СТОПАНСКА АКАДЕМИЯ „Д. А. ЦЕНОВ“ – СВИЩОВ

СЪЮЗ НА УЧЕНИТЕ В БЪЛГАРИЯ – КЛОН СВИЩОВ

Международна научна конференция

ПРОБЛЕМИ И ПРЕДИЗВИКАТЕЛСТВА ПРЕД ИКОНОМИЧЕСКИТЕ НАУКА И ОБРАЗОВАНИЕ ПРЕЗ XXI ВЕК

Свищов, 22 ноември 2024 г.

Сборник с доклади

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БАРИЕРИ ПРЕД ОТВОРЕНИТЕ ИНОВАЦИИ В МАЛКИТЕ И СРЕДНИТЕ ПРЕДПРИЯТИЯ
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POSITIVE ASPECTS AND CHALLENGES OF GENERATIVE ARTIFICIAL INTELLIGENCE APPLICATIONS

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Abstract: *The boom sparked by the emergence of the ChatGPT application in November 2022 triggered the race between tech giants around the world for capital investments in graphics accelerators and data centers. The paper aims to take a snapshot of the current state, development forecasts, advantages and hidden risks of the today's most popular generative artificial intelligence (GenAI) solutions. To achieve this goal, statistical analyses of the rate of implementation of GenAI solutions were used.*

Key words*: Generative Artificial Intelligence Applications, GenAI*
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1. Introduction

Over the past two years, the global artificial intelligence industry has been developing at an accelerated pace. According to various forecasts, in 2024, the production and distribution of software, hardware and services with artificial intelligence will amount to $ 184 billion (35% more than last year), reach $ 632 billion in 2028 and grow to a value of almost 830 billion dollars by 2030. (Statista Inc., 2024). The creation and deployment of AI systems will grow by an average of 29% per year, thanks mainly to generative artificial intelligence (GenAI), with the largest market share being machine learning, natural language processing and robotic solution management software (IDC Corporate, 2024). Users of such technologies will increase by approximately 70 million per year, reaching almost 730 million at the end of the current decade, up from 315 million this year (AltIndex, 2024).

In addition to the market growth of the industry, the cited studies also take into account the impact of artificial intelligence on global economic growth. The potential contribution of technology to the share of global GDP in the form of improved productivity, simplified business processes, reduced costs and new products and services created by 2030 is expected to be from 8.81% to 11.41%. North America will report the greatest impact of artificial intelligence systems (up to 10.5%), Europe will have a similar increase (9.7%), and Asian GDP will grow by 6.7% (Statista Inc., 2024).

2. The Boom of Generative Artificial Intelligence

This year, the widespread adoption of generative artificial intelligence technology has entered a critical phase of evaluating the profitability of such investments. According to IDC analysts, the largest investments in such solutions are made by business organisations in the financial, ICT and retail sectors

(approximately 45% of global sales), which are looking to improve their competitiveness and operations, and global spending on GenAI will grow by 59.2% per year, reaching $202 billion by 2028 (IDC Corporate, 2024). In a 2023 report, analyst firm McKinsey estimates that the use of GenAI could add up to $4.4 trillion annually to global GDP, increasing the overall impact of artificial intelligence technology by 15% to 40% (McKinsey & Company, 2023).

Such forecasts continue to attract funding to manufacturers of generative artificial intelligence systems, which in 2024 alone is $31.7 billion - 80% for companies in the United States versus 20% for companies in Europe and Israel (Accel Inc., 2024). About $25 billion has been invested in private GenAI companies in the U.S. (mainly OpenAI, Anthropic and xAI), while in Europe, $6.4 billion has been invested in Mistral, Aleph Alpha and DeepL. However, funding in the Old Continent is growing at a faster pace, as in 2023 investments in generative artificial intelligence in Europe were only $2.4 billion, compared to $22.4 billion overseas.

Generative AI is already here, and business organizations around the world are enthusiastically using and investing in the technology. According to the results of the global survey by Coleman Parkes Research Ltd. on the implementation rate of GenAI solutions by country and region, 83% of Chinese, 70% of British, 65% of American and 63% of Australian organizations use such solutions in their operations (SAS Institute Inc., 2024). The ranking by region recorded the highest use and implementation of GenAI in the processes of business organizations from North America (20%), the most implemented policies for the use of GenAI in the Asia-Pacific region (71%) and the availability of a dedicated budget for investing in GenAI again in the Asia-Pacific region (94%). Analysis by industry segment shows that banking and insurance are leading the way in terms of incorporating GenAI into day-to-day business operations.

GenAI software applications create text, code, images, audio, and video based on user prompts, powered by large language models (LLMs) that are trained on vast amounts of data from private and public information sources. A list of the currently most polar artificial intelligence programs for content generation is shown in Table 1:

Table 1. Popular Artificial Intelligence Applications for Content Generation.

Application	Language model or platform with powered content	Manufacturer
ChatGPT	GPT-4o	OpenAI
Gemini	Gemini Ultra	Google Deep Mind
Copilot	GPT-4o	Microsoft
Meta AI	Llama 3.1	Meta Platforms
Ernie Bot	Ernie 4.0	Baidu
Claude 3	Claude	Anthropic
Mistral 7B	Mistral	Mistral AI

Grok	Grok-1	x.AI
watsonx Assistant	watsonx Large Language Models	IBM
Apple Intelligence	AXLearn framework	Apple
PanGu Chat	Pangu	Huawei
Doubao	Doubao	ByteDance
BgGPT	GPT-3	INSAIT
GitHub Copilot	OpenAI Codex	OpenAI
DALL-E	GPT-3	OpenAI
Midjourney	Midjourney image generation platform	Midjourney
Stable Diffusion	Stable Diffusion model	OpenArt
Adobe Firefly	Adobe's Sensei platform	Adobe
MusicLM	MusicCaps dataset	Magenta Studio
MusicGen	Single Language Model	Meta Platforms
Sora	Sora text-to-video generating model	OpenAI
Runway AI	Gen-3 Alpha	Runway
Make-A-Video	Database of images with descriptions	Meta Platforms
Tongyi Qianwen	Qwen	Alibaba
Yuanbao	Hunyuan	Tencent

Source: Author's systematization.

Language models and platforms with content powering GenAI applications are now being created not only by manufacturers of information hardware and software but also by individual countries. Countries such as Japan, Saudi Arabia and others want to have their own generative artificial intelligence that speaks their language and knows their culture. Governments see national artificial intelligence hardware infrastructure and language models as a way to strengthen national security as the latter will be personalised according to the unique political, economic, cultural and scientific characteristics of the respective country (Bajwa, 2024).

Generative artificial intelligence hardware is also a trend in the current 2024. Manufacturers of computers, smartphones, original equipment and chips have started a new cycle of upgrading their apparatus solutions. Apple, Dell, HP Development Company, Lenovo, ASUSTeK Computer, Intel Corp., Advanced Micro Devices, NVIDIA Corp., Acer Inc. and Microsoft have launched initiatives to develop and sell AI PCs and GenAI smartphones. In addition to standard CPUs and GPUs, NPUs (neural processing units) are built into computers and phones with artificial intelligence, providing faster and more productive work with language models. At present, personal programming assistants and smaller language models work on this principle, which use data locally stored in computers to optimize standard user activities and operations (McEntegart, 2024).

3. Challenges of GenAI Applications

The study cited in the previous paragraph by Coleman Parkes Research Ltd. on the rate of implementation of GenAI solutions around the world also outlines the main obstacles that business organizations face in this process (SAS Institute Inc., 2024):

- Lack of a clear organizational strategy for the implementation of such solutions.
- Lack of sufficient data to fine-tune the LLM.
- Lack of appropriate tools for the successful implementation of AI technology.
- Insufficient privacy and security of organizational data.
- Unpreparedness to comply with upcoming regulations for the development and distribution of AI systems.
- Failure to comply with the rules in the current legislation on the development and dissemination of artificial intelligence systems.
- Lack of employees trained in GenAI application management.
- Lack of a reliable system for measuring the risks of bias and personal data privacy in LLMs, etc.

Due to the ongoing boom around generative artificial intelligence technology, technological companies do not stop investing billions in it, expecting it to lead to a jump in productivity or bring them significant financial revenues. Building massive data centres capable of handling the resource-intensive functioning of GenAI applications that largely exist in the cloud today requires huge capital expenditures, which are often paid for with financial leases[1]. In 2025, Google, Alphabet, Microsoft and Meta Platforms are expected to make capital expenditures totalling 160 billion dollars, reaching 2 trillion dollars in the next four to five years (Mak, 2024). The projected amounts raise the question of how sustainable and with positive returns such a level of investment in GenAI applications is.

In addition to the challenge of finding land for their new data centres, generative artificial intelligence manufacturers are also struggling to provide enough electricity to power and cool the chips in them. GenAI's electricity consumption has skyrocketed over the past year[2], which is why its harm to the environment may outweigh the benefits of sustainability. To mitigate the socio-

[1] To secure additional computing capacity and energy resources, Microsoft, for example, entered into cloud partnerships with third parties (CoreWeave and Oracle), signed contracts to purchase electricity from a restarted nuclear reactor at the Three Mile Island nuclear plant, and purchased hundreds of new servers with Nvidia GPUs (NBC News, 2024).

[2] Each ChatGPT query, for example, consumes approximately 2.9 Wh of electricity, almost ten times more than a standard Google search, and the chatbot's annual power consumption for prompt processing of 226.8 GWh can power all of Finland or Belgium in a single day, keep Ireland running for more than two days, fully charge about 3.13 million electric vehicles, or 47.9 million iPhone 15 (Hoffman, 2024).

economic and environmental impacts of the technology, manufacturers of such solutions can already foresee the use of closely located renewable energy sources and algorithms to optimise their performance in terms of emissions and computing power required at an early stage of their life cycle. An innovative method to reduce the power consumption of artificial intelligence applications by 95%, called Linear-Complexity Multiplication or L-Mul, was recently introduced by the company BitEnergy AI (Shavit, 2024).

Another major risk of generative artificial intelligence applications is their level of vulnerability to cyberattacks. While no major security breaches have been detected in business organizations' private language models by criminal hacking individuals or groups, third-party service providers, automated botnets, and competitors, GenAI solutions can be successfully used to improve quality issues (poor grammar or inaccurate information) of various phishing and ransomware campaigns, to spread disinformation, to thwart elections, to incite public disorder and to fraudulent audio or video deep fakes. Threats in development are the ambiguity on which datasets the LLMs underlying popular GenAIs are trained, the use of these models to hack websites, as well as the ability to generate malicious program code on demand from users.

Many users of GenAI applications also overlook the data privacy aspects that the latter have access to. Intentional or accidental leakage of user data from publicly available (ChatGPT, Gemini, Copilot, Apple Intelligence) or private LLMs[3] can expose them to a serious vulnerability. Different GenAI solutions have different privacy policies regarding the storage, use, and control of the data collected. While their manufacturers ensure that they do not share information with third parties without permission and do not use customer data to train their models, it is recommended that artificial intelligence tools are not trained on sensitive organizational data.

To address security and privacy challenges, generative artificial intelligence applications manufacturers are making voluntary commitments to create safe, ethical and trustworthy solutions through means of watermarking their content, internal and external security testing of AI systems before their release, sharing information across the industry and with governments, civil society and academia on managing AI risks, etc. (Crouse, 2023). A tool to check whether popular generative artificial intelligence models comply with European regulations on cyber-resilience and the presence of discriminatory bias in GenAI applications was developed by the INSAIT Institute, the Swiss polytechnic ETH Zurich and the company LatticeFlow AI in October 2024. (LatticeFlow AG, 2024).

[3] The first ChatGPT data breach on March 24, 2024, for example, exposed online information about about 1.2 million people over a nine-hour period (Nicastro, 2023).

4. Conclusion

In search of better production and financial results, business organizations around the world have begun to build their strategies for implementing and using artificial intelligence systems, transforming employee experience, customer interactions, business processes and innovations in the industry. The continuous production and deployment of hardware and software tools to improve human-machine interaction removes barriers to large-scale adoption of the artificial intelligence paradigm. The integration of GenAI applications into the business processes of organizations with different fields of activity offers new opportunities for efficiency, personalization, strategic forecasting and maintaining competitiveness, but also hides different types of challenges of an informational, social and financial nature.

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