations:** The GenAI tool, like ChatGPT, can only provide information that it has been trained on up until a specific date (e.g., September 2021) and does not have real-time access to new information [99] [90].

06 **Lack of emotional understanding:** GenAI tools do not inherently express emotions. While it can mimic certain emotional tones based on the training data, it does not genuinely comprehend or empathize with emotions expressed by users [61].

07 **Lack of creativity and originality:** The GenAI systems, like ChatGPT, responses are based on patterns learned from the text. It can only generate responses like what it has seen before. It may be unable to create unique and original content or ideas [16].

08 **Lack of Accuracy:** GenAI tools cannot generate clarifying questions, and the quality of answers would differ and may contain inaccurate information [101].

09 **Misinformation and Alternate Fact Creation:** ChatGPT can sometimes generate plausible-sounding responses that are incorrect or misleading [101]. It may lack a fact-checking mechanism and can generate responses that appear accurate but are inaccurate or biased [90].

We consider the categorization of the recommendations on GenAI as a future work that could be performed in-consultation with GenAI experts.

CONCLUSION

Generative AI tools rapidly transform the public and private sectors with disruptive GenAI technologies, like ChatGPT. It is estimated that GenAI can deliver a total value of $2.6 trillion to $4.4 trillion in economic benefits annually when applied to about sixty-three use cases across different industries.

GenAI technologies can be helpful to address most of the important issues we face, like climate change and the digital divide. The GenAI tools facilitate the private sector's numerous business functions to decrease staffing levels and save costs.

However, the progress in utilizing GenAI in the public sector is relatively low compared to the private sector. Governments have a diverse set of priorities based on the principle of serving the public interest and the need to respect standards and principles for ethical values of privacy, discrimination, bias, copyrights, safety, citizens' rights, transparency, accountability, etc.

Therefore, the public sector must take preemptive measures while introducing GenAI in their potential use cases of GenAI tools for the work of public servants. However, such tools could also affect the major principles which underpin the work of the public sector. Therefore, there is essence for the stakeholders to perform collaborative work to balance innovation and regulatory measures to manage GenAI tools' side effects.

It is equally important not to stifle innovation and the potential impact, including the economic effects that GenAI brings to businesses and society. While the creators of such GenAI tools require gathering feedback from diverse professional sources and users alike to ensure their protocols are robust, relevant, and effective in addressing GenAI tools' challenges, particularly ethical ones.

In this white paper, we describe GenAI tools applications, future opportunities, its impact on the digital economy, highlight key GenAI key challenges, including ethical issues, and finally propose recommendations, including strategy, policy, and regulatory recommendations for stakeholders.

Predicting the future of Generative AI-based tools, like ChatGPT, in 2050 is highly speculative and uncertain. However, based on the potential trajectory and advancements in GenAI technology-based models, some possibilities could shape their future. For example, enhanced understanding of natural language to become even more proficient at comprehending complex queries, context, and nuances in human communication. customization and personalization of GenAI models based on user preferences and specific industries. Moreover, focus on fair, and responsible use of GenAI models, multimodal capabilities, cooperation, and co-creation between human, and GenAI Language Models, and improved context retention.

It is also expected that in 2050, GenAI tools, like ChatGPT, will be an integral segment of communication. It'll be the go-to tool for businesses, organizations, and individuals to interact with computers and get high-quality, meaningful results quickly. ChatGPT will enable users to converse naturally in text and voice formats with AI bots that understand them.

However, it is essential to note that these possibilities are speculative, and the actual future of ChatGPT in 2050 will depend on numerous factors, including research advancements, societal and ethical considerations, and technological developments.

There is a need for researchers and practitioners to conduct extensive research as well as real-world case experiments to investigate the GenAI tools applications from technical, social, regulation, economic, and organizational perspectives to promote human-centric, fair, and responsible GenAI technologies in every sector of life.

The Digital Cooperation Organization is persistently working on emerging technologies, including AI and GenAI, and the DCO Member States have signed and adopted the Riyadh AI Call for Action Declaration, reaffirming their shared desire to usher in a brighter future for all by harnessing the huge potential of AI to improve the lives of people around the world. It highlights the use of human-controlled and responsible AI in the public and private sectors to benefit lives worldwide.

Subsequently, the DCO General Secretariat team is in the process of planning for the introduction of several AI initiatives, such as development of AI toolkit to assist the DCO Member States in the following key aspects: Assess AI readiness of a Member State to establish the groundwork for setting the stage for the future course of actions on the AI journey; and AI adoption and integration, including GenAI into a Member State business system to improve productivity, quality of services, and efficiency in the Member State's departments based on the results of the AI readiness results [10].

CONTRIBUTORS

LEAD AUTHORS

Dr. Syed Iftikhar H. Shah
Digital Research Director, Digital Research Lab
The Digital Cooperation Organization (DCO), DCO H/Q, Riyadh, Saudi Arabia

Dr. Sohail Iqbal
Associate Professor, and Lab Director - High Performance Computing
National University of Sciences and Technology (NUST), Islamabad, Pakistan.

ACKNOWLEDGEMENTS

Ahmad Bhinder
Policy Innovation Director
DCO

Hassan Nasser
Chief of Cabinet
DCO

Khaldoon Said
Marketing & Communications Director
DCO

Alaa Abdulaal
Chief of Digital Economy Foresight,
DCO

Nader Abi Al Mouna
Digital Research Manager
DCO

Khalid Abu Awad
PMO Director
DCO

Omar A. Alnemer
Special Files Manager
DCO

BIBLIOGRAPHY

1. Javaheri A., Burke B.,, "Vertical Snapshot: Generative AI", Available at: ; Accessed on 23 Sept 2023," Pitchbook, London, 2023.
2. C. P. G. P. C. e. al, "Booming Venture Capital Investment in Generative AI: Considerations for Investors and Companies," 2023. [Online]. Available: https://www.bennettjones.com/Blogs-Section/Booming-Venture-Capital-Investment-in-Generative-AI-Considerations-for-Investors-and-Companies. [Accessed 15 07 2023].
3. Mckinsey, " The economic potential of generative AI – the next productivity frontier," https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#work-and-productivity, USA, 2023.
4. OECD, "OECD AI principles Overview," 2019. [Online]. Available: https://oecd.ai/en/ai-principles . [Accessed 30 6 2023].
5. BBC, "Bard: Google's ChatGPT rival Launches in Europe and Brazil," 2023. [Online]. Available: https://www.bbc.com/news/technology-66187283. [Accessed 30 June 2023].
6. UN, "AI for Good Foundation," [Online]. Available: https://ai4good.org/. [Accessed 30 06 2023].
7. D. G. Harkut, K. Kasat and V. D. Harkut, "Introductory Chapter: Artificial Intelligence - Challenges and Applications," in Artificial Intelligence - Scope and Limitations, 2019, p. http://dx.doi.org/10.5772/intechopen.84624.
8. R. A. H. L. I. e. a. Vinuesa, "The role of artificial intelligence in achieving the Sustainable Development Goals," Nature Communications, vol. 11, no. 233, pp. 1-7, 2020.
9. ITU, "The role of AI in achieving the Sustainable Development Goals," 2023. [Online]. Available: https://aiforgood.itu.int/event/the-role-of-ai-in-achieving-the-sustainable-development-goals/. [Accessed 15 05 2023].
10. V. B. a. F. Laarmann, "Accelerating Innovation with Generative AI: AI-augmented Digital Prototyping and Innovation Methods," IEEE Engineering Management Review, pp. 1-5, 2023.
11. IBM, "What is Generative AI," 2023. [Online]. Available:https://research.ibm.com. [Accessed 14 5 2023].
12. BCG, "Generative AI," BCG, US, 2023.
13. W. Guangjing, Z. Ce and Y. Qiben, "A Comprehensive Survey on Pretrained Foundation Models: A History from BERT to ChatGPT," arXiv, 2023.
14. OpenAI, "OpenAI," 2023. [Online]. Available: https://openai.com/blog/introducing-openai/. [Accessed 8 February 2023].
15. G. Hurlburt, "What If Ethics Got in the Way of Generative AI?," IT Professional, vol. 25, no. 2, pp. 4-6, 2023.
16. T. Susnjak, "ChatGPT: The End of Online Exam Integrity?," 2022.
17. R. K. Michael, "A Conversation on Artificial Intelligence, Chatbots, and Plagiarism in Higher Education," Springer, 2023.
18. A. Vaswani, N. Shazeer, N. Parmar, J. Uszkoreit, L. Jones, A. N. Gomez, Ł. Kaiser and I. Polosukhin, "Attention is all you need, Advances in neural information processing systems," p. 5998–6008, 2017.
19. X. Zhai, "ChatGPT User Experience-Implications for Education," no. SSRN: https://ssrn.com/abstract=4312418 or http://dx.doi.org/10.2139/ssrn.4312418, 2022.
20. K.-M. L. Gabrielle, "Perspectives on the Social Impacts of Reinforcement Learning with Human Feedback," arXiv, 2023.
21. C. Lamanna, "Introducing Microsoft Dynamics 365 Copilot, the world's first copilot in both CRM and ERP, that brings next-generation AI to every line of business," 2023. [Online].

Available: https://blogs.microsoft.com/blog/2023/03/06/introducing-microsoft-dynamics-365-copilot/. [Accessed 17 06 2023].
22. S. Upanishad, "20 Best ChatGPT Alternatives (Free and Paid)," 2023. [Online]. Available: https://beebom.com/best-chatgpt-alternatives/. [Accessed 22 06 2023].
23. Salesforce-Einstein, "Say hello to Einstein GPT.," 2023. [Online]. Available: https://www.salesforce.com/products/einstein/overview/. [Accessed March 2023].
24. M. Timothy, "The 6 Best Alternatives to ChatGPT," 2023. [Online]. Available: https://www.makeuseof.com/best-alternatives-chatgpt/. [Accessed 23 4 2023].
25. E. Commission, "digital economy,," 2023. [Online]. Available: Digital economy | European Foundation for the Improvement of Living and Working Conditions (europa.eu) [Accessed 17 05 2023].
26. S. Niharika, "Microsoft and Columbia Researchers Propose LLM-AUGMENTER: An AI System that Augments a Black-Box LLM with a Set of Plug-and-Play Modules," 2023. [Online]. Available: https://www.marktechpost.com/2023/03/05/microsoft-and-columbia-researchers-propose-llm-augmenter-an-ai-system-that-augments-a-black-box-llm-with-a-set-of-plug-and-play-modules/. [Accessed March 2023].
27. UNCTAD, "Digital Economy Report 2021 - Cross-border data flows and development:For whom the data flow," 2021. [Online]. Available: https://unctad.org/system/files/official-document/der2021_en.pdf.. [Accessed 17 05 2023].
28. L. D. Williams, "Concepts of Digital Economy and Industry 4.0 in Intelligent and Information Systems," International Journal of Intelligent Networks, 2021.
29. D. Malta, "What is digital economy?," 2021. [Online]. Available: https://www2.deloitte.com/mt/en/pages/technology/articles/mt-what-is-digital-economy.html.
30. Thebrainyinsight, "Generative AI market," 24 12 2022. [Online]. Available: https://www.thebrainyinsights.com/report/generative-ai-market-13297. [Accessed 30 8 2023].
31. Australian Government,, "Adoption of AI in the public sector," 2023. [Online]. Available: https://www.architecture.dta.gov.au/ ; Accessed on 15th May 2023. [Accessed 5 10 2023].
32. A. Radford, K. Narasimhan, T. Salimans and I. (. 1. 2. ". Sutskever, "Improving Language Understanding by Generative Pre-Training," 2018.
33. C. Rosset, "Turing-NLG: A 17-billion-parameter language model by Microsoft," 2020. [Online]. Available: https://www.microsoft.com/en-us/research/blog/turing-nlg-a-17-billion-parameter-language-model-by-microsoft/.
34. B. Sterling, "Web Semantics, Microsoft Porject, Turing Natural Language Generation," 2020.
35. Z. Ghahramani and E. Collins, "LaMDA: our breakthrough conversation technology," 2021. [Online]. Available: https://blog.google/technology/ai/lamda/.
36. S. Pichai, "An important next step on our AI journey," 2 March 2023. [Online]. Available: https://blog.google/technology/ai/bard-google-ai-search-updates/.
37. Ming Liang Ng, " Common Misconceptions about ChatGPT: Unraveling the Truth Behind Large Language Models," 2023. [Online]. Available: https://www.linkedin.com/pulse/6-common-misconceptions-chatgpt-unraveling-truth-behind-ming-liang-ng/. [Accessed 30 06 2023].
38. W. Jiao, W. Wang, J. Huang, X. Wang and Z. Tu, "Is ChatGPT a good translator? A preliminary study," vol. https://wxjiao.github.io/downloads/tech_chatgpt_arxiv.pdf, 2023.
39. S. Lakshmisri, "ARTIFICIAL INTELLIGENCE IN PUBLIC SECTOR," INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY, 2019.
40. H. Mehr, H. Ash and D. Fellow, "Artificial intelligence for citizen services and government," Ash Center for Democratic Governance and Innovation: Harvard

Kennedy, 2017.

41. A. U. Kobilov, D. P. Khashimova, S. G. Mannanova and M. M. O. Abdulakhatov, "Modern Content and Concept of Digital Economy," International Journal of Multicultural and Multireligious Understanding, no. http://dx.doi.org/10.18415/ijmmu.v9i2.3524, 2022.
42. IMF, "International Monetary Fund. Annex to chapter 6: Classification of the functions of government (COFOG). Government Finance Statistics Manual, 2001.," https://www.imf.org/external/pubs/ft/gfs/manual/pdf/ch6ann.pdf, 2001.
43. D. Rotman, "ChatGPT is about to revolutionize the economy. We need to decide what that looks like. AI – MIT Technology Review," 2023. [Online]. Available: https://www.technologyreview.com/2023/03/25/1070275/chatgpt-revolutionize-economy-decide-what-looks-like/. [Accessed 22 06 2023].
44. D. Thompson and D. Alan, "Leta, GPT-3 + WebGPT AI - Episode 38 (WebGPT questions, truth, fact-checking) - Talk with GPT3," https://www.youtube.com/watch?v=tcicL5IbeAo, 2022.
45. Y. Thomas, D. Au, C. A. Chi and Y. I. Kwan, "Democratizing Financial Knowledge with ChatGPT by OpenAI: Unleashing the Power of Technology," SSRN, 2023.
46. Y. Thomas and A. C. Chung, "GPTQuant's Conversational AI: Simplifying Investment Research for All," SSRN, 2023.
47. A. Zaremba and E. Demir, "ChatGPT: Unlocking the Future of NLP in Finance," SSRN, 2023.
48. S. Ghoche, "3 Things ChatGPT Needs Before it Can be Deployed in Customer Service," 31 December 2022. [Online]. Available: https://www.linkedin.com/pulse/3-things-chatgpt-needs-before-can-deployed-customer-service-ghoche/. [Accessed 3 March 2023].
49. Kapturechat, "How chatbot can reduce the workload of customer query during the transition to work from home?," 23 April 2021. [Online]. Available: https://kapturechat.medium.com/how-chatbot-can-reduce-the-workload-of-customer-query-during-the-transition-to-work-from-home-58dae3cf0f7e. [Accessed 6 March 2023].
50. Y. Yuri, M. Aung, D. C. Wong and D. S. Ting, "The promise of artificial intelligence: a review of the opportunities and challenges of artificial intelligence in healthcare," British Medical Bulletin, 2021.
51. H. Alshurafat, "The usefulness and challenges of chatbots for accounting professionals: application on ChatGPT," Development and Learning in Organizations: An International Journal, 2023.
52. A. S. George, A. H. George and A. Martin, "A Review of ChatGPT AI's Impact on Several Business Sectors," Partners UniversalInternationalInnovationJournal, 2023.
53. A. J. Nastasi, K. R. Courtright, S. D. Halpern and G. E. Weissman, "Does ChatGPT Provide Appropriate and Equitable Medical Advice?: A Vignette-Based, Clinical Evaluation Across Care Contexts," MedRxiv, 2023.
54. L. M. Douglas, "Artificial Intelligence Discusses the Role of Artificial Intelligence in Translational Medicine: A JACC: Basic to Translational Science Interview With ChatGPT," JACC, 2023.
55. UN, "United Nations e-government survey 2012," United Nations E-Government Surve, New York, 2012.
56. A. K. Rehan, A. R. Khan, M. Jawaid and M. Sajjad, "ChatGPT - Reshaping medical education and clinical management," Pak J Med Sci, 2023.
57. G. v. Schalkwyk, "Artificial intelligence in pediatric behavioral health," Child Adolesc Psychiatry Ment Health, vol. 17, no. 38, 2023.
58. UNESCO, AI and Education - Guidance for poliymakers, Paris: UNESCO, 2021.
59. K. Enkelejda, S. Kathrin, B. Maria and D. Daryna, "ChatGPT for Good? On Opportunities and Challenges of Large Language Models for Education," 2023.
60. G. Eysenbach, "The Role of ChatGPT, Generative Language Models, and Artificial

Intelligence in Medical Education: A Conversation With ChatGPT and a Call for Papers," JMIR Publications, 2023.
61. J. Rudolph, S. Tan and S. Tan, "ChatGPT: Bullshit spewer or the end of traditional assessments in higher education?," Journal of Applied Learning & Teaching, vol. 6, no. 1, 2023.
62. O. C. Emmanuel, A. M.-E. Theresa and T. C. Aduke, "ChatGPT for Teaching, Learning and Research: Prospects and Challenges," Glob Acad J Humanit Soc Sci, vol. 5, no. 2, pp. 33-40, 2023.
63. L. Tung, "Stack overflow temporarily bans answers from OpenAI's ChatGPT chatbot," 2022. [Online]. Available: https://www.zdnet.com/article/stack-overflow-temporarily-bans-answers-from-openais-chatgpt-chatbot/.
64. D. Baidoo-Anu and L. O. Ansah, "Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning," SSRN, 2023.
65. N, Joshi, "How Artificial Intelligence can help your sales team," 04 08 2022. [Online]. Available: https://www.bbntimes.com/technology/how-ai-can-help-your-sales-team. [Accessed 07 05 2023].
66. T. Reuters, "Natural language processing (NLP) and machine learning (ML)," 2022. [Online]. Available: https://www.thomsonreuters.com/en/artificial-intelligence/natural-language-processing.html. [Accessed 14 February 2023].
67. X. Hui, "ChatGPT: The Game-Changer for the Digital Marketing Channels.," 2023. [Online]. Available: https://www.exabytes.sg/blog/chatgpt-digital-marketing-channels/. [Accessed 2023].
68. Y. K. Dwivedi, N. Kshetri, L. Hughes and E. L. Slade, ""So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," International Journal of Information Management, vol. 71, 2023.
69. A. Zarifhonarvar, "Economics of ChatGPT: A Labor Market View on the Occupational Impact of Artificial Intelligence," SSRN, 2023.
70. K. Lopez, F. S and Allam, "Reducing annotation burden through multimodal learning," Frontiers In Big Data, 2020.
71. J. P. Thiroux, Ethics: Theory and Practice (11th Edition) 11th Edition, Californnia State: Pearson, 2014.
72. WEF, "Top 9 ethical issues in artificial intelligence," 2023. [Online]. Available: https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/?DAG=3&gclid=Cj0KCQjwnf-kBhCnARIsAFlg493QB6X5gfM1ztcdPbw1MQY33mYxif6bIKDMDZybEps_Ye-3zGA_uX4aAuQYEALw_wcB. [Accessed 06 06 2023].
73. A. E. M. M. Philipp Hacker, "Regulating ChatGPT and other Large Generative AI Models", Working Paper,," Online Journal(arxiv.org), 2023.
74. S. Gururangan, S. Gehman, M. Sap, Y. Choi and N. A. Smith, "Realtoxicityprompts: Evaluating neural toxic degeneration in language models," Findings of the Association for Computational Linguistics, 2020.
75. S. Lucas, "ChatGPT gender bias: how it affects HR & tips to avoid pitfalls," 12 06 2023. [Online]. Available: ChatGPT gender bias: how it affects HR & tips to avoid pitfalls. [Accessed 29 08 2023].
76. a. P. T. 2. Jaime A. Teixeira da Silva, "Human- and AI-based authorship: Principles and ethics," Journal article in Wiley Online Library, 2023.
77. Q. Y. e. al., "The New Generation of Artificial Intelligence Technology ChatGPT Causes: Potential Legal Risk and Regulatory Countermeasures," in IEEE, proceeding of the 8th International Conference on Computer and Communication Systems, 2023.
78. A. P. C. H. J. H. &. S. L. Ten Teije, " Artificial Intelligence in Medicine," in 16th Conference on Artificial Intelligence in Medicine, AIME 2017, Vienna, Austria, 2017.
79. M. T. E. C. P. C. K. E. K. &. v. M. A. Aitken, "Establishing a social licence for financial

technology Reflections on the role of the private sector in pursuing ethical data practices.," Big Data & Society, 2020.
80. M. Pourhoseingholi and M. Hatamnejad, "Does chatGPT (or any other artificial intelligence language tools) deserve to be included in authorship list?," Journals Portal, 2023.
81. R. O. Mason, " Four ethical issues of the information age," MIS Quarterly: Management Information Systems, vol. 10, no. 1, pp. 5-12, 1986.
82. I. D. P. Authority, " OpenAI to stop using the personal information Italians community," 2023. [Online]. Available: https://www.gpdp.it/web/guest/home/docweb/-/docweb-display/docweb/9870832. [Accessed 09 6 2023].
83. T. Sun and R. Medaglia, "Mapping the challenges of artificial intelligence in the public sector: evidence from public healthcare," 2018. [Online]. Available: https://doi.org/10.1016/j.giq.2018.09.008
84. Council of the EU, "ChatGPT in the public sector – overhyped or overlooked," 2023. [Online]. Available: https://www.consilium.europa.eu/media/63818/art-paper-chatgpt-in-the-public-sector-overhyped-or-overlooked-24-april-2023_ext.pdf. [Accessed 30 6 2023].
85. P. McAleenan, "Moral responsibility and action in the use of artificial intelligence in construction," Management, Procurement and Law, vol. 173, no. 4, 2020.
86. B. Caroline, "Efficiency: What It Means in Economics, the Formula To Measure It," 2022. [Online]. Available: https://www.investopedia.com/terms/e/efficiency.asp#:~:text=The%20term%20efficiency%20can%20be,and%20all%20processes%20are%20optimized..
87. S. Yang, J. Jang, S. Ye, J. Shin, J. Han, G. Kim, S. J. Choi and M. Seo, "Towards continual knowledge learning of language models," arXive, 2021.
88. Z. Zhimin, H. Ning, F. Shi, F. Farha, Y. Xu, J. Xu, F. Zhang, Kim Kwang and R. Choo, "Artificial intelligence in cyber security: research advances, challenges, and opportunities," Artificial Intelligence Review, 2021.
89. M. Alzantot, Y. S. Sharma, A. Elgohary, B.-J. Ho, M. Srivastava and K.-W. Chang, "Generating natural language adversarial examples," in Conference on Empirical Methods in Natural Lanugage Processing, 2018.
90. B. Guo, X. Zhang, Z. Wang, M. Jiang, J. Nie, Y. Ding and Y. Wu, "How close is ChatGPT to human experts? Comparison corpus, evaluation, and detection," arXiv, 2023.
91. UAE, "UAE National Strategy for AI," 2018. [Online]. Available: https://ai.gov.ae/wp-content/uploads/2021/07/UAE-National-Strategy-for-Artificial-Intelligence-2031.pdf . [Accessed 30 06 2023].
92. OECD, "The AI wonk," 2023. [Online]. Available: https://oecd.ai/en/wonk/language-models-policy-implications. [Accessed 30 06 2023].
93. B. &. A. D. D. Lund, "Information Literacy, Data Literacy, Privacy Literacy, and ChatGPT: Technology Literacies Align with Perspectives on Emerging Technology Adoption within Communities. Social Science Research Network," Social Science Research Network, vol. 10, no. 2139, pp. 1-15, 2023.
94. A. M. Saghiri, S. M. Vahidipour, M. R. Jabbarpour, M. Sookhak and A. Forestiero, "A Survey of Artificial Intelligence Challenges: Analyzing the Definitions, Relationships, and Evolutions," Multidisciplinary Digital Publishing Institute (MDPI), 2022.
95. D. Priyanka, "Is ChatGPT dangerous for humanity?," 2023. [Online]. Available: http://timesofindia.indiatimes.com/articleshow/98471105.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst&pcode=461.
96. Cuelogic, "AI optimism and the Race for the Talent," 23 5 2019. [Online]. Available: https://www.cuelogic.com/blog/ai-optimism-and-talent. [Accessed 30 8 2023].
97. J. F. L. L. Chen Chen, "A Pathway Towards Responsible AI Generated Content," Online

Journal(arxiv.org), 2023.
98. B. M. T. a. Y. Seo, "OpenAI CEO calls for global cooperation to regulate AI," 2023. [Online]. Available: https://edition.cnn.com/2023/06/09/tech/korea-altman-chatgpt-ai-regulation-intl-hnk/index.html. [Accessed 30 06 2023].
99. A. Azaria, "ChatGPT usage and limitations. PrePrint," vol. DOI: 10.13140/RG.2.2.26616.11526, 2022.
100. J. Hartmann, J. Schwenzow and M. Witte, "The political ideology of conversational AI: Converging evidence on ChatGPT's pro-environmental, left-libertarian orientation.," arXiv, 2023.
101. S. Ortiz, "What is ChatGPT and why does it matter? Here's what you need to know," 2022. [Online]. Available: https://www.zdnet.com/article/what-is-chatgpt-and-why-does-it-matter-heres-what-you-need-to-know/.
102. The-Economist, ""An understanding of AI's limitations is starting to sink in"," 2020. [Online]. Available: https://www.economist.com/technology-quarterly/2020/06/11/an-understanding-of-ais-limitations-is-starting-to-sink-in. [Accessed 14 February 2023].
103. I. Polosukhin, L. Kaiser, A. N. Gomez, L. Jones, J. Uszkoreit, N. Parmar, N. Shazeer and A. Vaswani, "Attention Is All You Need," 2017.
104. N. S. Alkhatri, N. Zaki, E. Mohammed and M. Shallal, "The Use of Data Mining Techniques to Predict the Ranking of E-Government Services," IEEE, 2016.
105. IMF, "International Monetary Fund. Government Finance Statistics Manual 2014," https://www.imf.org/external/Pubs/FT/GFS/Manual/2014/gfsfinal.pdf, 2014.
106. A. Radford, W. Jeffrey, C. Rewon, L. David and A. Dario, "Language Models are Unsupervised Multitask Learners," 2019.
107. M. M. Mijwil, M. Aljanabi and A. H. Ali, "ChatGPT: Exploring the Role of Cybersecurity in the Protection of Medical Information," Mesopotamian journal of Cybersecurity, 2023.
108. R. João, S. Paula Espírito and N. Melão, "Impacts of Artificial Intelligence on Public Administration: A Systematic Literature Review," 19 – 22 June 2019, Coimbra, Portugal, 2019.
109. Y. Deborah, "Deloitte's AI chief: How to get better results from AI deployments," 28 October 2022. [Online]. Available: https://aibusiness.com/verticals/deloitte-s-ai-chief-how-to-get-better-results-from-ai-deployments. [Accessed 5 March 2023].
110. M. Sullivan, "Salesforce's Einstein GPT may be the most meaningful application of AI chatbots yet," 2023. [Online]. Available: https://www.fastcompany.com/90862354/salesforces-einsteingpt-may-be-the-most-meaningful-application-of-ai-chatbots-yet.
111. C. Wiklund, "4 Ways Leaders Can Overcome The Hidden Challenges Of Adopting AI," 2023. [Online]. Available: https://www.forbes.com/sites/forbestechcouncil/2023/03/07/4-ways-leaders-can-overcome-the-hidden-challenges-of-adopting-ai/?sh=4578ea067bb2.
112. B. Al-Mosalam and M. Halal, "Digital Dispute Settlement Provides Appropriate Environment for Saudi Private Sector," 2023. [Online]. Available: https://english.aawsat.com/home/article/4197811/digital-dispute-settlement-provides-appropriate-environment-saudi-private.
113. W. E. Mackay, J. Shawe-Taylor and F. v. Harmelen, "Human-Centered Artificial Intelligence," 2022.
114. A. Gangopadhyay and S. Mallik, "PROACTIVE AND REACTIVE ENGAGEMENT OF ARTIFICIAL INTELLIGENCE METHODS FOR EDUCATION: A REVIEW," arXiv, 2023.
115. M. Cheatham, T. H. Kung and A. Medenill, "Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models," Plos Digital Health, 2023.
116. M. Ghobakhloo, "Industry 4.0, digitization, and opportunities for sustainability," Journal of Cleaner Production, 2019.
117. F. Jiang, J. Y and Z. H, "Artificial intelligence in healthcare: past, present and future," 2017. [Online]. Available: http://www.ncbi.

nlm.nih.gov/pubmed/29507784..
118. K. Johnson, T. S. J and G. BS, "Artificial intelligence in cardiology. J Am Coll Cardiol," 2018. [Online]. Available: https://doi.org/10.1016/j.jacc.2018.03.521K.
119. McGuffie and A. Newhouse, "The radicalization risks of gpt-3 and advanced neural language models," arXive, 2020.
120. L. Weidinger, M. R. J. Mellor, C. Griffin, J. Uesato, P.-S. Huang, M. Cheng, M. Glaese and A. K. B. Balle, "Ethical and social risks of harm from language models," arXiv preprint, 2021.
121. N. Carlini, F. Tramer, E. Wallace, M. Jagielski, A. Herbert-Voss, K. Lee, A. Roberts, T. B. Brown, D. Song and U. Erlingsson, "Extracting training data from large language models.," in USENIX Security Symposium, 2021.
122. P. P. Liang, C. Wu, L.-P. Morency and R. Salakhutdinov, "Towards understanding and mitigating social biases in language models," in International Conference on Machine Learning, 2021.
123. Q. Guo, L. Li, R. Ma, X. Xue and X. Qiu, "Bertattack Adversarial attack against bert using bert," in Conference on Empirical Methods in Natural Language Processing, 2020.
124. S. Luccioni, Z. Talat, A. N´ev´eol, S. B. M. Clinciu, M. Dey, S. Longpre, M. Masoud, M. Mitchell and D. Radev, "You reap what you sow: On the challenges of bias evaluation under multilingual settings," in BigScience: Workshop on Challenges & Perspectives in Creating Large Lanugauge Models, 2022.
125. T. Y. Zhuo, Y. Huang, C. Chen and Z. Xing, "Exploring AI Ethics of ChatGPT: A Diagnostic Analysis," arXive, 22 February 2023.
126. M. Timothy, "The 6 Best Alternatives to ChatGPT," 2023. [Online]. Available: https://www.makeuseof.com/best-alternatives-chatgpt/. [Accessed March 2023].
127. N. Arya, "What is Google AI Bard?," 2023. [Online]. Available: https://www.kdnuggets.com/2023/03/google-ai-bard.html. [Accessed March 2023].
128. S. Upanishad, "20 Best ChatGPT Alternatives (Free and Paid)," 2023. [Online]. Available:https://beebom.com/best-chatgpt-alternatives/. [Accessed 2023].
129. C. Lamanna, "Introducing Microsoft Dynamics 365 Copilot, the world's first copilot in both CRM and ERP, that brings next-generation AI to every line of business," 2023. [Online]. Available: https://blogs.microsoft.com/blog/2023/03/06/introducing-microsoft-dynamics-365-copilot/. [Accessed March 2023].
130. W. Hu and Y. Tan, "Generating adversarial malware examples for black-box attacks based on GAN," arXive, 2017.
131. Subhajit Basu, "E-Government and Developing Countries: An Overview," International Review of Law Computers & Technology,, Vols. 18, NO.1,, 2004.
132. A. Government, "Adoption of AI in the public sector," 2023. [Online]. Available: https://www.architecture.dta.gov.au/. [Accessed 15 05 2023].
133. V. R, "The role of artificial intelligence in achieving the Sustainable Development Goals," Nature Journal, vol. 11, no. 233, 2022.
134. P. N. Singh, "The Digital Economy," 2003. [Online]. Available: https://people.ucsc.edu/~boxjenk/Digital_Economy.pdf. [Accessed 17 5 2023].
135. Salesforce-Einstein, "Say hello to Einstein GPT.," 2023. [Online]. Available: https://www.salesforce.com/products/einstein/overview/. [Accessed 22 06 2023].
136. G. Hurlburt, "What If Ethics Got in the Way of Generative AI?," IT Professional, vol. 25, no. 2, pp. 4-6, 2023.
137. Commission, European, "digital economy 1," 2023. [Online]. Available: www.eurofound.europa.eu/observatories/eurwork/industrial-relations-dictionary/digital-economy. [Accessed 15 5 2023].
138. EU, EU AI Act, 2023, web-link: Artificial Intelligence Act: deal on comprehensive rules for trustworthy AI | News | European Parliament (europa.eu); Accessed on 9th Dec, 2023

@dcorg | www.dco.org