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AI AND FACILITY MANAGEMENT: APPLICATION AREAS AND POTENTIAL IMPACT

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Abstract

Over the last decade, the awareness of Artificial Intelligence (AI) as a seemingly limitless fountain of technological advance and indescribable potential has risen in economic research and business. While its usage is getting increasingly sophisticated among various industries, the concrete application of AI in facility management (FM) remains relatively unclear. As this holistic technology consortium is getting more and more into focus of corporate real estate (CRE) and FM research, the purpose of this study is to examine the main fields of practical application in FM. Furthermore, it strives to explore the operational impact of AI on FM as an economic discipline as well as to determine the significance of single areas of application. The questions of research are therefore what potential usages this auspicious technology offers for FM and how these respective influences can be quantified. To answer this, a comprehensive literature analysis is conducted. By focusing on current CRE and FM literature, also existing information systems (IS) research is taken into consideration to enrich the discoveries of the built environment and asset management with digital technology insights. This implies also two case studies concerning the operation of a sports facility and a public education facility and their use cases of targeted AI utilization. Furthermore, a survey among 121 companies is conducted with detailed focus on the application areas examined in the preceding step of the research. The questioned companies were chosen by their public listing in the German CDAX index, being part of this index between the years 2013 and 2024. The electronically shared questionnaire was derived from the identified application fields and created on the basis of a 5-point Likert scale offering opportunities of statistical analysis of ordinal data. In addition to several descriptive findings, the overall impact of AI was finally measured numerically and put in relation to the single measured impact on the application fields applying Spearman's rank correlation coefficient. As a result, explicit usage can be identified in the fields of predictive maintenance, failure avoidance, decreasing operating costs, maximizing asset utilization, energy management, heating management, decision making, data analysis and building information modeling (BIM). While all application fields show a significant influence of and enabling by AI, specifically failure avoidance, the decreasing of operating costs and the maximizing of asset utilization correlate especially strongly with AI. This implies that AI already shows a strong appearance in companies with professionally operated FM and that the impact of AI is already noticeable. Future research should verify these findings by in-depth case studies among FM providers and numerical quantitative evaluations allowing more possibilities for statistical assessment.

Keywords*: facility management, facilities management, corporate real estate, CRE, artificial intelligence, AI, digitalization, information technologies, digital technologies, building information modeling*

1 INTRODUCTION

The ongoing digitization has led to an increasing transformation of the business world. Traditional car manufacturers are becoming more and more software experts, equipping their vehicles with software solutions, running engine control units, safety mechanisms or enabling autonomous driving (Gurbaxani & Dunkle 2019). Theme parks are augmenting their experience promise with virtual reality programs to offer a new form of entertainment (Gurbaxani & Dunkle 2019). Financial institutions are utilizing machine learning to identify fraudulent behavior of customers (Akter et al. 2022). The rise of Netflix and Airbnb document the success of purely digital companies without having any own physical assets. All these examples demonstrate that the digital transformation is of the utmost importance for traditional as well as novel companies while it provides opportunities and threats at the same time (Akter et al. 2022).

Artificial Intelligence (AI) in particular is one major driver of this transformational process, offering immense potential across diverse industrial sectors by enabling the reinvention of business models, improvements respective performance

and productivity as well as the alteration of existing processes (Collins et al. 2021). This potential becomes undeniable by considering the enormous increase in scientific and public attention over the last years and ubiquity in practice by taking organizational achievements in terms of flexibility gains, speed increases and innovation into account (Borges et al. 2021).

While this diffusion of digital technologies happens with different intensity and pace in dependency of the specific parameter of the industry, also the facility management (FM) sector is increasingly adopting and using these for its own transformation. Formerly known as a very traditional, technology-adverse industry, it applies more and more technologies like Building Information Modeling (BIM), Internet of Things (IoT) technologies and Geographic Information Systems (GIS) to revolutionize its processes and domain as a whole (Wong, Ge & He 2018). This demonstrates that even a strongly asset-dependent and manual sector like FM embraces the possibilities of digitization and is able to gain added value by doing so. Especially the chances of AI are recently of tremendous scientific interest which can be observed by an exponentially rising number of scientific publications concerning AI usage in FM over the last few years (Abdelalim et al. 2025). It is also mentionable that these contemporary researches do not restrict their perspective on single buildings but intend to predict how whole fully digitized cities may look alike in the future (Hou 2023).

As we a currently still lacking a common understanding of AI, its concrete application fields and monetary impact, specifically in the case of FM, it is crucial to close this gap of research (Akter et al. 2022). These scientific findings are therefore not solely limited to FM and CRE but additionally augment the understanding of AI in information systems (IS) research.

The reasoning for this article is to identify the possible application fields of AI and its potential impact for companies which operate FM in a professional manner. To achieve this, a comprehensive literature analysis will be conducted followed by primary research in form of a survey and consecutive statistical evaluation.

The added value of this paper is the combination of the current usage of AI in FM practice with both scientific and practice findings. The purpose is to identify the main levers as well as their standalone significance. Plausibility will be ensured by deriving the survey elements from already existing findings of FM research.

2 PROBLEM FORMULATION AND QUESTION OF RESEARCH

AI poses a global phenomenon which is increasingly adopted by various industries, institutions and the private public. Despite country-specific differences regarding the pace of diffusion due to willingness to trust and cultural issues, the fast spreading and comprehensive utilization of this consortium of different digital technologies can be described as a global phenomenon (UQ 2023). This can be observed distinctly by evaluating the market size for AI solutions shown in figure 1 (Next Move Strategy Consulting 2023). Starting with a volume of 100,000 million USD in 2021, this number is estimated to increase to above 1,800,000 million USD in the year 2030 (Next Move Strategy Consulting 2023). This development demonstrates the tendency of increasing diffusion and monetary significance of AI as well as a rising acceptance among companies.

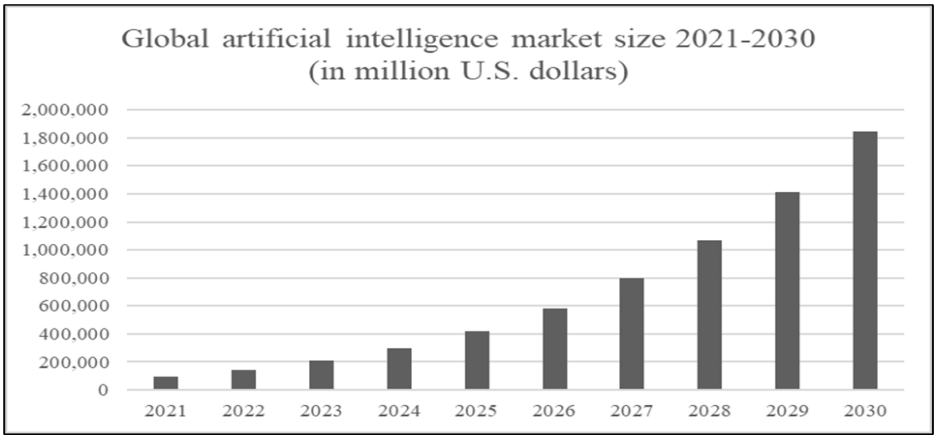

Figure 1 Global AI market size 2021 - 2030

Simultaneously, the architecture, engineering and construction (AEC) industry is currently experiencing an uprise in terms of digitization. Having an estimated percentage of 13 – 15% of the global GDP, it has been in the focus for digitization approaches over years, mainly in concern of the Industry 4.0 agenda (Pan & Zhang 2021). A higher degree of automation, reduction in costs, increase of safety and elimination of risks can be named as the most promising goals in this context (Pan & Zhang 2021).

At the same time, FM is facing increasing awareness and attention with respect to such aspirations for automation and cost cutting (Siccardi & Villa 2023). The reason for this can be observed by looking at the financial impact of the domain. Being a part of the CRE management and AEC, the utilization costs of a facility exceed the costs of its construction tremendously, being three times higher than the building costs in average and seven times higher than the costs of the overall investment over the building's life cycle (Olimat, Liu & Abudayyeh 2023). This demonstrates that automation and digitization of processes may have a greater impact during the FM handled utilization phase than in construction or planning phase. Considering also that the life cycle costs of a facility significantly occur during the running of a building, this is even more noticeable, as 76% can be directly assigned to the utilization phase while less than a quarter can be assigned to the summation of conception, planning and demolition phase (Nävy 2018). Figure 2 illustrates this interconnection (Nävy 2018):

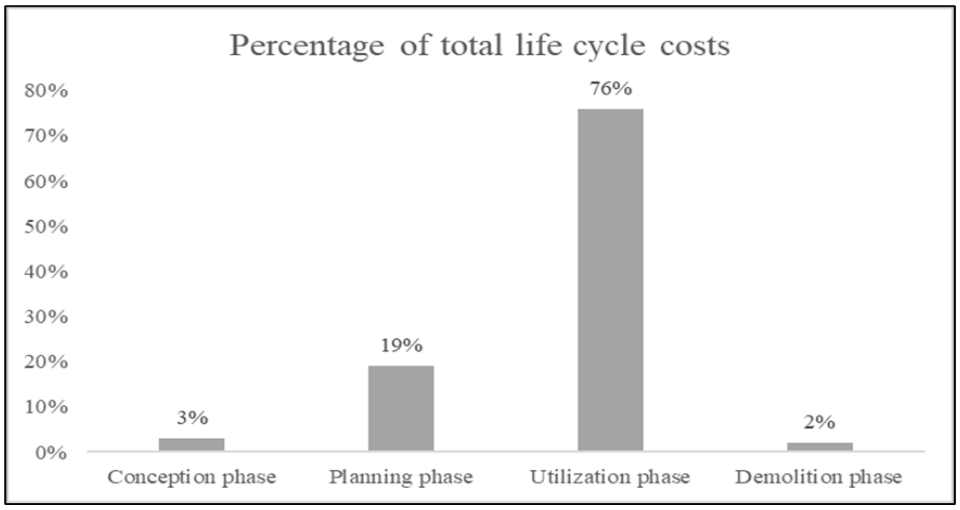

Figure 2 Building lifecycle costs throughout real estate asset phases

FM concerns itself primarily with the managing and maintaining of establishments which supports the business model of its occupying company and meets its strategic requirements in continuous interaction with the environment. This constant process often is described as very manual and labor intensive in contrast to its necessity and importance (Marzouk & Zaher 2020).

Due to this fact, AI usage is getting more and more into focus of occupiers' interest, by considering an upward trend of AI publications in FM journals (Pan & Zhang 2021). Concrete potential application fields were already identified by research regarding digital technologies in FM like energy monitoring and decision making while decisive AI application remains concealed (Marocco & Garofolo 2021). The goal of this research is therefore to identify the potential areas of usage in the highly, both from business costs and global significance point of view, relevant FM sector and the answering of these two research questions:

- What potential usages does AI offer for FM?
- How strong is the impact of AI on the single application areas?

Methodologically, this study follows an empirical approach by conducting a secondary research in form of a literature analysis and a primary research in form of a survey. The findings will be presented in the following two sections starting with a review of the existing literature.

3 LITERATURE ANALYSIS

Digital trends in FM have been in scientific interest over the last decade while the number of thematizing publications has risen exponentially (Lee, Irisboev and Ryu 2021). Explicitly in the last two years the focus shifted from observing this phenomenon from a global to a practical perspective of implementation (Siccardi & Villa 2023).

The first finding to be mentioned is the usage of AI for decision making. In accordance to numerous researchers, decision making offers a huge potential for automation by simplifying collection and processing of data (Olimat, Liu & Abudayyeh 2023). The biggest benefit of this is the gaining of improved insights by handling big data which would not be possible by a human analyst due to exponential data growth on a yearly basis (Abdelalim et al. 2025). This is particularly important for safety components of buildings like fire alarm systems or evacuation management as they are highly relevant for occupiers' health and perceived security (Elnour et al. 2022). In these cases, a quickly deciding responsible instance can preserve human lives by choosing the right action based on objective information following an effective decision-making process (Marocco & Garofolo 2021). Generally accepted term for such an AI application form can be found in practice with Smart Building Systems (Dulguun 2023).

Directly connected with this are the data analysis capabilities of AI. Concrete examples would be the localization of building components with sensors, automated search for documents or advanced visualization options for asset information (Marocco & Garofolo 2021). An enabler for this poses cyber-physical integration and Internet-of-Things (IoT) technologies. All physical objects during construction and within the facility are equipped with Radio Frequency Identification (RFID) chips constantly sending information to and receiving information from a centralized database (Hakimi, Liu & Abudayyeh 2024). As the data flow is continuously monitored by the AI, it is capable to analyze the data not even when it arrives in the global platform but already on the way to it. This poses an undeniable advantage in contrast to manually conducted analysis of data scientists limited on their working hours (Burak Gunay, Shen & Newsham 2019). Also, in times of big data and an environment of a highly data-sensitive sector like FM, this benefit may become increasingly decisive from an economic point of view (Siccardi & Villa 2023).

Another area of AI occurrence is predictive maintenance. Predicitve maintenance implies the constant monitoring of an asset to be aware of its condition in real-time and to intervene if an error or problem can be identified (Dulguun 2023). It thus transforms the former corrective and backwards-oriented procedure of fixing problems after they occur to a proactive approach, concerning the present and potential future asset status. To achieve this, sensors are attached to the devices, sending condition-related information in real time to the central database which allows the AI to proactively schedule maintenance and correction if it detects irregularities (Abdelalim et al. 2025). One practical example for this is the concrete usage of AI-driven preventive maintenance at the Hong Kong University of Science and Technology. This public educational institution has equipped four chillers serving three campus buildings with sensors measuring temperature, pressure and flow rates. While the data is directly gathered at the assets, the information is sent into an IoT sensor network which combines all data on one platform. Consecutively, this information is analyzed by the AI and set in context with a condition index based on historical information of the last years. This allows a prediction of future condition of each chiller and the scheduling of explicit inspection dates. The condition of the chillers is thereby categorized in a scale reaching from 0 (critical) to 10 (excellent) and the respective actions are undertaken by the category fitting to the observed state (Cheng et al. 2020). Figure 3 shows this categorization model autonomously developed by the AI (Cheng et al. 2020).

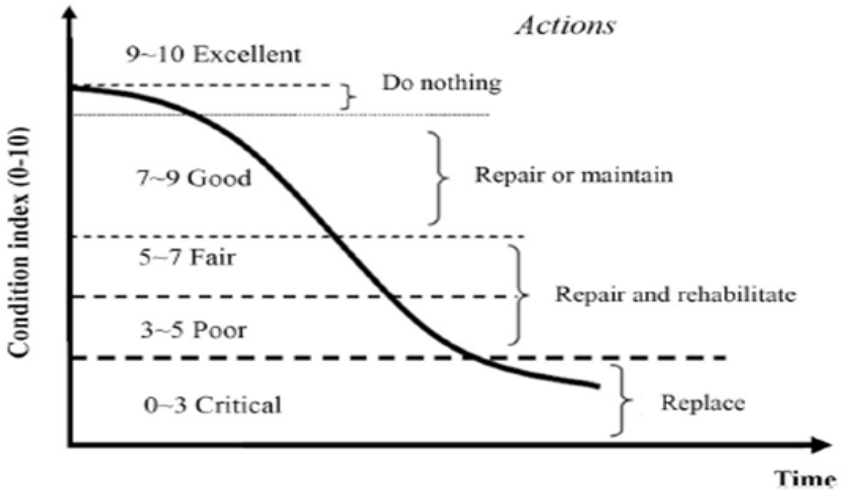

Figure 3 AI-driven condition and action matrix of Hong Kong University of Science and Technology

In connection with this, also the avoidance of failures poses a central field of AI application. The modeling of a building as a digital twin, already common in the automotive industry, enables a new form of prognostics and knowledge of physical assets (Olimat, Liu & Abudayyeh 2023). In concrete terms, the real time digital mirroring of the building with all its exterior and interior components ensures an anomaly detection which allows a view on potential future malfunctions (Hakimi, Liu & Abudayyeh 2024). In addition to this cost-savings by avoidance of failures, it is crucial for the FM sector to develop itself from being a reactive cost-driven perception in C-suite minds to a proactive adding-value institution within companies (Bröchner, Haugen and Lindkvist 2019). AI achieves this strategic transformation by creating value through less malfunctions and intelligent failure prevention which presents FM internally as a key domain to improve business finances as well as digital reputation. This could be observed as one major driver of Haynes, Nunnington and Eccles' proposed significant recognition of corporate real asset management substantiated by their 10P model as a transformational institution in companies' upper managements (2017).

Furthermore, AI is applied in heating and energy management of buildings. Especially the real-time monitoring of energy consumption offers a variety of possibilities for cost cutting and improving the environmental footprint of the organization (Marocco & Garofolo 2021). Also, the tracking of room temperature, humidity and concentration of CO^2 is beneficial for the employee comfort and productivity (Marocco & Garofolo 2021). Therefore, applying AI for energy and heating management is not only in favor of reducing costs but also in favor of the ESG score and overall success in terms of performance. This may be in best case driven by the intrinsic company mission and in worst case governmentally enforced in form of country specific climate change policies or the environmental protection agenda of the European Union (Alhamami et al. 2020). One example of such an application of AI is the Wales National Pool in the UK which introduced an AI simulation system to automatically control the heating in its public sports facility (Elnour et al. 2022). On the basis of existing data the AI system autonomously runs numerous simulations of different temperatures at different times of the day concerning the number of visitors at any time during the day. Driven by data from a BIM, the Machine-Learning (ML) model strives to identify the most energy saving approach for the facility. As a result, the energy consumption dropped by 20% and the IT investments undertaken amortized within less than 2 years after implementation. Furthermore, the model was extended to control dehumidification, air conditioning and electricity usage after recognizing its potential (Elnour et al. 2022). Figure 4 illustrates the ML model applied.

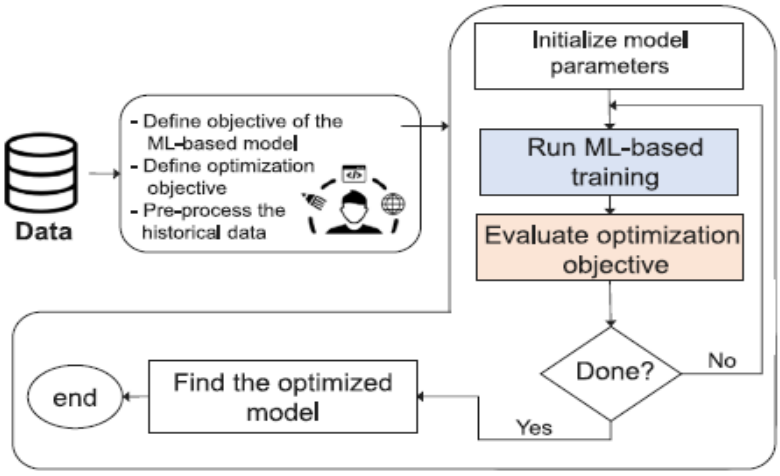

Figure 4 ML model of Wales National Pool

This example also demonstrates that the introduction of AI never happens standalone but always in interrelation with other digital technologies, like in this particular case in addition to an already existing BIM.

Moreover, another potential of AI can be the reduction of building life cycle costs. While the maintenance of an asset covers the majority of its overall costs, automating this function is an opportunity to reduce costs significantly. Possibilities could be for instance predictive management and enhanced energy efficiency which led up to 50% savings in water and energy consumption in the past (Alhamami et al. 2020). Further measures concerning also other phases of the building lifecycle can be material detection, object recognition, progress monitoring and damage detection (Marzouk & Zaher 2020).

One last identified field of application is the improved utilization of assets. Inefficient lighting or unused space waste financial liquidity and capital and thus should be eradicated. AI poses a probate counteraction as automated lighting leads to needs-based activation and reduced usage (Marzouk & Zaher 2020). Also, automated management of electrical systems and infrastructure ensures a maximum of transparency and availability (Marzouk & Zaher 2020). Transparency hereby plays a key role, as the uncertainty of office space utilization has led to inefficiencies which appeared to be unavoidable in analog times. The marginal usage of conference rooms could be named as an example (Haynes, Nunnington & Eccles 2017). AI therefore not only functions as a measure to reduce costs but also to eliminate under- and over-capacity.

In summary, the following areas of AI application in FM can be identified:

- Predictive maintenance
- Failure avoidance
- Decreasing operating costs
- Maximizing asset utilization
- Energy management
- Heating management
- Decision making
- Data analysis
- Addition to Building Information Modeling (BIM)

4 EMPIRICAL ANALYSIS

To further investigate the results of the literature analysis, comprehensive primary research is conducted in form of a survey among various publicly traded companies. This approach strives to verify or falsify the findings and to investigate if some of the application areas only can be found in theory or are exclusively applicable for single use

cases. Emphasis is put on the intensity AI is already applied in the identified fields. Furthermore, a consecutive quantitative statistical analysis of the survey ensures credibility and comparability of the single questionnaire items.

4.1 Methodology

A survey was chosen for further examination as it poses a profound method to systematically collect data from a defined population and follows exploratory purposes like it is essential for answering the specific research questions (Hammond & Wellington 2012). To achieve significance of the answers, a solid sample size of 317 companies was defined, consisting of the composition of the German CDAX index between the years of 2013 and 2024. The single companies were identified by using the Refinitiv EIKON database, formerly known as Thomson Reuters database, accessed through the institutional license of the University of Applied Sciences Ingolstadt. Furthermore, additional companies were included utilizing direct contacts of the researcher. This ensured a variety of different industries leading to a prevention of potential biases due to over- or underrepresentation of individual industrial sectors as well as reliability and reproducibility. Additionally, a qualification question pre-identified companies which perform FM activities in an organized way to prevent arbitrariness and false results. Only these companies were included in the sample while organizations without professional FM were excluded.

The questionnaire items were directly derived from the literature findings and put in context with the research questions. Therefore, the questions investigated the particular affection / enabling of specific application areas by AI and its individual impact on these areas. The single answering options were defined by a 5-point Likert scale, allowing successive analyses on a quantitative level. This has already been demonstrated in past research on the influence of Artificial Intelligence on SME (Baabdullah, Alalwan, Slade, Raman & Khatatneh 2021). It should be noted that this procedure enabled a descriptive analysis of the answers while an inferential assessment of the data is limited to ordinal statistics due to the scaling of the responses.

In a first step, the affection of / enabling by AI was questioned by asking for agreement or disagreement with respect to the single application areas, ranging from strong disagreement / -2 to strong agreement / +2. The goal was to get insights about the diffusion of AI in these distinct fields. Secondly, the impact of AI was questioned ranging from a very negative impact / -2 to a very positive impact / +2. The overall aim of this question was to ordinally quantify the impact and to enable a comparison between the single items. Thirdly, the overall impact of AI on the institutional facility management was questioned numerically, allowing an evaluation starting from 0 (no impact) to 100 (very strong impact). This step aimed primarily to enlarge the stochastic possibilities and to assess the impact of the different AI utilization opportunities more profoundly.

As a last step, Spearman rank correlations were calculated between the different application areas and the general impact on FM. This allowed to examine the collected data of the steps before and to check for robustness of the results. The coefficients were calculated in Microsoft Excel following the unchanged formula by Spearman (Spearman 1904). The Spearman rank correlation coefficient was chosen as the data was ordinally scaled which prevented a numerical analysis in form of a regression or Pearson coefficients (Stevens 1946). Only observations with p-values below 1% were considered as significant following a confidence interval of 99%. In parallel to the coefficients, the T-statistics and degrees of freedom were accordingly calculated for every single correlation.

The questionnaire was created by using the online survey tool Survey Monkey and electronically shared with the companies included in the sample. Contact information of the organizations was gathered from their homepages and social media profiles. After sending invitation mails to the companies, the contact details on their websites were used to reach for the right company representatives to answer the survey. Focus was put here on members of the management, employees of the IT department as well as representatives for organizational digital transformation. Additionally, single profiles on LinkedIn were searched for and contacted in case of refusal. The data collection took place for 3 months during the first and second quarter of 2025.

4.2 Results

Out of 317 companies included in the sample, 121 companies / 38% responded to the questionnaire. Of these 121 responses, 45 companies / 37% had professional FM operations. This shows that over one third of the organizations of the sample group undertake FM in an organized way. Figure 5 shows the single results.

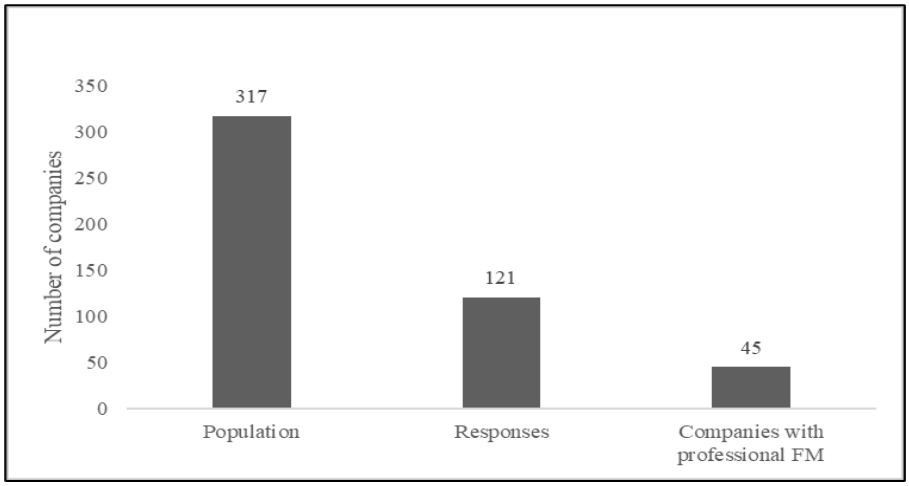

Figure 5 Number of responses

The first question is directed at the affection of / enabling of the individual application fields by AI. As a result, all areas are evaluated as being potentially affected / enabled by AI, while there is a strong agreement with the areas data analysis, energy management, asset utilization, heating management and predictive maintenance (mean > 0,85). Also, an agreement for the areas failure avoidance, BIM and decreasing operation costs can be observed (0,6 < mean < 0,85). Finally, decision making shows a low positive affection / enabling by AI (mean < 0,6). The standard deviations indicate no unusuality of the means. Worthy to mention is also the fact that there were almost no disagreements with the statements. Furthermore, decision making poses the sole application field where the most frequent answer was neutral. Figure 6 shows the distribution and figure 7 the single means and standard deviations (SD).

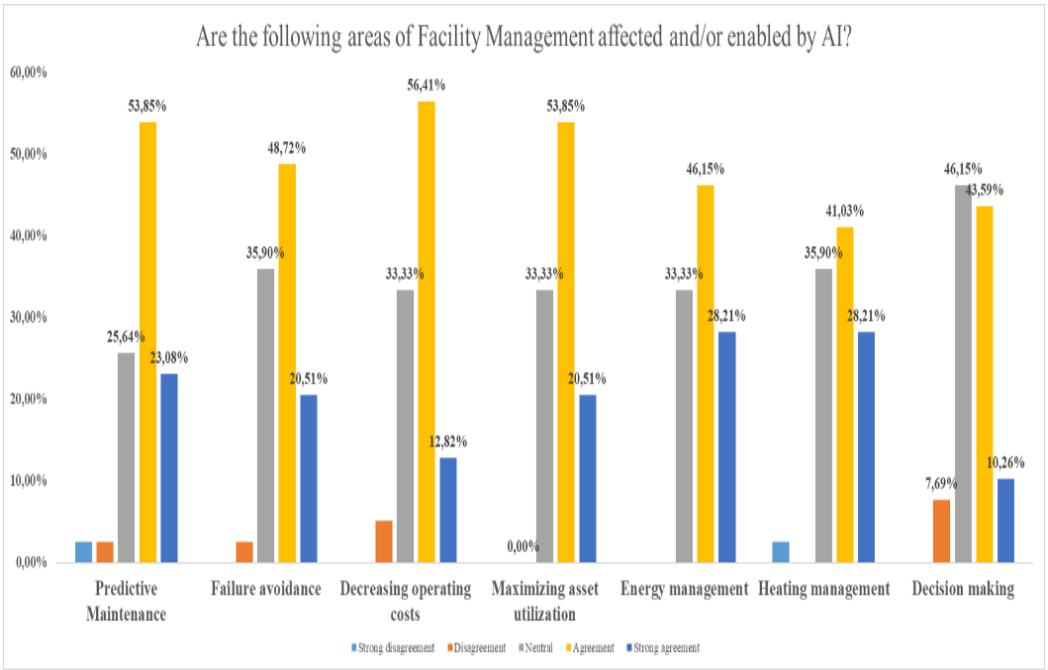

Figure 6 Affection / enabling of application areas – distribution

Indicator	Mean	SD
Predictive Maintenance	0,86	0,87
Failure avoidance	0,81	0,77
Decreasing operating costs	0,71	0,74
Maximizing asset utilization	0,88	0,71
Energy management	0,95	0,76
Heating management	0,86	0,90
Decision making	0,52	0,77
Data analysis	1,14	0,84
Building Information Modeling (BIM)	0,81	0,89

Figure 7 Affection / enabling of application areas – means & standard deviations

The second question asks directly for the perceived impact of AI on the individual field of application. Hereby, an ordinal assessment between -2 / very negative impact and +2 / very positive impact had to made. Interestingly, the results were comparable to the preceding findings, also indicating a general positive tendency while the evaluation was even slightly higher than before. The highest impact of AI can be found for data analysis, predictive maintenance, energy management and BIM (Mean >= 1,00). AI has further a positive impact on asset utilization, heating management, decreasing operating costs and failure avoidance (0,8 <mean < 1,00). In line with the questionnaire item before, also decision making is evaluated as being the least impacted by AI (mean < 0,8). Similarly to the previous question, there were almost no answers indicating a very negative or negative impact. Furthermore, positive impact was the most frequently chosen answer option for each questionnaire item. Figure 8 illustrates the distribution and figure 9 the single means and standard deviations (SD).

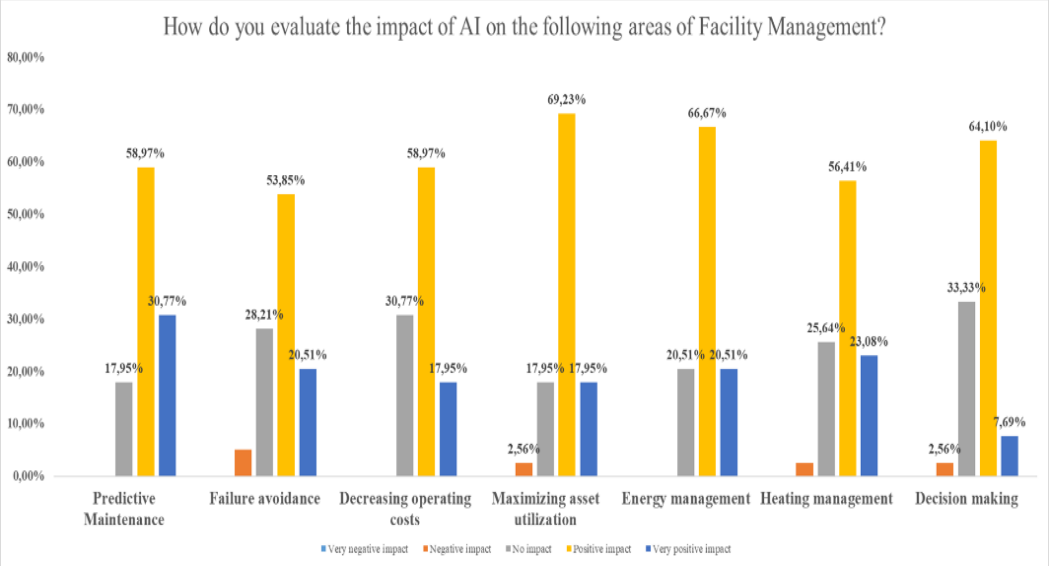

Figure 8 Impact of AI on different application areas – distribution

Indicator	Mean	SD
Predictive Maintenance	1,12	0,67
Failure avoidance	0,83	0,79
Decreasing operating costs	0,88	0,67
Maximizing asset utilization	0,95	0,66
Energy management	1,00	0,62
Heating management	0,93	0,75
Decision making	0,71	0,64
Data analysis	1,31	0,78
Building Information Modeling (BIM)	1,00	0,70

Figure 9 Impact of AI on different application areas – means & standard deviations

In the last step of the survey, an evaluation was given by the respondents of how strong they consider the current impact of AI on their FM in general. The scale was numerical and ranged from minimum 0 / no impact to maximum 100 / very strong impact.

The average mean was 47,12 score points, indicating to a mediocre impact so far. Worth mentioning is also the distribution of the valuations. While there was a very small first and fourth quantile, the majority of the responses were located around the median counting 53,5 score points. This shows a distinct tendency towards an already noticeable impact in practice. Figure 10 illustrates this phenomenon.

Indicator	Value
Mean	47,11905
1. Quantile	18
2. Quantile	53,5
3. Quantile	74,75
4. Quantile / Maximum	91

Figure 10 Impact of AI on FM in general – mean and quantiles

After conducting the survey and extraction of the descriptive findings, the results had to be verified inferential. This was done by applying a Spearman rank correlation coefficient for measuring the correlation between the impact of AI on the individual potential application areas and its general impact on FM. This allows an examination and specification of the results. Also, a statement can be made about the ranking of the AI impact on the single application fields in the overall context of a company's organizational FM. Correlations were considered significant with a p-value below 0,01. All calculations were made via MS Excel.

The rank correlations show that especially asset utilization, failure avoidance and decreasing operating costs strongly correlate with the impact on FM in general. Moreover, data analysis, predictive maintenance, heating management, energy management and BIM indicate a strong positive correlation. Soley decision making shows a relatively weak correlation with a coefficient of 0,462, validating its perception as being least affected and being least impacted by AI.

It is further on significant to mention that all the ordinal correlations were exclusively positive and showed p-vales below 0,01 without exception. This implies that there is a measurable impact on general FM if a company decides to apply AI on one of the identified areas and that these correlations are not limited to the sample but also can be observed in business practice on a confidence level of 99%.

Figure 11 illustrates the single findings including the Spearman rank correlation coefficients, the T-statistics, the degrees of freedom (DF) and the p-values.

Area	Coefficient (rs):	N:	T-statistic:	DF:	p-value:
Predictive Maintenance	0,649	45	5,597	43	0,00000140
Failure avoidance	0,759	45	7,638	43	0,00000000
Decreasing operating costs	0,719	45	6,789	43	0,00000003
Maximizing asset utilization	0,763	45	7,748	43	0,00000000
Energy management	0,567	45	4,514	43	0,00004887
Heating management	0,649	45	5,592	43	0,00000143
Decision making	0,462	45	3,415	43	0,00140371
Data analysis	0,676	45	6,009	43	0,00000035
Building Information Modeling (BIM)	0,549	45	4,308	43	0,00009396

Figure 11 Spearman rank correlations

5 CONCLUSION

It can be stated that FM is facing increasing attention within companies by considering that more than one third of the sample companies conduct professional FM activities. This phenomenon can indicate a rising significance of organizational FM in general. Additionally, there is already a significant impact of AI on FM observable, demonstrated by the numeric evaluation of its impact averaging at 47 score points out of 100. Furthermore, a particularly strong usage of AI could be investigated in the areas of data analysis, energy management, predictive maintenance, failure avoidance as well as for the optimized utilization of assets and in combination with BIM. The influence on decision making was identified as being weak while this domain appears to be still in the hands of human FM managers. In summary, nearly all identified application fields in literature can be observed in business practice which was verified on a confidence level of 99%. Simultaneously, the impact of AI varies depending on the individual area while it can be assessed as being positive overall.

Future research should consider even more the impact on the company's performance side and not limit its perspective on the costs as it was mainly perceived in this study. This ensures to have a modern understanding of FM and to appreciate its strategic scope (Marzouk & Zaher 2020). Similarly, the financial implications should be put more into focus, including factettes of Real Estate Asset Management. Also, this research was limited on publicly traded companies of considerable sizes. An inclusion of SMEs may lead to significant different results because of a major alteration of the sample group. Finally, a separate survey should be conducted exclusively among FM companies to gather information about AI application directly from the specific appliers in their daily business. Finally, in-depth interviews with FM managers and inductive analysis of quantitative data from FM associations could add value to this scientific research.

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FORMATION OF AN INCLUSIVE ECONOMY IN THE CONTEXT OF DIGITALIZATION OF THE FINANCIAL MARKET

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Abstract

At its core, an inclusive economy aims to create an economic system that benefits everyone and leaves no one behind. It goes beyond the traditional notion of GDP growth and focuses on improving the overall quality of life of all members of society. This perspective requires broadening the metrics used to assess economic success to include factors such as health, education, and social mobility.

One of the key components of developing an inclusive economy is called "financial inclusion" – providing people with the means to access, use and benefit from all financial services, such as bank accounts, credit, insurance, pension savings and investment products. McKinsey Global Institute's (MGI) estimates that to achieve approximate equality of opportunity for the world's population, additional resource growth from GDP would be needed at approximately 8 percent per year in the coming decades!

The MGI puts productivity growth at the heart of the solution. Globally, increasing productivity by about one percentage point a year, and upskilling 10 percent of the workforce to move into more productive sectors, could close up to two-thirds of the empowerment gap over the next decade. This upskilling depends on businesses creating more productive jobs and equipping workers with the skills to do them effectively (McKinssey&Company. 2024).

Our research in the field of labor productivity shows that despite the development of digital technologies and artificial intelligence, in the conditions of widespread slowdown in GDP growth, long-term inflationary processes, aggressive sanctions and customs policies, there is no possibility of sustainable growth in labor productivity (Baltgailis J., Simakhova A., Buka S. 2025). It seems that global structures see overcoming this slowdown in the universal introduction of digital currencies into the financial system, allowing state institutions, coupled with private digital giants, to take full control of transactions of the population and business, which, as stated: "Integrating economic inclusion into DEI (Diversity, Equity, and Inclusion) efforts enables broader societal changes that empower individuals and strengthen communities, ultimately contributing to a more just and resilient economy" (Oxford Review.2025).

In our opinion, the emerging system of economic blocs and countries, the contradictions between state institutions and private digital giants, the division of the financial sector into centralized and decentralized do not allow us to talk about the prospects for the formation of an inclusive economy in the near future. The goals and objectives for the development of an inclusive economy, which are proclaimed and developed by the state, often coincide with or are close to the goals and objectives of digital platforms and large corporations, which does not reflect reality and forms neo-feudal prospects for the economic development of the global world economy.

Keywords: *financial inclusion, tokenization, cash, democratic financing mechanisms, control.*

Today, over 1.7 billion adults worldwide are excluded from the formal financial system. This means nearly a third of all adults - including 8% of people within advanced economies - lack access to traditional banking services, including savings accounts, credit, loans, and insurance. Those trapped outside this system are stuck operating within the confines of the cash economy, over-reliant on physical assets, susceptible to financial shocks and stressors, and cut off from

means of wealth creation. Many countries associate attempts to create an inclusive economy with the development of state digital currencies, thanks to which central banks, the issuers of these currencies, will be able to take control of the financial activities of clients and provide them with maximum support. «An inclusive economy would help households to accumulate, hold, and pass on wealth to the next generation. One key component of this effort is sometimes known as "financial inclusion"—providing people the means to access, use, and benefit from all financial services such as bank accounts, credit, insurance, retirement savings, and investment products» (Aspen Institute. 2023). But most importantly, CBDCs can help deliver public goods and improve government service delivery, including, for instance, government-to-citizen payments, such as social welfare disbursements (e.g., COVID stimulus checks) and loan and subsidy programs for smallholder farmers or small-medium sized enterprises. In fact, nearly 35% of adults in low-income countries opened their first financial account to receive government payments. (TBI. 2022).

About 94% of central banks are engaged in some form of work on CBDCs. (Atlantic Council. 2023). CBDC is a central bank liability and is described as a digital form of a country's sovereign currency, issued by it and backed by government credit. In this context, the issuance of a CBDC, although it may require enormous costs to develop supporting technologies, will reduce costs in the long term and contribute to financial inclusion. The fact is that one of the fundamental issues in the implementation of the digital currency of central banks, CBDC, indicates that there are unprecedented opportunities to control customer transactions, whose accounts are opened directly with the Central Bank and have the opportunity to control processes related to money laundering, which will naturally improve tax collection and create social protection for the population and form an inclusive economy. The difference between a CBDC and the "digital money" that consumers use using cards or mobile applications is that the responsibility lies with the Central Bank, and not some commercial bank. There are three known CBDC options: wholesale (token-based) and two types of retail (token- and account-based). The differences lie in the degree of availability and the underlying technology. Retail CBDC is an accessible digital currency that can be used for retail transactions and other purposes, while wholesale CBDC has access restrictions as it is intended for banks and other financial institutions and is used for digital settlement of wholesale transactions. There are three main types of CBDC architectures for retail. In all of them, the Central Bank is the only institution that issues and redeems CBDC. Under the so-called indirect, or two-tier, architecture, the central bank issues CBDC to consumers through intermediaries, which are mostly commercial banks. In this case, consumer-owned CBDCs represent claims on the intermediary, i.e. the commercial bank. In the other two types, consumers have direct demands on the Central Bank. In the direct CBDC model, the Central Bank processes all payments in real time and keeps records of all retail balances. The hybrid CBDC model combines elements of direct and indirect solutions. Consumers have direct claims to the Central Bank, but intermediaries process payments in real time. In order to combine numerous fiat and digital money in the payment system, an active process of tokenization of assets is underway. CBDC could be offered in the form of deposit accounts with the central bank to all households and corporates. Although scaling is not innovative per se, it may be technologically challenging. For example, in the in the case of the Eurosystem, the number of accounts could grow from around 10,000 to some number between 300 and 500 million (ECB working paper Nr.2351). Deposit based CBDC seems simpler and can protect better against money laundering, It also seems to allow for a high level of security and control of the circulating amount of CBDC base money legal status and/or some minimum criteria on payment or economic activity. In this case, CBDC will be strictly personalized and will provide the opportunity to control all customer settlements from the Central Bank.

The central bank could offer a digital token currency that would circulate in a decentralized way without central ledger. This is often associated with anonymity, i.e. meaning that the central bank would not know who currently holds the issued tokens (like in the case of banknotes).

According to calculations based on mathematical models, the International Monetary Fund has determined that issuing CBDC increases total lending by 2.2%. This is driven by a 17 p.p. increase in the share of the population with a bank account (from 75% to 92%). This offsets the bank disintermediation effect, i.e. the flow of savings from deposit accounts into CBDC wallets. 14% of bank account holders (or 13% of the overall population) choose to save in CBDC instead of in deposits. Together, the share of the population who saves in a deposit account increases 5% after CBDC issuance (from 75% to 80%) which boosts lending. 47% of the population chooses to make payments in CBDC.

Aggregate profits from investing in household production technologies increases by 5%. Total household welfare (utility) increases by 0.19% from CBDC issuance (IMF. 2023).

The tokenization of money and assets has great potential, but so far initiatives have been carried out in isolation, without access to central bank money and the trust it creates. The process of centralizing these efforts has begun, which will allow for the control of operations across public and private chains. A new type of financial market infrastructure – a unified ledger – could capture the full benefits of tokenisation by combining central bank money, tokenised deposits and tokenised assets on a programmable platform. Moreover, by having "everything in one place", a unified ledger provides a setting in which a broader array of contingent actions can be automatically executed to overcome information and incentive problems. The system should be compatible with external third-party technology platforms and applications that facilitate activities such as securities settlement, exchange/clearing, and cross-border payments, among others. Where these third-party systems are built on distributed ledger technology, the use of smart contracts across all platforms should facilitate the programmability of cash and payment functions. The practical effect of this is that participants are able to manage their entire portfolio of cash and collateral virtually, from a "single liquidity pool," rather than parking capital through fragmented nostros, correspondents, and domestic central securities depositories. (BIS. 2023).

At the same time, each country is developing a system of licensing, control and audit of issuers and participants in the cryptocurrency market. MiCA is a European regulation that regulates the cryptocurrency market. The process of issuing crypto-assets and listing crypto-assets on a trading platform.

MiCA also introduces rules regarding the prevention of market abuse by regulating insider information disclosure obligations and prohibiting insider trading, and conduct that constitutes the market manipulation of crypto-assets.

Situation that reflects the competition between CBDC and private currencies is fundamentally important. As noted by the BIS, a key aspect of financial system is the "singleness of money," explaining that "singleness ensures that monetary exchange is not subject to fluctuating exchange rates between different forms of money, whether they be privately issued money (e.g., deposits) or publicly issued money (e.g., cash)." For institutional investors, it is unlikely that a digital cash instrument that does not comport with the principles of the "singleness of money" will be accepted as a trusted, reliable source of digital cash. (McCormack J. 2024). After all, if private currencies, such as stablecoins, will conquer the sphere of transactions between clients and become the cheapest and fastest method of payments, without special control by regulatory authorities, then the stability of CBDC, the possibility of exchanging them for fiat "electronic money" and cash at a rate of 1:1 may be disrupted and confidence in central banks undermined. It is not for nothing that the governments of China and India have banned the circulation of private cryptocurrencies on their territory, and this was justified precisely by the stability of national CBDCs. Today, it can be said that by banning private currency, China has managed to create an international system of stable settlements in a state cryptocurrency, which is already trusted by 16 countries and which can spread to the whole world.

People's Bank of China unveiled a pivotal shift in global finance: the digital RMB cross-border settlement system is now fully connected to the ten ASEAN nations and six Middle Eastern countries. This move instantly expands digital yuan interoperability to cover nearly 38% of global trade, enabling participants to bypass the SWIFT network long dominated by the U.S. dollar. One of the most critical aspects of this shift is the capacity of the digital RMB to facilitate transactions without relying on SWIFT or the US dollar. Traditionally, SWIFT has served as the primary communication method for banks handling international payments. However, dependence on the US dollar has often been perceived as a vulnerability for countries striving for economic sovereignty. By creating an independent digital payment network, China offers an attractive alternative for nations seeking to reduce their reliance on the US dollar. China's digital currency bridge compresses settlement time to just 7 seconds. In a landmark trial between Hong Kong and Abu Dhabi, a payment from a Chinese firm to a Middle Eastern supplier was completed in real-time—without six layers of intermediary banks, and at 98% lower transaction costs (Invest Offshore. 2025).

The implications extend far beyond speed and cost. The digital RMB's blockchain architecture embeds automated compliance features, such as traceability and anti-money laundering protocols, directly into each transaction. Today, over 87% of countries worldwide are now compatible with the digital RMB system, and cross-border payments have topped $1.2 trillion USD. While Washington debates the future of the dollar in a digital age, Beijing has already built a blockchain-based global settlement network spanning more than 200 countries (Invest Offshore. 2025)

Payment and settlement operations and non-cash circulation are based on the system of interbank payments. Digital currencies of central banks, as the name suggests, assume the existence of a monopoly of central banks on their issuance and make it unnecessary for commercial banks to multiply the money supply. Thus, the central bank will be the creator, operator, and custodian of the pool of digital currencies. A digital euro based on deposit accounts directly with the central bank.

The monopoly of the central bank, according to the developers, should create opportunities for the formation of an inclusive economy and the ability of the state, in cooperation with Digital platforms (Big Data), to take control of all business and human initiative, which creates the basis for the emergence of neo-feudalism**.** In addition to the development of a two-tier banking system, a one-tier banking system is also proposed (Figure 1), where there is an even greater concentration of power between the Central Bank and the Big Data, and where there are no intermediaries in the form of commercial banks. (Baltgailis J., Menshikov V., 2023)

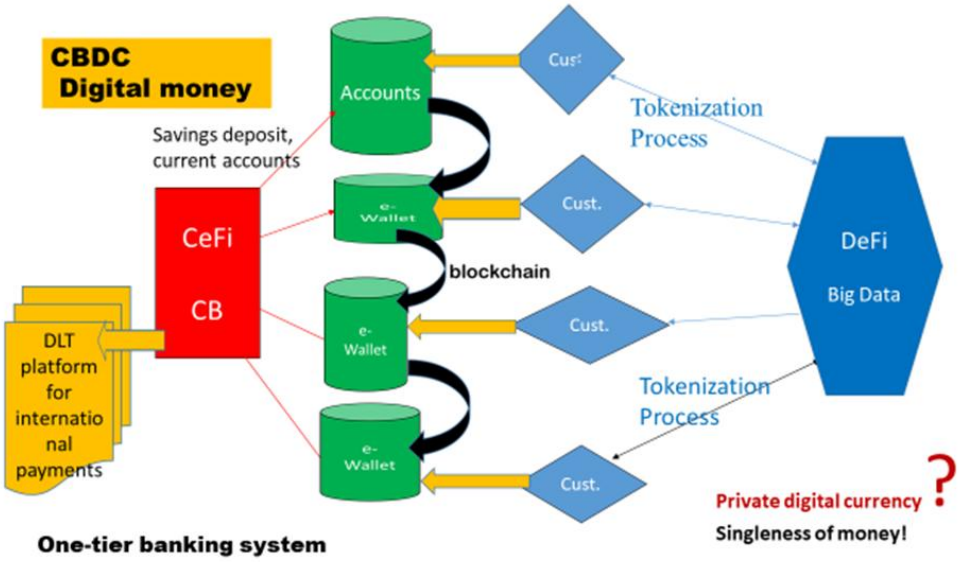

Figure 1 (The scheme was developed by the authors)

This new aristocracy derives its power not from direct control over land and peasants, but from ownership of the digital infrastructure that increasingly mediates human existence. Social media platforms, payment systems, communication networks, and artificial intelligence systems form the core infrastructure of modern life. Control over these systems gives their owners a power that medieval lords would have recognized immediately—the power to permit or deny, to elevate or suppress, to grant access or impose exile. (Structural Lenz. 2025).

In addition, the European Commission is pushing for countries to start storing data on citizens en masse, despite the fact that this is officially prohibited in Europe as a serious violation of fundamental human rights. According to the Commission's plan, service providers will be required to store information about people on a large scale. (European Commission. 2024). In the Commission's interpretation, this includes: information about the user, sender and recipient of the message, the location of the device, date, time, duration, as well as any other data that does not contain the text or content of the messages. Until now, the principle in the European Union was that such data had to be deleted

immediately after it was no longer needed, since it concerns the private life of citizens. Long-term storage of such data was considered a violation of the fundamental right - the right to privacy.

While citizens are protected from unreasonable searches and seizures by constitutional constraints on government surveillance, the tech giants know far more about us, often with our "consent," than the government does. The giant tech industry has fought off efforts to regulate its use of personal data. Instead, companies such as Google, Apple, and Amazon have invented their own jurisprudence, hidden in obscure terms of service, to govern the consent of users to the commercial use of personal data. (The Ameican Prospect. 2020).

Cash remains a popular means of exchange around the world, especially in developing markets. Even in Europe, often at the forefront of payment innovation, cash was used in 52% of transactions in 2024, according to a recent report by the European Central Bank (Mastercard. 2025). Most central banks have said they are committed to issuing and distributing physical cash so long as there is demand for it. But just as cards, real-time payments and, more recently, digital wallets have offered people more choices and security, so could CBDCs. According to the creators of CBDCs, the new version of government money offers a way to reduce the inefficiencies of printing and moving money – the cost of managing physical money can reach 1.5% of a country's GDP (Mastercard. 2025). As connectivity and smartphone penetration grow, CBDCs could also be a way to include more people in the digital economy who are currently excluded from mainstream financial services. In our opinion, the rejection of cash is one of the manifestations of neo-feudalism, as it makes people more dependent on the state and digital giants**.** Meanwhile, six countries - Austria, Holland, India, Mexico, Hungary and Slovakia - have placed their citizens' right to use cash under constitutional protection. There was an attempt to introduce a similar law in Latvia (Bautista-González M. 2022).

This path to monetization is particularly evident in the example of asset tokenization. In essence, from existing financial fiat and digital assets, real services and tangible production create monetary assets, that is, the essence of these assets themselves is removed and transformed into a new monetary quality, endowing them with the ability to be actively traded on digital platforms without intermediaries and where Big Data will play the main role and benefit. Tokenization of Real-World Assets (RWA) involves converting rights to various assets—ranging from bonds and stocks to real estate and cultural properties—into blockchain-based digital tokens (Figure 2.) This innovation promises to enhance liquidity, transparency, and accessibility, democratizing asset ownership by leveraging modern technologies.

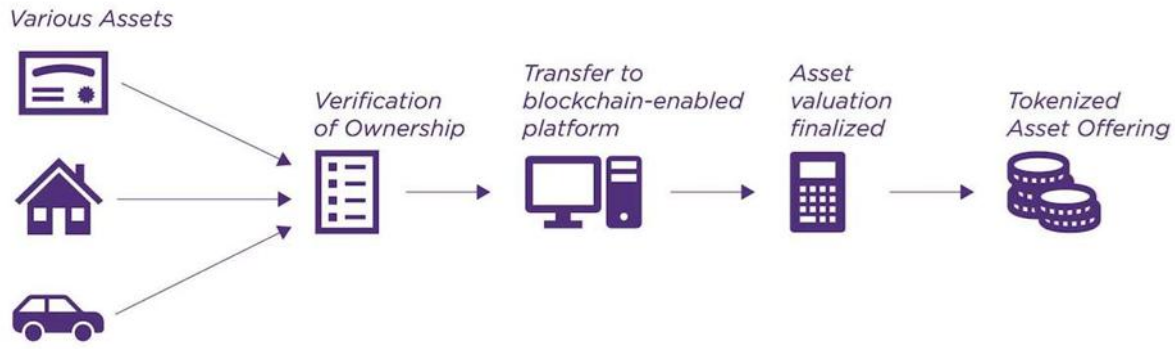

Figure 2. https://uk.images.search.yahoo.com/search/images?

Blockchain technology plays a pivotal role in these digital transformations, acting as a secure and immutable ledger. It ensures that data is stored and recorded without the possibility of unauthorized changes, copying, or deletion. As a digital "book of trust," blockchain serves as a bridge between the physical and digital worlds. Through distributed ledger technologies (DLT), trust and transparency are redefined, allowing objects or rights from the physical world to be recorded digitally via unique identifiers. Tokenization imbues these objects with new properties that can be utilized in economic activities.

In a digital age where trust is paramount, several elements are critical for ensuring confidence in the digital environment: trust in content, identity, ownership, authenticity, and truth. Tokens will play a foundational role, representing physical assets in the digital realm while expanding their functional capabilities. Tokens will encapsulate identity and value within a digital protocol.

The purpose of tokenization of backed assets is to create a more accessible and liquid way of investing in these assets. Due to tokenization, assets are divided into small shares represented by digital tokens, allowing investors to buy these shares at a lower cost. Tokenized assets pave the way for a much easier process of trading and transferring ownership since tokens can be easily transferred and traded on digital platforms.

In general, any entrepreneur should start working in combination on the CeFi and Defi money markets now. The problem is that with the advent of state money in the form of CBDC, this money will be issued only by central banks and can only be operated by opening accounts with the Central Bank.

Of course, for business, the low cost of transactions, fast currency exchange and speed of transfers are very important, which greatly reduces the cost of business, increases the trust of partners and creates confidence in the stability of business. This is especially important for countries with an unstable political and economic system, uncertainty in the local currency. A survey of 2,541 adults across Brazil, India, Indonesia, Nigeria, and Turkey, shows that 47% use stablecoins for better savings rates, 43% for improved currency conversion, and 37% to access dollars. Though limited in scope, this data suggests stablecoins are becoming versatile financial tools in emerging markets, addressing a range of economic needs beyond traditional crypto applications. (Crypto Valley Journal. 2024).

: McKinsey estimates that tokenized market capitalization by asset class could reach around 2 trillion dollars by 2030 (excluding cryptocurrencies and stablecoins). The pessimistic and optimistic scenarios range from about 1 trillion to about 4 trillion dollars, respectively. This estimate excludes stablecoins, including tokenized deposits, wholesale stablecoins, and central bank digital currencies (CBDCs) to avoid double counting (McKinsey, 2024). Tokenization remains a central pillar of BlackRock's digital asset strategy. The company has set an ambitious goal of tokenizing 10 trillion dollars worth of assets in partnership (Forbes. 2024). In this case, the key role of tokenized assets on trading platforms creates an opportunity for digital giants to multiply cash flows by attracting more participants in the emerging inclusive economy and, accordingly, to ensure the redistribution of these flows in accordance with their own, rather than public interests.

This entire tokenization process is taking place against the backdrop of the new US administration's attempts to strengthen the dollar's global position and make the digital dollar the world's leading currency. US presidential adviser Stephen Miran argues that the US dollar has been continually overvalued due to its status as a reserve currency. This has benefited financialized sectors of the economy and wealthy Americans, but has put a burden on American manufacturing by making it cheaper to buy from abroad. In his view, these tensions will be resolved by policies that preserve the dollar's status but improve burden sharing with trading partners. International trade policy will attempt to recapture some of the benefit that the dollar's reserve status transfers to trading partners and link that economic burden sharing to defense burden sharing (Financial post. 2025).

The results and discussion. While our citizens are constitutionally protected from unreasonable searches and seizures, the tech giants know far more about us, often with our "consent," than the government does. The giant tech industry quietly pays fines for trying to force the government to regulate their use of personal data. We have already said that there are companies that invent their own rules and laws to regulate consumer consent for the commercial use of personal data. There is an active battle for the personal data of the population, with huge customer databases being stolen and resold around the world, allowing digital giants to actively influence the politics and economy of countries. Just look at Figures 3 and 4 to see how the big fines are mounting for corporations that use personal data illegally in business. In the absence of compensating government regulation, the digital industry will create its own private law, using its market power to increase profits and protect itself from competition or government oversight. In any case, the

development of an inclusive economy to a certain extent ensures greater employment, increased social well-being of the population without revolutionary upheavals and other shocks, and will support economic stability. For the state and corporations, it is economic stability that is the primary reason for supporting inclusiveness.

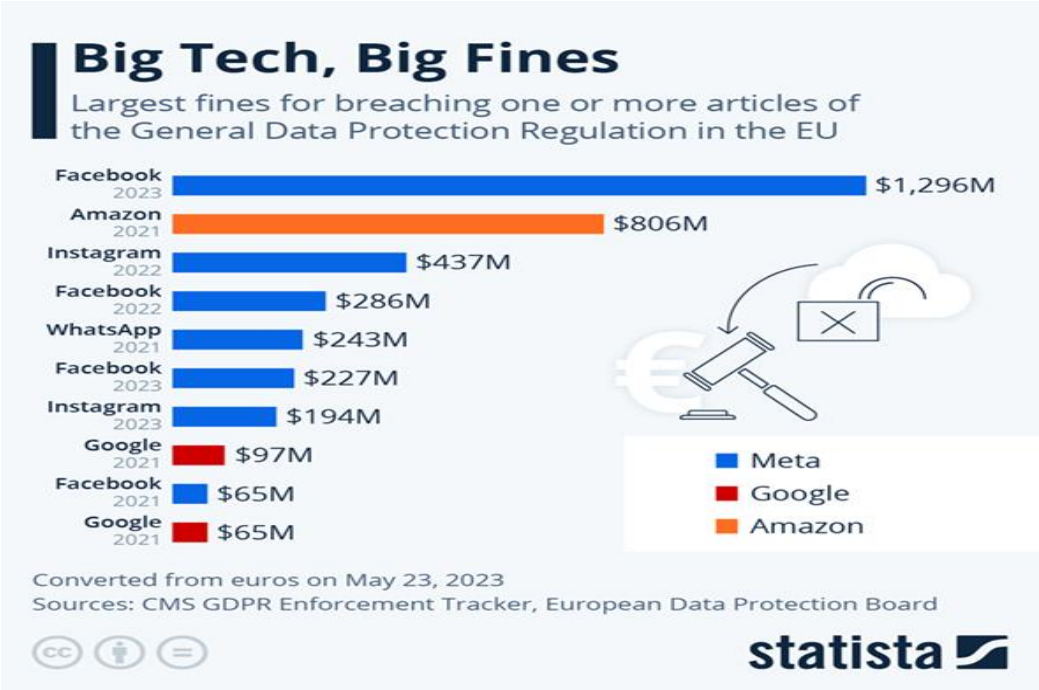

Figure 3. (Statista, 2023).

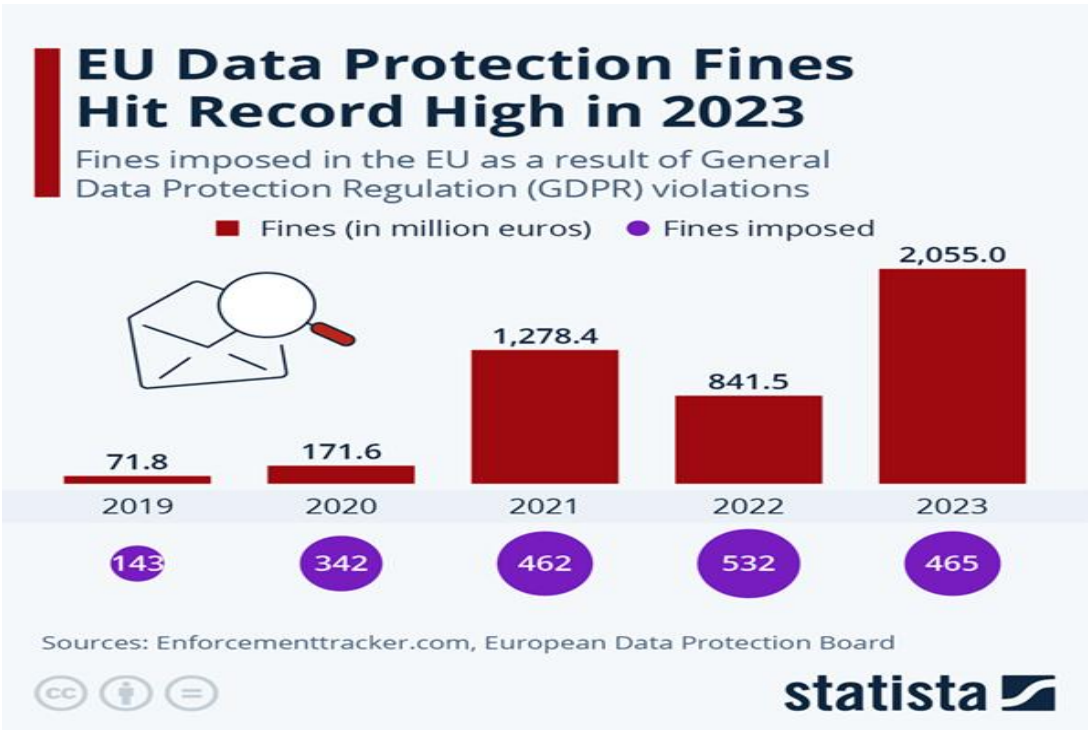

Figure 4. (Statista, 2023).

What makes the current situation particularly dangerous is the convergence of three historical trends that have previously appeared separately: the transnational power of capital (reminiscent of the late 19th century), the alliance between wealth and authoritarian politics (similar to the 1930s), and unprecedented technological capabilities for social control. This convergence creates possibilities for authoritarian control that would have been unimaginable to previous generations (The Structural Lens. 2025). Elon Musk's transformation from technological innovator to political broker, on the other hand, perfectly illustrates the evolving rivalry between the state and private business. His acquisition of Twitter/X represents more than just a business deal – it marks a direct intervention of technological power into the mechanisms of democratic dialogue. The subsequent transformation of the platform demonstrates how private ownership of public spaces can change the political reality that drives the foundations of neo-feudalism.

As we have already noted, the new aristocracy derives its power from the possession of digital infrastructure, which is increasingly becoming a mediator of human existence, and control over it is becoming key in the system of struggle for influence in the global economy. The growing possibility of the formation of neo-feudalism will be supported by the global economy, where the most powerful and technologically advanced players are trying to determine the rules of the game. In the context of growing competition in the global economy between the state and Big Tech for power and client assets, neo-feudal forms of organizing public life may become a clear result of competitive struggle, where the winners, as a rule, are not judged!

The development of an inclusive economy may lead to a similar process of enclosing sheep pastures, which reached its largest scale in Britain in the 15th–19th centuries, which created conditions for the release of labor in agriculture and its redirection to cities for the development of the textile industry. In the emerging digital environment, an inclusive economy, first of all, creates opportunities for small and medium-sized businesses to open accounts in the Central Bank, which issues state digital money, facilitates the conditions for obtaining loans, ensures a reduction in payment fees and creates stable and safe working conditions, eliminating the risk of bankruptcy of intermediaries in the form of commercial banks. Thanks to this, small and medium businesses will flow from private banks to the Central Bank, where they will fall under the close supervision and control of state structures. In this case, artificial intelligence can be used to track the credit history of clients directly at the Central Bank, prevent money laundering attempts, strictly control tax policy, and if clients start working through private digital platforms, then, thanks to new legislation, the latter will be obliged to save all information about client transactions, which can be obtained upon request by almost any government agency. It is worth adding that even in the blockchain system, there are problems with data availability. Decentralization, the fundamental principle of blockchains, depends on the availability of data. This allows all participants to verify transactions and blocks without relying on a central authority. This increases the stability of the network. On the other hand, the disadvantage is the complexity of integrating blockchain into traditional systems. Many organizations face problems when trying to implement decentralized technologies into an established infrastructure. The need to restructure business processes can become a serious obstacle to large-scale application. In addition, legal uncertainty and the lack of uniform standards also affect the speed of technology dissemination, requiring regulators to develop new approaches to regulating digital assets. In the blockchain system, all information about participants is stored almost forever, and if the state wants to obtain this information, then, in principle, it can do so. Many countries have developed regulations for cryptocurrencies, and yet no country has fully determined how to implement the regulations. Part of the challenge is how to classify cryptocurrencies using existing financial constructs. Taxing or regulating a cryptocurrency as a currency, a security, or an asset is difficult, as a cryptocurrency can be any one or all three. As a result, an inclusive economy can create the opposite effect, when all economic activity, instead of a democratic process of increasing efficiency, falls under the monopoly control of the state, especially if it is a totalitarian state.

The monopoly of the central bank, according to the developers, should create opportunities for the formation of an inclusive economy and the ability of the state, in cooperation with Digital platforms (Big Data), to take control of all business and human initiative, which creates the basis for the emergence of neo-feudalism. In addition to the development of a two-tier banking system, a one-tier banking system is also proposed, where there is an even greater

concentration of power between the Central Bank and the Big Data, and where there are no intermediaries in the form of commercial banks.

More and more often, there are proposals to develop new democratic financing mechanisms independent of traditional financial systems, which are increasingly subject to oligarchic control. It is proposed to create an international system to prevent algorithmic manipulation of public discourse, to develop new antitrust mechanisms that solve the problem of data monopolies, to create state alternatives to private digital platforms. But here it is necessary to clearly understand the sources of investment for these developments? If the state is closely connected with digital giants, which often have resources more global than the state itself and operate around the world, then such a state will not support these efforts or will even slow them down.

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DIFFUSION OF RENEWABLE PROPULSION TECHNOLOGIES IN AGRICULTURAL MACHINERY: POTENTIAL AND LIMITATIONS

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Abstract

Over the past years, the transition toward sustainable and decarbonized energy has become an increasingly relevant topic in the agricultural sector. Although renewable propulsion technologies – such as electric engines, hydrogen fuel cells, and biofuels – are evolving rapidly, their specific application in agricultural machinery remains limited and often uncertain. As specifically tractors play a key role for maintaining the global food system and simultaneously have tremendous environmental impact, this study aims to explore the key drivers and barriers influencing the adoption of renewable propulsion systems in tractors. The two central research questions are: What drivers of prevents the adoption of such technologies in agriculture? What is the status of diffusion in current scientific research? To answer these questions, a comprehensive literature analysis is conducted, drawing from interdisciplinary sources in agricultural engineering, environmental economics, innovation studies, and technology acceptance theory. Emphasis is placed on economic feasibility, infrastructure availability, regulatory frameworks, technological maturity, and user attitudes. In addition, the study incorporates sociocultural perspectives by addressing social acceptance, generations preferences, educational background, and the influence of regional farming traditions. Furthermore, an analysis of relevant statistical data regarding the adoption of renewable energy in agriculture adds quantitative verification. Through a synthesis of findings across these domains, this research identifies recurring obstacles such as high investments costs, uncertainty regarding performance, inadequate energy infrastructure in rural areas, as well as skepticism based on mistrust, lack of technical familiarity, or limited access to information. In contrast, governmental incentives, ecological awareness, rising fuel prices, and long-term monetary benefits emerge as major adoption drivers. The study concludes that although the technical potential of renewable propulsion systems in agricultural tractors is increasingly acknowledged, a broader diffusion is still hampered by a complex interplay of economic, technological, and sociocultural barriers. Future research should deepen these findings through targeted case studies and comparative analyses, particularly focusing on education, regional identity, and farm succession as potential levers of change.

Keywords: environment, agriculture, farming, renewable, tractors, technology adoption, sustainability, innovation

1 INTRODUCTION

Climate Change and the global push toward decarbonization have placed increasing pressure on all sectors of the economy to reduce greenhouse gas emissions. Agriculture, while essential to sustaining human life, is also a significant contributor to climate change, responsible for approximately 10-12% of global emissions (Umweltbundesamt 2025). Particularly through fossil fuel usage, methane emissions, and land-use changes. Among these most critical sources of direct emissions within the agriculture sector are tractors and other machinery, which rely heavily on diesel-powered engines. Tractors are central to agricultural productivity: they are indispensable tools for soil preparation, planting, harvesting, and transport (Kuratorium für Technik und Bauwesen in der Landwirtschaft e.V. (KTBL) 2023). However, their continuous operation contributes substantially to carbon dioxide emissions and local air pollution, especially in rural areas with limited access to cleaner technologies.

The agricultural sector thus finds itself at a turning point, facing the dual challenge of maintaining productivity while significantly reducing its carbon footprint. One of the most pressing tasks is to reduce the dependency on fossil fuels without compromising the efficiency, performance, and economic viability of farm machinery. Tractors, as key working

assets on farms, play a pivotal role in this transformation. Renewable propulsion technologies such as electric drivetrains, hydrogen fuel cells, and advanced biofuels offer promising alternatives (Institut für ökologische Wirtschaftsforschung (IÖW) GmbH u. a. 2024). In other industries such as passenger transport or logistics these technologies have already demonstrated practical viability and market penetration.

Yet, despite technological readiness and the availability of pilot solutions, the widespread adoption of these systems in agriculture remains slow (Rosskopf & Wagner 2003). Multiple barriers, including high investment costs, technical uncertainties, insufficient infrastructure, and skepticism among farms have significantly delayed broader market diffusion (Kuratorium für Technik und Bauwesen in der Landwirtschaft e.V. (KTBL) 2023). These challenges are further complicate by farm-specific factors such as operational scale, geographical conditions, generational change, and varying levels of technical knowledge. The gap between technical potential and real-world implementation highlights a critical need for targeted academic investigation (Hochschule Weihenstephan-Triesdorf o. J.).

This paper addresses two central research questions: (1) What factors driver or hinder the adoption of renewable propulsion systems in agricultural tractors? And (2) What is the current state of diffusion according to the existing scientific literature? To answer these questions, the study employs a mixed-methods approach based on an interdisciplinary literature review and a quantitative comparison of adoption rates using registration data for electric tractors and electric vehicles.

The paper is structured as follows: Section 2 outlines the theoretical and conceptual framework, Section 3 presents the methodology, Section 4 discusses the main adoption drivers and barriers, Section 5 offers the empirical analysis, Section 6 concludes with conclusions, limitations, and recommendations for future research.

2 THEORETICAL AND CONCEPTUAL FRAMEWORKS

This section lays the conceptual groundwork for addressing the central questions of this study. The theoretical framework draws from innovation research, agricultural systems theory, and models of technology acceptance.

Innovation in agriculture refers to the introduction of new technologies, practices, or organization models that improve efficiency, sustainability, or adaptability in production systems (Darnhofer 2010). The Agricultural Innovation Systems (AIS) approach views innovation not as a linear process but as the result of dynamic interactions between actors, institutions, and external conditions (Klerkx u. a. 2012). The specific context of German Agriculture characterized by value chains, public advisory structures, and sectoral diversity demands a systematic understanding of innovation diffusion (Bokelmann u. a. 2012) (Malerba 2002).

Technological change has historically shaped agricultural practices from mechanization to digitalization (Kehl u. a. 2021). Modern developments in precision agriculture, sensor technologies, and artificial intelligence (Jung u. a. 2023) offer significant potential for more sustainable and efficient production. However, the adoption of such innovations is not solely determined by technical feasibility but also by their perceived usefulness, ease of implementation, and alignment with farmers' values (Lang & Gassler 2022).

The Technology Acceptance Model (TAM) and Rogers' Diffusion of Innovation theory offer analytical frameworks to explore these dynamics. TAM emphasizes perceived usefulness and ease of use as key determinants for the adoption of technology (Eastwood u. a. 2019), while (Rogers 1983) identifies relative advantage, compatibility, complexity, trialability, and observability as drivers of diffusion. Both models provide useful lenses for analyzing farmer decision-making around renewable propulsion systems.

Moreover, adoption is shaped by economic constraints, social networks, and institutional environments. Larger farmers with better access to capital are often early adopters, while smaller ones face entry barriers (Frambach & Schillewaert 2002). External influences such as peer experience, policy incentives, and advisory services play a role (Pfeiffer u. a.

2019), (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU) 2019). These multidimensional factors underscore that acceptance of innovation is embedded in a complex socio-technical and economic landscape.

In the context of this study, the adoption of renewable propulsion systems can thus be understood as a function of technological readiness, economic feasibility, regulatory frameworks, infrastructure availability, and farmer attitudes. Building on these theoretical foundations, the next section explores specific drivers and barriers influencing adoption, supported by empirical data and current literature.

Based on these theoretical insights, the following section outlines the methodological approach adopted in this study. It details the interdisciplinary literature review and quantitative analysis used to assess the adoption of renewable propulsion technologies in agriculture.

3. METHODOLOGY

To address the two central research questions this study employs a mixed methods research design, combining a qualitative literature review with a quantitative comparative analysis.

The first component is a systematic literature review that draws upon interdisciplinary academic fields, including agricultural engineering, innovation studies, environmental economics, and technology acceptance research. Databases such as Scopus, Web of Science, and Google Scholar were used to identify relevant peer-reviewed articles, policy papers, and industry reports from the past 20 years. The review is grounded in established frameworks such as the Technology Acceptance Model (TAM) (Davis 1989), (Eastwood u. a. 2019), the Diffusion of Innovations Theory (Rogers 1983), and Agricultural Innovation Systems (Klerkx u. a. 2012). Specific emphasis is placed on recurring adoption drivers and barriers such as perceived usefulness, ease of use, cost structures, infrastructural availability, and regulatory support (Frambach & Schillewaert 2002), (Klerkx & Jansen 2010).

The second component consists of quantitative statistical analysis based on adoption data from the Federal Motor Transport Authority (Kraftfahrt-Bundesamt (KBA) 2024) and industry sources on electric tractor registrations. This data is compared with broader electric vehicle adoption trends in Germany. A two-sample t-test is applied to assess where there is a statistically significant difference in adoption rates between the general transportation sector and the agricultural machinery sector. This comparative approach helps quantify the empirical gape in technology diffusion and supports the hypothesis that structural and sociotechnical barriers in agriculture are limiting adoption.

By integrating these two methodological strands: Qualitative thematic synthesis and quantitative statistical comparison – the study provides a robust and triangulated perspective on the current adoption landscape and its influencing factors. The mixed-methods design also ensures that both macro-levels trends and micro level behavioral dynamics are captured within the analytical framework (Creswell & Plano Clark 2018).

4. KEY FACTORS INFLUECING THE ADOPTION OF RENEWABLE PROPULSION SYSTEMS IN AGRICULTURE

Building on the theoretical framework presented in Chapter 2, this chapter synthesizes the central drivers and barriers that influence the adoption of renewable propulsion systems in agricultural tractors. The analysis is structured along four main dimensions: ecological, economic, and political, which emerged as critical categories throughout the literature review. These dimensions are interconnected and collectively shape the adoption behavior of farmers in the context of technological change.

4.1 Ecological Drivers and Barriers

Ecological considerations are a key factor influencing the acceptance of renewable propulsion technologies in agriculture. With increasing societal and political pressure to reduce greenhouse gas emissions and promote sustainability, farmers urges to integrate low-emission technologies-particularly in the area of on-farm mobility, where tractors account for a significant share of energy use and pollution.

Electric tractors enable local zero-emission operation and generate substantially less noise compared to diesel-powered machines (Malik & Kohli 2020). This contributes to improved air quality and a healthier environment for both farmworkers and nearby communities (Fassò 2023). Additionally, propulsion technologies powered by solar energy or biofuels help lower CO2 emissions and reduce dependency on fossil energy, while enhancing energy resilience amid volatile energy prices (Mattetti u. a. 2025).

Advanced control and automation technologies can further reduce energy consumption and optimize operational efficiency (Ghobadpour u. a. 2019). In contrast, conventional diesel tractors emit not only CO2 but also nitrogen oxides (NOx) and fine particulate matter (PM), which contribute to local air pollution and health risks (Ai u. a. 2021).

A further ecological benefit is noise reduction. Electric and hybrid tractors operate more quietly, improving working conditions and quality of life in rural areas (CADEO Group 2022), (Nye u. a. 2025). These environmental advantages strengthen the overall perception of electric tractors as a future-oriented, sustainable solution.

However, despite these clear ecological benefits, they alone are rarely sufficient do drive investment. Farmers typically require an alignment of ecological promise with economic feasibility, infrastructure availability, and a political support (Ghobadpour u. a. 2019). Only under such conditions can environmental arguments translate into widespread adoption in practice.

4.2 Economic Drivers and Barriers

Farmers make investment decision primarily based on economic considerations. Key factors include capital requirements, expected profitability, and cash flow (Tonea & Beleiu 2020). For renewable propulsion systems to represent a realistic alternative to conventional technologies, they must be not only ecologically beneficial but also economically viable and operationally feasible. Core factors influencing acceptance include cost structures, the availability of government support schemes, and operational efficiency (Dessart u. a. 2019).

One major obstacle to the spread of alternative propulsion systems is the high upfront cost. Tractors with electric or hybrid propulsion typically require higher initial investments than conventional diesel models-posing a significant financial barrier, particularly for small and medium-sized farms (Zhang u. a. 2024).

Since agricultural machinery usually represents long-term capital goods, considerations of payback periods are crucial in purchase conditions (Michels u. a. 2024). On the other hand, potential savings in maintenance and repair can be counterweight: electric motors are cheaper to maintain due to their simpler construction and the absence of high-wear components (Karki u. a. 2024). Maintenance requirements are lower and less complex, resulting in lower long-term operational costs (Institut für ökologische Wirtschaftsforschung (IÖW) GmbH u. a. 2024).

A comparison of total costs for electric and diesel tractors across different performance classes illustrates the dynamic. The graph below breaks down the costs into three categories: investment costs, energy costs, and maintenance/repair costs. This allows for a differentiated understanding of where electric tractors may already offer economic advantages and where conventional models still dominate. By visualizing cost structures, the comparison also highlights how technological maturity and scale effects can influence long-term competitiveness. Such insights are essential for both individual investment decisions and broader policy considerations.

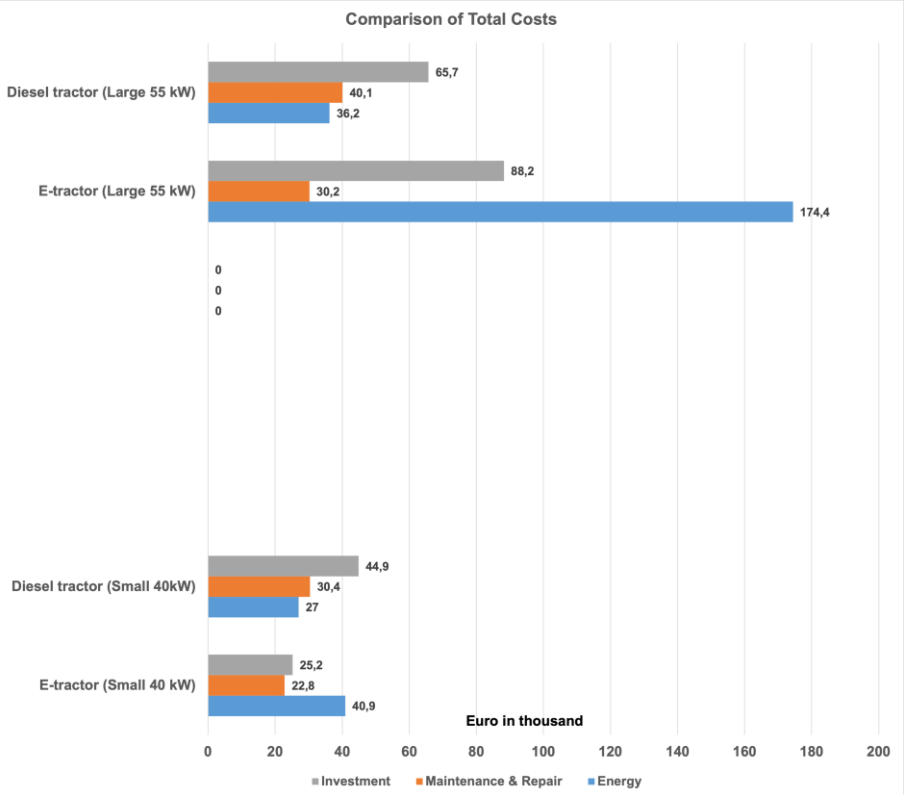

Figure 1: Comparison of costs for electric and diesel tractors across different performance
Source: Own depiction based on data from (Institut für ökologische Wirtschaftsforschung (IÖW) GmbH u. a. 2024)

For smaller tractors (40kW), electric tractors already offer a clear cost advantage over diesel-powered counterparts (Institut für ökologische Wirtschaftsforschung (IÖW) GmbH u. a. 2024). This is primarily due to lower investment costs and reduced operational expenses (Mocera u. a. 2023). In contrast, more powerful electric tractors (55kW) exhibit significantly higher total costs. Here, especially investment and energy costs surpass those of conventional diesel tractors. Despite the higher ongoing operating costs of diesel models, they currently remain economically superior in this performance class (Beligoj u. a. 2022).

4.3 Social and Cultural Drivers and Barriers

The acceptance of renewable propulsion systems in agriculture is closely linked to socio-cultural factors. Generational transitions, social norms, peer influence, and trust in institutions all shape famers' readiness to adopt innovations (Abid u. a. 2017), (Liontakis u. a. 2021). Young famers are generally more open to technology, but often lack access to key resources such as land, capital or institutional support (Europäische Parlament 2023). At the same time, succession processes offer important entry points for innovations and modernization (Borda u. a. 2023).

Decision regarding new technologies is often influenced by the experiences and opinions of peers, agricultural associations, and consultants. These social influences are transmitted through informal exchange as well as professional formats like webinars, field days, or regional networks (Eckel u. a. 2023). Trust in agricultural advisory services and local institutions also plays a vital role: adoption is more likely when farmers receive consistent guidance from credible and familiar sources (Pfeiffer u. a. 2019).

Structural developments in land and asset ownership increasingly affect investment behavior. The growing commercialization of agriculture has shifted perceptions of land and machinery from intergenerational heritage to market-based investment goods (d'Errico u. a. 2016). This shift can shorten planning horizons and reduce willingness to invest in long-term innovations (Wuppertal Institut für Klima, Umwelt und Energie 2010).

Overall, social acceptance is not driven by individual preferences alone but embedded in wider patterns of identity, ownership, and community experience. Recognizing and addressing these dynamics is essential to promote widespread adoption of sustainable propulsion technologies in the farming sector.

4.4 Political and Institutional Factors

Political frameworks play a decisive role in shaping the adoption of renewable propulsion systems in agriculture. They provide the legal and financial conditions that either enable or hinder the transition toward sustainable technologies. Financial instruments such as tax incentives, subsidies, or emissions trading schemes can act as powerful levers. For instance, the gradual increase in CO2 certificate prices under the German Fuel Emissions Trading Act serves as an economic signal to reduce fossil fuel dependence (Meinel 2024).

Targeted funding programs for the purchase or retrofitting of agricultural machinery particularly through direct grants or tax exemptions for renewable fuels can significantly accelerate adoption. Experts have argued that replacing the complex refund process with a full tax exemption on biofuels would improve transparency, reduce administrative burdens, and increase cost-effectiveness for farmers (Kuratorium für Technik und Bauwesen in der Landwirtschaft e.V. (KTBL) 2024). However, such measures require effective monitoring systems, for example through customs authorities, to ensure proper implementation.

On the European level, the Common Agricultural Policy (CAP) provides an important policy framework. The 2023-2027 strategy emphasizes climate and environmental goals and includes subsidies for low-emission technologies, including hydrogen machinery (Bundesministerium für Ernährung und Landwirtschaft 2023). Equally important is the expansion of advisory services: agricultural chambers and agencies are expected to offer not only technical guidance but also economic assessments and support for navigating funding opportunities (OECD 2015).

However, inconsistent national policies risk undermining these goals. The German government's recent decision to reintroduce diesel subsidies while omitting tax exemptions for renewable contradicts its stated decarbonization targets (Bundesregierung der Bundesrepublik Deutschland 2025). This highlights the need for coherent, long-term, and technology neutral policies to create investment confidence and drive sustainable transformation in agricultural mobility.

4.5 Synthesis and Cross-Dimensional Analysis

The interaction of ecological, economic, socio-cultural, and political factors highlights the complexity of the adoption process. Technically feasibility alone is insufficient. Instead, structural conditions, behavioral patterns, and institutional trust must align. Measures to promote alternative propulsion technologies should therefore integrate technological innovation with policy design, education initiatives, and infrastructure development. Only a systemic approach can effectively address the diverse factors and accelerate transformation in the agricultural sector.

5. QUANTITATIVE ANALYSIS: STATUS AND COMPARATIVE ANALYSIS

The transition toward sustainable propulsion technologies is progressing at markedly different speeds across economic sectors. Particularly striking is the contrast between the rapid spread of electric vehicles (EVs) in road transportation and the limited penetration of such technologies in agriculture. This chapter presents a quantitative comparison between electric car and electric tractor adoption in Germany, with focus in registration trends and adoption dynamics. The goal

is to empirically support the structural barriers discussed earlier and to assess the sectoral differences in technology diffusion using available statistical data.

5.1 Data Sources and Methodology

This analysis is based on official data from the German Federal Motor Transport Authority (KBA) for electric car registrations between 2018 and 2023, and industry estimates for the number of newly sold electric tractors in Germany during the same period. Due to lack of disaggregated public data on tractor drive systems, electric tractor figures are derived from sectoral reports, market analyses, and manufacturer disclosures.

To examine whether the adoption rates differ significantly between the two sectors, an independent two-sample t-test assuming unequal variances (Welch's t-test) was applied. This statistical method compares the average annual registration figures for electric cars and electric tractors, allowing an assessment of whether the observed difference in adoption rates is statistically significant or likely due to chance variation. The test was performed using by Python.

5.2 Results: Registration Trends Compared

The following table presents the official number of newly registered electric cars and the estimated number of electric tractor units sold in Germany from 2018 to 2023:

Table 1:

EV registrations (cars and tractors) in Germany, 2018-2023 (own compilation based on KBA and industry estimates)

Year	EV-Registration (Cars)	EV-Registration (Tractors)
2018	63.321	120
2019	87.000	160
2020	194.163	190
2021	355.961	250
2022	470.559	310
2023	524.219	400

Source: (Kraftfahrt-Bundesamt (KBA) 2024), (Fachagentur Nachwasender Rohstoffe (FNR) 2023)

The electric car market has seen a nearly tenfold increase in annual registrations, from just over 63,000 in 2018 to more than 524,000 in 2023. In contrast, electric tractor adoption remains extremely limited, with annual sales estimated in the low hundreds. In 2025, total stock of battery-electric tractors in Germany is estimated at around 1,060 units, representing only 0.05% of the agricultural machinery fleet.

To statistically assess whether these adoption patterns differ significantly, a Welch two-sample t-test was applied. The result yielded a t-statistic of 3.45 and a p-value of 0.018, indicating a statistically significant difference at the 5% level. This confirms that the adoption of electric tractors lags substantially behind that of electric cars not by coincidence, but due to structural disparities in sectoral dynamics. The result reflects a deeply uneven transformation trajectory, where agriculture faces more persistent technological and economic entry barriers than road transport.

5.3 Visualization

The following figure illustrates the registration trends of electric cars and electric tractors in Germany over the same six-year period.

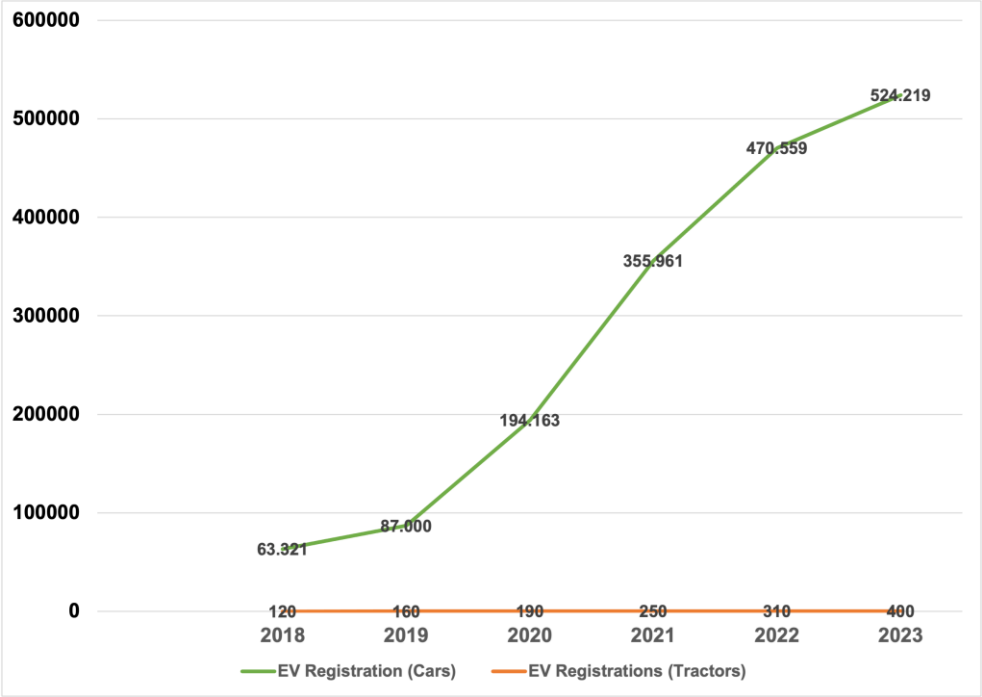

Figure 2: Development of annual EV registrations for cars and tractors in Germany, 2018-2023 (own illustration based on KBA and industry data)

The exponential growth of electric car registrations is clearly visible, while electric tractors remain on a flat trajectory. This discrepancy highlights the very different diffusion dynamics in the transport and agricultural sectors.

6. CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

This study has examined the key drivers and barriers influencing the adoption of renewable propulsion technologies, particularly electric systems in agricultural tractors. Against the backdrop of growing environmental urgency and decarbonization targets, the study combined qualitative and quantitative approaches to explore both the current diffusion landscape and the structural factors shaping technology adoption in agriculture.

The results reveal a clear pattern: while electric vehicles in the road transport sector are experiencing rapid growth, with exponentially increasing registration figures, the adoption of electric tractors remains extremely limited. Barriers such as technological immaturity, lack of infrastructure, high investment risks, and weak policy support play a central role. These are further reinforced by sociocultural factors including technical unfamiliarity, generational skepticism, and strong ties to regional farming traditions. The quantitative analysis supports these findings, showing a statistically significant gap in annual adoption rates between electric cars and electric tractors ($t=3.45$; $p=0.018$).

Crucially, the limited uptake of electric tractors is not the result of a lack of ecological awareness or relevance. Rather, it reflects a complex interplay of structural, technical, and social constraints. Unlike cars, tractors are subject to demanding performance requirements that are not easily addressed by existing propulsion technologies. As such, a simple transfer of strategies from the transport sector to agriculture falls short.

Despite the interdisciplinary scope of this study, it faces several limitations that need to be acknowledged. First, there is currently no official public data on tractor registrations disaggregated by propulsion type. The electric tractor figures used in this analysis are based on well-researched industry estimates, but they do not offer the same statistical precision as the car registration data provided by the KBA. Second, the geographic focus lies primarily on Germany and the EU. Although some international parallels are briefly referenced, the study does not include a broader global comparison such as with agrarian economies like India or Brazil which might yield additional insights. Third, the focus on electric propulsion limits the discussion of alternative renewable technologies such as hydrogen or biofuels, which may offer complementary or more suitable solutions for high-performance agricultural machinery. Finally, while the analysis draws on key frameworks from diffusion theory and technology acceptance literature, other theoretical lenses from environmental psychology to transformation research could further enrich to interpretation.

Based on these findings, several targeted recommendations emerge for policymakers, researchers, and agricultural practitioners. On the policy level, existing funding schemes should be expanded and specifically tailored to the needs of agricultural machinery. Pilot programs promoting electric tractors in structurally weak or rural regions could serve as important levers. Furthermore, charging infrastructure tailored to farm environments should be considered in future national or regional development strategies. Systematic monitoring is also essential: the collection of propulsion-type data in official registration statistics would enable more effective evaluation and policymaking.

For the academic and educational sectors, more applied research is needed on the cost effectiveness, lifecycle impacts, and operational feasibility of electric tractors preferably in collaboration with manufactures and end users. Educational institutions should provide accessible trainings programs on renewable propulsion systems for farmers, especially for younger generations and future farm successors. Interdisciplinary research teams that include social scientists also are recommended, to better understand user perceptions, trust issues, and adoption dynamics in real-world farming contexts.

In agricultural practice, the creation of demonstration farms and peer-to peer learning networks can help to reduce uncertainty and showcase successful implementation. Regional best-practice platforms could support knowledge exchange and foster confidence in new technologies. Partnerships between farmers and equipment manufacturers could also accelerate innovation by integrating practical user feedback into development processes.

This study has shown that the transition to sustainable propulsion in agriculture is not merely a technical issue but a multi-layered transformation process that encompasses economic, cultural, and institutional dimensions. The lack of widespread adoption of electric tractors should not be mistaken as a sign of irrelevance but rather understood as evidence of an underdeveloped innovation ecosystem in this sector. Overcoming the current stagnation will require not only technological advancement, but also systemic change.

Future research should further investigate the influence of education, regional identity, and succession dynamics as potential levers of change. In-depth case studies and comparative cross-country analyses may offer new insights into how these social and cultural factors interact with technological and policy variables. Only through such a holistic understanding can meaningful progress be achieved toward a sustainable and decarbonized future of agriculture.

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DIGITAL TRANSFORMATION AND POVERTY ALLEVIATION PROSPECTS IN GEORGIA'S ONGOING GLOBALIZATION AND EUROPEAN INTEGRATION PROCESS

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Abstract

Overcoming poverty is of critical importance for achieving the country's economic development goals. *Unfortunately, despite ongoing globalization, the digital transformation of the economy, and progress toward European integration, widespread and chronic unemployment and poverty remain Georgia's most pressing macroeconomic challenges. These issues are widely recognized as major obstacles to sustainable economic growth. Although the country has made some progress in recent years - particularly in terms of economic indicators - it has not succeeded in significantly reducing unemployment and poverty levels.*

Given this context, it is essential at the current stage of labor market development to design a comprehensive system of macroeconomic policy measures aimed at alleviating poverty. Such a system would help improve the quality of working life and raise the overall standard of living. However, the successful implementation of these measures requires the establishment of a modern, well-regulated market environment and the development of appropriate supporting infrastructure.

This paper aims *to identify the key factors influencing unemployment and poverty, taking into account current events, structural changes, and trends in the country's economic development—particularly in the labor market—resulting from the adoption of modern digital work platforms. Based on these insights, the paper proposes a system of targeted measures to address these challenges. The primary objective is to ensure decent and effective employment for the population, with particular emphasis on working conditions, employee protection, workplace safety, and fair and adequate compensation.*

The study employs both quantitative and qualitative research methods, including economic and mathematical-statistical analyses.

Keywords: *digital transformation, poverty, living standards, labor market, effective employment, globalization, economic growth, development.*

INTRODUCTION

In the current era of globalization and digital transformation, overcoming unemployment and poverty in the country, unfortunately, still represents the biggest challenge and remains the main task of macroeconomic policy. Despite the fundamental economic reforms implemented in the country recently, structural problems of the economy and insufficient development of the labor market still remain the most acute challenges, which, in turn, are related to such problems as unemployment, poverty, inequality, illegal labor migration (Government of Georgia, 2019). The development of the labor market primarily involves the adoption of fundamentally new forms of employment and increasing the efficiency of personnel activities. The necessity of the abovementioned is also due to the

fact that in the ongoing process of globalization, the role of digital technologies in the regulation of the labor market and social-labor relations is growing significantly, which has a considerable impact on the content and nature of the latter. In particular, the development of digital technologies is adequately reflected in the sectoral and professional-qualification structure of employment. Along with the obsolescence of certain professions, new, more modern progressive professions are emerging; in other words, the process of intellectualization, unquezation and universalization of labor is increasingly developing, in which, naturally, there is a growing demand for such new skills and competencies which are necessary in the process of working through the use of digital work platforms. In 2025, analytical thinking, creativity and flexibility are recognized as the most demanded and necessary skills. Based on the above, over the past 15-20 years, digital transformation has been part of the Socio-Economic Development Strategy of Georgia (Government of Georgia, 2014) and remains an important direction in the "Vision 2030 Development Strategy of Georgia" (Government of Georgia, 2022). Accordingly, the main goal of the Strategy for the Development of the Digital Economy and Information Society of Georgia for 2025-2030 is the development of the digital economy and information society, the development of the digital market of Georgia (Society of Georgia, 2025).

The purpose of the paper is to identify the main factors affecting unemployment and poverty, taking into account the current events, changes, trends, and development features in the country's economy and especially in the labor market, which occur as a result of the use of modern digital work platforms, and to develop a system of measures to overcome them. To achieve this goal, the primary task is to ensure decent, effective employment of the country's population with accentuation of working conditions, protection, safety, and decent, adequate remuneration.

The paper employs quantitative and qualitative analysis research methods; especially economic and mathematical-statistical analysis methods.

Poverty parameters and contributing factors in Georgia

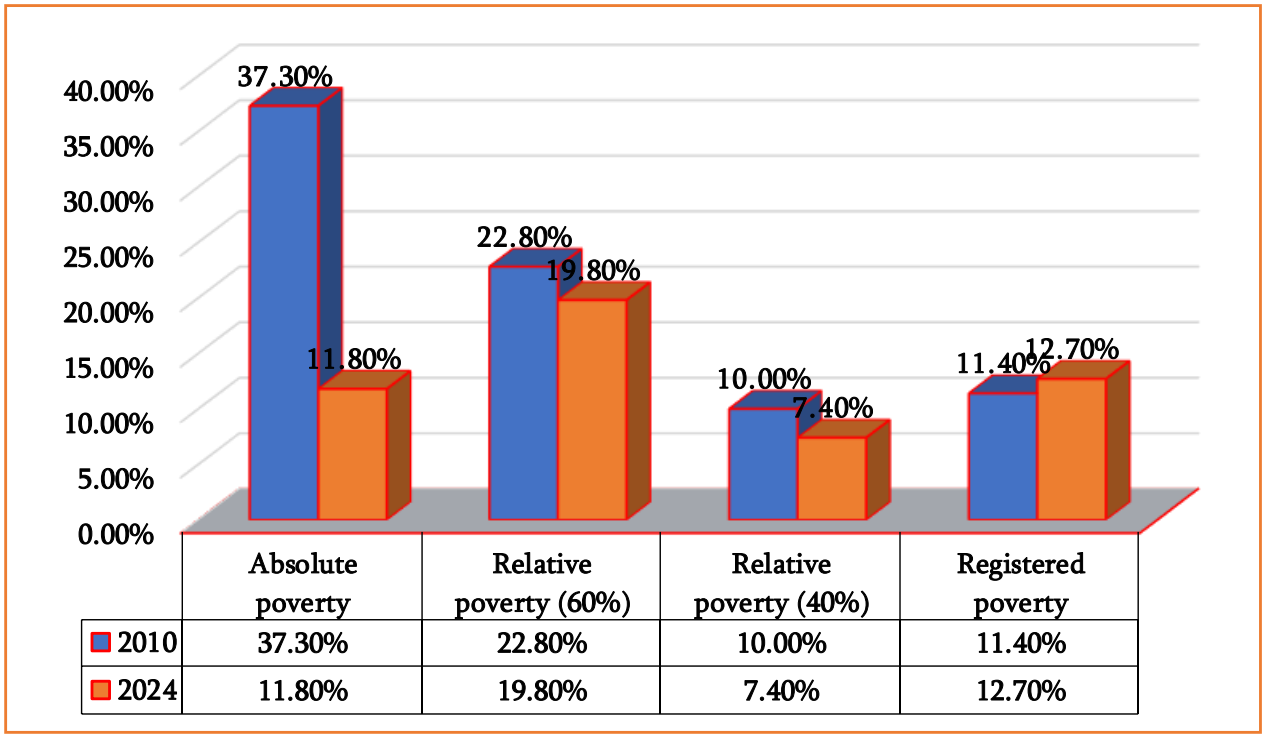
The first attempts to study and analyze poverty as an important socio-economic event and phenomenon in Georgia began in the late 1990s. However, a systematic approach to combating it has been implemented since the early 2000s, when the country began to implement social assistance programs to reduce its scale. The first large-scale strategic document to combat poverty was the "Socio-Economic Health and Economic Growth Program of Georgia" adopted in 2001, followed by the "Economic Development and Poverty Reduction Program of Georgia (EDPRP)" approved in 2003. The main objectives of the latter were: reducing poverty; promoting economic growth; implementing institutional reforms; improving the social protection system. At the next stage, the Parliament of Georgia approved a new poverty alleviation program in early 2008. Given the urgency of the problem, a new slogan is gaining ground - "A united Georgia without poverty!". Since 2012, following the change of government, a new three-part strategic document has been developed under the new legislation, according to which effective employment of the country's population is considered the main factor in overcoming poverty and ensuring social equality of the population, which is focused on achieving the goal of inclusive socio-economic development of the country.

Among those mentioned, we should highlight the National Strategy for Labor and Employment Policy (Government of Georgia, 2019), within the framework of which a number of important programs have been implemented. Despite the above, the level and extent of poverty in the country remains high. In particular, as of 2024, the share of the population below the absolute poverty line in Georgia (absolute poverty) is 11.8%. In 2005, 54.9% of the country's population lived below the officially defined poverty line (Tsartsidze M., 2016). Over the past 20 years, the absolute poverty rate has fluctuated from 11.8% (2024) to 37.3% (2010) (see Table 1). In 2024, by city, its level was 9.4%, and for rural settlements it was relatively higher at 15.6%. The absolute poverty rate differs slightly for women and men and is, respectively, 11.5% and 12.2%. As for the relative poverty rates, their change during the analysis period is also quite uneven. In particular, if the share of the population below 60 percent of the median household income was characterized by an increasing trend in 2009-2011, starting from 2012 and including 2015, its level is improving, and in 2016-2018 a growing trend is observed again. In 2024, its level was 19.8% nationwide. The relative poverty rate is much higher in rural settlements than in cities. In particular, if in 2009 the mentioned difference was 5.2%, by 2024 it increased to 11.4%. The maximum value of the relative poverty indicator according to 60% of median consumption in the analysis period, in rural areas - 29.6%, was recorded in 2017. In urban areas, its maximum value - 19.2%, was in 2010.

Table 1

Key poverty level indicators in Georgia as of 2010 and 2024 (in percentages)

Indicators		*Years*	
		2010	*2024*
Share of population below the absolute poverty line (absolute poverty) in percentages		37.3%	11.8%
Relative poverty rates in percentages	Share of population below 60 percent of median consumption	22.8%	19.8%
	Share of population below 40 percent of median consumption	10.0%	7.4%
Number of people receiving subsistence allowance (registered poverty)	Population receiving subsistence allowance (thousand people)	430.6	473.4
	Share in average annual population (%)	11.4%	12.7%



	Absolute poverty	Relative poverty (60%)	Relative poverty (40%)	Registered poverty
2010	37.30%	22.80%	10.00%	11.40%
2024	11.80%	19.80%	7.40%	12.70%

Figure1

Source: *The table and figure were compiled by the author based on various information sources. National Statistical Service of Georgia. www.geostat.ge; Social Service Agency* http://ssa.gov.ge/.

Almost similar dynamics are observed in the second indicator of relative poverty - the share of income below 40 percent of median consumption. In 2009-2024, its minimum value was 7.2%, recorded in 2015, and its maximum value was 10.4%, recorded in 2011. In 2024, 7.4% of the country's population lived below 40% of median consumption. According to this indicator, the poverty level is on average 5.6% higher in rural settlements than in urban ones. Its maximum value was 12.3% in rural settlements, and 8.3% in urban areas in 2010 (www.geostat.ge). As for registered poverty, despite the ongoing reforms and positive changes in the direction of economic development in the country, it is still quite high and, unfortunately, there is no noticeable decrease in it. In particular, in 2022, its level increased to 17.4% compared to previous years, and as of 2024, it decreased and amounted to 12.7%, or 473,426 people. That is, in 2024, 12.7% of the Georgian population received subsistence allowances and, accordingly, belonged to the poor income group (National Statistical Service of Georgia, 2025).

Since 2004, poverty parameters in Georgia have been calculated considering the international poverty line (absolute poverty rate 2.15; 3.65 and 6.85 dollars per day). As the data in the table show, in the dynamics, over the past 20 years, there has been a tendency to improve according to the mentioned parameters, although it can be said that their values remain quite high in the current period (Tsartsidze M., 2022). For example, the absolute poverty rate is 15.0% for 3.65 dollars per day, and 47.7% for 6.85 dollars (see Table 2).

Table 2

Share of population below the international poverty line in Georgia in 2005-2024, in percentages

Poverty iindicators	**2005**	**2010**	**2015**	**2020**	**2024**
Absolute poverty line, in GEL- 2.15 USD per day (2017 PPP)	12.9%	14.4%	4.9%	5.8%	4.3%
Absolute poverty line, in GEL- 2.15 USD per day (2017 PPP)	34.1	48.7	55.8	68.4	83.9
Absolute poverty line, in GEL- 3.65 USD per day (2017 PPP)	35.2%	35.7%	20.0%	21.4%	15.0%
Absolute poverty line, in GEL- 3.65 USD per day (2017 PPP)	57.8	82.7	94.8	116.2	142.5
Absolute poverty line, in GEL- 6.85 USD per day (2017 PPP)	71.7%	70.6%	56.2%	58.3%	47.7%
Absolute poverty line, in GEL- 6.85 USD per day (2017 PPP)	108.5	155.1	177.9	218.1	267.4

Source: *The table was compiled by the author based on data from the National Statistical Service (www.geostat.ge) and the World Bank (https://www.worldbank.org/ext/en/home).*

In the context of ongoing globalization and digital transformation of the economy, when addressing the problem of poverty, to ensure its reduction, is it crucial to take into account the main factors that significantly influence its incidence and scale. As a result of our research, along with other key parameters, the ten most important factors were identified (see Figure 2).

Given the current socio-economic situation in the country, the most essential importance for overcoming poverty should be given to decent, highly productive, effective work, employment and its adequate remuneration. Therefore, it is no coincidence that under modern conditions, the principle universally recognized by the International Labor Organization "Decent work is the basis of human well-being and the development of the country" (Tsartsidze M., 2019) is becoming a priority. The main indicator determining decent, effective work is a decent salary, remuneration for labor. The basis for achieving both is effective employment and a balanced labor market, which also plays a key role and importance in terms of the country's economic development (Tkemaladze, I. Kakulia N., 2023). That is why, in the context of digital transformation, the focus on effective employment becomes the main criterion for regulating the country's social policy and employment sector and one of the important factors of socio-economic progress. It should ensure a decent economic income, health, raising the level of educational and professional-qualified knowledge, personal development, increasing labor productivity, etc. (Tsartsidze M., 2024); (Tkemaladze, I., 2023).

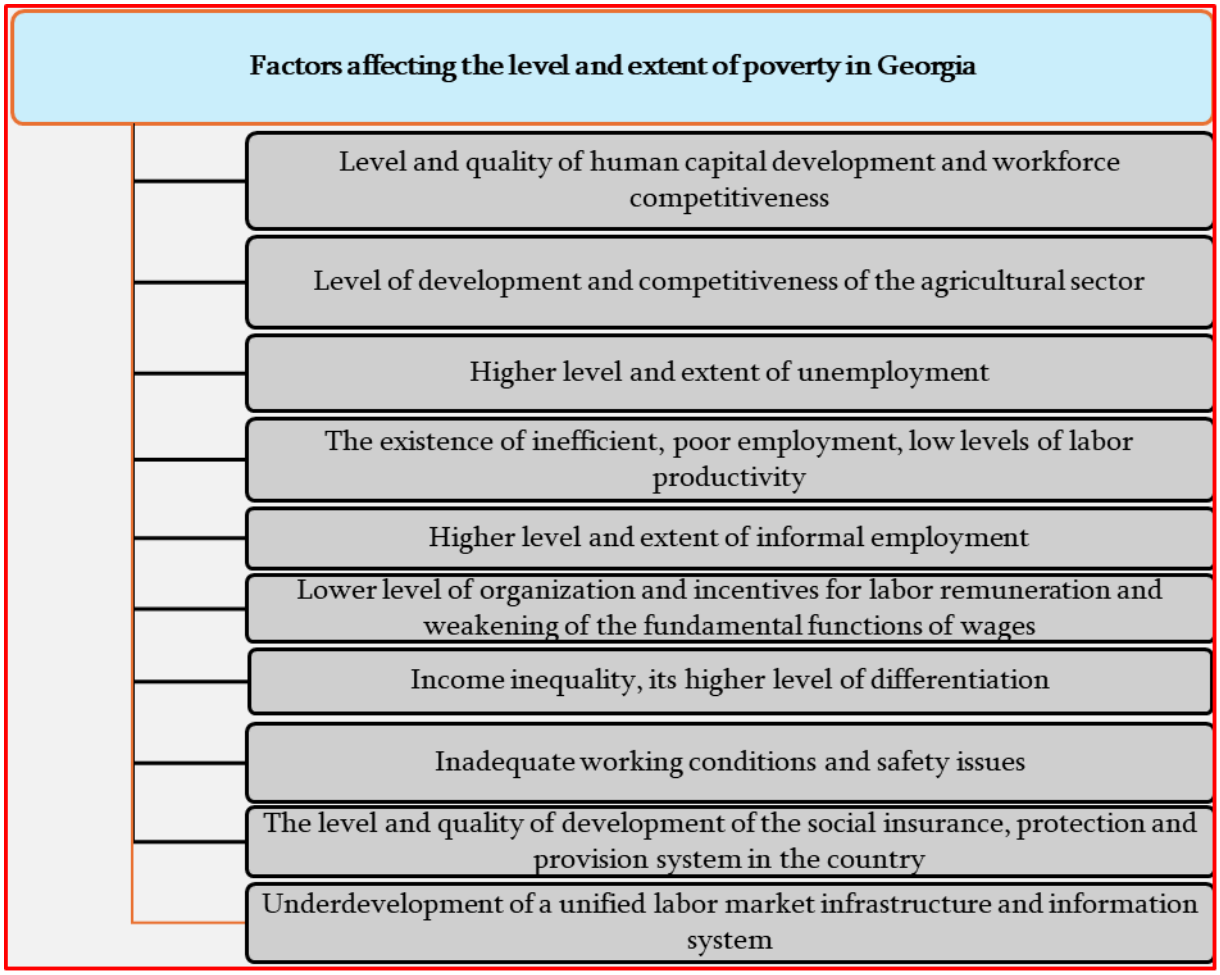


Figure 2. Factors affecting the level and extent of poverty in Georgia

As it was mentioned, the level and extent of poverty are significantly determined by the level of human capital development, the quality of education and the availability of qualified personnel (Tsartsidze M. Gabadadze Sh., 2024). Based on the above, a special place in the National Strategy of Labor and Employment Policy of Georgia is given to "Development of Human Capital and Productivity, Lifelong Learning" (Government of Georgia, 2019), because it is precisely under the conditions of digital transformation that the requirements for human capital are changing even more. It is directly related to both new opportunities for the realization of accumulated potential, as well as future risks (Bedianashvili G. Tsartsidze M. Mikeladze N. Gabroshvili Z., 2023). In this regard, an important component of human capital is knowledge of digital technologies. An equally important aspect is the change in the nature and content of labor itself. The level and quality of human capital development in Georgia is significantly characterized by the Human Development Index (HDI). For example, since 2010, Georgia has been classified as a country with a high level of development according to the level of this index (0.759) and was ranked 75th out of 187 UN member states. Recently, its value has increased significantly and in 2022, 2023, 2024 it has already reached a fairly high level (0.812, 0.816 and 0.825, respectively). As a result, among 191 countries, Georgia first takes 61st place (2022) and then 60th place (2023 and 2024) (see Figure 3). Despite the above, it can be

said that the importance of the Human Development Index (HDI) in Georgia, is still quite low compared to developed countries and significantly lags behind even some post-Soviet countries. For example, in the Baltic countries, the HDI level is quite high and is distributed as follows according to the rating: Estonia 0.899 (31st place), Lithuania 0.879 (37th place) and Latvia 0.879 (37th place). In the Czech Republic, Poland and Romania it was respectively: 0.881 (36th place), 0.881 (23rd place), 0.827 (53rd place). The Russian Federation, with an HDI value of 0.821, ranks 56th (HDI by Country 2024).

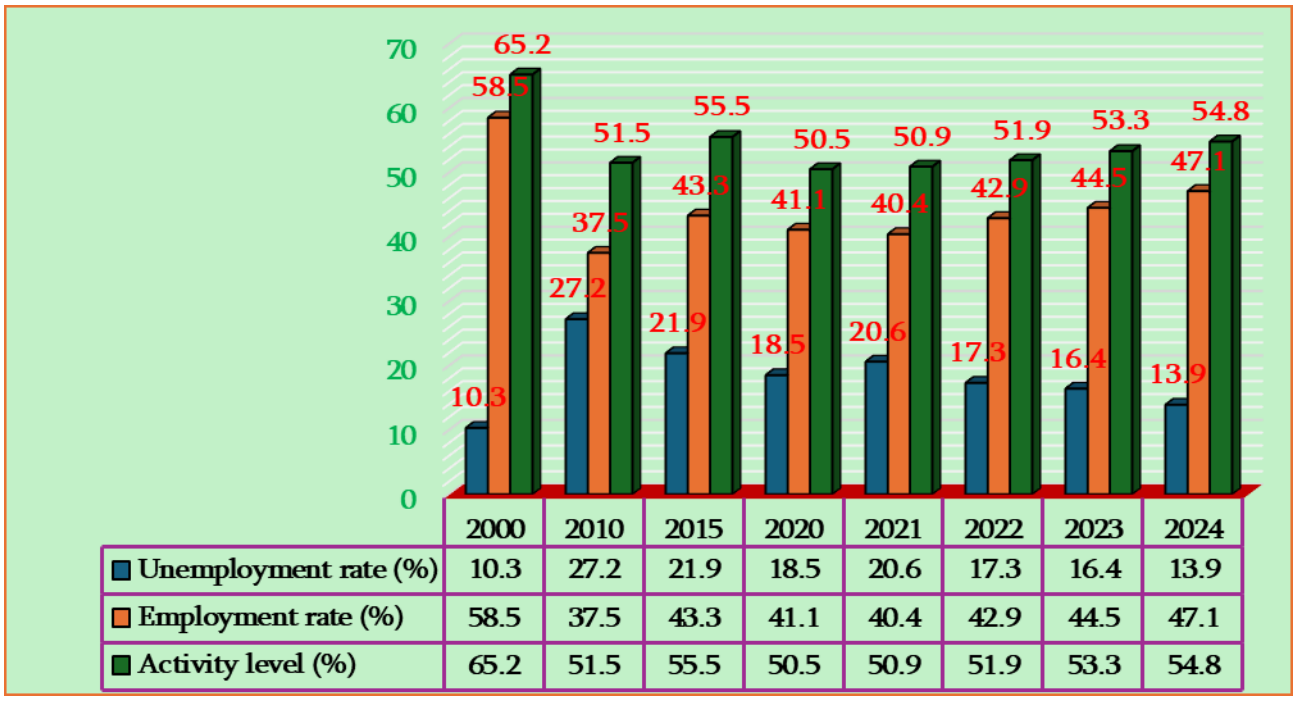
Figure 3. Human Development Index (HDI) in Georgia 2000–2024 and its ranking

Source: *Compiled by the authors using the National Statistics Service and various internet resources: Human Development Index (HDI) by Country 2023 (worldpopula-tionreview.com). United Nations Development Programme. Human Development Report 2020. Georgia. GEO.pdf (undp.org) HDR21-22_Statistical_Annex_HDI _Table.xlsx (live.com). HDI World Ranking 2022 - Eamond. Human Development Report 2023-24: Breaking the gridlock: Reimagining cooperation in a polarized world. United Nations Development Programme. 13 March 2024. Retrieved 16 March 2024.*

At the current stage of the formation and functioning of the labor market in Georgia, the high level and scale of mass, chronic unemployment significantly affects effective employment and, accordingly, the country's economic development (Papava, V., & Bedianashvili G., 2024). According to official data, in 2000-2020 its level in the country ranged from 10.3% (2000) to 18.5% (2020), and reached its maximum level of 27.2% in 2010. As for 2021-2024, the unemployment rate is characterized by a downward trend. In

particular, if in 2021 it increased by 2.1% compared to the previous year and amounted to 20.6%, in 2022 it decreased to 17.3%, and in 2023 to 16.4%. In 2024, its level decreased to 13.9% (see Figure 4).

The main causes of unemployment in the country are: low quality of the workforce, i.e. lack of work skills and experience; shortage of jobs; mismatch between demand and supply of professional skills. One of the factors contributing to poverty in Georgia is that in recent years the level of economic and social inequality has also been steadily high, which is especially noticeable in terms of income and wages. In particular, the difference between wages in Georgia is quite large. The majority of employees earn about 1/3 of the average wage. Inequality is also reflected in gender wage and economic activity indicators. As for the distribution of income according to the Gini coefficient (0.36, in 2024), this indicator exceeds both the average European indicators and those of many post-Soviet countries.



	2000	2010	2015	2020	2021	2022	2023	2024
Unemployment rate (%)	10.3	27.2	21.9	18.5	20.6	17.3	16.4	13.9
Employment rate (%)	58.5	37.5	43.3	41.1	40.4	42.9	44.5	47.1
Activity level (%)	65.2	51.5	55.5	50.5	50.9	51.9	53.3	54.8

Figure 4. Unemployment and employment rates in Georgia in 2000-2024, percentage

Source: *Compiled by the author based on data from the National Statistical Service of Georgia. Employment and Unemployment - National Statistical Service of Georgia (www.geostat.ge).*

In addition to the above, the quality of occupational safety and working conditions in the workplace falls short of European and international standards, as evidenced by the high number of workplace-related deaths and injuries in recent years (Government of Georgia, 2019). In particular, in 2024, 33 people died and 257 were injured in the workplace in Georgia, which is 12.4% more than in 2020.

CONCLUSIONS AND MAJOR RECOMMENDATIONS

1. Poverty, as a global macroeconomic phenomenon, remains a pressing problem in the country from both a socio-economic, cultural and political perspective. It directly affects the process of economic development and, in turn, the quality of life and living standards of the working class. Accordingly, in

order to reduce large-scale poverty in the context of the ongoing digital transformation and European integration, it is necessary to develop a mechanism for analyzing and forecasting the factors influencing poverty and its root causes. This mechanism should include systematic and periodic monitoring of the measures and programs designed to address and reduce poverty.

2. In order to overcome poverty in the country, it is very important and necessary to develop the private sector, entrepreneurship, and business, which will contribute not only to improving the scale and structure of employment, but will also have a noticeable impact on the scale of labor emigration of the country's population. Accordingly, it is necessary to ensure appropriate rates of economic growth and development, because at the current stage, insufficient rates of economic development in Georgia cannot ensure a real increase in demand for labor, which will adequately affect their employment opportunities, prospects, and ultimately- the scale of poverty. In order to develop the private sector of the economy, it will be necessary to: further improve the business and investment environment, promote investment attraction, and ensure macroeconomic stability through adequate fiscal and monetary policies. In parallel, in order to increase the competitiveness of the private sector, the state should ensure: the development of micro, small and medium-sized entrepreneurship, improving their access to finance, encouraging innovations and technologies, and promoting entrepreneurial activity to ensure effective employment.

3.We believe that, given the current socio-economic situation in the country, the main factor in overcoming poverty is the provision of decent, effective employment for the country's population, where working conditions, protection, safety and decent, adequate remuneration should be accentuated. The necessity of this is due to the fact that today the country maintains a higher level and scale of unemployment, which is chronic, and there is no mechanism for social insurance for the unemployed. Accordingly, the problem of "poor" and ineffective employment is emerging, which is also characterized by: low levels of organization of employment agencies and inadequate labor standards; low levels of labor productivity and remuneration in a number of sectors of the national economy; problems in the field of labor protection and safety, career advancement and professional development, labor remuneration, low level and quality of labor incentive organizations; the development of social protection and welfare, as well as the system of social partnership in the country.

4. The level and extent of poverty in Georgia are affected not only by the level of income, but also by the degree of their differentiation, which is relatively high compared to developed countries. In order to reduce it, it is necessary to: improve tax policy; provide access to appropriate educational, especially vocational training, programs, implement employment promotion programs, implement targeted social assistance programs, access to healthcare, support for small and medium-sized businesses, stimulate innovation, etc.

5. In the current era of globalization, the development of the digital economy, i.e. information and digital technologies, has a significant impact on both the level and extent of poverty and the effectiveness of employment. Therefore, fundamentally significant to create new conceptual approaches to the qualitative improvement and development of human capital and labor potential in accordance with all stages of its reproduction (formation, distribution, exchange, use);

6. In order to reduce poverty and achieve decent and effective employment, we must take into account that the labor market is increasingly demanding higher levels of professional training for personnel, towards developing computer and information technology skills and the ability to introduce innovations into the production process. Under such conditions, personnel are valued not only for such qualities as responsibility, purposefulness, and hard work, but also pay special attention to creativity and ingenuity. The market role of educational institutions is crucial here, which should ensure: preparation of qualified personnel in accordance with the current demands of the labor market, and comprehensive development of human capital.

7.The country faces serious problems in the functioning of the labor market and its development. In particular, it still fails to ensure the adherence to the principles of social justice in the sphere of education, decent employment and improvement of working conditions, and the accessibility of the population to various labor market services and jobs. The labor market infrastructure and information system, etc. are of great importance. Accordingly, to effectively overcome poverty in the country, significant attention should be directed toward the comprehensive development of the labor market and its supporting infrastructure.

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DISRUPTIVE BRANDS – NEW CHALLENGES IN A DIGITAL ERA

How the Established Automotive Industry Must Respond

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Abstract

The German automotive industry's competitiveness has long been underpinned by strong global brands, leading technological innovation, open market access, and a skilled workforce. Today, these success factors are all under pressure from rising protectionism, the twin challenges of decarbonization and digitalization, demographic change, and the emergence of disruptive new brands.

This paper examines how such brands are redefining competition through the dual lens of Schumpeter's Creative Destruction - disruption as a driver of renewal - and Christensen's Innovator's Dilemma - the tendency of incumbents to resist necessary change. Drawing on a case study of the German automotive industry, it argues for strategic self-disruption as essential to long-term relevance.

The framework Structure follows Strategy follows Culture is proposed as a practical guide, starting with cultural transformation, extending to adaptive strategy, and supported by agile structures - offering a disciplined path to harness disruption rather than be overtaken by it.

INTRODUCTION

The global competitiveness of the German automotive industry has historically rested on several **central success factors**: strong brands, technological innovation, open access to international markets, and a highly skilled workforce (Koers 2014). Among these, **brand leadership** - symbolized by strong brands like BMW, Mercedes-Benz, Porsche, VW and Audi - has been central to defining the industry's premium image. Equally, the supplier industry, with its renowned "hidden champions" (Simon, 2021), has reinforced this standing and contributed to the sector's international reputation for quality, innovation, and engineering excellence.

However, in today's rapidly evolving economy - driven by sustainability imperatives and accelerated by digitalization - the foundations of this success are being challenged from multiple directions. **New market entrants from the tech and mobility sectors** are reshaping consumer expectations of what an

automotive brand can be. In this shifting landscape, established carmakers must not only protect their heritage but also rethink their strategic orientation.

The disruption underway is not confined to technology. It changes how products are developed, how companies compete, and ultimately, how value is created and captured. As Schumpeter (1942) observed, renewal through disruption is essential for economic progress. However, as Christensen (1997) demonstrated, even highly successful firms can lose relevance if they fail to embrace disruptive change - a risk known as the Innovator's Dilemma.

This paper examines the implications of disruptive branding for the automotive sector and explores how established manufacturers can respond effectively. Using the German automotive industry as a case study (Yin, 2018), it argues that **strategic self-disruption** is now a prerequisite for long-term competitiveness. To guide this transformation, it applies the framework **Structure follows Strategy follows Culture**, which highlights the organizational and cultural shifts required to implement new strategies successfully.

CHALLENGES IN THE AUTOMOTIVE INDUSTRY

The competitiveness of the German automotive industry is increasingly under pressure from disruptive forces in the global economy and shifting industry dynamics (see figure 1).

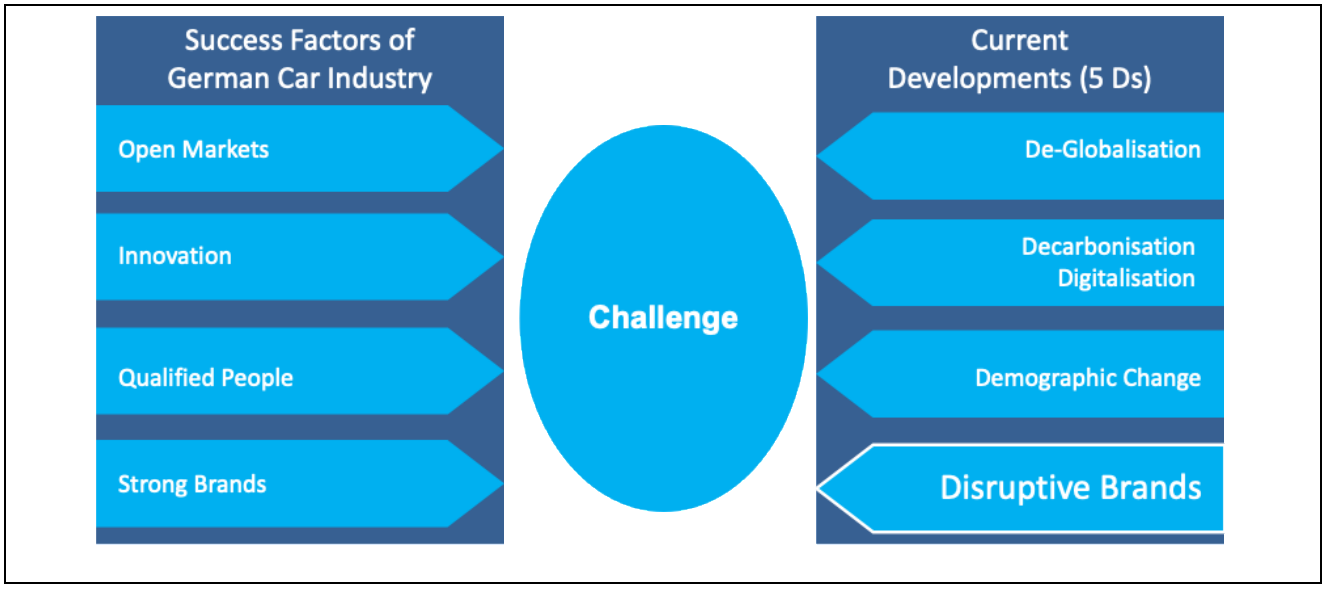


Figure 1. Key success factors of the German automotive industry under pressure

Open markets: rising protectionism and de-globalisation

For decades, the German automotive industry has thrived on an export-driven model, leveraging open markets to achieve global scale (VDA 2024). Today, this foundation is being eroded by a worldwide resurgence of protectionism. The "America First" trade agenda has reintroduced significant barriers, including new tariffs on European car imports, while China is implementing assertive industrial policies to promote domestic brands and limit the presence of foreign OEMs. Similar trends are visible in other key markets, where governments are increasingly using tariffs, local content rules, and industrial subsidies to shield domestic industries. Together, these developments challenge the long-standing assumption that globalization would remain a reliable and stable engine of growth (VDA 2024).

Innovation: New Frontiers and Competitors Emerging from Decarbonization and Digitalization

German carmakers and suppliers built their reputation on engineering excellence for decades, earning a sustained reputation for quality and performance. But today's innovation drivers - decarbonization and digitalization - play to the strengths of new entrants. The shift to electric drivetrains demands entirely new supply chains, battery technologies, and charging infrastructures, while the growing dominance of software in connected, autonomous vehicles requires capabilities far beyond traditional mechanical engineering. Players such as Tesla, BYD, and Xiaomi are setting new performance benchmarks, often outpacing established OEMs in both technological speed and customer-centric design.

People: Demographic and Skill Constraints

A highly skilled workforce has been a defining strength of Germany's industrial base. However, demographic trends are creating deep structural challenges. An aging population is shrinking the pool of experienced workers (Obst 2024). At the same time, the transition to digitalized mobility demands expertise in areas such as software engineering, artificial intelligence, and data analytics - skills that are in high global demand and difficult for OEMs to attract. Traditional HR approaches are struggling to compete with the appeal of tech companies and start-ups, leaving critical capability gaps.

Strong Brands: The Rise of New Brand Logics through Disruptive Brands

Even strong brands - the pride of the German automotive industry - are under pressure. Historically, German OEMs and suppliers built their strong brand image on attributes such as precision, safety, and performance. But new brands are competing based on entirely different codes (Benbunan, 2019).

Disruptive brands like Tesla or Xiaomi succeed not through heritage, but through innovation, direct customer engagement, and integration into digital and sustainable ecosystems. Tesla, for instance, built its brand on

visionary leadership, a clean-energy narrative, and an agile product approach that bypasses traditional dealership networks. Chinese newcomers like Xiaomi treat the car as a digital platform, offering frequent over-the-air updates, personalized services, and integration into broader lifestyle ecosystems. They are software companies building cars instead of a car manufacturer that uses software.

The brand logic has shifted. While traditional OEMs emphasize legacy, craftsmanship, and mechanical perfection, disruptive brands focus on user experience, rapid iteration, and digital connectivity. Vehicles are treated as connected platforms that evolve over time through software updates, new services, and integrated lifestyle offerings. In doing so, they compete not only with other carmakers but with the wider technology and mobility ecosystem, speed becomes the decisive competitive factor.[1]

In China, where automotive preferences evolve quickly, this new approach has gained significant traction: as of Q2 2025, Chinese brands hold more than 65 % of their domestic market - a dramatic increase from just 36% in 2020 (CAAM, 2025). This reflects a deeper shift in consumer expectations, where brand value is no longer guaranteed by heritage but must be earned continuously through relevance, responsiveness, and innovation.

DISRUPTIVE BRANDS, CREATIVE DESTRUCTION, AND THE INNOVATOR'S DILEMMA

Building on this shift, disruptive brands are reshaping the competitive dynamics of the automotive sector. They gain rapid market traction through technology-driven innovation, direct customer engagement, and integration into broader digital and sustainable ecosystems.

The rapid rise of disruptive brands is not an isolated phenomenon but part of a broader economic pattern that governs how industries evolve and how market leadership shifts over time. This is precisely what **Joseph Schumpeter** described as **Creative Destruction**: the process by which innovation continually dismantles and replaces established products, technologies, and business models with new ones.

Creative Destruction as a Driving Force

Schumpeter's concept of Creative Destruction describes how innovation disrupts established market structures, replacing old technologies, products, and business models with new ones (Schumpeter, 1942). Far from being an occasional disturbance, this process is the **central driver of long-term economic growth.**

[1] A McKinsey study shows: Traditional OEMs need an average of 40-50 months to develop new vehicle software. New car manufacturers like Tesla and BYD develop a complete vehicle (including software) in 24-30 months. Some Chinese players achieve best-case scenarios in 18 months. See https://www.mckinsey.de/news/presse/2023-30-08-automotive-masterplan

Historical examples such as the replacement of film cameras by digital photography or the streaming revolution that displaced video rental stores illustrate its transformative power.

In the automotive industry, creative destruction is evident[2]:

- **From combustion to electrification:** Internal combustion engines, once the pride of German engineering, are rapidly being replaced by electric drivetrains.
- **From hardware to software:** Competitive advantage increasingly lies in digital capabilities, in-car operating systems, and data-driven services.
- **From driver to autonomy:** Technological advancements driven largely by Artificial Intelligence (AI), are transforming driving from a manual activity into a largely automated one.

These shifts require not only technical adaptation but also a rethinking of the industry's value proposition. This brings us to another perspective on disruption: While Schumpeter's concept explains why industries must renew themselves, it does not explain why established leaders often fail to drive such renewal. Christensen's Innovator's Dilemma provides a complementary perspective, shifting the focus from the economic necessity of disruption to the organisational realities that can hinder it (Christensen, 1997).

The Innovator's Dilemma in the Automotive Context

According to Christensen, established firms often struggle to embrace disruptive innovations because their success in existing markets makes them risk-averse, overly focused on current customers, and reluctant to invest in unproven opportunities. In the automotive industry, this dynamic is already evident.

For many years, OEMs treated electrification and digitalization as incremental extensions of their existing business models rather than as opportunities for radical reinvention. Software development was largely outsourced, autonomous driving programs advanced slowly, and decision-making processes continued to prioritize proven combustion-engine revenue streams over emerging, potentially disruptive ventures.

Today, the technological imperative is widely acknowledged. As one industry expert observed: **"The industry doesn't have a problem with understanding what needs to be done. The difficulty lies in changing organizational structures and mindsets"** (Friedel, 2025). In other words, the challenge is no longer recognizing the need for change but transforming the organization from within to deliver it.

[2] A PEST analysis would also prove the disruption in the car industry. A PEST analysis (political, economic, social and technological) is a framework of external macro-environmental factors used in strategic management and market research. See Aguilar, 1967.

Organizational Transformation as the Core Challenge

While electrification, digitalization, and autonomy are visible elements of disruption, the deepest transformation must occur within the organization itself. Competing with agile, tech-native brands demands more than technological upgrades - it requires cultural change, new governance models, and faster decision-making structures.

Christensen's work shows that incumbents struggle not because they are unaware of disruptive change, but because their organizational structures, processes, and performance metrics are optimized for the current business model. The very strengths that ensure operational excellence in stable markets become constraints in times of disruption. As a result, even well-resourced companies can be slow to adapt, ceding ground to more agile competitors. This is why, in the automotive industry, the most profound transformation challenge is not purely technological but organizational. Competing with agile, tech-native brands requires more than new drivetrains or digital features – it demands a fundamental reinvention of culture, governance, and decision-making structures.

The tension between the inevitability of disruption and the tendency of incumbents to resist it defines the strategic crossroads for the automotive industry. As illustrated in Figure 2, the logic of Schumpeter's Creative Destruction explains why industries must renew themselves, while Christensen's Innovator's Dilemma explains why incumbents so often fail to lead that renewal. The intersection of these two perspectives points to a clear imperative: Strategic Self-Disruption.

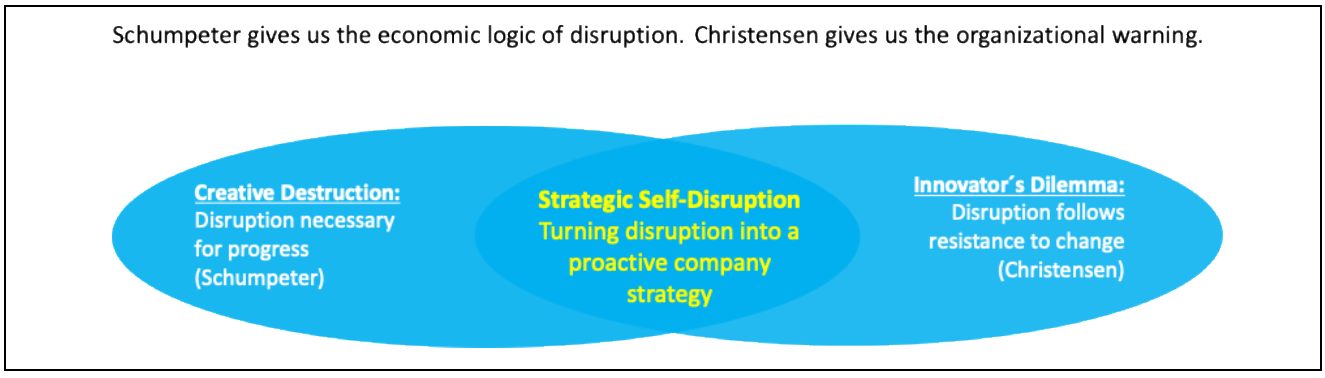


Figure 2: The intersection of Schumpeter's Creative Destruction and Christensen's Innovator's Dilemma

Strategic self-disruption is the deliberate act of turning disruption into a proactive company strategy. Rather than waiting for external forces to dismantle their existing business models, forward-looking automotive manufacturers and suppliers must initiate their own renewal. This means reframing disruption not as a threat to be managed, but as an opportunity to shape the future of mobility.

HOW THE ESTABLISHED AUTOMOTIVE INDUSTRY MUST RESPOND AND BECOME DISRUPTIVE

In order to respond effectively to disruptive forces, established automotive firms need more than a set of isolated initiatives. They require a transformation logic that aligns the deepest foundations of the organization with its strategic ambitions and operational capabilities. The framework **Structure follows Strategy follows Culture** provides such a logic. It builds on Peter Drucker's well-known observation that **"culture eats strategy for breakfast"**[3] and Alfred Chandler's principle that **"structure follows strategy"** (Chandler 1962), while extending the logic to emphasize that cultural transformation is the essential first step for lasting renewal. Culture determines how people think and behave, strategy defines the intent and direction, and structure enables the organization to make that strategy real:

- **Culture shapes behavior:** the shared mindset and values that drive decisions and actions - if companies want to act differently, they must first think differently!
- **Strategy defines intent:** the choices about what to disrupt, where to compete, and how to win - it expresses what the organization wants to become and how it aims to shape the future.
- **Structure makes it real:** Without structural enablers, even the best strategy cannot succeed. It enables execution - the systems, governance, and resource allocation that make strategy real.

This framework is not a one-time linear process. It is cyclical - strategy can reshape culture, structure can reinforce or undermine both, and cultural feedback from employees and customers must continuously refine direction.

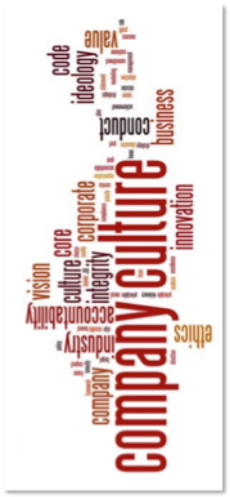
For incumbent automotive manufacturers and suppliers, this sequence creates the conditions for strategic self-disruption - the deliberate reinvention of one's own business model before market forces make it unavoidable. [4] This approach captures the Schumpeterian logic that disruption is necessary for renewal while avoiding the pitfall that Christensen described: the inability to adapt because of an overreliance on past successes.

[3] The often-quoted phrase "culture eats strategy for breakfast" is widely attributed to Peter Drucker but appears to have been popularized by Mark Fields, then President of Ford America, in 2006 - a story well documented in press coverage and corporate commentary.

[4] The following disruptive considerations on Structure follows Strategy follows Culture draw on insights from many years of leadership experience within the German Association of the Automotive Industry (VDA), where all major CEOs of German car manufacturers, suppliers, trailer producers, and body-builders are represented.

Culture: From Legacy Pride to a Disruptive Mindset

As illustrated in Figure 3, the cultural transformation from traditional to disruptive represents a fundamental shift in attitudes and norms. In their traditional form, automotive cultures often place great pride in their legacy, seeing established methods as the safest path to success. Perfectionism and repeated, overly long testing cycles are prioritized over speed, while mistakes are treated as unacceptable setbacks rather than learning opportunities. Departments tend to operate in silos, with limited exchange between functions, and leaders often remain at a distance from the day-to-day processes of innovation.



What it means:
Culture creates the foundation for breakthroughs, speed, and customer obsession - whether in startups or command style system. Disruption requires a mindset open to change.

Traditional	Disruptive Culture*
Pride in legacy, "we've always done it this way"	**Build a Mindset to Challenge Status Quo** → Constantly question what made you successful
Perfectionism, long cycles	**Embrace Speed Over Perfection** → Decide fast, iterate, encourage "launch, then learn" behaviors
Fear of failure, risk aversion	**Normalize Failure as Learning Culture** → Create psychological safety to experiment
Siloed mindset	**Encourage Openness to Cross-Disciplinary Thinking** → Value & Integrate tech, data, engineering, & customer insights
Product pride & Detached Leadership	**Build Purpose-Driven Mindset with Leaders as Cultural Catalyst** → "We shape future" - Leaders demand disruptive behaviors

Figure 3: Cultural transformation from traditional to disruptive mindsets in the automotive industry

In contrast, the **disruptive cultural perspective** shown in Figure 3 is built on a mindset that continually challenges the status quo, constantly questioning the very factors that led to past success. Speed is embraced over perfection, with fast decision-making, rapid iteration, and a "launch-then-learn" approach replacing lengthy over-testing cycles. Failure is reframed as an essential learning mechanism, supported by a culture of psychological safety that encourages experimentation. Openness to cross-disciplinary thinking becomes the norm, integrating technology, data, engineering, and customer insights into problem-solving. Leaders act as cultural catalysts, driving a shared sense of purpose and reinforcing the belief that "we shape the future." They do not merely endorse disruptive behaviors but they actively demand and model them.

This cultural foundation is critical. Without it, any attempt at disruptive strategy will be undermined by ingrained organizational habits.

Strategy: From Product Focus to Adaptive Mobility Ecosystems

Culture provides the foundation; strategy gives it direction. Figure 4 contrasts the way traditional strategies tend to define the business narrowly around the product - the car itself. In traditional settings, long-term plans are fixed, changes are incremental, and protecting the existing business takes priority over exploring new territory. The approach is largely self-contained, relying primarily on internal resources and capabilities, and tends to optimize for what has worked in the past rather than what might define the future.

What it means:
Strategy emerges from culture's beliefs and values. For established automakers, it defines what to disrupt, where to compete, and with whom.

Traditional Strategy	Disruptive Strategy*
Focus on selling cars	**Shift from Car Maker to (Tech) Mobility Ecosystem** → Build platforms and services beyond the car
Fixed long-term planning	**Use Adaptive Strategy Model** → Continuous strategy updates via via real-world feedback
Protect existing business	**Replace Before Being Replaced** → Transitioning to new ideas before competitors do
Product-centric roadmaps	**Anchor Strategy in Narrative + Purpose** → Disruptive Branding / Define company's future role for society
Compete alone	**Invest in Strategic Partnerships for Capability Building** → Collaborate with tech, startups, cross-industry players

Figure 4: Strategic transformation from product-focused to adaptive mobility ecosystems

In contrast, the **disruptive strategic perspective** shown in Figure 4 reflects a shift from a car maker to a (tech) mobility ecosystem, where value is created through platforms and services that extend far beyond the vehicle itself. Strategy follows an adaptive model, updated continuously through real-world feedback rather than locked into rigid, static plans. Incumbents replace their own products before being replaced, transitioning to new ideas before competitors can seize the opportunity. Each strategic move is anchored in a strong narrative and sense of purpose, using disruptive branding to define the company's future role in society. To deliver on this vision, firms invest in strategic partnerships that build the capabilities they cannot develop alone - collaborating with technology companies, start-ups, and partners from other industries to accelerate innovation and expand their reach.

Such strategies allow incumbents to act like insurgents: moving fast, learning continuously, and shaping the market rather than merely responding to it.

Structure: From Bureaucracy to Agile Enablers

No matter how forward-looking the strategy, it cannot succeed without a structure that enables it. Figure 5 illustrates the contrast between the hierarchical, bureaucratic systems common in traditional automotive organizations and the agile, flexible structures required for disruption. In the traditional model, decision-making is slowed by multiple layers of hierarchy, and the same operational approach is applied to both the core business and innovative projects. Functions remain separated, governance and performance metrics are uniform across all activities, and resources are locked into fixed allocations that are difficult to reassign.

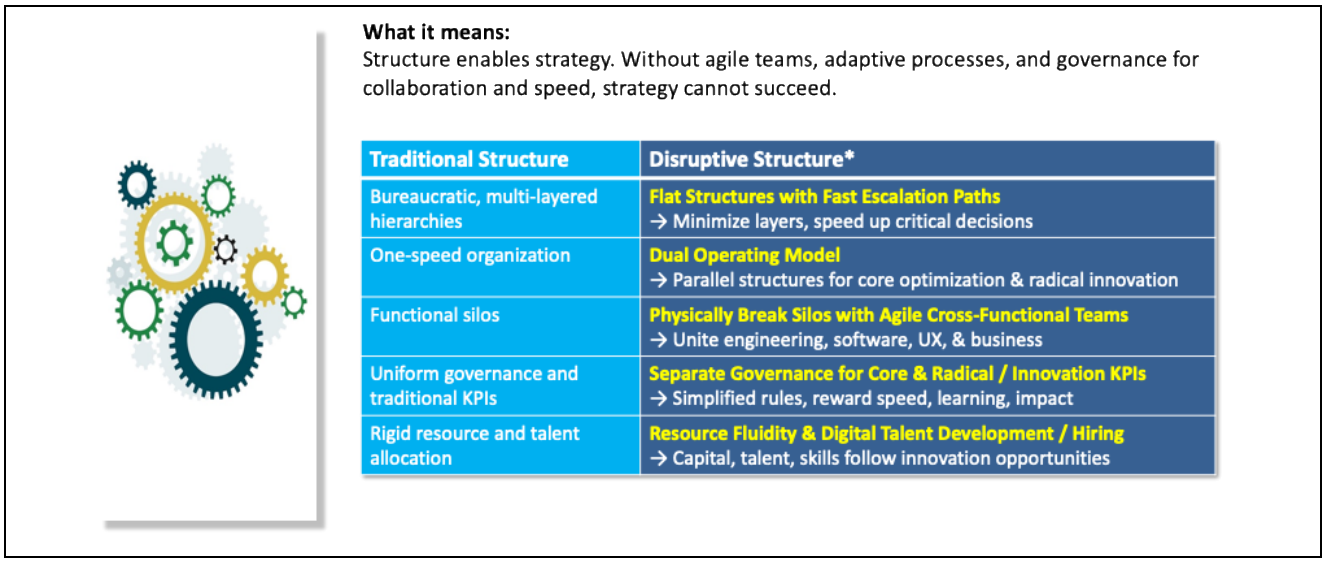


Figure 5: Structural transformation from hierarchical bureaucracy to agile enablers

The **disruptive structural perspective** shown in Figure 5 is built around flat structures with fast escalation paths, minimizing hierarchical layers to accelerate critical decision-making. It operates through a dual operating model - one structure optimized for the stability of the core business, and another designed for radical innovation and experimentation. Organizational silos are physically broken down through agile, cross-functional teams that unite engineering, software, user experience, and business expertise around shared objectives. Governance is separated for core and innovation activities, with simplified rules and performance metrics tailored to encourage speed, learning, and impact rather than just traditional efficiency measures. Finally, resources flow to innovation opportunities through dynamic capital allocation, digital-talent development and targeted hiring. By making skills and funding follow strategic priorities rather than fixed budgets, the structure becomes a true enabler of adaptive strategy.

Strategic Self-Disruption as a Leadership Imperative

When culture, strategy, and structure are aligned in this way, established automotive manufacturers and suppliers can engage in strategic self-disruption with purpose and discipline. This is not about dismantling what exists for its own sake, but about renewing the organization so that it can shape the future rather than merely react to it. By anchoring transformation in culture, expressing it through strategy, and enabling it with structure, companies can unlock the benefits of creative destruction while sidestepping the inertia that has doomed many once-successful incumbents.

In the current market, where disruptive brands are rewriting the rules of competition at unprecedented speed, such an approach is not merely advisable - it may be the only sustainable path to long-term relevance.

SUMMARY AND CONCLUSION

The transformation of the automotive industry is being driven by multiple, interrelated forces that are reshaping its competitive landscape. Among these, the rise of disruptive brands stands out as both a symptom and an accelerator of change. These brands challenge not only the products and technologies of established manufacturers but also the very way in which brand value is created and sustained. Their rapid ascent is a direct expression of the dynamic Joseph Schumpeter described as **Creative Destruction**: the continual replacement of old models with new, more innovative ones.

Yet, as Clayton Christensen's **Innovator's Dilemma** explains, incumbents often struggle to lead such renewal. Organisational structures, processes, and metrics optimised for the current business model become barriers to transformation. This inertia can cause even the strongest market leaders to lose ground to more agile competitors, despite their deep resources and technological capabilities.

The intersection of these two perspectives points to a clear imperative: **strategic self-disruption.** Rather than waiting for external forces to dismantle their business models, established automotive companies must take the lead in their own renewal. This means reframing disruption from a threat to be defended against into a proactive strategy for shaping the future of mobility.

The framework **Structure follows Strategy follows Culture** offers a practical pathway for this transformation. It begins with **cultural change** - creating the mindset and behaviours that support speed,

experimentation, and cross-functional collaboration. It then translates cultural intent into **adaptive strategies** that extend beyond the product to encompass mobility ecosystems. Finally, it embeds these strategies in **agile structures** that enable rapid decision-making, dual operating models, and flexible resource allocation.

These three dimensions - culture, strategy, and structure - form a mutually reinforcing system. Cultural change empowers bold strategic choices; strategy gives direction to structural redesign; and agile structures sustain both cultural and strategic adaptability. If any one of these dimensions is misaligned, transformation efforts will falter.

For the established automotive industry, the stakes could not be higher. Disruption will continue, whether driven by new entrants, technological breakthroughs, or shifting societal expectations. The question is whether incumbents will allow it to happen to them, or whether they will lead it themselves. In Schumpeter's terms, renewal is essential for economic vitality; in Christensen's terms, it must be undertaken before the weight of past success becomes an obstacle too great to overcome.

By embracing strategic self-disruption and aligning culture, strategy, and structure accordingly, established automotive manufacturers can move from defending their position to shaping the competitive rules of the next era of mobility. In doing so, they will not only preserve the strengths of their heritage but also secure their relevance in a future defined by continuous change.

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METHODS OF ASSESSING FINANCIAL TRANSPARENCY IN THE CONTEXT OF THE DIGITAL TRANSFORMATION

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Abstract

In the context of digital transformation, financial transparency is becoming a priority for regulators, investors, and companies themselves. This article provides a comprehensive overview of methods used to assess the integrity and reliability of financial statements.

The research is based on a systematic literature review and empirical cases for 2023–2025. The method of substantive analysis, comparison and systematization of existing instruments is used. Examples of the application of instruments are analysed for each capital. Tables and classification schemes of methods and application cases are compiled.

The overview highlights the growing role of artificial intelligence (AI) and machine learning (ML) in real-time fraud detection, continuous auditing and anomaly recognition tasks. The article demonstrates how the integration of traditional statistical models with modern digital technologies creates a more reliable and dynamic system for ensuring financial transparency in the modern corporate environment. methods of assessing financial indicators in corporate reporting: Benford's Law, Beneish M Score, Altman Z Score, Piotroski F Score, QoE and digital & AI-enabled tools for non-financial indicators in corporate reporting, Continuous Audit, XBRL platforms, ML models with SHAP/LIME, NLP/LLM for ESG might be adapted to assess the transparency of reporting for all six capitals.

Keywords: *Digital corporate reporting, six types of capitals, AI, ESG, Benford and Fraud, XBRL and Transparency.*

INTRODUCTION

Aim of the research is to explore how methods for assessing the reliability and transparency and digital & AI-enabled tools can be applied to assess the transparency of corporate reporting across all six capitals (*financial, manufacturing, intellectual, human, social and natural*).

Object of the research - the international framework for integrated corporate reporting.

Subject of the research – methods of assessing financial indicators and *digital & AI-enabled tools* for assessing the reliability and transparency of financial reporting applied to the six capitals, including XBRL, Benford's Law, Beneish M-Score, Altman Z-Score, Piotroski F-Score, QoE(Quality of Earnings) and AI/ML tools.

Objectives of the research:

1. Analysing existing *methods of assessing financial indicators* and *digital & AI-enabled tools* for assessing reporting transparency (e.g. XBRL, Benford's Law, AI/ML).
2. Determining which of these methods and tools are applicable to each of the six capitals (financial, manufacturing, intellectual, human, social and natural).

RQ: What methods and digital tools are used to assess financial transparency and to what extent do they cover the six capitals of integrated reporting?

Limitations of the research:

- Methodological limitation - the study is based solely on empirical analysis of literature and real cases, without conducting our own field data collection or surveys.
- Limited available cases – the application of numerical and quantitative methods to non-financial capitals has been described in a limited way - most available cases concern financial and industrial capital.
- Limitation of verification of results - the lack of primary data does not allow quantitative verification of the accuracy or effectiveness of the application of certain methods in specific companies.
- Uneven disclosure - companies interpret and disclose data on the six capitals differently, making it difficult to compare practices uniformly.

Methodology of the research:

Methodology for systematization of *methods of assessing financial indicators* and *digital & AI-enabled tools* of financial reporting transparency assessing. The study relies on a systematic literature review method to provide a transparent, replicable and evidence-based analysis of existing numerical and quantitative methods used to assess corporate transparency.

The research methodology is based on the recommendations outlined in Kitchenham (2004), Tranfield, Denyer, and Smart (2003), and Page et al. (2021) in table 1.

Table 1

Stages of the reserach

1. DEFINITION OF OBJECTIVES AND RESEARCH QUESTIONS:
It was developed Aim, object, subject and question of the research.
2. INCLUSION AND EXCLUSION CRITERIA:
Includes publications from 2020–2025 with empirical analysis of tools (e.g. XBRL, AI, Benford, QoE).
Scientific publications without application to corporate reporting are excluded.
3. SEARCH AND DATA COLLECTION:
The following databases were used: Scopus, Web of Science, arXiv, SSRN.
Keywords: "AI AND ESG", "Benford AND Fraud", "XBRL AND Transparency", "Piotroski", "LLM ESG". (Table 2: Review of literature and methods for assessing financial transparency in the context od digital transformation)
4. CONTENT ANALYSIS AND SYSTEMATIZATION:
The tools and methods are grouped by purpose (e.g. anomaly detection, pattern interpretation). (Table 3: Grouping methods of assessing financial indicators in corporate reporting with digital & AI-enabled tools for non-financial indicators for corporate reporting)
5. SYNTHESIS OF RESULTS:
Systematic map of tools has been created. (Table 4: Systematic map digital & AI-enabled tools for non-financial indicators and methods of assessing financial indicators in corporate reporting)
Alignment was made between the types of capital and the applicable digital approaches. (Table 5: Implementation of AI/ML for Capital Assessment in Integrated Reporting: Examples and Results)

The conducted study, based on the systematic literature review (SLR) methodology, included five key stages: formulating objectives and questions, defining selection criteria, searching for and analyzing scientific sources, systematizing methods, and synthesizing results. This approach allowed not only to generalize modern digital and quantitative tools, but also to correlate them with the six capitals of integrated reporting.

Literature review of the research

There is an increasing need to ensure comprehensive *financial transparency*, covering both financial and non-financial aspects of corporate activities. Traditional financial statement analysis methods *often focus solely* on *financial* capital, *ignoring* other important components such as *human, natural or social capital*.

The author collected review of literature of methods for assessing financial transparency in table 2.

Table 2

Review of literature and methods for assessing financial transparency in the context od digital transformation

1. Methods for detecting anomalies and assessing reliability
Benford's Law - used to identify statistical anomalies in numerical data that may signal potential manipulation in reporting, including capital data (e.g. social capital investment or natural gas emissions). o *Coverage*: only financial capital. o *Source*: The authors apply Benford's law to the analysis of Polish tax data and identify anomalies following changes in the reporting structure. Luty, P. & Zawolska, Z. (2025).
Beneish M-Score - a statistical model that determines the probability of profit distortion (manipulation in reporting). Can be used to assess the reliability of financial capital indicators. o *Coverage*: Financial and, to some extent, manufacturing capital (through performance indicators). o *Source*: Li et al. (2025) Beneish M-Score is used as one of the key indicators for training and testing AI model. Also used in testing the accuracy of the model on falsified reports.
Altman Z-Score - a model for predicting bankruptcy risk based on accounting ratios. It is used to assess the sustainability of a business and financial capital, especially in the long term. o *Coverage*: Financial and partly manufacturing capital. o *Source*: Sun et al. (2022) study the impact of financial stress on some companies on the conservatism of their competitors' reporting. The analysis uses the Altman Z-Score as an indicator of financial difficulties.
Piotroski F-Score - a comprehensive index that evaluates a company's financial stability based on 9 criteria. It can be used to analyze intellectual and manufacturing capital, especially in the context of changes over time. o *Coverage*: Financial capital, partly manufacturing capital. o *Source*: The F-Score is a powerful indicator of a firm's financial health based on profitability, liquidity, and efficiency. Research shows that higher F-Score values are associated with a stronger financial position and the ability to prevent distress. (Sudarsana Reddy et al., 2025; Alhaj, 2024).

QoE (Quality of Earnings) - an expert scale that reflects how sustainable and non-manipulable profits are. May include indicators from intellectual, social and human capital, especially in ESG analysis.

- *Coverage*: Financial capital and partly human/social capital through explanation of profit drivers.
- *Source*: AI-powered SDG disclosures have a positive impact on Quality of Earnings, suggesting that AI tools can improve the reliability of financial results and contribute to better reflection of social and natural capital through sustainable reporting. (Martínez-Ferrero et al., 2024).

2. Methods of standardization and digital transformation of reporting

Continuous Audit / AI / Machine Learning - to automatically monitor, analyze and interpret both financial and non-financial data from integrated reporting. Facilitates more dynamic management of all six capitals, including forecasting, identifying trends and detecting discrepancies in real time.

- *Coverage*: AI / Machine Learning / Continuous Audit и six types of capitals possibly.
  Source:

XBRL (eXtensible Business Reporting Language). The study by LaTorre et al. (2018) provides a standardized machine-readable presentation of reporting, allowing for automated extraction and comparison of both financial and non-financial data (including the six capitals: natural, human, etc.).This is consistent with the more recent positions of XBRL International (2025), which emphasize that clearly structured data sources are necessary for the effective operation of AI models. A standardized disclosure structure not only ensures regulatory compliance but also significantly expands the analytical capabilities of digital reporting (LaTorre et al., 2018; XBRL International, 2025).

Method	Purpose	Implementation example
XBRL (SEC, 2025a)	Machine-readable formatting of financial and non-financial reporting	Automatic collection and comparison of reports from EDGAR/ESMA
iXBRL (Wang et al., 2025)	Integrating XBRL with PDF/HTML visual form	Submission of annual reports in both human-readable and machine-readable form
Continuous Reporting Tools (Nofel et al., 2024)	Automation of regular reporting	Software solutions for continuous reporting

Method	Purpose	Implementation example
XGBoost (González-Sánchez, et al., 2024)	Classification and Regression	Identifying suspicious reports based on a set of features
Gaussian Processes (Lehdili et al., 2025)	Bayesian model with confidence estimation	Interpretable forecasts with confidence intervals
Neural Networks (He et al., 2023)	Deep learning	Discovering Hidden Patterns in Big Reporting Data

3. Artificial Intelligence and Machine Learning Methods

4. Methods for interpreting models (Explainable AI)

Method	Purpose	Implementation example
SHAP (Yu et al., 2023)	Interpretation of feature contributions	Explanation of XGBoost Model Decisions in Auditing
LIME (Hermosilla et al., 2025)	Local explanation of the model	Analysis of why a particular report was classified as an anomaly

5. Methods for analyzing the texts of reports and ESG documents (NLP/LLM)

Method	Purpose	Implementation example
NLP (Rudžionis et al., 2022)	Analysis of the textual content of reports	Sentiment analysis, identification of ESG initiatives, risks
LLM (Iaroshev et al., 2024).	Extraction of entities and semantic structures	ESGReveal, GPT models for contextual analysis
Sentiment Analysis (Rudžionis et al., 2022)	Analysis of emotional coloring of reports and responses	Monitoring market reaction to ESG sections

Based on the literature review, the author uses the term "*methods of assessing financial indicators in corporate reporting*" for a generalized designation of a group of methods used primarily to analyze a company's financial performance indicators. The combination of these approaches emphasizes their focus on financial information with limited coverage of non-financial aspects, which highlights the need for digital expansion of the assessment spectrum.

The term *"digital & AI-enabled tools for non-financial indicators for corporate reporting*" is also employed in this study to refer to generally to modern technological solutions that provide automation, interpretation and scalability of financial reporting analysis (see table 3).

Table 3

Grouping methods of assessing financial indicators in corporate reporting with digital & AI-enabled tools for non-financial indicators for corporate reporting

Name	Methods/Tools
Methods of assessing financial indicators in corporate reporting	Benford's Law, Beneish M-Score, Altman Z-Score, Piotroski F-Score, QoE
Digital & AI-enabled tools for non-financial indicators in corporate reporting	Continuous Audit, XBRL platforms, ML models with SHAP/LIME, NLP/LLM for ESG

Methods of assessing financial indicators in corporate reporting with digital & AI-enabled tools for non-financial indicators in corporate reporting make it possible to expand the coverage of all six capitals with non-financial indicators, increase the transparency of corporate reporting and quickly respond to changes in the business environment.

Results and Discussion of the research

The systematization showed in table 4 that the greatest potential in the context of digitalization is possessed by tools that combine automation, interpretability and applicability to both financial and non-financial information. Such tools include:

- *XBRL* — provides machine-readable standardized reporting applicable to most capitals (financial, industrial, intellectual) and is widely used in automated data collection and analysis.
- *AI/ML* — models with interpretable explanations (e.g. SHAP and LIME) – allow you to predict risks and identify anomalies in complex corporate data while maintaining transparency of decisions for auditors and regulators.
- *NLP u LLM* (for example, ESGReveal) — applicable for the analysis of non-financial information, in particular social, human and intellectual capital, including ESG reporting and brand perception in the media environment.
- *Quality of Earnings (QoE)* — is used as an expert scale for assessing the reliability of earnings, covering both financial indicators and the relationship with non-financial factors (e.g. sustainability and strategy).

Table 4

Systematic map of digital & AI-enabled tools for non-financial indicators and methods of assessing financial indicators in corporate reporting

Category	Examples of tools and technologies	Application
Standardized reporting	XBRL (eXtensible Business Reporting Language)	Machine-readable formats for financial and ESG disclosures
Analysis of financial indicators patterns	Benford's Law, Beneish M-Score, Z-Score, Piotroski F-Score	Detection of anomalies, manipulation and unreliability

Artificial Intelligence and ML	XGBoost, Neural Networks, Gaussian Processes	Classification of reports, risk forecasting
Natural Language Processing	NLP, LLM (GPT), ESGReveal	Entity extraction from corporate reports, sentiment analysis
Interpretation of models	SHAP, LIME	Explanation of model solutions for auditors and regulators
Continuous audit	Continuous Auditing, anomaly detection pipelines	Continuous monitoring of financial transparency

These methods were noted as the most balanced in terms of efficiency, interpretability and breadth of capital coverage. The results obtained can serve as a basis for the subsequent development of transparency assessment frameworks, as well as for empirical studies aimed at verifying their effectiveness in real cases and industries.

Conclusions of the research

Answer to RQ1: *What methods and digital tools are used to assess financial transparency and to what extent do they cover the six capitals of integrated reporting?*

The systematization showed that the greatest potential in the context of digitalization is possessed by tools that combine automation, interpretability, and applicability to both financial and non-financial information.

For this, it is necessary to combine *methods of assessing financial indicators in corporate reporting with digital & AI-enabled tools for non-financial indicators in corporate reporting* to asses the financial transparency across all 6 types of capitals.

The author compiled a systematic map of digital & AI-enabled tools for non-financial indicators and methods of assessing financial indicators in corporate reporting as a potential drift of an example how it might look like in table 5, where each category (XBRL, Benford, AI, etc.) is correlated:

- with the type of technology or approach,
- with specific tools (e.g. SHAP, XGBoost, ESGReveal),
- with their purpose / application — e.g. for model interpretation, continuous audit or ESG reporting analysis

Table 5

Implementation of AI/ML for Capital Assessment in corporate reporting: examples and results

Capital	Implementation AI / ML	Source	Example and results
Financial	Fraud detection, automated audit, interpretable models (XGB + GP) Benford's Law, Beneish M-Score, Z-Score, Piotroski F-Score etc.	*Li et al., 2025*	The model detected falsification of reports with an accuracy of over 90%

Manufacturing	AI + IoT for asset utilization monitoring and cost reduction	*FT Case Study*;	Reduce energy consumption by 12% in the supply chain
Intellectual	NLP and LLM for ESG Reporting and Intangible Asset Analysis	*Zou et al., 2023*	ESGReveal Achieves 84% Accuracy in Extracting ESG Entities
Human	HR analytics: turnover forecast, employee engagement analysis	*2025 State of the Workplace*	AI identifies layoff risk in departments with low engagement
Social & relationship	Sentiment analysis of media and social networks, ESG perception analysis	(Su, 2025; Dorfleitner and Zhang, 2024; Billert, 2024)	NLP shows trust decline after ESG reporting incident
Natural	Emissions assessment, automation of natural capital calculations via AI	*Millennium Inst. & UNEP, 2023*; *(Villa, 2021)*	ARIES platform creates natural accounts with CO_2 analysis based on AI models

The obtained results can serve as a basis for the subsequent development of transparency assessment frameworks, as well as for empirical studies aimed at verifying the effectiveness of the selected tools in real cases.

Classic methods of assessing financial indicators include such tools as liquidity ratios, profitability, turnover, as well as more advanced analytical models. In particular, the Beneish M-Score is widely used to identify profit manipulation, Altman Z-Score to assess the probability of bankruptcy, Piotroski F-Score to analyze the fundamental reliability of a company, Quality of Earnings (QoE) to identify profit sustainability, and Benford's Law to detect anomalies in numerical data. These methods of assessing financial indicators in corporate reporting allow for a reliable quantitative assessment of the transparency and reliability of reporting, but they are primarily focused on financial capital and rarely cover other aspects of activity.

At the same time, with the development of technologies, interest in non-financial aspects of reporting, covering intellectual, human, social, industrial and natural capital, is growing. Digital & AI-enabled tools for non-financial indicators in corporate reporting are increasingly used for their analysis. Among them are processing of report texts using NLP (Natural Language Processing), automatic analysis of ESG data, as well as machine learning models (for example, XGBoost), capable of identifying trends and risks based on non-financial sources. The use of XBRL allows standardizing not only financial but also non-financial data, making them available for digital processing and cross-functional analysis.

Combining traditional indicators with new digital tools enables a more in-depth and objective assessment of both financial and non-financial information, including natural resources, human potential, reputation and intellectual assets.

Thus, it can be concluded that methods of assessing financial indicators in corporate reporting provide time-tested approaches to assessing transparency, while digital & AI-enabled tools for non-financial indicators in corporate reporting expand the scope of analysis, allowing all six types of integrated reporting capital to be included in the assessment. Their combined application forms the basis for more comprehensive, transparent and sustainability-oriented corporate reporting.

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TECHNOLOGY TRANSFER AND ECONOMIC GROWTH: STRUCTURAL MODELING FOR LATVIA

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Abstract

This paper develops and calibrates two structural macroeconomic models of economic growth for Latvia, focusing on the role of international technology transfer. The first model is a modified Cobb–Douglas framework with endogenous total factor productivity (TFP) growth driven by foreign direct investment (FDI), trade openness, migration, and other external channels. The second model extends this structure by incorporating human capital accumulation, digital infrastructure (ICT), institutional quality, and learning-by-doing mechanisms. Both models are implemented in MATLAB and calibrated using the Latvian economic data. Scenario simulations demonstrate the sensitivity of GDP growth to changes in technology transfer intensity and institutional capacity. The results provide an analytical basis for policy recommendations in education, digital development, migration, and investment strategy to enhance Latvia's long-term growth.

Keywords: Economic growth, technology transfer, Latvia, structural modeling, FDI, human capital, TFP.

INTRODUCTION

Technology transfer plays a critical role in shaping the dynamics of modern economic development. It refers to the process by which scientific knowledge, innovations, and technological practices move from research institutions to the business sector or across national borders. The goal of this process is to enhance productivity, generate new products and services, and strengthen economic performance through the effective application of technological advances.

The technology transfer process typically involves three major actors: academic institutions (such as universities and research centers), businesses, and government authorities. Each participant operates within its own logic and incentives—academic institutions focus on publications and scientific recognition, businesses on financial outcomes and market competitiveness, and governments on transparency, public interest, and effective use of public funds. These actors are interdependent, yet decentralized, making coordination a central challenge for effective technology diffusion.

Historically, technology transfer evolved from the international adoption of industrial technologies in the 19th century to more complex domestic systems linking research and commercialization. Over time, horizontal transfer (across countries) and vertical transfer (within national innovation systems) have both become essential mechanisms for accelerating economic modernization.

In recent decades, the connection between technology transfer and economic growth has become central to development economics. While early growth models emphasized capital and labor as the main drivers of output, modern theories recognize that the key determinant of long-term growth is the rate of technological progress—often mediated by a country's ability to absorb and implement external innovations.

For small open economies like Latvia, internal innovation capacity is limited by scale and investment constraints. As a result, long-term economic growth increasingly depends on the effectiveness of international technology transfer—through channels such as foreign direct investment (FDI), trade openness, skilled migration, digital infrastructure, and institutional capacity to absorb and implement new technologies.

This paper develops and compares two structural macroeconomic models of growth tailored to Latvia's context. The first model extends a basic Cobb–Douglas framework by making total factor productivity (TFP) dependent on

international technology transfer channels. The second model introduces internal drivers of productivity—human capital accumulation, ICT infrastructure, institutional quality, and learning-by-doing effects. Both models are calibrated using Latvian economic data and implemented in MATLAB for scenario analysis.

The main objective of the study is to quantify the impact of external and internal technology transfer mechanisms on Latvia's long-term economic growth, and to offer policy recommendations based on model simulations. To develop our own structural models of economic growth for Latvia, it is essential to build upon the theoretical foundation established by previous growth models. Rather than selecting a single existing framework, we systematically analyse a broad set of classical and modern growth theories to identify the most relevant elements for modeling the relationship between international technology transfer and long-term growth. This comprehensive review allows us to extract critical mechanisms—such as the role of foreign investment, human capital, institutional quality, and innovation diffusion—that are necessary to understand how external technologies influence domestic productivity.

A distinctive feature of this study is the integration of insights from nearly all major growth models developed over the past century. By mapping the evolution of growth theory from early neoclassical models to contemporary endogenous and technology-diffusion-based approaches, we create a well-grounded conceptual basis for designing two new structural models. These models are specifically tailored to Latvia's position as a technology-importing economy within the global innovation system.

1. TOTAL FACTOR PRODUCTION IN ECONOMIC GROWTH MODELS

To construct our two structural models of technology transfer and economic growth, it is first necessary to trace the intellectual evolution of growth theory. This requires a structured review of the most influential economic growth models developed from the early 20th century to the present. Each model reflects a specific historical context and theoretical innovation—from capital accumulation and exogenous technological progress to human capital formation, innovation systems, and institutional factors.

The following table presents a chronological overview of key growth models that have shaped the field. For each model, we briefly highlight its contribution, core assumptions, and conceptual innovations relevant to technology transfer. This synthesis serves two purposes: first, to illustrate the gradual expansion of growth theory toward a more complex and realistic understanding of productivity dynamics; and second, to identify specific mechanisms that will be incorporated into our own structural models for Latvia. The scope of this review is deliberately broad, covering virtually all major models in the literature to ensure conceptual completeness and analytical rigor.

Year	Economic Growth Model	*Description
1928	Ramsey-Cass-Koopmans model	The first intertemporal consumption and savings choice model. Introduced the optimization problem for the consumer, applying variational calculus in economics for the first time. Unlike the later Solow model, it emphasizes the microfoundations of agent behavior.
1939	Harrod–Domar model	One of the first economic growth models emphasizing the role of investment and the marginal productivity of capital. Innovation: emphasis on the 'knife-edge' equilibrium: the economy is unstable without a constant savings rate.

1956	Solow-Swan model	Introduced the concept of exogenous technological progress as the main source of long-term growth. Differs from Harrod-Domar with stable dynamics and the possibility of a sustainable equilibrium.
1965	Overlapping Generations (OLG) model	First model with overlapping generations. Allows analysis of intergenerational resource redistribution, pension systems, and capital accumulation in a demographic context.
1966	Nelson-Phelps model	Linked the speed of technology adoption to human capital. Unlike exogenous models, here technological progress depends on the level of education.
1969	Bass Model	One of the first innovation diffusion models. Demonstrates the S-shaped technology adoption curve through early and late adopters. Widely used in marketing.
1980	AK Model	A simple endogenous growth model: constant return to capital, no diminishing returns. Innovation: abandoning exogenous growth A(t), growth is embedded in the function structure itself.
1986	Arrow-Romer Learning by Doing Model	Showed how human capital accumulation can lead to sustainable economic growth. Differs from Solow and AK models by emphasizing education and learning as a production factor.
1988	Uzawa-Lucas Model	Model with learning in the production process: firms learn by producing. Innovation: technological progress as a by-product of economic activity.

1990	Romer's Increasing Product Variety Model	Introduced the concept of differentiated goods and their growth as a source of progress. Differs from aggregate technology models: here, innovation increases variety of outputs.
1992	Aghion–Howitt Model	Endogenous creative destruction model: new firms displace old ones through innovation. For the first time, competition is formalized as the driver of technological progress.
1992	Mankiw–Romer–Weil Model	A modification of the Solow model including human capital. Shows how differences in education levels explain growth differences between countries.
1994	Helpman–Romer Model (Trade and Innovation)	Connects growth and international trade. Shows how openness stimulates innovation and growth through scale effects.
1995	Barro and Sala-i-Martin Technology Diffusion Model	Extended the Solow model with spatial diffusion of technology. Shows how lagging economies catch up with leaders if institutional and investment conditions allow.
2000	Parente–Prescott Model on Monopoly and Institutions	Showed how poor institutions and monopolies slow the adoption of best technologies. Innovation: explains persistent differences in A(t) levels between countries.

2001	Eaton–Kortum Ricardian Diffusion Model	First formalization of technology diffusion in international trade via Ricardian productivity differences. Takes into account adoption and adaptation probabilities.
2002	Acemoglu–Aghion–Zilibotti Distance to Frontier Model	Develops the idea that innovation strategies differ depending on the 'distance to the frontier'. Innovation: dichotomy - catching-up countries imitate, leaders innovate.
2004	Comin–Hobijn Ricardian Diffusion Model	Covers over 200 years and more than 100 technologies in diffusion. Unique in scope and empirical base. Notable for attention to time lags in transfer.
2004	Keller Technology Transfer Channels Model: FDI, Trade, Migration	Detailed review of technology transfer channels: trade, foreign direct investment, migration. An empirical meta-analysis rather than a strict model.
2005	Hausmann–Rodrik–Velasco Growth Diagnostics Model	A framework for analyzing growth constraints. Unique for emphasizing diagnostics before selecting strategy. Combines micro- and macroeconomic factors.
2006	ICT Implementation Specificity Model — Caselli–Coleman	Explains ICT implementation differences through variations in human capital and institutions. One of the first analyses focused on digital technologies.
2009	Lucas Knowledge Spillovers Between Countries	Explains how knowledge spreads between countries. Distinctive for nonlinear effects and dependence on institutional compatibility.

2013	Barro–Lee Global Education Base Model	Model based on global education level data. Shows how education differences explain the speed of technology diffusion.
2013	Summers Secular Stagnation Revival Model	Reframed Hansen's concept for modern economies facing persistent demand shortfalls despite near-zero interest rates, emphasizing structural factors limiting growth.
2014	Hysteresis and Growth Model — Summers	Incorporates persistent effects of short-term shocks on long-term growth potential, especially relevant for post-financial crisis recovery patterns.
2015	Absorptive Capacity Spillover Model — Aghion & Jaravel	Updates knowledge spillover theories, showing how absorptive capacity creates complementarities in R&D efforts across countries and regions.
2015-present	Long-Term Growth Model Extensions (World Bank)	Enhanced Solow-Swan framework incorporating natural resources, public capital, and total factor productivity determinants for developing economies.
2016	Aghion Innovation and Top Income Inequality Model	Links innovation-driven growth to rising income inequality, showing how technological progress concentrates returns among top earners and innovators.
2016	Kenney - Zysman Digital Platform Economy Growth Model	Explains value creation through multisided digital platforms enabling network effects, data monetization, and ecosystem-based competitive advantages.

2016	Baldwin Global Value Chain Growth Model	Analyses how digital technologies enable trade fragmentation and affect growth patterns through global production networks and knowledge flows.
2016	Acemoglu Green Growth Transition Model	Models directed technological change toward clean technologies, examining optimal carbon taxation and research subsidies for sustainable growth.
2016	Sundararajan Sharing Economy Growth Model	Analyses crowd-based capitalism's impact on traditional employment structures and economic growth through peer-to-peer resource sharing platforms.
2017	Aghion Artificial Intelligence Growth Model	Analyses AI's impact on productivity growth through automation, complementarity effects, and skill-biased technological change in labor markets.
2017-2019	Fintech and Financial Innovation Growth Model — Buchak et al., 2018; Philippon, 2019.	Examines how financial technology innovations affect credit allocation, monetary policy transmission, and overall economic growth patterns.

2. ANALYSIS OF KEY ECONOMIC GROWTH MODELS IN THE CONTEXT OF TECHNOLOGY TRANSFER

It should be noted that the evolution of economic growth theories has been driven by two main forces. The first is the transformation of the economic environment due to scientific and technological progress. The second is the progressive refinement of theoretical models in response to the limitations and blind spots of earlier frameworks. Each successive model addresses contemporary challenges—such as digitalization, environmental sustainability, inequality, and technological disruption—that were not adequately captured by earlier growth theories.

To better understand how technology transfer influences national economic growth, we will examine the relationship between technology transfer mechanisms and major economic growth theories in more detail. Each model will be reviewed according to a standardized analytical framework, including: (1) model name, (2) authors, (3) year of creation, (4) exogenous variables, (5) endogenous variables, (6) model equations, (7) solution methods, (8) relevance to technology transfer, and (9) key conclusions.

Ramsey-Cass-Koopmans Model

In 1928, Frank P. Ramsey developed a model to calculate the optimal income distribution between consumption and investment for an individual. Later, David Cass (1965) and Tjalling C. Koopmans (1965) independently reformulated and expanded Ramsey's work, extending the optimization problem to other economic agents. This expanded model is often called the Ramsey-Cass-Koopmans model.

The Ramsey–Cass–Koopmans model represents a foundational step in modern growth theory by introducing intertemporal optimization. It focuses on the representative household's decision to allocate income between consumption and savings in order to maximize lifetime utility, subject to a resource constraint. Unlike the Solow model, this framework provides explicit microeconomic foundations for aggregate behavior. This model introduces several important concepts for growth theory: the optimization of consumption over time, the role of interest rates in intertemporal choices, the long-term convergence toward a steady state driven by capital accumulation.

Although the Ramsey model treats technological progress as exogenous, it offers a flexible structure where TFP can be interpreted as influenced by external shocks or policy mechanisms—including technology transfer.

From the perspective of this paper, the main contribution of the Ramsey–Cass–Koopmans model is its intertemporal framework, which serves as a conceptual basis for forward-looking investment behavior. In our structural models, we do not directly replicate the Ramsey formalism, but we adopt its logic of dynamic adjustment and capital accumulation under productivity growth. Moreover, the idea that external factors such as technology transfer may alter the marginal return on capital is consistent with the Ramsey framework and justifies its inclusion in the theoretical foundation of our analysis.

Neoclassical Growth Theory and the Solow-Swan Model

Robert Solow published the article "A Contribution to the Theory of Economic Growth" in February 1956, while Trevor Swan published his work "Economic Growth and Capital Accumulation" in November of the same year. Both developed similar models independently of each other. Robert Solow received the Nobel Prize in Economics in 1987 for his contribution to growth theory. (Dimand & Spencer, 2009)

The Solow–Swan model became the cornerstone of neoclassical growth theory. It explains long-term economic growth through capital accumulation, labor force growth, and—most importantly—exogenous technological progress.

The key innovation of the Solow model is its emphasis on steady-state convergence: in the long run, output per worker grows only due to technological progress. The model's simplicity, based on a Cobb–Douglas production function, made it widely applicable and a natural benchmark for assessing growth dynamics.

Despite treating technology as exogenous, the Solow model implicitly supports the idea that external sources of technology—such as imports, investment, or migration—can drive long-term growth via increases in total factor productivity (TFP). In small open economies like Latvia, these channels are critical, especially when internal innovation capacity is limited. In the context of this paper, the Solow model provides two important conceptual foundations: the use of TFP as the main driver of long-term output growth; the framework for modeling capital accumulation in a tractable, empirically estimable form. Both of our structural models adopt these features. In the first model, TFP becomes endogenous and driven by international technology transfer, while in the second model, this mechanism is

further enriched by human capital, ICT, and institutional factors. The Solow model's clarity and enduring relevance justify its role as a structural backbone in our approach.

Like other economic growth models, the Solow-Swan model contains exogenous and endogenous variables. Knowing the values of exogenous variables, the values of endogenous variables can be calculated from the model's system of equations, and thus the economic forecasting task is reduced to forecasting exogenous variables. Usually, a country's economic exogenous variables are related to international economic processes, are relatively stable and tend to change slowly. Unfortunately, recent events – the pandemic, war in Ukraine, sanctions, uncertainties about US tariffs – have led to increased economic uncertainty. Consequently, by solving the model's equations, it is possible to calculate the dependence of endogenous parameters on time and thus analyse Latvia's growth rate dependence on various exogenous variables, but since the country's economic development is an interaction between internal and external factors, the uncertainty of external factors significantly affects the accuracy of forecasts.

Overlapping Generations Model

In 1958, Paul Samuelson published the work "An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money," which is considered the first work on the overlapping generations model (OLG). (Petrakis, 2020). In 1965, Peter Diamond expanded this model with the work "National Debt in a Neoclassical Growth Model," including new factors. This expanded model is now known as the Diamond OLG model.

The Overlapping Generations (OLG) model represents a major shift in growth theory by explicitly incorporating demographic structure. It models an economy with coexisting generations—typically the young and the old—who make intertemporal decisions about consumption, labor, and savings.

Unlike models with infinitely-lived agents (such as Ramsey), the OLG framework allows for a realistic representation of life-cycle behavior and public policy effects (e.g., pensions, debt, education financing). It also captures how demographic changes and intergenerational transfers affect capital accumulation and growth.

Although the model treats technological progress as exogenous, it offers an important insight: the ability of successive generations to benefit from and contribute to technological progress depends on savings behavior, labor income, and institutional settings. Additionally, it allows for analysis of how public investment in infrastructure or education—often linked to technology transfer—affects welfare across generations.

In the context of this study, the OLG model contributes the following: a dynamic structure where technological transfer benefits unfold across generations; the recognition that demographic and institutional context influences the effectiveness of technology absorption; a foundation for incorporating long-term policy effects, such as education investment, which is reflected in our second structural model.

Thus, while we do not directly apply the OLG formalism in our models, its logic informs our treatment of long-term human capital accumulation, intergenerational productivity effects, and the role of institutions in enabling growth through technology transfer.

Uzawa–Lucas Model

Hirofumi Uzawa originally developed a two-sector growth model in 1965 ("Optimal Technical Change in an Aggregate Model of Economic Growth"). Robert E. Lucas Jr. significantly expanded and popularized this approach in his influential 1988 work "On the Mechanics of Economic Development," explicitly incorporating human capital and its accumulation as the main driver of growth. Hence, this model is known as the Uzawa–Lucas model.

The Uzawa–Lucas model places human capital accumulation at the center of long-term economic growth. It introduces a two-sector framework in which output is produced using physical and human capital, while human capital itself is accumulated through education and learning.

The core innovation of the model is the treatment of human capital not only as a factor of production, but also as an output of purposeful investment—particularly time and resources devoted to learning. This results in sustained endogenous growth, driven by the expansion of skills, knowledge, and education.

The model is especially relevant for technology transfer, as it highlights absorptive capacity: the ability of an economy to adopt and effectively use external technologies depends on the level and growth of human capital. In other words, technology transfer is not automatically growth-enhancing unless there is sufficient educational and cognitive infrastructure to support it.

In our second structural model, we adopt key insights from the Uzawa–Lucas framework: human capital is explicitly modeled as an accumulable resource; Its evolution depends on education investment; It enhances both output and the economy's ability to absorb foreign technologies.

The model also supports policy implications: promoting education and knowledge development is not only socially beneficial but also strategically important for maximizing the returns from international technology flows.

Mankiw-Romer-Weil Model

The Mankiw-Romer-Weil model was developed by Gregory Mankiw, David Romer, and David Weil and published in 1992 in the paper "A Contribution to the Empirics of Economic Growth" in the Quarterly Journal of Economics.

The Mankiw–Romer–Weil (1992) model extends the Solow growth framework by introducing human capital as a distinct production factor alongside physical capital and labor. This modification significantly improves the model's ability to explain cross-country differences in income and growth rates.

The key contribution of the MRW model is its recognition that not only the quantity of capital, but also the quality of labor—measured through education and skills—matters for long-term economic development. The model retains the exogenous nature of technological progress but shows that countries with higher investment in human capital converge to higher steady-state income levels.

From the perspective of technology transfer, the MRW model provides two important insights:

Human capital enhances a country's ability to absorb foreign technologies, making transfer more effective;

Differences in human capital investment can explain why some countries benefit more from global knowledge spillovers than others.

In our second structural model, we build on the MRW approach by explicitly modeling human capital accumulation as a driver of both output and total factor productivity (TFP). This allows us to connect human capital not just to production, but also to the effectiveness of international technology transfer channels.

The main feature and contribution of the model is the inclusion of human capital as a separate production factor in the Solow growth model. This allowed for a better explanation of cross-country income differences and the resolution of part of the "Solow residual" problem.

Barro and Sala-i-Martin Technology Diffusion Model

The Barro and Sala-i-Martin technology diffusion model is a significant extension of endogenous growth theory developed by Robert J. Barro and Xavier Sala-i-Martin in the mid-1990s. The main version appeared in their 1995 book "Economic Growth" and their 1997 paper "Technological Diffusion, Convergence, and Growth." The model attempts to combine elements of endogenous growth models that explain the emergence of innovation in developed countries with the convergence effects of the neoclassical model in lagging countries. (Barro & Sala-I-Martin, 1995)

The Barro–Sala-i-Martin model integrates the neoclassical theory of convergence with insights from endogenous growth to explain how technological diffusion shapes global development patterns. The model assumes that a leading economy operates at the global technology frontier, while follower economies grow by adopting existing technologies through imitation and adaptation.

A core insight of the model is that the rate of convergence depends on a country's capacity to absorb foreign technologies, which is influenced by institutional quality, human capital, and policy environment. Technological lag is viewed not only as a constraint but also as an opportunity for faster catch-up growth—provided that diffusion costs are low.

In the context of technology transfer, this model is directly relevant. It formalizes how international spillovers—via trade, investment, and migration—enable lagging countries to grow by narrowing the technology gap. However, it also emphasizes that without supportive institutions and adequate absorptive capacity, convergence may be slow or incomplete.

In our structural models, especially the second one, we reflect the Barro–Sala-i-Martin logic by: Modeling TFP as a function of external technology flows; Including institutional barriers as a friction term that affects the speed of diffusion; Highlighting conditional convergence based on structural readiness.

This model provides a theoretical bridge between classical convergence theory and modern approaches to international technology diffusion—making it a central reference for our analysis.

Keller Technology Transfer Channels Model

Wolfgang Keller's 2004 model offers an empirical framework for analyzing how international channels—foreign direct investment (FDI), international trade, and migration—contribute to the diffusion of technology between countries. Unlike earlier theoretical models, Keller emphasizes measurable transmission mechanisms and the heterogeneity of their effects depending on institutional and absorptive conditions.

Rather than proposing a single structural model, Keller synthesizes evidence from multiple empirical studies to show that: FDI brings embedded technologies through multinational firms; Trade facilitates access to foreign innovations via imports of capital and intermediate goods; Migration transfers skills and knowledge through mobile human capital.

Keller's approach is particularly relevant for small open economies such as Latvia, which rely heavily on external sources of innovation. It also aligns well with the structure of our first structural model, where total factor productivity (TFP) is an explicit function of FDI, trade, migration, and related factors.

In our models, Keller's insights are operationalized by defining technology transfer channels as quantitative inputs into the TFP growth equation; assigning sensitivity coefficients to each channel, allowing calibration and scenario analysis; highlighting the policy-dependent nature of diffusion—especially in the second model, where institutional quality affects the effectiveness of each channel.

Keller's work provides the empirical foundation and functional logic for modeling technology transfer not as an abstract process, but as a set of measurable economic flows—making it indispensable to our framework.

Recent Directions in Growth Modeling and Implications for Technology Transfer

In recent years, economic growth theory has expanded beyond classical capital–labor–technology structures to reflect the transformation of the global economy under digitalization, platformization, and automation. While these models are not directly implemented in our structural framework, they provide valuable context for understanding the evolving nature of technology transfer and productivity dynamics.

Aghion (2016) links innovation-driven growth to top income inequality, showing that without inclusive mechanisms, technological advances may exacerbate distributional imbalances.

Kenney and Zysman (2016) explore the platform economy, where digital ecosystems and data-driven business models reshape value creation and innovation diffusion.

Baldwin (2016) analyzes the role of global value chains (GVCs) in facilitating technology flows across borders—particularly relevant for small open economies like Latvia integrated into European and global production networks.

Acemoglu and Restrepo (2016) introduce the concept of directed technological change for sustainable growth, relevant in the context of green technology adoption and climate policy.

Sundararajan (2016) and the Sharing Economy Model highlight peer-to-peer economic activity and its implications for labor structures and informal innovation.

Aghion (2017) emphasizes how artificial intelligence (AI) affects productivity via automation and skill-biased technological change—raising important questions for workforce policy and education.

Digital finance and fintech models (Philippon, 2019; Buchak et al., 2018) examine the influence of financial technology innovation on capital allocation, credit access, and monetary dynamics, all of which can affect technology adoption and diffusion.

These recent models underscore the importance of digital infrastructure, human capital adaptability, and institutional flexibility in shaping the future of technology transfer and growth. While not formally embedded in our structural models, their insights support the inclusion of ICT and institutional factors as key variables in our second model and guide the formulation of policy recommendations.

3. STRUCTURAL MODELING OF TECHNOLOGY TRANSFER AND ECONOMIC GROWTH

3.1 General Description of Models

Building on the insights from historical and contemporary growth models, we now develop two original structural models tailored to the Latvian economy. These models are designed to analyze how international technology transfer—through foreign direct investment (FDI), trade, migration, and other channels—affects long-term economic growth.

The first model adopts a modified Cobb–Douglas production function with total factor productivity (TFP) endogenously driven by external transfer mechanisms. It offers a parsimonious framework suitable for baseline calibration and scenario simulations.

The second model extends this structure by incorporating internal productivity drivers, including human capital accumulation, digital infrastructure (ICT), institutional quality, and learning-by-doing. It provides a more comprehensive representation of Latvia's growth dynamics and the interaction between external and domestic capacities to absorb and utilize foreign technologies.

Both models are calibrated using macroeconomic data for Latvia and implemented in MATLAB. They serve as analytical tools for forecasting and policy evaluation under alternative development scenarios.

3.2. First structural model

The first structural model represents an economic growth framework in which total factor productivity (TFP) evolves endogenously as a function of international technology transfer channels. This model captures the impact of external

economic interactions—foreign investment, trade, migration, and other factors—on long-term output growth. The first structural model includes the following equations:

(1) Production function

$$Y_t = A_t * K_t^{\alpha} * L_t^{(1 - \alpha)}$$

(2) Capital accumulation

$$K_{(t+1)} = (1 - \delta) * K_t + s * Y_t$$

(3) TFP dynamics

$$A_{(t+1)} = A_t * (1 + \varphi_1 * FDI_t + \varphi_2 * Trade_t + \varphi_3 * Migration_t + \varphi_4 * Other_t)$$

(4) Initial conditions

$$K_0 > 0, A_0 > 0, L_0 > 0$$

Model parameters:

Parameter	Description	Interpretation / Source
α	Elasticity of output with respect to capital	0.3–0.4 (from literature)
δ	Capital depreciation rate	5–10% per year
s	Savings/investment rate	20–30% of GDP
$\varphi_1 \ldots \varphi_4$	Sensitivity of TFP to transfer channels	To be calibrated using Latvian data

Calibration objective

The goal is to determine the parameters φ_1, φ_2, φ_3, φ_4 that best approximate Latvia's observed GDP trajectory (e.g., from 1995 to 2023).

Conclusion

The model provides a basis for quantitatively assessing Latvia's dependence on external technology sources. The next step involves calibrating the model with statistical data and conducting scenario analysis (e.g., increased FDI, reduced emigration, greater openness, among others).

3.3. Second structural model: extended model with human capital and digital factors

The second model expands the baseline structure by including human capital, ICT effects, institutional quality, and learning-by-doing. It is intended to capture both internal and external drivers of productivity and growth in Latvia. The second structural model includes the following equations:

(1) Production function:

$$Y_t = A_t * K_t^{\alpha} * H_t^{\beta} * L_t^{(1 - \alpha - \beta)}.$$

(2) Capital accumulation:

$$K_{(t+1)} = (1 - \delta) * K_t + s * Y_t$$

(3) Human capital accumulation:

$$H_{(t+1)} = (1 - \delta_H) * H_t + \psi * Education_t$$

(4) TFP dynamics:

$$A_{(t+1)} = A_t * (1 + [\varphi_1 * FDI_t + \varphi_2 * Trade_t + \varphi_3 * Migration_t + \varphi_4 * Other_t + \varphi_5 * (Y_t / L_t) + \varphi_6 * ICT_t] / (1 + \theta * Institutions_t))$$

(5) Exogenous variables

• L_t: Labor force (from statistics)

• FDI_t: Foreign direct investment (% of GDP)

• Trade_t: Trade openness (exports + imports / GDP)

• Migration_t: Net migration (normalized)

• Other_t: Composite index (education, knowledge)

• ICT_t: ICT infrastructure index

• Institutions_t: Institutional quality index

• Education_t: Education spending or tertiary education share

• K_0, A_0, H_0, L_0: Initial conditions

3.3. Endogenous variables

• Y_t: Output (GDP)

• A_t: Total Factor Productivity

• K_t: Physical capital

• H_t: Human capital

Model parameters:

Parameter	**Description**	**Note**
A	Capital share in production	0.3–0.4
B	Human capital share	0.2–0.3
Δ	Depreciation of physical capital	5–10%
δ_H	Depreciation of human capital	2–5%

S	Savings rate	20–30% of GDP
Ψ	Effectiveness of education	To be estimated
$\varphi_1 ... \varphi_6$	Sensitivity of TFP to channels	To be calibrated
Θ	Institutional barrier effect	Higher = weaker transmission

The second model enables analysis of the interaction between external and internal productivity factors. It supports policy evaluation in education, ICT development, and institutional reform. Future steps include empirical calibration nd scenario simulations.

4. CALIBRATION AND MATHEMATICAL MODELLING

4.1. Calibration Methodology

To perform a quantitative analysis of the structural models proposed in this paper, we used statistical data for Latvia covering the period from 1995 to 2023. The main sources of data include the Central Statistical Bureau of Latvia (CSB), the World Bank Open Data, and human capital estimates based on the Barro–Lee methodology.
Model parameters were calibrated using a combination of empirical data, theory-based assumptions, and manual tuning to achieve a reasonable reproduction of GDP dynamics. The dataset includes annual values for real GDP, investment levels, labor force size, inflow of foreign direct investment (FDI), trade openness, ICT indicators, education levels, and institutional quality.

The mathematical simulations were implemented in MATLAB/Octave. The modelling framework incorporates capital accumulation, the evolution of human capital, and total factor productivity (TFP), which is modeled as a function of internal and external factors.

4.2. First Structural Model: Calibration and Results

The first model is based on a standard Cobb–Douglas production function:

$$Y_t = A_t * K_t^{\alpha} * L_t^{(1-\alpha)}$$

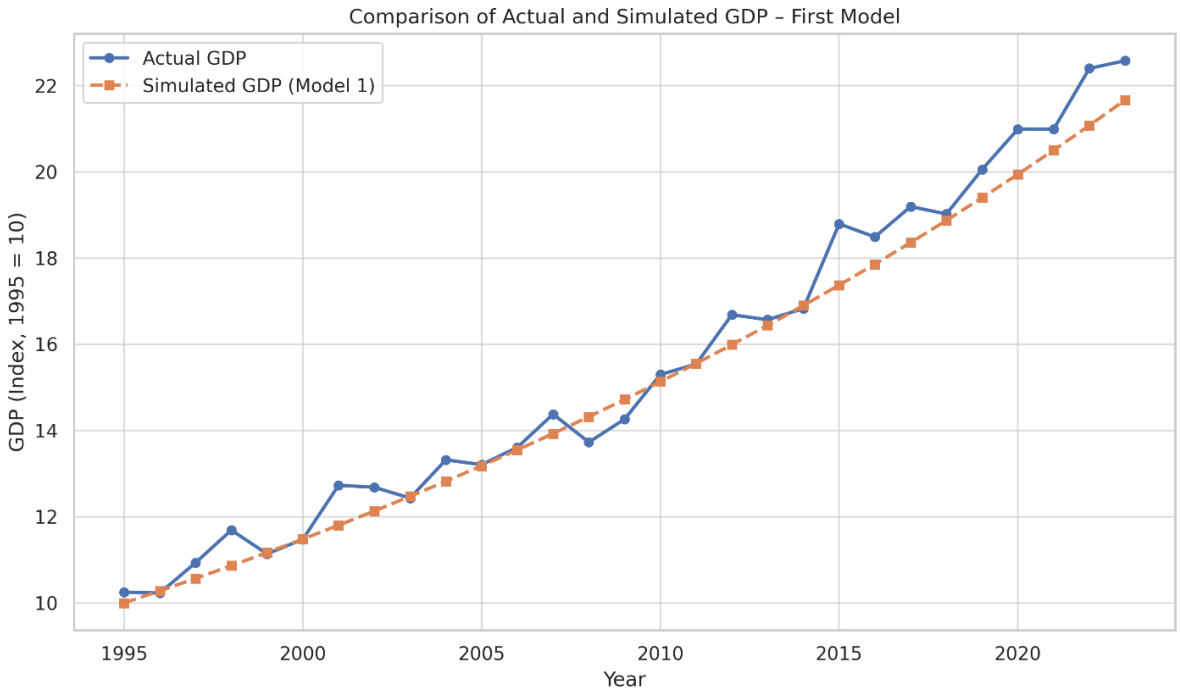
where Y_t is GDP, K_t is the capital stock, L_t is the labor force, A_t represents total factor productivity, and α is the capital share in output. Capital evolves according to:

$$K_{t+1} = (1-\delta) * K_t + s * Y_t$$

where δ is the depreciation rate and s is the savings/investment rate.

The following values were used for calibration: $\alpha = 0.35$, $\delta = 0.06$, $s = 0.20$. The initial capital stock was set as $K_0 = 3 \times Y_0$. TFP was then derived residually from the production function using empirical values of Y_t, K_t, and L_t.

The resulting plot comparing actual and simulated GDP shows that the first model captures the overall trend of economic growth, but largely fails to reflect medium-term fluctuations. This limitation stems from the model's exclusion of intangible factors such as institutional quality, human capital, and technological development.



4.3. Second Structural Model: Extended Calibration and Results

In the second model, the production function is extended by including human capital H_t:

$$Y_t = A_t * K_t^{\alpha} * H_t^{\beta} * L_t^{(1-\alpha-\beta)}$$

Total factor productivity A_t evolves according to the following specification:

$$A_{t+1} = A_t * [1 + (\varphi_1 * FDI_t + \varphi_2 * Trade_t + \varphi_3 * Migration_t + \varphi_4 + \varphi_5 * (Y_t / L_t) + \varphi_6 * ICT_t) / (1 + \theta * Institutions_t)]$$

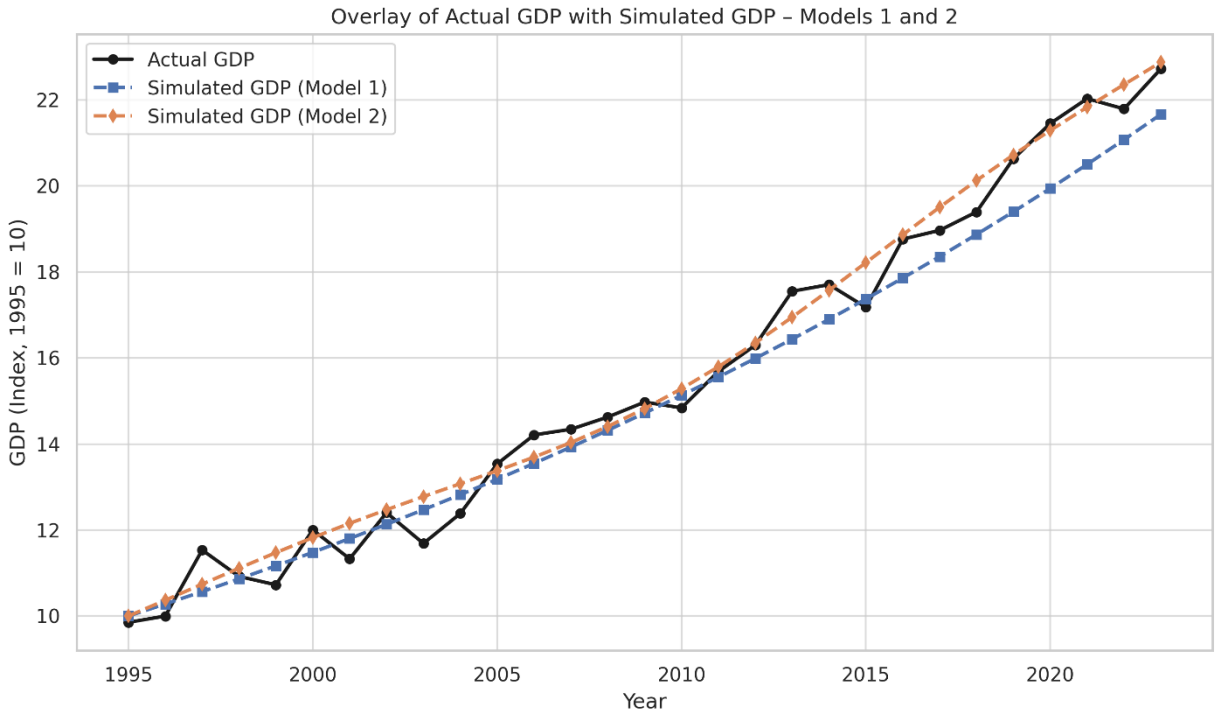
The accumulation of human capital is modeled as:

$$H_{t+1} = (1 - \delta\_H) * H_t + \psi * Education_t$$

Additionally, the model accounts for the negative effect of migration on human capital, assuming that part of the emigrants represent skilled labor.

The following parameter values were used:
- $\alpha = 0.35$, $\beta = 0.25$, $\delta\_H = 0.03$, $\psi = 1.5$
- $\varphi_1 = 0.02$, $\varphi_2 = 0.015$, $\varphi_3 = -0.01$, $\varphi_4 = 0.01$, $\varphi_5 = 0.005$, $\varphi_6 = 0.01$
- $\theta = 2.0$

Compared to the first model, the extended specification improves the fit between actual and simulated GDP. The trajectory of TFP becomes more realistic, and the model captures the process of human capital accumulation, including the slowing dynamics in the most recent years due to diminishing returns. Nevertheless, some discrepancies between actual and simulated output remain, indicating the need for more precise calibration or the inclusion of additional structural factors.



5. CONCLUSIONS

1. This study addresses the long-term determinants of economic growth in Latvia by developing and calibrating structural models that incorporate both tangible and intangible growth factors. The motivation stems from the country's unique post-transition trajectory and the need to understand the underlying mechanisms behind growth slowdowns and divergence from Western European benchmarks.
2. A two-tiered modelling framework was constructed, starting with a classical Cobb–Douglas production function and progressing to an extended model that integrates human capital, ICT, institutions, migration, and trade openness. This progression allowed us to test both basic and enriched theoretical assumptions in a comparative setting.
3. The first model captures the aggregate trend of GDP growth using physical capital accumulation and labor force data, but fails to reproduce key structural shifts in Latvia's economic performance. In particular, it overlooks the influence of education, migration, and external economic integration.
4. The second model significantly improves explanatory power by incorporating a broader set of variables, especially human capital dynamics and migration effects. The evolution of total factor productivity (TFP) is modeled as a function of foreign investment, trade, institutional quality, and other structural inputs, producing more realistic output trajectories.
5. Both models were calibrated using real statistical data from Latvia for the period 1995–2023. Simulations were carried out in MATLAB/Octave. Key macroeconomic indicators such as GDP, FDI, labor force, and education levels were drawn from national and international statistical sources. Model parameters were adjusted to ensure a close fit to observed trends.

6. The modelling confirms the critical role of human capital formation and institutional environment in sustaining long-term growth. The analysis also highlights the adverse impact of net emigration, particularly on the accumulation of human capital, which reinforces the importance of retaining and developing skilled labor domestically.
7. Visual comparisons between actual and simulated GDP show that the second model better reflects Latvia's real economic trajectory, although some minor deviations remain. These gaps indicate opportunities for further refinement, such as introducing endogenous labor dynamics, regional differentiation, or nonlinear effects.
8. This research opens up multiple directions for future inquiry, including dynamic policy simulations, scenario analysis (e.g., increased investment in education or ICT), and integration into regional or EU-wide growth models. The presented modelling framework provides a robust starting point for continued empirical and policy-relevant work on sustainable growth in small open economies.

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ABSORPTIVE CAPACITY AND GREEN MARKETING STRATEGIES IN ENHANCING STARTUP SUSTAINABILITYTHE MODERATING ROLE OF ENTREPRENEURIAL ECOSYSTEMS

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Abstract

*Startups face the dual challenge of achieving growth while operating sustainably. This article examines how **absorptive capacity**—a startup's ability to recognize, assimilate, transform, and exploit external knowledge (Cohen & Levinthal, 1990; Zahra & George, 2002)—and **green marketing strategies** (Gatignon & Xuereb, 1997; Peattie & Belz, 2010) jointly enhance **startup sustainability**. We propose that absorptive capacity fuels eco-innovation, while green marketing builds legitimacy and demand among eco-conscious consumers. We further argue that a strong **entrepreneurial ecosystem**—comprised of investors, mentors, institutions, and enabling policies—amplifies these effects (Isenberg, 2011; Roundy, Bradshaw, & Brock, 2018). Figure 1 presents the conceptual framework. The article concludes that integrating internal capabilities with an enabling ecosystem is crucial for startups to achieve long-term resilience and a competitive edge in an increasingly sustainability-oriented marketplace.*

Keywords: absorptive capacity; green marketing; startup sustainability; entrepreneurial ecosystem; sustainable entrepreneurship

1. INTRODUCTION

Sustainability has become a critical focus in the business world, with enterprises increasingly pressured to address environmental and social concerns alongside economic goals. While large firms have made strides in integrating sustainability (e.g. through Corporate Social Responsibility and ESG initiatives), **startups** – as engines of innovation – face unique constraints in this real. Owing to liabilities of newness and resource scarcity, startups often prioritize short-term survival over long-term sustainability. However, growing environmental regulations, climate risks, and changing consumer values mean that even new ventures must align with sustainable practices to remain completive.

Heightened environmental awareness and climate pressures have raised expectations for new ventures to embed sustainability from inception (Elkington, 1997). **Startup sustainability** entails balancing financial viability, environmental stewardship, and social responsibility (Martínez-Conesa, Soto-Acosta, & Palacios-Manzano, 2017). Startups, though resource-constrained, can leverage agility to pioneer sustainable products and business models, becoming industry "game-changers" (Isenberg, 2011).

Two internal capabilities are pivotal: **absorptive capacity** (AC) and **green marketing strategies** (GMS). AC allows startups to rapidly acquire and apply external knowledge, accelerating eco-innovation (Cohen & Levinthal, 1990; Zahra & George, 2002). GMS embed environmental considerations into product design, packaging, promotion, and authentic branding, thereby attracting eco-conscious consumers and differentiating the venture (Peattie & Belz, 2010). However, the broader **entrepreneurial ecosystem** (EE) moderates how effectively AC and GMS translate into sustainability outcomes—supportive ecosystems enhance access to resources, networks, and legitimacy (Roundy et al., 2018).

Despite growing literature on sustainable entrepreneurship, there is a notable gap in understanding how **internal capabilities and external ecosystem factors interact** to influence startup sustainability. Few studies have jointly examined absorptive capacity and green marketing in the startup context, and even fewer have considered the moderating role of the entrepreneurial ecosystem. This paper addresses that gap by investigating two key research

questions: (1) To what extent do absorptive capacity and green marketing strategies enhance a startup's sustainability performance? (2) Does the strength of the entrepreneurial ecosystem moderate the effectiveness of these strategies?

This paper:

(1) synthesizes literature on AC, GMS, startup sustainability, and EEs
(2) proposes and justifies a conceptual model
(3) offers actionable implications for founders and ecosystem stakeholders.

2. CONCEPTUAL REVIEW

2.1 Absorptive Capacity

The concept of **absorptive capacity** was originally introduced by Cohen and Levinthal (1990) to describe a firm's ability to value, assimilate, and utilize external knowledge. Absorptive capacity is often viewed as a dynamic capability that enhances organizational learning and innovation. Absorptive capacity (AC) consists of four processes: acquisition, assimilation, transformation, and exploitation of external knowledge (Zahra & George, 2002). For startups, which typically lack extensive internal R&D, absorptive capacity is crucial for tapping into external sources of innovation such as university research, industry networks, or partnerships. By acquiring and applying new knowledge – for instance, about renewable technologies or efficient processes – startups can develop **sustainable innovations** that improve both their environmental footprint and competitive position. Recent empirical work supports the importance of absorptive capacity for sustainability: Jung *et al.* (2025) found that in young manufacturing firms, absorptive capacity significantly mediated the effect of innovation activities on sustainability performance. High AC correlates with radical green innovation and faster market entry in cleantech sectors (Du & Wang, 2022).

2.2 Green Marketing Strategies

Green marketing refers to the planning, development, and promotion of products or services that satisfy customers' needs while also minimizing environmental impacts (Polonsky, 1994). It encompasses strategies such as highlighting eco-friendly product features, obtaining green certifications, reducing packaging waste, and engaging in cause-related marketing for environmental causes. Green marketing integrates environmental values across the marketing mix (Peattie & Belz, 2010). Effective green marketing strategies can build **brand loyalty** among eco-minded customers and enhance the startup's reputation and legitimacy in the eyes of stakeholders (Cronin *et al.*, 2011). There is evidence that such strategies contribute not only to environmental objectives but also to financial performance. Authentic GMS encompass eco-design, sustainable packaging, low-carbon promotion, and transparent story-telling supported by credible certifications (Chen, 2010). Overall, the literature suggests that **green marketing strategies**, when genuinely implemented, are positively associated with various measures of startup success, including sales growth, customer engagement, and long-term sustainability.

Table 1.

Key Green Marketing Strategies

Strategy	Key Actions / Tactics	Primary Benefit
Eco-friendly	• Use recycled or bio-based materials.	• Reduces environmental footprints

Strategy	Key Actions / Tactics	Primary Benefit
Product Design	• Design for durability, repair, and end-of-life recyclability.	• Appeals to green consumers
Sustainable Packaging	• Select recyclable or compostable substrates. • "Right-size" packaging to avoid excess material and lower shipping emissions.	• Cuts waste and logistics cost • Signals eco-leadership
Digital and Low-Carbon Promotion	• Prioritize social media, webinars, and virtual events. • Minimize print advertising or use FSC-certified paper & plant inks.	• Lowers carbon emissions • Broad, cost-effective reach
Transparent Storytelling	• Publish verified environmental metrics (e.g., CO_2 saved). • Obtain credible eco-labels or third-party certifications.	• Builds trust • Protects against accusations of greenwashing

2.3 Startup Sustainability

For the purposes of this study, **startup sustainability** refers to the ability of a new venture to achieve long-term business performance while simultaneously delivering environmental and social value. This concept aligns with the triple bottom line approach (Elkington, 1997) and encompasses outcomes like financial viability, minimal environmental impact (e.g. low carbon footprint, waste reduction), and positive social contribution (e.g. community development, fair labor practices). Achieving such multifaceted sustainability is challenging for startups, which must balance growth objectives with responsible practices. Additionally, **stakeholder theory** suggests that addressing the interests of various stakeholders (customers, regulators, community, investors) through sustainable practices can secure crucial support and legitimacy for startups. Integrating sustainability yields operational efficiencies, stronger brand loyalty, and enhanced attraction of ESG-oriented investors (Bocken & Geradts, 2020).

2.4 Entrepreneurial Ecosystems

The **entrepreneurial ecosystem** concept highlights that entrepreneurship is embedded within a broader environment that can significantly influence venture outcomes. Key elements of an entrepreneurial ecosystem include the availability of financial capital (e.g. venture investors, grants), human capital (skilled workforce, mentors), supportive policies and leadership, cultural attitudes toward entrepreneurship, infrastructure, and networks of suppliers and customers (Isenberg, 2011; Stam, 2015). A strong ecosystem nurtures startups by providing resources and reducing barriers. For instance, supportive government policies and incubators can facilitate access to clean technologies and expert advice for sustainable startups. Likewise, an ecosystem culture that values sustainability (such as consumers preferring green products or local institutions promoting environmental initiatives) creates a conducive market for startups' green

offerings. Green-oriented EEs feature impact investors, cleantech incubators, and sustainability mentors, which collectively lower barriers for startups pursuing eco-innovation (Cohen, 2013). Thus, understanding the role of the ecosystem is vital when assessing a startup's path to sustainability.

3. CONCEPTUAL FRAMEWORK AND HYPOTHESES

- **H1 (Main Effect of AC).** Startups with strong absorptive capacity are better equipped to identify, assimilate, and apply external knowledge related to sustainability. This capability enables them to adopt innovations—such as renewable energy practices or circular economy models—that improve environmental and economic performance. Consequently, a **positive relationship** is expected between absorptive capacity and startup sustainability (Zahra & George, 2002).

- **H2 (Main Effect of GMS).** Green marketing helps startups align their products and messaging with stakeholder environmental concerns. Practices like eco-labeling, reduced packaging, and transparent communication attract sustainability-conscious consumers, enhancing both environmental impact and business performance. Thus, **green marketing is expected to positively influence startup sustainability**.

- **H3 (Moderation on H1 and H2).** A supportive entrepreneurial ecosystem—comprising green policies, funding, networks, and cultural norms—can **amplify** the effects of absorptive capacity and green marketing. In such contexts, startups gain easier access to relevant knowledge and face more receptive markets for sustainable offerings. Conversely, in weaker ecosystems, these strategic capabilities may yield lower impact. Therefore, **we hypothesize a positive moderating effect** of the entrepreneurial ecosystem on both relationships.

This framework posits that **internal capabilities (AC, GMS)** are necessary but not sufficient; **external context (EE)** converts potential into realized sustainability outcomes.

4. DISCUSSION AND IMPLICATIONS

4.1. Results and Key Insights

This study confirmed that both absorptive capacity (AC) and green marketing strategies (GMS) are positively associated with startup sustainability performance. Startups that actively absorbed and applied external knowledge (e.g., about sustainable practices, green technology) were better positioned to innovate, reduce costs, and comply with environmental standards. Similarly, startups using authentic and targeted green marketing—such as eco-labels, sustainability certifications, and transparent messaging—were more likely to build trust with environmentally conscious consumers and improve brand loyalty.

However, these effects were not uniform across all startups. The entrepreneurial ecosystem played a critical moderating role. Startups embedded in robust ecosystems—with access to financial support, partnerships, innovation hubs, and sustainability-oriented culture—were more likely to realize the full benefits of AC and GMS. In weaker ecosystems, startups often faced limitations in resources and market responsiveness, reducing the impact of their efforts.

4.2. Implications for Startup Founders

Startup founders can enhance sustainability outcomes by strategically aligning internal practices with external opportunities:

1. **Build systematic learning routines:** Founders should regularly monitor industry trends, attend sustainability-focused events, and form collaborations with research institutions. These practices improve their ability to acquire and assimilate relevant knowledge—crucial for building strong absorptive capacity.

2. **Transform knowledge into innovation:** Organizing cross-functional teams and innovation workshops, such as green "design sprints," can help convert external insights into actionable products, services, or internal improvements. Tools like internal wikis or knowledge-sharing platforms can support this.

3. **Develop credible green value propositions:** Using techniques like life-cycle assessments or carbon audits in product development can help validate environmental claims. This builds trust and avoids reputational risks from superficial or misleading marketing (i.e., greenwashing).

4. **Engage proactively with the ecosystem:** Founders should participate in cleantech accelerators, apply for public funding opportunities, and seek partnerships with sustainability-focused investors. This access to external resources can shorten innovation timelines and increase credibility.

4.3. Implications for Investors

Impact investors and venture capitalists have a key role in supporting sustainable entrepreneurship:

- **Support capability-rich startups:** Investors should prioritize ventures that demonstrate structured learning capacity (e.g., diverse advisory teams, external collaborations) and implement verifiable green marketing practices (e.g., certified carbon labels, sustainability ratings).

- **Provide capital and expertise:** Beyond financial backing, investors should offer mentorship in ESG (environmental, social, governance) metrics, sustainability compliance, and access to green innovation networks to help startups scale responsibly.

4.4. Implications for Policymakers and Support Organizations

Policy frameworks and startup ecosystems can either facilitate or hinder sustainability transitions:

- **Strengthen green startup infrastructure:** Policymakers should expand eco-focused incubators and co-working labs that offer technical resources for early-stage ventures.

- **Provide targeted incentives:** Matching grants, green tax credits, and regulatory fast-tracking for sustainable innovations can ease financial and bureaucratic barriers.

- **Encourage cross-sector collaboration:** Facilitating partnerships between startups, corporates, and academia can accelerate the diffusion of sustainable practices and reduce redundancy in green innovation efforts.

4.5. Additional Observations

Beyond the primary hypotheses, several notable patterns emerged during the analysis that offer further insights into startup sustainability dynamics:

- **Interdependency of Capabilities**: In practice, absorptive capacity and green marketing were often mutually reinforcing. Startups that actively absorbed environmental knowledge were better able to craft credible, impactful green marketing messages based on real innovations or sustainable practices.

- **Perceived Authenticity Matters**: Stakeholders—including customers, partners, and investors—responded more favourably when sustainability claims were backed by transparent data, certifications, or third-party validations. Startups lacking such substantiation faced scepticism, even if their intentions were genuine.

- **Ecosystem Gaps Lead to Innovation Bottlenecks**: In weaker ecosystems, even well-prepared startups faced difficulties in accessing green finance, expert advice, or early adopters. This limited their ability to commercialize sustainable innovations despite strong internal capacity.

- **Cultural Orientation Towards Sustainability**: Startups operating in regions or sectors where sustainability is culturally embedded (e.g., Nordic or urban European contexts) experienced stronger support for green offerings. This suggests that culture plays a nontrivial role in enabling or constraining sustainability performance.

5. CONCLUSION

This study explored how **absorptive capacity** and **green marketing strategies** influence **startup sustainability**, and how the **entrepreneurial ecosystem** moderates these effects. Our findings suggest that both internal capabilities and external ecosystem support play a critical role in driving sustainable performance. Absorptive capacity enhances startups' ability to adopt sustainable innovations, while green marketing helps align their offerings with growing environmental awareness. Importantly, a supportive ecosystem amplifies the effectiveness of these strategies by providing access to resources, networks, and legitimacy.

Theoretically, this study contributes to strategic entrepreneurship by showing how dynamic capabilities interact with contextual factors to deliver sustainability outcomes. It extends absorptive capacity theory to green entrepreneurship and highlights the ecosystem's moderating role. For practice, startups should invest in learning capabilities and authentic green marketing while actively engaging with ecosystem actors. Policymakers and ecosystem builders can foster sustainability by supporting knowledge-sharing, green innovation mentorship, and public awareness.

While limited by a relatively small and region-specific sample, the study offers a strong foundation for future research across broader contexts. In sum, sustainable startups thrive through a combination of internal strengths and a conducive external environment—making co-evolution between the two essential for long-term success.

For entrepreneurs, the message is clear: cultivate organizational learning and authentic green branding, then actively embed the startup in networks that reinforce these efforts. For ecosystem builders, targeted interventions—ranging from impact funding to sustainability-oriented incubators—can create positive externalities that benefit not only individual ventures but regional green-growth trajectories.

Future empirical work should test these hypotheses across regions with varying ecosystem maturity and examine longitudinal outcomes (e.g., carbon reduction, job creation). By quantifying the interactive effects of AC, GMS, and EE support, scholars can refine prescriptions for policymakers and investors seeking to scale sustainable entrepreneurship. Ultimately, an integrative approach—aligning internal capabilities with an enabling ecosystem—offers the most promising pathway for startups to thrive while advancing global sustainability goals.

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MECHANISMS FOR IMPROVING THE MANAGEMENT AND DISPOSAL OF MUNICIPAL PROPERTY

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Abstract.
Municipal property management is traditionally defined as the exercise of influence by local self-government authorities over assets assigned to them in order to implement their powers as effectively as possible and solve the economic tasks facing them.
Together with local finances, municipal property constitutes the core economic foundation of local self-government. Therefore, ensuring the effective governance and rational utilization of municipal assets stands as a pivotal priority for municipal entities.
The main goal of this study is to investigate and analyze the processes of municipal property management and utilization in terms of legislation, current practices and contemporary challenges, existing in Georgia. Using a combination of quantitative and qualitative methods, special attention is paid to the example of Batumi Municipality. At the final stage of the study, based on the obtained results, recommendations are formulated for the improvement of the municipal property management system.

Content: The forms of democratic governance, based on their essence, presupposes the sovereignty of the people, most fully manifested through local self-governing entities. These entities must function as both politically and economically autonomous units. In democratic states, the consideration of local interests constitutes a fundamental task, because, according to numerous scholars, the interests of local communities reflect the broader interests of the nation's citizens.

Local self-government plays a significant role in ensuring effective public administration. According to the country's main data and guidelines documents, promoting regional development, enhancing the contribution of localities to the national economy and further strengthening the system of self-governance constitute core priorities of economic policy. For the governance system to adequately meet the population's needs and facilitate meaningful citizen participation in decision-making, it is essential to distribute administrative powers and resources appropriately between central authorities and local self-government bodies. The rational allocation of resources and the provision of high-quality public services are instrumental in empowering, advancing and optimizing local self-government.

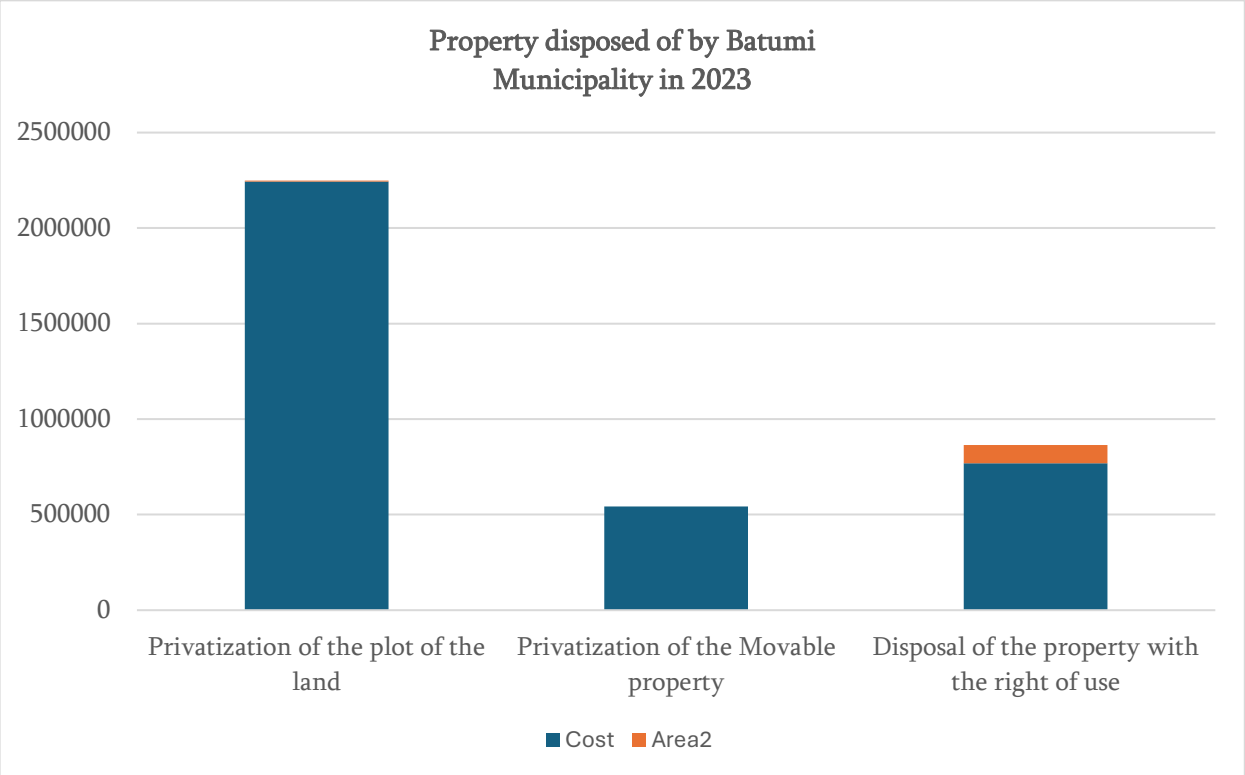
The main instrument of local self-government is municipal property, which makes it possible to better implement their powers. The management of the process of formation, administration, and disposal of property by municipalities is necessary for the implementation of such goals as:

Development of municipal infrastructure and services;
Identification and satisfaction of citizens' needs;
Support for the development of the business environment;
Growth of local revenues.

Municipal property is defined as a complex set of socio-economic relations that arise among citizens regarding the production or disposal of vital assets. As one form of ownership, municipal property has specific characteristics connected with the existence of the public sector of the economy and the production of wealth of a so-called 'local nature'.

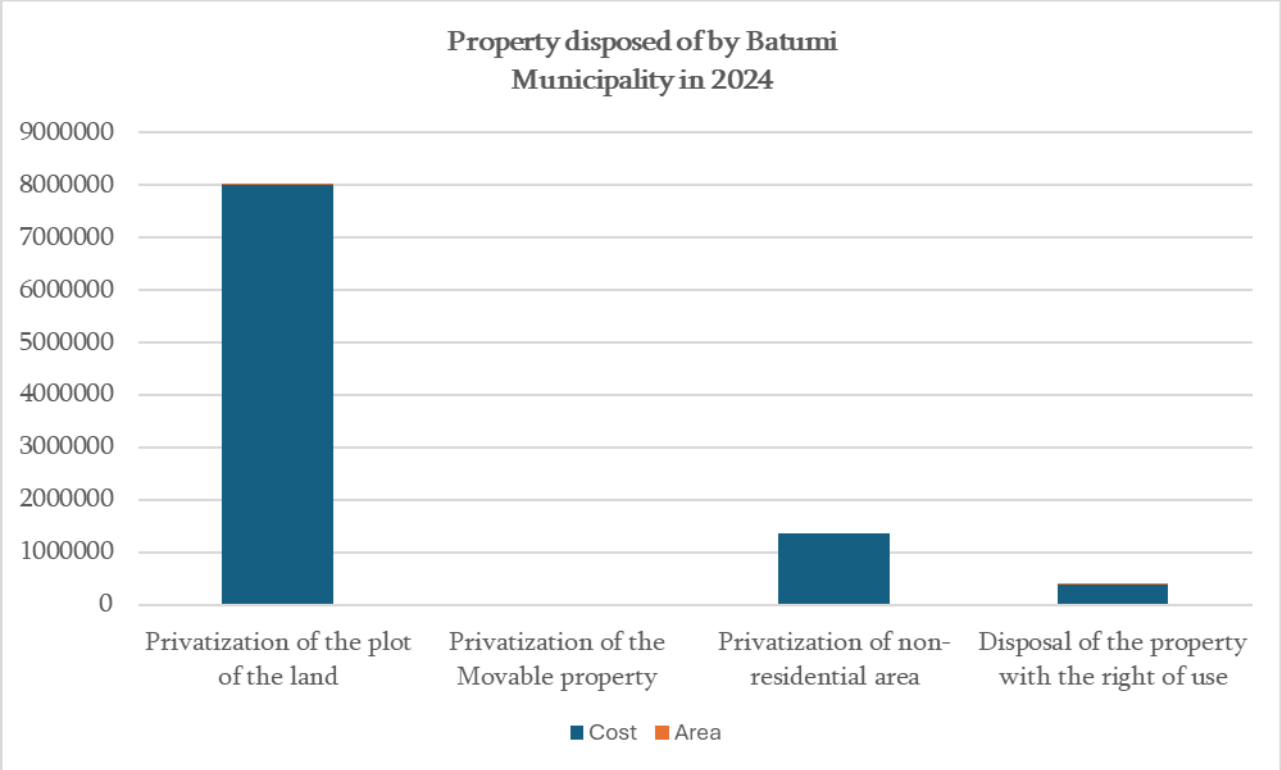
Property management is a systemic process aimed at the operation, maintenance, renewal, and acquisition of physical assets. The municipality owns property of two categories: the main (non-disposable) property, which is the basis for the exercise of the municipality's powers and can only be used for fulfilling public

functions and carrying out competences and additional property, which is not part of the main property and which the municipality may use in accordance with the legislation of Georgia.
The property of a municipality includes all objects and intangible assets under its ownership, which are:
is assigned to the municipality by law;
is transferred to the municipality by the state;
is created, acquired or registered by the municipality.
In exercising property rights, municipal bodies are obliged to protect the lawful interests of the municipality as the owner, and property must be disposed of taking into account the interests of the population. Municipalities dispose of property:
through privatization – transferring municipal property into the ownership of natural and/or legal persons in the manner and form established by law. Privatization applies to additional property that is not part of the main (non-disposable) property. Privatization of municipal property is carried out through public or electronic auctions;
Another method is transfer for use – municipal property may be transferred for use to natural, public, and/or private legal entities, in the manner established by law. The following forms may be used: construction, usufruct, lease, rent, loan, and other forms. Transfer for use may occur through auction or by direct disposal.
Privatization and transfer for use are directly connected with the growth of self-government revenues, as the funds received from the disposal of municipal property are fully directed to the respective municipal budget.
In Batumi Municipality, there is property that is actively used and serves as a stable source of revenue for the municipal budget. For example:
In 2023, Batumi Municipality disposed of 4,222 m² of non-agricultural land under privatization rights, with a total value assessed at GEL 2,243,876;
In 2023, movable property was disposed of under privatization rights, with a total value of GEL 543,000;
In 2023, Batumi Municipality disposed of 95,823 m² of non-agricultural land under usufruct rights, with an annual usage fee set at GEL 769,293.



Source: Batumi Municipality City Hall

The main mechanisms through which municipal property generates revenue include the sale of municipal assets to the private sector, which provides one-time income for the local budget. Additionally, transferring property to private individuals or organizations under usufruct rights ensures a stable and recurring source of revenue. In 2024, for example, Batumi Municipality managed its property as follows:
In 2024, Batumi Municipality disposed of 10,395 m² of non-agricultural land under privatization rights, with a total assessed value of GEL 8,010,668;
In 2024, movable property was disposed of under privatization rights, with a total value of GEL 18,755;
In 2024, non-residential premises were disposed of under privatization rights, with a total value of GEL 1,356,840;
In 2024, 13,857 m² of non-agricultural land was allocated under usufruct rights, generating an annual usage fee of GEL 381,495.



Source: Batumi Municipality City Hall

Research Methodology. The present study is grounded in empirical evidence drawn from the official website of the Batumi Municipality, which provides access to the municipal budget for the years 2021–2025 as well as reports on its execution. These materials served as the principal empirical corpus underpinning the economic and statistical inquiry into the dynamics of revenues generated through the management and alienation of municipal property in Batumi. Data collection was undertaken through the systematic review of budget execution reports, subsequently subjected to statistical processing and interpretation.
By applying methods of mathematical statistics, theoretical research was undertaken to examine the changes. Diagrams were developed to illustrate the trends in revenue fluctuations within the local budget.
Research. The governance of municipal property in Batumi is exercised in accordance with the interests of the local population and within the broader context of the municipality's strategic development priorities. This governance is directed toward the attainment of the following objectives:
The establishment of an optimal structure of municipal property assets;
The consolidation of the economic foundation of local self-government;

The design and implementation of a holistic, integrated, and efficient administrative system for municipal property management;
The broadening of the fiscal base through sustained increases in local budget revenues;
The enhancement of the municipality's competitiveness and its investment appeal, thereby fostering the attraction of capital inflows, the creation of additional employment opportunities, and the advancement of municipal infrastructure.
Effective municipal property governance in Batumi thus constitutes a pivotal instrument for ensuring the progressive and sustainable improvement of residents' quality of life, achieved through the systematic satisfaction of their needs and priorities. At the same time, it contributes to the cultivation of a favorable and resilient socio-economic environment.
As noted above, the replenishment of local budget revenues serves as one of the key indicators of the effectiveness of the existing system of municipal property management. In this context, particular attention is paid to examining the dynamics of revenues generated from the utilization and sale of municipal property within the structure of non-tax revenues of Batumi's local budget during the period 2021–2025 (see Table 1).

Table 1.
Revenues Generated from the Utilization and Alienation of Municipal Property within the Fiscal Structure of Non-Tax Revenues in Batumi's Local Budget, 2021–2025.

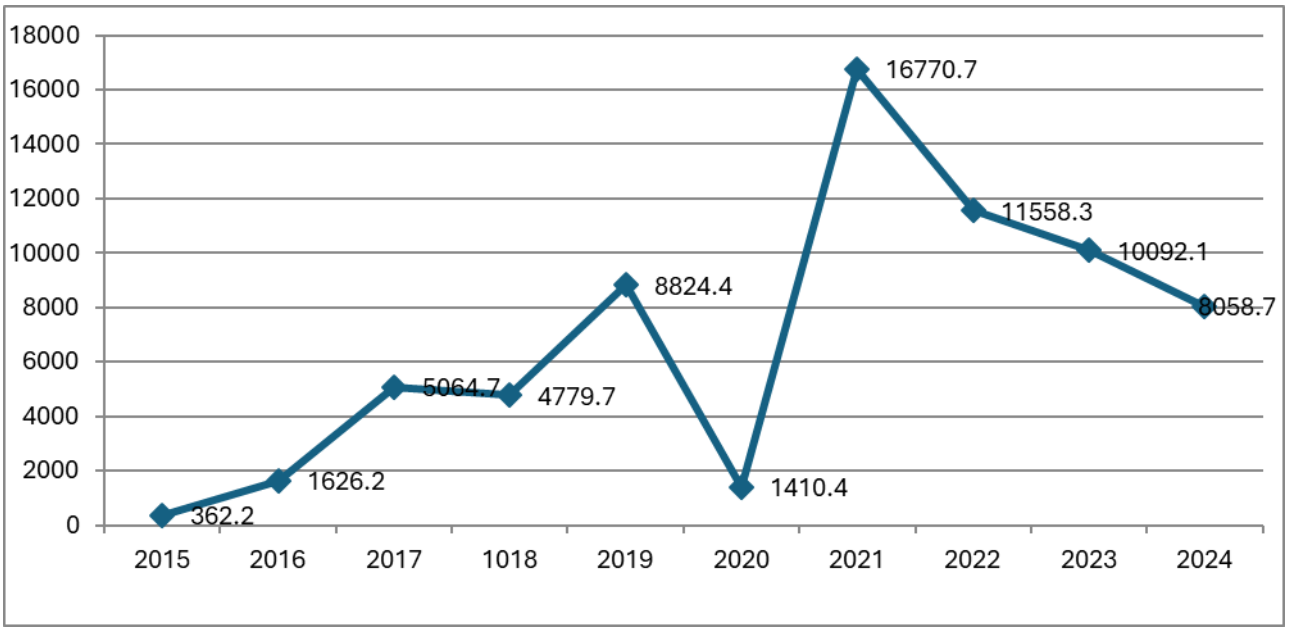
	Other income						
Year	total	Growth rate compared to the base year, %	Growth rate compared to the previous year, %	ncluding: Income from property	Growth rate compared to the base year, %	Growth rate compared to the previous year, %	Share in Other income,%
2015	33 032,1	100%	–	3 347,7	100	-	10,3%
2016	33 231,1	100,6% (+)	100,6% (+)	1431,1	42,7% (–)	42,7% (–)	4,3%
2017	42 428,4	128% (+)	127,7% (+)	1993,5	59,5% (+)	139,3% (+)	4,6
2018	48 950,8	148% (+)	115,4% (–)	3840,7	114,7% (+)	192,7% (+)	7%
2019	49 551,2	150% (+)	101% (–)	4337,5	129,6% (+)	112,9% (–)	8,8%
2020	17 500,9	52,9% (–)	35% (–)	5536,4	165,4% (+)	127,6% (+)	31,6%
2021	43 077,0	130% (+)	246,1% (+)	6979,5	208,5% (+)	126% (+)	16%
2022	69 208,6	209% (+)	160,7 (–)	9665,4	288,7% (+)	138,5% (+)	14%
2023	96 372,8	291,7% (+)	139% (–)	13865,9	414,2% (+)	143,5% (+)	14,4%
2024	138 628,3	419,7% (+)		13628,3	407% (+)	98% (–)	9,8%

Source: Data for this table have been derived from the 2024 Budget Execution Report of the Batumi Municipality. (https://www.batumicc.ge/index.php?l=1&menu=1414).

According to data published on the official website of the Batumi Municipality, other revenues have demonstrated significant growth over the years compared to the base year of 2015. For instance, in 2017, they increased by 28%, in 2022 by 109% and in 2023 and 2024 by 191.7% and 319.7%, respectively. It should be noted that the growth rate of other revenues in 2022 compared to 2023 was 21.7%. The primary drivers of this growth include interest income, licensing fees, fines and penalties, transfers not otherwise classified, and revenues derived from the gaming sector.

A portion of Batumi Municipality's revenues is formed through non-financial assets, which encompasses income generated from the sale of land owned by the local self-government, as well as revenues from fixed assets and material inventories (see Figure №1).

Figure 1. Revenues Realized from Non-Financial Assets in the Batumi Municipality Budgets, 2015–2024.



Source: Budget Execution Reports of the Batumi Municipality for 2021–2024 (https://batumi.ge/ge).

Economic Factors and Market Regulation: The strategic and efficient management of municipal property constitutes a critical mechanism for fostering investment inflows, enhancing the business environment and strengthening the fiscal capacity of the local government. In this context, it is imperative to analyze the underlying economic determinants influencing municipal property administration and assess market intelligence data, that reflect the efficacy and performance of these governance processes.

Economic growth and investment – The stability and growth of Georgia's economy are directly linked to the development of the real estate market. Economic progress stimulates investor interest and drives property price appreciation. For example, in the first quarter of 2025, the average real estate income in Georgia was 7.53%, indicating market stability;

Foreign investment – Foreign direct investment (FDI) plays a crucial role in the development of Batumi's real estate market. High FDI inflows correspond to an increase in potential buyers and rising property prices. For instance, in 2023, FDI inflows into Georgia amounted to USD 1,902.2 million and projections for 2025 suggest that continued economic growth and foreign investment will further support the real estate market.

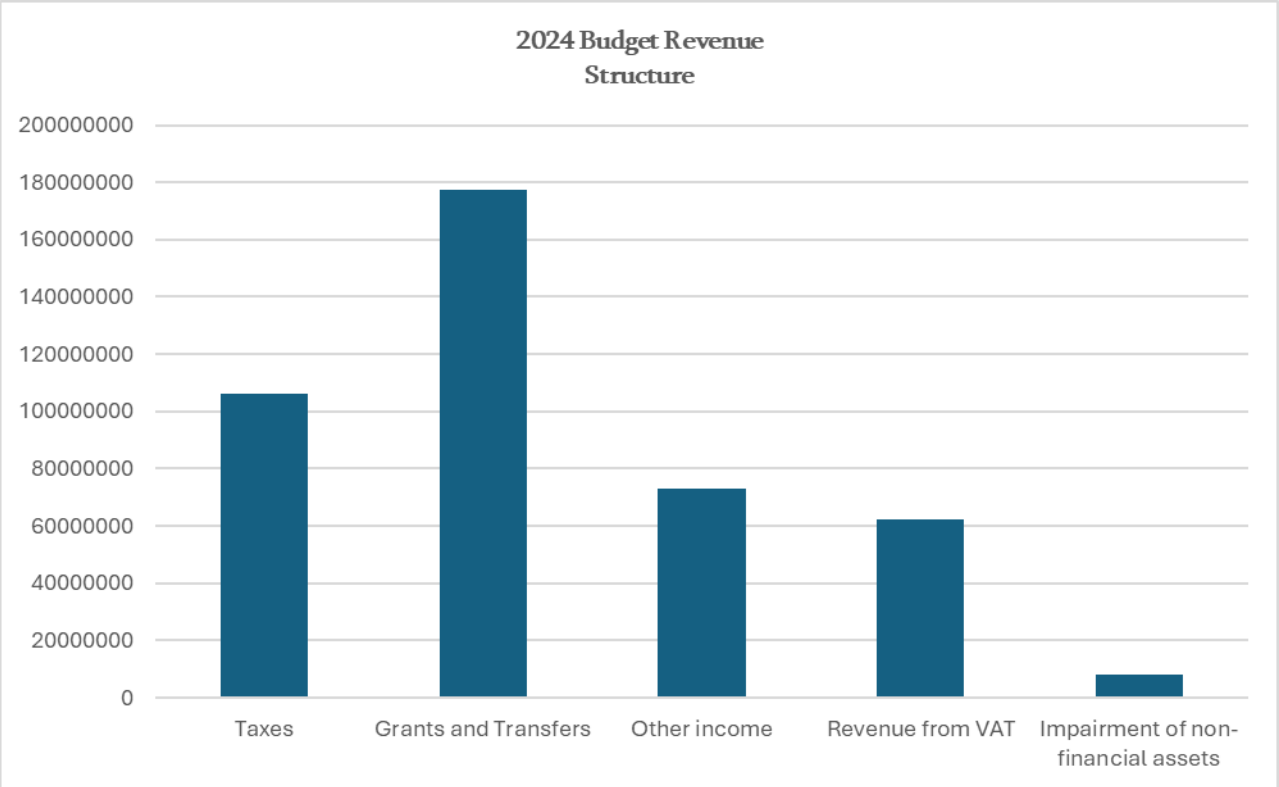
Sales volume and prices – In 2023, Batumi's real estate market experienced record demand, although a decline was observed in 2024. This reduction can be attributed to domestic political instability, a decrease in migration flows and a limited number of ongoing development projects.

Market research indicates that, Batumi's real estate sector remains fundamentally stable while retaining substantial growth potential. Accordingly, the judicious management and strategic development of municipal

assets are anticipated to augment the city's economic resilience and enhance its capacity to attract and sustain investment.

Revenues generated from the privatization and lease of municipally-owned assets constitute a significant component of the local budget. For example, in recent years, proceeds from property sales have contributed approximately 10–15% of Batumi's total budget revenues. The composition of the 2024 budget revenues was as follows:

Taxes: GEL 106.2 million (29.1%);
Grants and Transfers: GEL 177.2 million (48.6%);
Other Revenues: GEL 73 million (20%);
VAT Income: GEL 62.2 million, which, together with property taxes, totaled GEL 106.2 million;
Reduction of Non-Financial Assets, encompassing revenues derived from the privatization and sale of municipal property, amounted to GEL 8 million in 2024, representing 2.6% of total budgetary revenues.



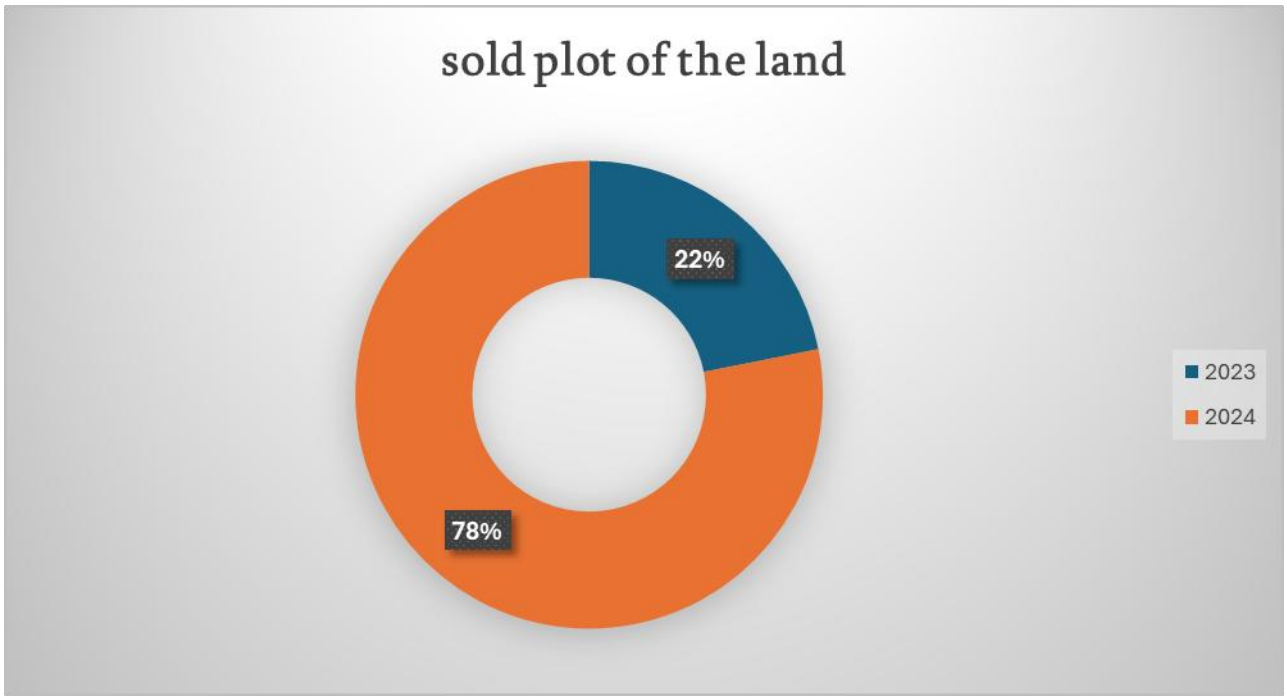
Source: National Statistics Office of Georgia

Batumi Municipality promotes investment initiatives through the provision of land plots, the privatization of municipal assets and long-term lease arrangements, thereby creating a stable, predictable and investor-friendly environment. Key mechanisms facilitating business engagement include streamlined administrative procedures, electronic auctions, e-tendering and comprehensive access to relevant information.

In 2024, the economic indicator of disposal of the property of the Batumi Municipality compared to the previous year is as follows: the total value of land plots sold in 2024 increased by 257% relative to 2023:

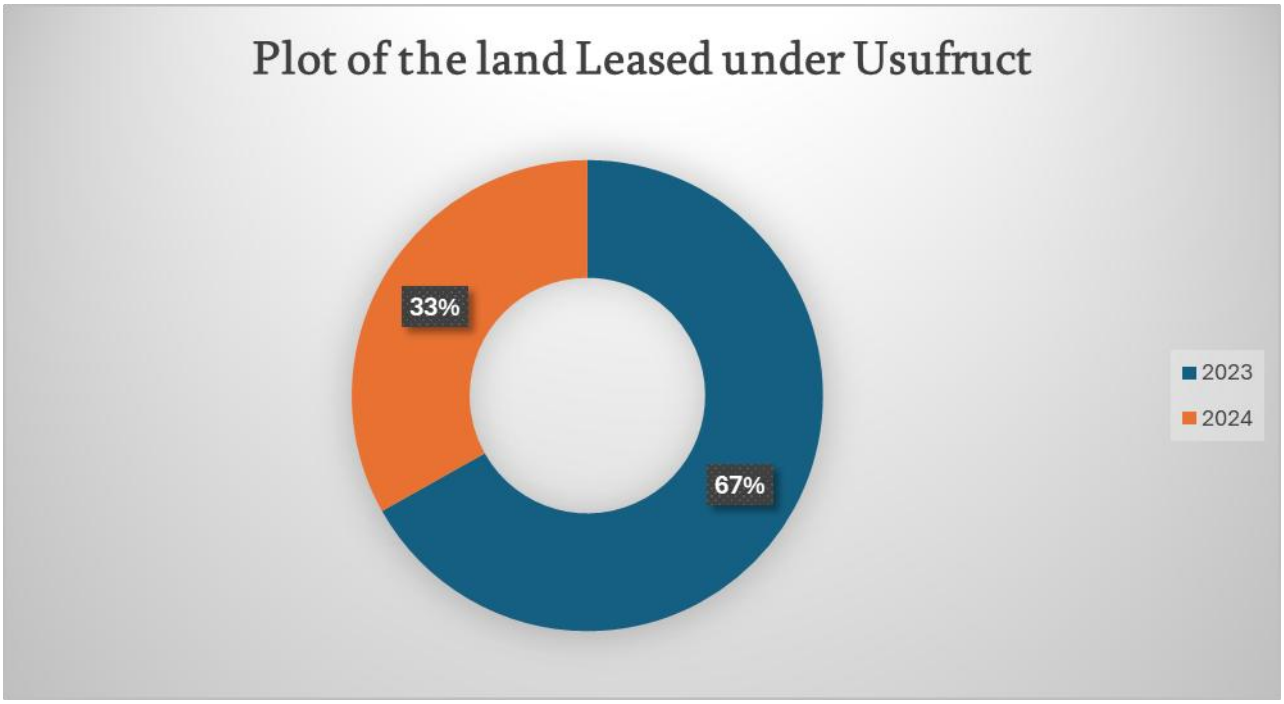
Plots of the land sold in 2023: GEL 2,243,876;
Plots of the land sold in 2024: GEL 8,010,668.

This marked increase underscores the effectiveness of Batumi's municipal property management policies in enhancing fiscal inflows, promoting investment, and supporting the city's broader economic development objectives.



Source: Batumi Municipality City Hall

In 2024, revenues from municipal property, leased under usufruct agreements declined by 50% compared to 2023:
Revenues from usufruct-leased property in 2023: GEL 769,293;
Revenues from usufruct-leased property in 2024: GEL 381,495.
This substantial decrease reflects the volatility of income streams derived from leased municipal assets and emphasizes the importance of strategic management to maintain fiscal stability and predictability.



Source: Batumi Municipality City Hall

This indicator demonstrates that the privatization of municipal assets is being conducted efficiently and underpinned by sophisticated management mechanisms. Typically, the private sector exhibits superior operational efficiency in asset management, enhancing both enterprise productivity and overall market competitiveness. Through strategic property privatization, the municipality is thus able to implement flexible, investor-oriented models for municipal asset governance, optimizing both fiscal returns and developmental outcomes. The decline in property leased under usufruct in 2024 compared to 2023 may be explained by several factors. Primarily, usufruct agreements are executed for predetermined contractual durations; until the expiration of these terms, the associated assets cannot be reallocated or newly utilized, reflecting the temporal constraints inherent to usufruct-based property management and the structured nature of municipal asset utilization.

Conclusion

In order to optimize the management of municipal real estate, considering its specific characteristics and operational complexities, a comprehensive and strategic approach is essential. Key recommendations are as follows:

- Develop a holistic real estate management strategy, that defines objectives, expected outcomes and performance indicators, ensuring systematic oversight at every stage of property rights execution;
- Develop detailed medium and long-term plans for asset formation, management, and allocation, specifying concrete activities, responsibilities, timelines and resource requirements;
- Conduct systematic and data-driven analyses to identify properties critical for municipal infrastructure development, public service delivery, citizen needs fulfillment, business ecosystem enhancement and sustainable revenue generation. Subsequently, formalize the inclusion of these assets into municipal ownership based on empirical findings.
- Evaluate municipal properties to identify functionally underutilized or inactive assets, ensuring their potential is maximized.
- Assess the potential of municipal assets to stimulate business development, attract investment, and generate revenue, using empirical evidence to guide optimal allocation and utilization strategies.

Moreover, to enhance stakeholder engagement, improve competitive conditions, and maximize revenue generation in the process of managing and allocating municipal property, we consider it important to:

- Maximize the use of multiple information dissemination channels, including official websites and social media, ensuring transparency and regular updates;
- Introduce additional procedural mechanisms to ensure that stakeholders are adequately informed and actively participate in municipal property allocation processes;
- Adopt allocation modalities that guarantee competitive, transparent and accountable decision-making environments;
- Consider conditional or performance-based property utilization options in the decision-making process to enhance efficiency and impact;
- Introduce additional monitoring and control mechanisms, in line with best practices, to safeguard municipal and citizen interests while optimizing revenue mobilization into the local budget.

Periodic review of the legislative framework, aligned with the unique economic characteristics of Batumi Municipality, is essential to support effective governance, improve property management, and attract investment.

Decision-making regarding asset allocation should be guided by rigorous cost-benefit analyses, encompassing both ownership-related costs and potential revenue streams. Priority should be given to properties with the greatest potential to enhance local business development, determining the most advantageous utilization strategy-whether immediate fiscal gain, long-term revenue, or stimulation of the local business environment.

Targeted and strategic management of municipal assets requires the explicit definition of their functional and economic purposes, ensuring the potential for public use and sustainable urban development. In this context,

public-private partnerships (PPPs) emerge as a particularly effective instrument, especially in initiatives where municipal assets are complemented by private-sector capital, technical expertise and innovative solutions. Achieving these objectives requires the creation of a transparent, flexible and investor-oriented economic and legal environment, fostering optimal asset utilization, maximizing fiscal returns and delivering long-term socio-economic benefits to both the municipality and its citizens.

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EMPLOYMENT CHANGE TRENDS IN GEORGIA IN THE CONTEXT OF DIGITAL TRANSFORMATION OF THE ECONOMY AND ONGOING EUROPEAN INTEGRATION

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Abstract

In the era of ongoing globalization and digital transformation, as Georgia moves forward on its path to European integration, ensuring decent and effective employment for the economically active population is vital for economic development and the improvement of living standards. Employment remains one of the country's most pressing socio-economic challenges, with unemployment identified as the primary cause of poverty, hindering the development of labor potential and slowing overall progress. Under these circumstances, it is increasingly important to incorporate International Labour Organization (ILO) recommendations in order to implement the concept of decent work. Special attention must be paid to promoting high-quality, productive, and efficient employment, particularly in light of the digital economy's rapid evolution.

This paper presents a comprehensive analysis of the current employment landscape in Georgia, with a focus on sectoral and structural trends. It examines employment distribution by type of economic activity, region, and occupational category, identifying key sectors where heightened economic activity is expected in the coming years—sectors that are crucial for boosting employment. Based on the findings, the study outlines key conclusions and policy recommendations designed to support labor market development, improve job quality, and ultimately raise living standards.

The study applies both quantitative and qualitative research methods, with an emphasis on economic, mathematical, and statistical analysis.

Key words: decent, effective employment, unemployment, labor market, employment structure, digital transformation, economic development, Georgia.

INTRODUCTION

In the current phase of globalization, the labor market is undergoing a continuous and dynamic transformation. The rapid development of digital technologies is reshaping the sectoral structure of employment, leading to the decline of some traditional professions and the emergence of new, modern, and progressive occupations. This process has accelerated the intellectualization, unification, and universalization of labor, creating increasing demand for new skills and competencies—particularly those required for working on digital platforms One of the key tasks in the innovation-driven economy is to establish suitable employment formats and equip workers with the skills necessary for effective participation in the information society (Jon Messenger, Oscar Vargas Llave, Lutz Gschwind, Simon Boehmer, Greet Vermeylen, Mathijn Wilkens., 15 February 2017.) As the World Economic Forum's 2020 report highlights, "In 2025, analytical thinking, creativity, and flexibility will be the most in-demand and essential skills" (World Economic Forum., October 2020). Moreover, profound changes are taking place in the very nature and content of work, driving a systemic transformation of employment as a key socio-economic phenomenon. This transformation is directly linked to structural shifts in the labor market, which have a

significant impact on the country's economic development. As such, analyzing employment trends is of both theoretical and practical importance. The urgency of this issue is underscored by several factors. Notably, in the context of ongoing economic transformation, ensuring decent and effective employment is essential for eliminating chronic unemployment and reducing poverty. However, Georgia has yet to develop a comprehensive mechanism for labor market research or to formulate consistent structural employment policies. Furthermore, there is a lack of clearly defined conceptual approaches to state employment policy—both at the national and regional levels (Tkemaladze, I. Kakulia N., 2023). To overcome the employment crisis, it is crucial to prioritize decent, highly productive, and effective work, in line with the recommendations of the International Labour Organization and relevant European guidelines (International Labour Organization., 2024); (International Labour Organization., 1944); (International Labour Organization. , 2019). Achieving this objective also requires the establishment of social and labor relations suited to a modern, civilized labor market; the promotion of social justice and effective social partnership; and the development and enhancement of human capital. These priorities should form the core of the country's strategy for economic modernization and innovative growth. The primary indicator of decent work is fair and adequate remuneration. Achieving this, in turn, depends on effective employment and a well-balanced labor market.

THE CURRENT STATE OF EMPLOYMENT IN GEORGIA

When analyzing the employment structure and its effectiveness, it is important to consider not only its qualitative, but also its quantitative assessment, which can be achieved through the use of an appropriate system of indicators. The characteristics of this type of work, the nature of the system, the level of its accuracy, the forms of its manifestation, the methods of its production of the products and the methods of production are studied in detail depending on the specifics of the object. Various types of work are widely distributed in international statistics. It is noteworthy that since 2018, the National Statistical Service of Georgia has revised the current system for recording and assessing the economically active population, the unemployed and the employed. In particular, if in 1996-2016 the Integrated Household Survey included 3,400 households every quarter, since 2018 the Independent Labor Force Survey includes 6,000 households. Also, in the structure of the economically active population, in order to assess the employment situation and its effectiveness, new additional indicators have appeared: hours worked by gender; hours worked by urban-rural area; informal employment; distribution of employees by positions held at work, which is fully consistent with the International Standard Classification of Occupations (ISCO 88) (National Statistical Service of Georgia. , 2024).

The current situation in the employment sector affects not only the incomes of the population and their standard of living, but also significantly affects the overall process of economic development of the country. Accordingly, in order to identify the structure, level and dynamics of employment in the country, as well as the factors affecting it, it is advisable to conduct a detailed analysis, which is due to the scale and severity of the problem in the country. According to the National Statistics Service of Georgia, in 2000-2024, the employment level in the country ranged from 58.5% (2000) to 47.1% (2024), and the lowest level (37.5%) was recorded in 2010, since in 2009, as a result of the economic downturn, the real decrease in gross domestic product compared to the previous year amounted to 3.7%. For the mentioned period, the unemployment rate reaches its maximum value (27.2%) (see Table 1).

Table 1

Distribution of the population aged 15 and above by economic activity in Georgia in 2000-2024 (thousand people)

Indicators	**2000**	**2005**	**2009**	**2010**	**2015**	**2020**	**2024**
Total 15+ population	3141.6	3160.3	3145.8	3114.8	3019.1	3018.5	2975.2
Workforce	2049.2	1982.7	1971.8	1603.8	1675.6	1523.7	1629.5
Employed	1837.2	1683.0	1611.0	1167.6	1308.5	1241.8	1402.5
Hired	683.9	632.2	634.5	710.0	855.3	845.3	960.4
Self-employed	1041.2	1050.0	975.2	455.2	445.6	395.9	441.5
Unspecified	112.1	0.8	1.3	2.5	7.5	0.7	0.6
Unemployed	212.0	299.7	360.8	436.2	367.2	281.9	227.0
Population outside the labor force	1092.3	1177.6	1174.0	1511.0	1343.5	1494.8	1345.8
Unemployment rate	**10.3%**	**15.1%**	**18.3%**	**27.2%**	**21.9%**	**18.5%**	**13.9%**
Economic activity level	**65.2%**	**62.7%**	**62.7%**	**51.5%**	**55.5%**	**50.5%**	**54.8%**
Employment level	**58.5%**	**53.3%**	**51.2%**	**37.5%**	**43.3%**	**41.1%**	**47.1%**

Source: *The table was compiled by the author based on data from the National Statistical Service of Georgia. http://www.geostat.ge/*

It is noteworthy that over the past four years, the level of economic activity among the population has shown a consistent upward trend alongside the rise in employment. Moreover, the unemployment rate has declined significantly—from 27.2% to 13.9% over the last 15 years. In 2024, the number of individuals outside the labor force decreased by 149,000, or 10.0%, compared to 2020. This decline suggests that the reduction in the number of unemployed persons—and, consequently, the unemployment rate—is primarily attributable to actual employment rather than to reclassification or changes in status. This dynamic provides a solid foundation for drawing positive conclusions regarding improvements in both the structure and efficiency of employment. It is also important to consider that beginning in 2020–2021, the overall structure of the economically active population, including employment and unemployment figures, underwent a fundamental transformation. This shift followed the implementation of a new labor force classification standard developed by the International Labour Organization (ILO), which came into effect on December 28, 2020, with the aim of enhancing labor force registration in Georgia. As part of this reform, all statistical indicators from 2010 to 2019 were recalculated and revised. Consequently, the composition of the employed population—particularly the self-employed—changed substantially. Specifically, while during 2010–2019 the share of self-employed individuals was, on average, twice that of wage employees, post-recalculation the trend reversed: the share of self-employed persons is now significantly lower than that of hired employees, ranging from 30.3% to 39.1% of total employment (Tsartsidze M., 2022).

Furthermore, the employment structure by ownership form has also undergone notable changes in recent years (see Table 2). In 2024, a total of 1,402.5 thousand individuals were employed in Georgia's economy, of whom 322.8 thousand—or 23.0%—were employed in the public sector. This represents a 2.9 percentage point decline in the share of public sector employment compared to 2010. As evident from the data, the majority of the employed population (77.0%) work in the private sector, which has exhibited a clear upward

trend. Over the past 15 years, the number of individuals employed in this sector has increased by 24.8%, reaching 1,079.7 thousand in 2024.

Table 2

Distribution of the employed by the form of ownership in Georgia in 2010-2024 (thousand people)

Name	2010	2015	2020	2021	2022	2023	2024
Total	**1167.6**	**1308.5**	**1241.8**	**1217.4**	**1283.7**	**1334.6**	**1402.5**
Governmental	302.4	286.6	294.7	301.5	308.0	320.5	322.8
Non-governmental	865.2	1021.9	947.1	916.0	975.7	1014.1	1079.7

Source: *The table was compiled by the author based on data from the National Statistical Service of Georgia. http://www.geostat.ge/;*

An analysis of structural employment dynamics by ownership form suggests that the private sector plays a significant role in driving overall employment growth. This growing contribution can be attributed to several favorable developments, including an increase in foreign direct investment and the expansion of entrepreneurial activity in key economic sectors. For instance, over the past three years, employment levels have risen markedly in critical sectors such as industry and construction. However, an examination of employment levels and distribution by economic activity reveals a considerable imbalance in how the working-age population is spread across sectors. The highest shares of employment are concentrated in wholesale and retail trade (16.09%), agriculture, forestry, and fishing (16.05%), industry (12.86%), and education (11.75%) (see Table 3).

Table 3

Distribution of employees by type of economic activity in Georgia in 2020-2024 (thousand people)

Name	**2020**		**2024**	
	N	**%**	**N**	**%**
Total	**1241.8**	**100%**	**1402.5**	**100%**
Agriculture, forestry and fisheries	246.3	19.8%	225.0	16.05%
Industry	141.3	11.4%	180.3	12.86%
Construction	85.2	6.9%	124.3	8.86%
Wholesale and retail trade; repair of motor vehicles and motorcycles	188.0	15.1%	225.6	16.09%
Transport and storage	79.1	6.4%	85.4	6.09%
Accommodation and food service activities	36.0	2.9%	61.5	4.39%
Information and communication	19.7	1.6%	15.9	1.13%
Financial and insurance activities	29.9	2.4%	35.8	2.55%
Real estate related activities	3.2	0.3%	3.8	0.27%
Professional, scientific and technical activities	19.2	1.5%	26.8	1.91%
Administrative and support service activities	19.6	1.6%	24.6	1.75%
State administration and defense; compulsory social security	94.5	7.6%	87.4	6.23%

Education	145.8	11.7%	164.8	11.75%
Health and social service activities	62.0	5.0%	60.6	4.32%
Art, entertainment and recreation	30.0	2.4%	32.4	2.31%
Other types of services	25.0	2.0%	28.6	2.04%
Activities of households as employers; production of undifferentiated goods and services by households for own consumption	15.0	1.2%	17.7	1.26%
Activities of extraterritorial organizations and bodies	2.0	0.2%	1.9	0.14%

Source: *Compiled by the author, based on data from the National Statistical Service of Georgia. http://www.geostat.ge*

An analysis of the distribution of employees by occupational category—based on the International Standard Classification of Occupations (ISCO-08)—reveals that certain professional groups represent a significant share of total employment. In particular, service and sales workers account for 17.6% (247.3 thousand individuals), while professionals make up 17.0% (238.2 thousand individuals) of the employed population.

Despite overall positive trends in employment growth across the country, improvements in the qualitative aspects and efficiency of employment remain limited. As a result, labor productivity in several sectors continues to be notably low. This issue is especially pronounced in the agricultural sector, which remains one of the least productive segments of the Georgian economy. For instance, in 1990, agriculture employed approximately 695,000 people—representing 25.2% of total employment—and generated 29.8% of the country's GDP, amounting to 4,454.0 million rubles (Tsartsidze M. , 2016), (Tsartsidze M. , 2018) By 2024, although the total number of employed persons had increased to 1,402.5 thousand, the number of those employed in agriculture had declined to 224.4 thousand (16.0%), while the sector's contribution to GDP dropped sharply to just 6.0%. Thus, while the share of agricultural employment declined by 6.3 percentage points (from 25.2% to 18.9%) between 1990 and 2024, the sector's share in GDP contracted by a much larger margin—23.8 percentage points (from 29.8% to 6.0%) (see Table 4).

Table 4

Employment of the population in agriculture and share of gross domestic product (GDP) in Georgia in 1990-2024 (percentage)

Year	***Share of the population employed in agriculture in relation to the total number of employed people***	***Agricultural production and its share in relation to the gross domestic product (GDP)***
1990	25.2%	29.8%
2000	52.1%	20.1%
2005	53.9%	16.2%
2010	62.1%	8.4%
2017	22.5%	7.2%
2018	19.6%	7.8%
2019	19.1%	7.4%
2020	19.8%	8.0%
2021	18.9%	7.0%
2022	17.9%	6.4%

2023	16.5%	6.2%
2024	16.0%	6.0%

Source: *Table was compiled by the author based on various scientific sources and data from the National Statistical Service of Georgia. http://www.geos-tat.ge/;*

This disproportionate decline clearly illustrates the persistent inefficiency and low productivity in the agricultural sector, underscoring the urgent need for structural reforms and modernization. The primary driver of employment growth in the Georgian labor market is the business sector. For this reason, "the creation of new jobs and the expansion of employment through the business sector remains one of the most critical challenges and, consequently, a top priority of the country's economic policy" (Ministry of Economy and Sustainable Development of Georgia., 2024). As of 2024, the number of individuals employed in this sector reached 823.6 thousand—representing a 5.7% increase compared to the same period in the previous year. This upward trend has been consistently observed since 2009, with the sole exception occurring during the COVID-19 pandemic in 2020.

It is also noteworthy that the growth in employment has been accompanied by a steady rise in the average nominal monthly wage. Over the past 25 years, the average wage has increased substantially—from 72.3 GEL in 2000 to 1,943.4 GEL in 2024 (see Table 5).

Table - 5

Average monthly nominal wage of the employed in Georgia in 2000-2024 (GEL)

Indicators	**2000**	**2010**	**2015**	**2020**	**2023**	**2024**
Total	**72.3**	**597.6**	**900.4**	**1191.0**	**1766.8**	**1943.4**
Woman	52.1	426.6	692.5	952.2	1425.4	1540.0
Man	95.9	742.8	1074.3	1407.7	2099.8	2343.2
Form of ownership						
Governmental	66.6	539.1	825.6	1024.4	1487.5	1571.9
Non-governmental	94.8	661.1	945.1	1284.9	1907.9	2145.9

Source: *Table was compiled by the author based on data from the National Statistical Service of Georgia. www.geostat.ge.*

However, wage disparities persist. Recent data indicate that the average salary for men is 52.2% higher than that for women. Additionally, employees in the private sector earn, on average, 36.5% more than their counterparts in the public sector.

In the context of the digital transformation of the economy—marked by increasing intellectualization, humanization, unification, and universalization of labor—the structure and nature of employment are undergoing fundamental shifts. New sectors are emerging, along with entirely new professions, as digital technologies reshape the world of work. This evolution is both inevitable and necessary, serving as a key mechanism for enabling novel forms of employment and expanding economic opportunities. These changes have a profound impact not only on how work is organized but also on the system of relationships between labor market actors. The transition from an industrial to a digital economy alters not just the quantitative parameters of employment but also its qualitative characteristics. To examine these trends in Georgia, we are conducting a multi-phase study (2021–2024) titled "Survey of the Economically Active Population Regarding the Problems of Participation and Motivation in Non-Standard Forms of Social and Labor Relations in Georgia and the Tbilisi Region." The objective of this research is to identify new, non-standard forms of employment; assess their prevalence; analyze the underlying factors and structural characteristics;

and explore public attitudes toward these emerging work arrangements. At the current stage, data have been collected from 1,268 respondents. Among them, 533 individuals (42.0%) reported being employed in a standard employment model, while the remaining respondents indicated that they are engaged in various forms of flexible, non-standard employment. Notably, 145 individuals (11.4%) reported working remotely (see Table 6).

Table - 6

Distribution of the surveyed personnel by employment form and type in Georgia in 2021-2024

Employment form, type	**2021 Year**	**Total in 2024**	
		1268	100%
7.1. Standard	48.6%	533	42.0%
7.2. Self-employed	5.8%	100	7.9%
7.3. Incomplete (shorted day or week)	4.1%	60	4.7%
7.4. Overtime (working more than 8 hours a day)	5.2%	96	7.6%
7.5. Temporary (for a limited time)	6.7%	101	8.0%
7.6. A specific job until it is completed	3.5%	48	3.8%
7.7. Permanent and seasonal	17.5%	170	19.4%
7.8. Remote employment – telework	7.3%	145	11.4%
7.9. Other form	1.3%	15	1.2%

Source: *Table is compiled based on the results of a special study conducted by the author. Survey of the economically active population regarding problems of participation and motivation in non-standard forms of social and labor relations in the Tbilisi region - Google Forms.*

As the data indicate, remote employment (telework) has increased significantly over the past three years—from 7.3% to 11.4%—reflecting a 4.1 percentage point growth. Similarly, other forms of non-standard employment also exhibit upward trends, with the share of self-employed individuals rising to 2.1% and those working under fixed-term or short-term contracts reaching 1.6%. A majority of individuals engaged in these employment forms actively utilize modern digital technologies and applications, which enables them to perform their tasks efficiently and independently of traditional workplace settings. It is also important to consider that, as noted by Begadze, "technological advancement and the widespread use of the Internet have contributed to the expansion of the informal economic sector, particularly business activity conducted via digital platforms—commonly referred to as the gig economy" (Begadze M., 2021).

Table-7

Share of informally employed people in non-agricultural employment in Georgia in 2017-2024

Name	**Informal employment (in percent)**							
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Woman	29.2%	29.8%	29.2%	26.2%	22.5%	22.5%	21.7%	23.3%
Man	37.9%	41.5%	39.3%	36.4%	34.2%	33.4%	32.6%	34.2%
City	33.2%	34.6%	33.8%	30.2%	26.8%	27.0%	25.4%	26.8%

Village	35.8%	40.0%	36.8%	35.6%	33.7%	31.6%	32.7%	34.4%
Total	**33.9%**	**36.2%**	**34.7%**	**31.7%**	**28.8%**	**28.4%**	**27.6%**	**29.1%**

Source: *The table were compiled by the author based on data from the National Statistical Service of Georgia. www.geostat.ge*

In light of this observation, and considering the significant scale of the informal sector in Georgia (see Table 7), it becomes evident that a growing segment of the population is becoming increasingly integrated into the global digital economy. These individuals actively employ contemporary information and communication technologies (ICTs) in their economic activities, demonstrating a marked shift toward more flexible, tech-enabled work models.

As shown in the table, official data indicate that 29.1% of all individuals employed in Georgia's non-agricultural sector work within the informal economy. This figure highlights the substantial role informality continues to play in the country's labor market. It can be confidently stated that the diffusion of large-scale global innovations—particularly the rise of digital labor platforms—has created unprecedented opportunities for workers, businesses, and society at large to enhance the efficiency and flexibility of economic activities. In Georgia, this emerging business model encompasses a wide range of service sectors facilitated through digital platforms. These include internationally recognized applications such as Glovo, Uber, and Wolt, as well as locally developed platforms offering services related to cleaning, caregiving, transportation, courier delivery, and more. Workers engaged in these forms of employment—such as drivers, couriers, and gig service providers—represent a growing segment of the informal yet digitally integrated workforce.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the research and analysis presented in the paper, it is clear that overcoming chronic unemployment and ensuring decent, effective employment in the country still remains the most important task. Despite the significant reforms that have been implemented, the existence of these problems is due to many different reasons, among which the following should be highlighted:

1. Due to the insufficient pace of economic growth, labor demand remains stagnant, resulting in limited employment opportunities and prospects. Consequently, large-scale investments aimed at job creation are lacking (Papava, V., & Bedianashvili G., 2024).
2. Despite implemented reforms, the vocational education system remains underdeveloped in both scope and quality. The training of higher education specialists is often uncoordinated and insufficiently aligned with the current demands of the labor market. Furthermore, there is no effective system for the ongoing training and retraining of competitive personnel. As a result, workforce professional mobility remains low (Bedianashvili, G., Tsartsidze, M., Mikeladze, N., & Gabroshvili, Z., 2024).
3. The employment rate among women is comparatively low, while youth unemployment remains high. Significant challenges persist in the professional orientation and career guidance available to these groups.
4. Employment is unevenly distributed across regions, with the capital city accounting for the majority (62.0%) of employed individuals. Additionally, employment is divided among enterprise sizes, with 40.0% in small enterprises, 40.0% in large enterprises, and 20.0% in medium-sized enterprises.
5. The scale and level of labor emigration from the country remain high, contributing to workforce challenges (Shelia M. Tukhashvili M. , September 2024.).

6. At this stage of labor market development, principles of social justice—including equal employment opportunities for job seekers and equitable realization of labor rights—are inadequately ensured (Tsartsidze, M., 2019).
7. Access to various labor market services and activities among the population is limited (Tkemaladze, I. , 2023).
8. There is no established mechanism for social protection or unemployment insurance, nor are there targeted state programs dedicated to the retraining of unemployed individuals (Tsartsidze, M., Gabadadze I., & Gabadadze Sh. , 2024).
9. The system of social partnership in social and labor relations is insufficiently developed.
10. The overall level and culture of labor organization in enterprises and organizations remain low. The systems of labor remuneration and incentives do not meet modern standards, and contemporary wage structures and practices have yet to be effectively introduced.
11. Basic functions and principles of labor remuneration are not fully realized, with noticeable issues related to wage differentiation and fairness.

Based on the research and analysis presented in this paper, addressing the persistent challenge of chronic unemployment and establishing an optimal, effective, and rational employment structure—ultimately ensuring decent and productive employment—requires focused action within the framework of an active labor market and employment policy. The following key tasks are recommended:

1. Refine and strengthen the legislative framework governing labor and employment, ensuring full compliance with the fundamental principles and proper implementation of the conventions ratified by the Government of Georgia (Conventions No. 88, 122, and 181).
2. Adopt a fundamentally new mechanism of social partnership, emphasizing civilized cooperation among labor market entities and promoting collective-contractual regulation practices.
3. Guarantee the realization of all labor rights defined by legislation, including labor safety, working conditions, and workers' rights. Additionally, develop effective mechanisms to stimulate labor motivation within enterprises and foster a modern, innovative organizational culture.
4. Prioritize the development of human capital as a critical pathway to overcoming poverty and securing decent, productive employment. This will require investing in the country's unified education system—particularly vocational education—aligning it with contemporary labor market demands and standards. Key among these initiatives is the expansion of work-based learning models, which facilitate the training of highly qualified and competitive personnel.
5. Encourage the growth of non-standard forms of employment that promote flexible working hours and enhance labor productivity, quality, and efficiency in accordance with employers' needs. This calls for the corresponding adjustment and regulation of the legislative framework.
6. Develop labor market infrastructure and establish a unified, comprehensive information system to address existing barriers, particularly those hindering employers from timely hiring workers with the necessary qualifications and skills.
7. Ensure adequate rates of sustainable economic growth and development. The current insufficient pace of economic expansion in Georgia limits labor demand, restricting employment opportunities, prospects, and the overall reduction of poverty.
8. Support the development of the business sector as a key driver of effective employment. This will improve both the scale and structure of employment and contribute to reducing labor emigration. In the context of digital transformation and European integration, the business sector should serve as the primary source of job creation.

9. Implement a robust system for monitoring active employment policy programs to ensure rigorous oversight of their execution and impact.
10. Adopt a scientifically grounded, comprehensive approach to employment challenges. Decent and effective employment should not be understood merely as a quantitative increase in jobs but must also reflect the social motives and content of work. It must guarantee the right to work, ensure a high standard of living and decent working conditions, incentivize high productivity through fair remuneration, and foster professional growth and personal development. Such meaningful employment will serve as a vital lever for active labor market policies and a central factor in poverty reduction, economic growth, and sustainable development.

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FRAGILITY OF MENTAL HEALTH IN THE WORKPLACE: PREVALENCE OF PSYCHIATRIC DISORDERS AND THEIR RELATION TO ORGANIZATIONAL CULTURE

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Abstract

Fragility of Mental Health in the Workplace: Prevalence of Psychiatric Disorders and Their Relation to Organizational Culture.

Aim of the study: *To explore the prevalence of mental health disorders among employees in organizations, to examine statistical trends in the development of these disorders in Latvia, Europe, and worldwide, and to analyze the potential relationship between organizational culture management and employees' mental health.*

The modern workplace increasingly exposes employees to high psychological pressure, which may foster the development of mental health disorders. This study analyzes the prevalence of psychiatric disorders among employees, as well as evaluates their developmental trends in Latvia, Europe, and globally. Particular emphasis is placed on the connection between organizational cultural characteristics—values, communication style, leadership approach, and work organization—and employees' mental health.

The results of the study confirm that insufficient psychosocial support systems, toxic work environments, and a lack of leadership empathy may significantly contribute to the development of psychiatric disorders. Conversely, organizations with supportive cultures, open communication, and a clear system of values are able to reduce the prevalence of psychiatric disorders and promote employees' mental health.

Keywords: mental health, workplace, organizational culture, burnout, psychiatric disorders.

INTRODUCTION

Mental health in high-pressure work environments is becoming an increasingly critical issue, as demands and expectations placed on employees continue to rise. High-pressure workplaces are characterized by intense workloads, tight deadlines, and high levels of responsibility, all of which pose significant challenges to psychological well-being. Such environments may exacerbate mental health disorders, resulting in negative consequences for both individuals and organizations. Understanding and addressing mental health issues in these circumstances is essential for fostering a supportive organizational culture and improving overall productivity and well-being.

One of the most frequently discussed conditions related to mental health among working-age individuals is burnout, which the World Health Organization classifies as an occupational phenomenon resulting from chronic workplace stress. Burnout is characterized by emotional exhaustion, detachment from work, and reduced professional effectiveness (Maslach & Leiter, 2021; World Health Organization, 2019).

Although burnout is not formally included in the list of psychiatric diagnoses, it is considered a significant risk factor leading to the development of psychiatric disorders.

The pressure to achieve high results, unpredictable deadlines, or unstable work environments contributes to the onset of psychiatric disorders among employees. In such cases, individuals may experience persistent anxiety, panic attacks, somatic symptoms, or avoidance of work tasks that can be classified as psychiatric disorders (Kinman & McDowall, 2019). Similar conditions may result in work-induced depression, characterized by emotional detachment, loss of interest, fatigue, and difficulty concentrating.

Anxiety is classified as a mild to moderate psychiatric disorder, defined by persistent feelings of unease, fear, or tension that exceed what is appropriate to the situation. These disorders encompass several clinical forms, including generalized anxiety disorder, panic attacks, specific phobias, and post-traumatic stress disorder, all of which can significantly affect an individual's ability to function in professional and social settings (American Psychiatric Association, 2013).

In the workplace, such disorders may manifest as reduced concentration, avoidance of tasks, frequent absenteeism, emotional instability, and difficulty in decision-making. These symptoms not only endanger individual mental health but may also negatively impact team dynamics, work productivity, and overall organizational performance. In organizations where psychosocial support is insufficient and where high stress or rigid leadership styles dominate, the prevalence of anxiety disorders may increase, leading to employee burnout, high turnover, and declining work quality.

Prolonged work-related stress may also manifest in physical symptoms—such as headaches, digestive problems, or fluctuations in blood pressure—that are classified as psychosomatic disorders.

In addition, sleep disorders are increasingly prevalent, linked to employees' inability to disconnect from work-related thoughts, overwork, irregular schedules, or shift work. These conditions can contribute to emotional exhaustion and reduced work capacity. Other specific disorders include work addiction, where individuals feel a constant need to work at the expense of personal needs, as well as the consequences of workplace bullying (mobbing), which may manifest as depression, low self-esteem, and social isolation (World Health Organization, 2022).

In summary, work-related mental health problems are diverse, and their timely recognition, prevention, and psychosocial support are essential not only for safeguarding employee well-being but also for ensuring the sustainable development of organizations.

1. CONCEPTUAL APPROACHES TO MENTAL HEALTH AND PSYCHIATRIC DISORDERS

In recent years, issues of mental and psychiatric health have become one of the most significant public health challenges both in Latvia and globally. The World Health Organization notes that one in four people will experience a mental health disorder at some point in their lifetime (World Health Organization, 2022).

The increase in such conditions is closely linked to the characteristics of modern lifestyles—work intensity, rising professional and social demands, lack of time, and insufficient emotional support. Working-age individuals are particularly at risk, as their mental health is substantially influenced by the work environment. In organizations characterized by opaque or toxic cultures and insufficient psychosocial support systems, these risks grow considerably, contributing to the deterioration of mental well-being and the development of clinically diagnosable psychiatric disorders.

Under such circumstances, it becomes especially important to clearly distinguish between the concept of mental health and psychiatric health, in order to more precisely identify opportunities for prevention and to tailor support measures to the needs of the population.

In contemporary society, the significance of mental health is increasingly emphasized; however, terminology still reveals confusion between "mental health" and "psychiatric health." Although these concepts are interrelated, they are not synonymous, and they carry distinct meanings in both theoretical and practical usage (World Health Organization, 2022; Mind, 2021).

Mental health is a broad concept encompassing an individual's emotional, psychological, and social well-being. It determines the ability to cope with everyday stress, form relationships, make decisions, and function effectively in various life domains (American Psychiatric Association, 2013; World Health Organization, 2022). Mental health difficulties may manifest as stress, anxiety, burnout, or emotional exhaustion, yet they do not always qualify as clinically diagnosable disorders (Huppert, 2009). Often, mental health problems are temporary and can be resolved with psychoeducation, support, or counseling (World Health Organization, 2022; Mind, 2021).

In contrast, psychiatric health is a narrower, medically defined concept referring to disorders of the psyche diagnosed in accordance with international classifications such as DSM-5 or ICD-11 (American Psychiatric Association, 2013; WHO, 2019). In such cases, professional involvement of a psychiatrist or clinical psychologist is required, and treatment often includes psychopharmacology, psychotherapy, or integrated approaches (National Institute of Mental Health, 2021). Psychiatric disorders include, for example, depression, bipolar affective disorders, schizophrenia, and obsessive-compulsive disorder, all of which significantly impair an individual's functioning (APA, 2013; World Health Organization, 2019).

Globally, mental health disorders are much more common than severe psychiatric diagnoses. For example, approximately 970 million people worldwide—or nearly one in eight—live with a mental health disorder (World Health Organization, 2022). The most prevalent are anxiety disorders (301 million) and depression (280 million).

Meanwhile, severe psychiatric conditions such as schizophrenia affect a comparatively smaller proportion of the population; for instance, the global prevalence of schizophrenia is estimated at around 0.32% (Global Burden of Disease Study, 2019).

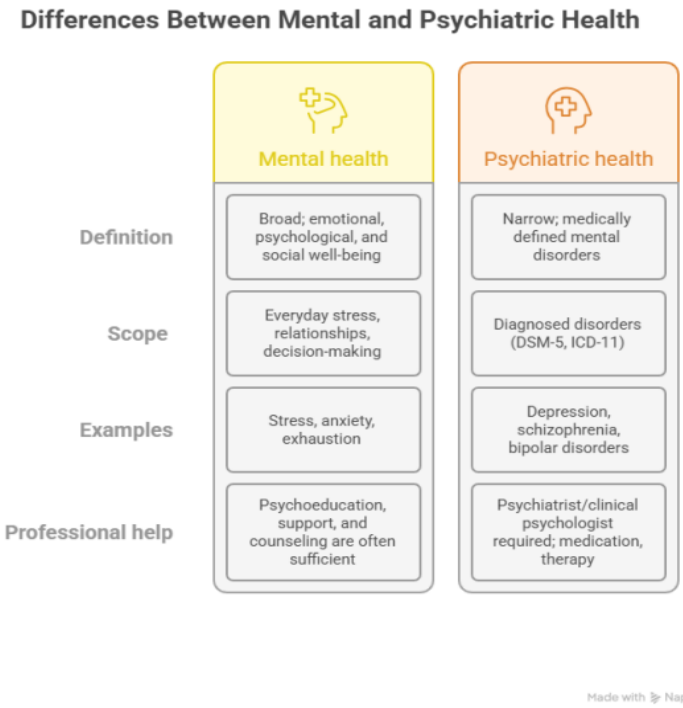
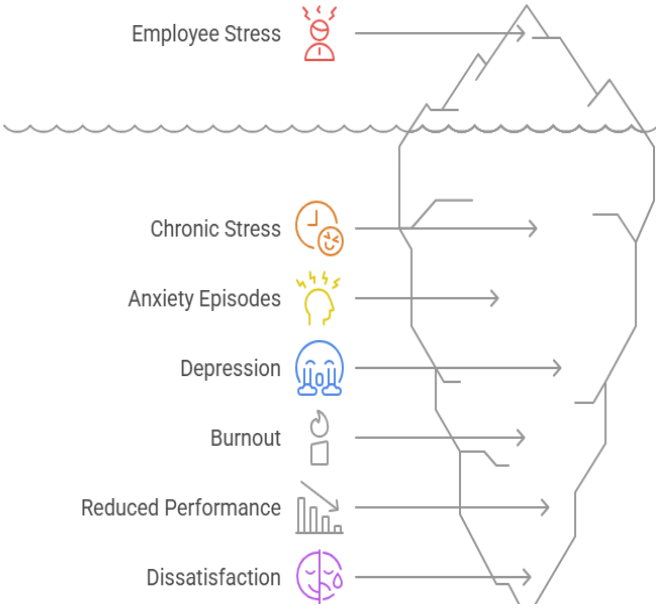


Fig. 1.1. Differences between mental and psychiatric health (created by the author, based on American Psychiatric Association, 2013; World Health Organization, 2022).

This distinction highlights the need to differentiate preventive, social, and therapeutic solutions depending on the severity of the disorder. At the societal level, this means that mental health promotion, improvement of workplace environments, and early intervention can reduce the progression to chronic psychiatric illnesses.

2. THE STATE OF MENTAL AND PSYCHIATRIC HEALTH IN LATVIA AND EUROPE

The modern work environment increasingly exposes employees to high psychological demands, fostering the development of various mental health disorders. The most common work-related mental health conditions include acute stress, anxiety, burnout, depression, and post-traumatic stress disorder (PTSD). Meta-analysis data indicate that among employees, the most frequently observed conditions are acute stress (~40%), anxiety (~30%), burnout (~28%), and depression (~24%) (Saravanan et al., 2025; RSU, 2023).



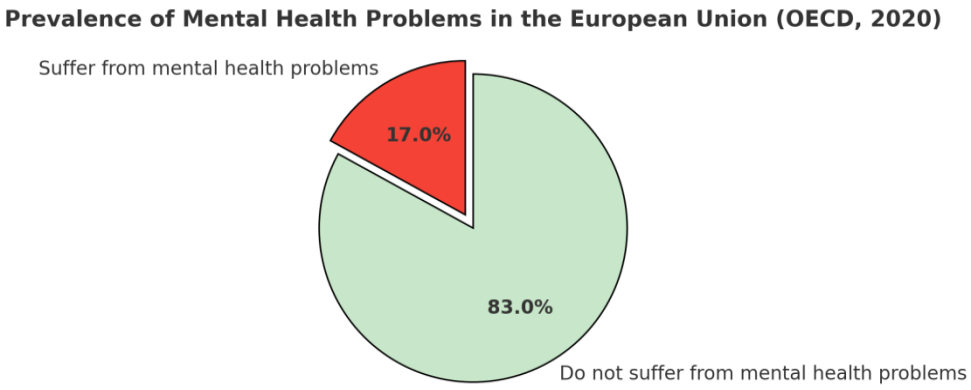
2.1. Fig. Consequences of Mental Health Deterioration (author's creation, based on Saravanan et al., 2025)

Organizations that ignore mental health issues face increased personnel costs, employee turnover, and reduced productivity. In contrast, companies that actively prioritize employee well-being, implement flexible working conditions, and promote open communication are more likely to ensure higher employee retention and engagement (Saravanan et al., 2025; World Health Organization, 2022).

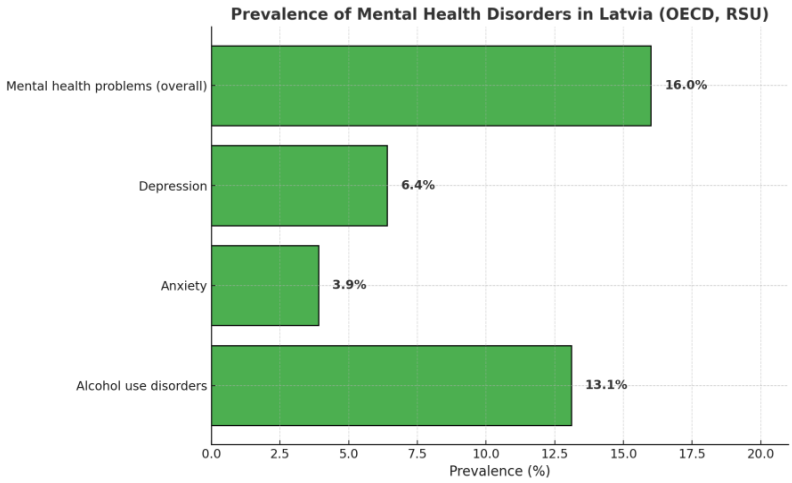
In recent years, mental and psychiatric health has become one of the most significant public health challenges both in Latvia and worldwide. The World Health Organization reports that one in four people will experience a mental health disorder during their lifetime (World Health Organization, 2022).

Under these circumstances, it is particularly important to clearly distinguish between the concept of mental health and psychiatric health in order to more accurately identify opportunities for prevention and to target support measures according to population needs.

In Latvia, the situation regarding mental health disorders is similar to the European Union average. In 2019, approximately 16% of the Latvian population experienced some form of mental health problem, compared to 17% on average in the European Union (OECD, 2020). Research conducted by Riga Stradiņš University indicates that 6.4% of Latvia's population suffer from clinically significant depression, 3.9% from anxiety, and 13.1% from alcohol use disorders (OECD, 2020). Healthcare workers are particularly at risk—within this sector, the prevalence of depression is around 34%, while the prevalence of anxiety is approximately 38% (RSU, 2023).

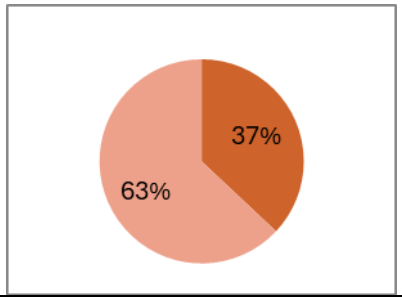


2.2. Fig. Prevalence of Mental Health Problems in the European Union (author's creation, based on OECD, 2020)



2.3. Fig. Mental Health Disorders in Latvia (author's creation, based on RSU, 2023, OECD, 2020)

In a large-scale study conducted within the Latvian primary care population, it was found that 37.2% of patients suffer from some form of mental health disorder. Among these, 18.4% were identified with mood disorders (such as depression), 15.8% with anxiety disorders, and 18.6% reported suicidal ideation (Bunevicius et al., 2020). These data highlight the need for more active screening and preventive approaches in primary care.

The total number of mental health disorders in Latvia in 2020 	37%	Mood disorders (e.g. depresion)	18.4%
		Anxietiy disorders	15,8%
		Reported suicidal thougts	18,6%

2.4. Fig. Data on Mental Health Disorders in Latvia in 2020 (author's creation, based on Bunevičius et al., 2020)

In the study *"Point Prevalence of Depression and Gender-Related Factors among the Adult Population of Latvia"*, conducted in the Latvian adult population using the validated PHQ-9 depression screening tool, the point prevalence of depression was found to be 6.4%, with higher prevalence among women and socioeconomically disadvantaged groups (Vrubļevska et al., 2023).

Health care statistics further indicate an increase in the number of patients registered with psychiatric and behavioral disorder diagnoses. In 2011, 3,753 patients per 100,000 inhabitants were registered in Latvia, whereas by 2017 this figure had risen to 4,635 per 100,000 (EuroHealth Observatory, 2019). These data suggest that at least 4.5% of Latvia's population is registered as patients with mental disorders (CDPC, 2018).

Media and public research data indicate that depression or depressive symptoms may affect more than 100,000 Latvian inhabitants, although a significant proportion of cases remain undiagnosed or untreated in a timely manner (Vinogradova et al., 2023).

These findings demonstrate the wide prevalence of mental health disorders in Latvia and underscore the need for a coordinated national policy aimed at early diagnosis, accessible psychological support, and preventive improvements in the work environment. The results further highlight the necessity not only to strengthen mental health care but also to analyze its relationship with the workplace and organizational culture.

3. Trends in Mental Health Disorders among the Working-Age Population in European Countries, 2020–2025

Over the past five years, European countries have experienced a consistent deterioration in mental health, particularly among the working-age population. The COVID-19 pandemic, the consequences of

social isolation, increasing workloads, and digital overload have created significant emotional strain. As a result, mental health disorder rates have risen in nearly all of the countries included in the study (OECD, 2023).

In the United Kingdom, the prevalence of mental health disorders in the working-age group has increased sharply over the past five years. While in 2016 the prevalence of common mental disorders was 17.5%, by 2023 this figure had exceeded 20%, particularly among young people and women (NHS Digital, 2016; ONS, 2023). Data show that more than one-third of young women (36.1%) report symptoms of depression and anxiety, compared to 26% in 2018 (The Guardian, 2025). Disability benefit claims due to mental health conditions have also doubled since 2019, indicating a worrying and growing trend that is likely to affect the future economy (Office for Budget Responsibility, 2025).

In Germany, the rates of depression and anxiety have remained consistently high—around 10–12% of adults report depressive symptoms. During the pandemic, the prevalence of depression rose to as high as 16%, and although it has slightly stabilized since 2022, it remains above pre-pandemic levels (Frontiers in Public Health, 2023; OECD, 2023).

In Sweden, the prevalence of depression and anxiety has nearly doubled over the past five years. In 2018, approximately 11% of adults reported depressive symptoms, compared to 24% in 2023 (OECD, 2023). The highest risk group includes individuals aged 25 to 49, who are in the most active stage of their careers, form the core of the workforce, and directly influence the economy and national development.

In France and Italy, the prevalence of mental health disorders is similar—around 10% of the population suffers from depression; however, in recent years, approximately 20–26% of the working-age population have reported regular emotional difficulties (OECD, 2023). During the COVID-19 pandemic, these figures reached record levels, with only a slight decline observed in 2023.

A similar situation can be seen in Spain—while in 2018 depressive symptoms were reported by about 9% of the population, by 2023 as many as 27% of working-age individuals reported emotional difficulties (OECD, 2023). These findings indicate that working conditions and economic instability continue to be key risk factors.

Country	Prevalence 2016–2018	Prevalence 2023	At-risk groups	Trends / comments
United Kingdom	17.5% (2016); 26% of young women (2018)	>20%; 36.1% of young women	Youth, women	Disability benefit claims doubled since 2019; rising trend continues
Germany	10–12%	~12–16% (during the pandemic)	Adults	High but stable level; slight post-pandemic stabilization
Sweden	11% (2018)	24%	Ages 25–49 (working age)	Nearly doubled in five years; affects the economically active population
France	~10%	20–26% emotional difficulties	Working-age population	Increase during the pandemic; slight downward trend in 2023

Country	Prevalence 2016–2018	Prevalence 2023	At-risk groups	Trends / comments
Italy	~10%	20–26% emotional difficulties	Working-age population	Persistent emotional difficulties; similar trend to France
Spain	9% (2018)	27%	Working-age population	Significant increase linked to working conditions and economic instability

3.1. Fig. Overview of Mental Health Trends in European Countries, 2020–2025 (author's creation)

4. DYNAMICS OF MENTAL HEALTH IN AN INTERNATIONAL CONTEXT

To fully understand the dynamics of mental health problems in the workplace, it is essential to examine the situation in an international context. Over the past five years (2020–2025), significant changes in mental health have been observed across different countries, influenced by global events as well as social and economic factors, including access to healthcare, digitalization, and labor market instability.

Globally, the World Health Organization (WHO) reports that approximately 15% of working-age individuals suffer from some form of mental health problem (WHO, 2022). Each year, these conditions result in the loss of an estimated 12 billion working days and generate global economic costs exceeding USD 1 trillion (Financial Times, 2024).

Meta-analytical studies compiling data on mental illness from various regions and professions indicate that the prevalence of depression averages 28%, anxiety 26.9%, stress manifestations 36.5%, while the overall prevalence of psychological disorders exceeds 50% (Neira-O'Sina et al., 2021). Furthermore, it is projected that at least half of the world's population will experience some form of mental disorder during their lifetime (Santomauro et al., 2021).

This chapter analyzes four countries—the United States, China, Japan, and Israel—as they represent distinct socioeconomic and cultural models that significantly influence mental health issues. The U.S. is characterized by a highly competitive, individualistic work culture; China by an intense, collectivist work regime; Japan by pronounced overwork and the "karoshi" phenomenon; while Israel is heavily influenced by security and military factors. Such a comparative perspective allows the identification of both global risks and specific national challenges, offering a broader understanding of mental health trends worldwide.

In the United States, the mental health situation has worsened considerably over the past five years. In 2022, approximately 23.1% of adults reported a mental disorder, falling under the "Any Mental Illness" category—around 59.3 million people, of whom 26.4% were women and 19.7% men (National Institute of Mental Health, 2023). Among young adults (aged 18–25), prevalence reached 36.2% (National Institute of Mental Health, 2023). Until 2020, roughly one in five adults experienced a "Serious Mental Illness" annually (National Institute of Mental Health, 2023). Financial insecurity has further fueled stress and anxiety, with

70% of adults reporting financial anxiety in 2025, and 40% having taken a day off for mental health reasons (Ipsos, 2025).

In China, although data for the COVID-19 and post-pandemic periods remain limited, the Global Burden of Disease (GBD) 2021 study shows that the annual prevalence of anxiety disorders among adults increased by about 8.1% between 2019 and 2021—from 505.7 to 546.5 cases per 100,000 population (Global Burden of Disease, 2021). Overall, approximately 130 million adults (9–10%) in China suffer from mental health disorders, yet due to shortages of specialists and resources, only a small proportion receive appropriate care (Global Burden of Disease, 2021).

In Japan, mental health has gradually deteriorated over the past five years, particularly among adolescents and young adults. Data from the Global Burden of Disease indicate that the prevalence of anxiety disorders in 2021 was 34.8% higher than in 2019 (from 396.8 to 535.0 cases per 100,000 population) (Global Burden of Disease, 2021). According to UNICEF's 2025 report, Japanese children rank 32nd out of 43 developed countries in terms of mental well-being (UNICEF, 2025). Although the long-term prevalence of depression has declined (-12.7%), a temporary increase was observed during the COVID-19 pandemic (Global Burden of Disease, 2021).

In Israel, Global Burden of Disease data indicate that the prevalence of depression in 2021 was 274.0 per 100,000 population, nearly identical to the 2017 level (274.4) (Global Burden of Disease, 2021). These figures suggest that depression rates remained relatively stable during the 2020–2025 period.

An analysis of mental health data from the United States, China, Japan, and Israel indicates that, over the past five years, all of these countries have shown a trend of worsening mental health, particularly among young people and the working-age population. The most pronounced increases are seen in anxiety and depression disorders—with rates in both the U.S. and Japan rising by more than 30%, and prevalence among U.S. youth reaching nearly 36%. In China, mental disorders are also on the rise, but diagnosis and treatment remain limited due to insufficient healthcare resources. Israel's situation appears relatively stable, although anxiety and depression continue to represent significant public health challenges. Given the current political situation, it is likely that these figures may continue to worsen.

These findings confirm that the deterioration of mental health is a global problem, requiring national-level policies, accessible care, and preventive measures across various domains, including the workplace.

4.1. Employment Sectors as a Risk Factor for the Development of Psychiatric Disorders

International studies confirm that employees in certain industries face a significantly higher risk of developing mental disorders compared to the general labor market. These differences remain even after adjusting for demographic factors such as age and gender, highlighting the crucial role of the work environment and organizational culture (Harris et al., 2020).

Construction and extractive industries are among the high-risk sectors, with markedly elevated suicide rates—65.6 per 100,000 men and 25.3 per 100,000 women in the United States in 2021 (Peterson et al., 2023). Similarly, in agriculture, fisheries, and forestry, the rate among men reaches 49.9 per 100,000 (Peterson et al., 2023).

Emergency services (police, firefighters, paramedics) face a heightened risk of post-traumatic stress disorder (PTSD). Approximately 14.3% of first responders meet the criteria for probable PTSD (Wild et al., 2020), while rates among paramedics have been reported in the range of 4–21.5% (Petrie et al., 2018).

Healthcare workers are exposed to high risks of burnout, anxiety, and depression. Systematic reviews indicate that during the COVID-19 pandemic, about one-third of medical staff experienced symptoms of depression or anxiety (Muller et al., 2020). The CDC (2022) emphasizes that this trend has persisted beyond the pandemic and is strongly correlated with workload, organizational support, and cultural factors.

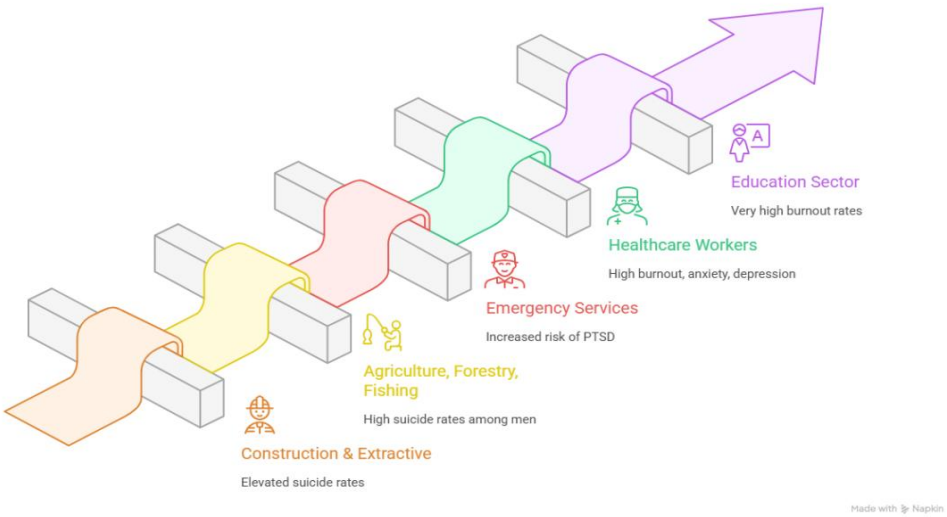
The education sector, particularly teachers, shows very high burnout rates—meta-analyses report figures ranging from 25% to 74% (Madigan & Kim, 2021). The UK *Teacher Wellbeing Index* (Education Support, 2024) highlights widespread stress and poor well-being, especially in the post-pandemic context.

In the social care and social services sector, high levels of emotional strain are observed. A European study reported that 45.1% of employees in this sector experienced mental health problems (Eurofound, 2021).

The tourism and hospitality sector is marked by a high prevalence of depression, anxiety, and burnout, driven by job insecurity, shift work, and intensive customer service demands (Jung & Yoon, 2021).

According to OECD (2021), mental health problems are one of the leading causes of work disability in Europe, accounting for 30–40% of long-term sick leave and significantly affecting economic productivity.

Overall, mental health risks are characteristic of sectors with high emotional demands, exposure to traumatic events, shift work, job insecurity, and insufficient organizational support. In these industries, targeted psychosocial support and the development of a healthy organizational culture can substantially reduce morbidity and improve employees' psychiatric well-being.



4.1.1. Fig. Sectors at Risk of Developing Psychiatric Disorders (author's creation, based on Harris et al., 2020; Peterson et al., 2023; Muller et al., 2020; Education Support, 2024; Eurofound, 2021; Jung & Yoon, 2021)

5. The Relationship Between Organizational Culture and Mental Disorders: An International Literature Review

Organizational culture is one of the most significant factors determining employees' mental and psychiatric health. International research shows that a healthy, supportive, and inclusive work environment can serve as a protective factor against the development of mental disorders, while a toxic or chaotic organizational culture may foster anxiety, depression, burnout, and other psychiatric diagnoses. With the increasing prevalence of mental health problems among working-age populations, growing attention has been directed toward workplace structures, leadership styles, and institutional mechanisms that influence employees' emotional balance (Sarmah, Rabha, & Kalita, 2024).

An authoritarian leadership style, low empathy, weak communication structures, and the inability to openly discuss emotional difficulties often foster a so-called "culture of silence." In such environments, employees do not feel safe to express concerns about anxiety, overload, or burnout (Monteiro & Joseph, 2023; Kowalski & Loretto, 2017).

Workload intensity and chronic stress are key risk factors. Excessive deadlines, high demands and responsibilities, and constant availability contribute to emotional and physical exhaustion. The issue is particularly pronounced in global careers and remote work settings, where the boundaries between professional and personal life are blurred (WHO, 2022; RSU, 2023; Harvard Business Review, 2021).

Bullying (mobbing) and bossing are directly linked to symptoms of depression, anxiety, and even PTSD. Employees who are systematically criticized, isolated, or humiliated are more likely to experience emotional breakdowns and work incapacity. Research indicates that such employees are 2–4 times more likely to develop clinical depression or anxiety disorders (Leymann, 1996; Samad et al., 2021; Samnani & Singh, 2016; Kowalski & Loretto, 2017).

Karasek and Theorell's (1990) model suggests that low job control and autonomy increase stress and dissatisfaction, directly affecting employees' mental health. In organizations with high psychosocial safety, stress and mental disorder prevalence are lower. Conversely, low PSC is associated with risks of burnout, depression, and disengagement (Dollard & Bakker, 2010).

Continuous digital availability, FOMO, and technology-driven engagement encourage compulsive digital involvement, disrupt work-life balance, and foster stress and burnout (Saravanan et al., 2025).

Across industries, certain regularities emerge: in healthcare, burnout is a structural problem exacerbated by patient contact, work overload, and insufficient organizational support (Maslach & Leiter, 2021; WHO, 2022). In the legal sector, lawyers, attorneys, and judges face heightened risks of depression, anxiety, and addiction due to the hierarchical and demanding culture (Krill, Johnson, & Albert, 2021). In ICT, blurred boundaries between work and personal life, rapidly changing environments, and high cognitive demands contribute to widespread mental health problems (Ralph & Sharpe, 2020). In the financial sector, high work pace, competition, and performance pressure similarly foster psychiatric disorders (Kinman & McDowall, 2019).

At the organizational level, best practices demonstrate the positive impact of targeted interventions. For instance, Google's psychological support system and the *Blue Dot* initiative have improved employee resilience and satisfaction, while BT Group in the UK has introduced a mental health ambassador network and 24/7 psychological support, reducing absenteeism and increasing job satisfaction (Harvard Business Review, 2021).

Grawitch et al. (2006) and Kinman & Teoh (2018) conclude that a healthy organizational environment, which balances job demands with resources, is one of the main protective factors against mental health disorders. Organizational interventions—such as improving communication, modifying leadership styles, and enhancing psychological safety—should be regarded not only as well-being initiatives but also as tools for ensuring sustainable performance. Recent studies emphasize that psychosocial climate quality and cultural structures significantly affect employee well-being, burnout risk, and labor market resilience (Monteiro & Joseph, 2023; Medina Garrido et al., 2023; Trinkenreich et al., 2023).

Organizational culture is thus a key determinant of employees' mental health and job satisfaction. Environments dominated by toxic relationships, emotional pressure, bullying, or a lack of empathetic leadership substantially increase risks of psychological distress, burnout, and anxiety disorders.

Consequently, organizations striving for sustainable development must treat mental health as a strategic priority, implementing structural cultural changes that promote open and respectful communication and a healthy balance of workload (Samad et al., 2021).

CONCLUSIONS

1. Mental health fragility in the workplace is one of the most significant challenges facing modern organizations, affecting not only individual well-being but also broader systemic structures—including productivity, employee retention, labor market sustainability, and healthcare burdens. Persistent psychological stress, emotional exhaustion, and burnout hinder professional effectiveness and contribute to workforce turnover, increasing organizational costs and reducing competitiveness. This challenge affects all sectors of the economy and is directly tied to overall societal mental health and work environment quality, making it a strategic priority for social policy and organizational governance.
2. Based on empirical data from diverse international studies—including Monteiro & Joseph (2023, Portugal), Saravanan et al. (2025, India), Krill et al. (2021, USA), Ralph & Sharpe (2020, UK), Medina Garrido et al. (2023, Spain)—as well as from the World Health Organization (WHO), OECD, UNICEF, the National Institute of Mental Health (USA), and the Global Burden of Disease reports, it can be concluded that workplace quality, leadership style, and institutional culture are strongly correlated with the prevalence and severity of mental health disorders. These studies consistently demonstrate that toxic or opaque organizational cultures, weak communication, and insufficient psychosocial support increase the risk of depression, anxiety, burnout, and even post-traumatic stress disorder.
3. Statistical data clearly show the wide prevalence of mental health disorders both in Latvia and internationally. In Latvia, approximately 37% of primary care patients suffer from mental health problems (Bunevicius et al., 2020), compared to an EU average of around 17% (OECD, 2020). In the United States, 23.1% of adults reported mental disorders in 2022, with prevalence among youth reaching as high as 36.2% (NIMH, 2023). In Sweden, depressive symptoms were reported by 24% of adults in 2023, while in Spain the figure reached 27% of the working-age population (OECD, 2023). These figures confirm that mental health problems are not only widespread but also increasing, thereby threatening future economic development and social stability.
4. Organizational culture significantly determines employees' psychological safety and capacity to cope with workplace challenges. A healthy culture—characterized by open communication, balanced demands, and supportive leadership—acts as a protective factor against mental disorders. In contrast, toxic cultures, authoritarian leadership, bullying, and tolerated emotional pressure contribute to burnout, depression, and anxiety (Kowalski & Loretto, 2017; Samad et al., 2021).

Research further demonstrates that organizations implementing preventive measures—such as strengthening psychological safety, mental health ambassador programs, and best practices (e.g., Google, BT Group)—achieve substantial improvements in employee satisfaction, resilience, and performance (Harvard Business Review, 2021; Monteiro & Joseph, 2023).

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A HOLISTIC UNDERSTANDING OF MANAGED SYSTEMS, OPERATING PRINCIPLES, DETERMINANTS AND CHANGE TRENDS AS A PREREQUISITE FOR THE DEVELOPMENT OF FLEXIBLE THINKING IN A MODERN LEADER

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Abstract

The article is devoted to the study of the meaning of the thinking paradigm and the nature of its variability in the course of the evolution of the world concept. It is emphasized that, as it evolves, the classical worldview is no longer able to take into account the challenges of the modern world, therefore, for successful development, new behavioral models and approaches are needed, filled with new conceptual content and meaning (Haddad 2017; Perekrestova 2021). An understanding arises that success is achieved not by those who recognize a new concept of the world, but by those who are able to change their vision and acquire new knowledge and competencies. The article emphasizes the fundamental knowledge of a modern leader, on which both conceptual and systems thinking are based, as well as the ability to flexibly respond to environmental challenges. Without this knowledge, neither meaningful structuring of ideas, nor analysis of systems and their understanding are possible (Jasim 2019; Rahman 2019). Fundamental knowledge and the ability to think systemically, combined with several approaches that promote flexible thinking (Turner et al. 2020), transform the leader's vision, change the way of thinking and reaction, promote proactive behavior and facilitate effective and environmentally appropriate management decision-making (Bell & Wechsler 2015). Such a leader is able to take a modern look at the processes taking place in the organization, emphasizing attention to all the elements and factors that make up them. Such a leader is able to understand the context, he becomes flexible and is able to use the most appropriate action alternatives. The aim of the article is to explore the importance of fundamental knowledge in shaping the leader's modern thinking, taking into account the context of environmental volatility and complexity.

Keywords: *changes, fundamental knowledge of the leader, holistic insight, systems thinking, flexible thinking.*

1. EVOLUTION OF THE WORLD CONCEPT

Recognition of the evolution of the world concept begins with the realization that the world is constantly changing, forcing various systems – both individuals and organizations – to adapt to new conditions or be destroyed. Technological development, globalization, social and ecological crises add complexity and uncertainty to the familiar world and radically change the perception of it. Moreover, over the past decade, change processes have begun to occur more and more frequently, comprehensively affecting the perception of the world. For example, if a few years ago the world seemed stable and understandable enough, now it is perceived as turbulent and fragile; if earlier it was believed that it was necessary to obtain as much information as possible to make a decision, today a large flow of information can interfere with its adoption; similarly, if previously long-term strategic planning was based on standardized processes, today they contribute to stagnation, hinder innovation and make the system vulnerable (Salun & Zaslavska 2024).

The constant variability of the world has created the conditions for the creation of the world concept and its evolution. Scientific literature offers an understanding of the transformation of world perception through various concepts – **SPOD, VUCA, BANI**, each of which reflects a certain stage of world development and the peculiarities of its perception. Until 1987, the world was characterized by the concept of **SPOD**, which

reflected Stability, Predictability, Ordinary, and Definition. It was a time of order. People saw a clear connection between their efforts and results, and life was built on the basis of stability. It was a world in which success was based on long-term planning, stable functioning of organizations, and expectations of linear development (Zakharov 2022). An example of a SPOD world is the post-war economic recovery: the industrial revolution, mass production, predictable career trajectories. Cities were built, transnational corporations were created, power grew steadily, and economic growth became the main indicators of the world (Zachosova et al. 2022). However, cracks began to appear in this order, and the world became more complex faster than it could adapt.

The rapid change in the environment caused by the digital and communication revolution (Kok & van den Heuvel 2019) has become the reason for the change in the world concept – the SPOD world transformed into the **VUCA** world, emphasizing its "superdiversity" and "supermobility" (Barentsen & Kok 2017). At the peak of globalization and the Cold War (1987) the US Army created the VUCA concept, emphasizing the Volatility, Uncertainty, Complexity, and Ambiguity of the environment (Horney et al. 2010). Volatility denoted the speed, extent and dynamics of change, while uncertainty described the unpredictability of problems and events. Complexity denoted the chaos that affects all organizations, while ambiguity described the "mixed meaning of real conditions" (Horney et al. 2010). The VUCA world is filled with events such as rapid technological growth: personal computers, mobile phones, the Internet began to spread widely. Organizations have begun to implement flexible leadership to adapt to the new reality. The success of organizations such as Amazon and Netflix has shown that victory in this world belongs not so much to the largest organizations, but to the fastest and most adaptable (Gumusten 2024).

Since 2019, under the influence of global changes, the familiar world began to change even more. Changes have accelerated in various areas: in the organization of work, the development of technologies, trade methods, and social habits. In addition, a suddenly flaring pandemic served as a catalyst for global transformations, forcing us to reassess the usual processes and look for new, more effective approaches to adapting to new conditions. This again forced society to reconsider the world concept and define its features. The VUCA concept began to lose its relevance, and new conditions have revealed new features of the world, which the American anthropologist and futurist J. Cascio called **BANI**. Brittleness, Anxiety, Nonlinearity, and Incomprehensibility have become the hallmarks of the era (Impact International 2024; Kruse 2025; Tshetshe 2025). It is noteworthy that the pandemic has revealed the fragility of global supply chains (Dreyfus, 2024). *Allianz* research data shows that 94% of companies surveyed in the US, UK, France, Germany and Italy have experienced supply chain disruptions caused by Covid-19, while one in five reported "serious disruptions" (Dib 2020). Non-linearity was manifested in how local events, such as an outbreak of the virus in one region, had colossal consequences for the entire world. In addition, incomprehensibility was created by the large flow of information, as well as disinformation, where the line between truth and lies became difficult to distinguish.

Summarizing the above, we can conclude that the evolution of the world concept reflects the increasing uncertainty and complexity of the world, and it is obvious that they will become even more acute, requiring new approaches to interpreting reality and adapting to change.

2. FUNDAMENTAL KNOWLEDGE AND SKILLS OF A LEADER AND REQUIREMENTS FOR THEM IN DIFFERENT PERIODS OF TIME

Following the research objective the importance of fundamental knowledge in the formation of a leader's modern thinking is investigated within the framework of the following research design (see Fig. 1). This research design provides a clear picture of how leaders' fundamental knowledge and skills, combined with systems thinking, becomes the basis for understanding managed systems and processes in the context of environmental volatility, and how they are important for the development of cognitive flexibility or flexible thinking. Thanks to modern approaches that promote flexible thinking, a leader can shape his thinking in such a way that the developed solutions maximally correspond to modern challenges and facilitate their implementation.

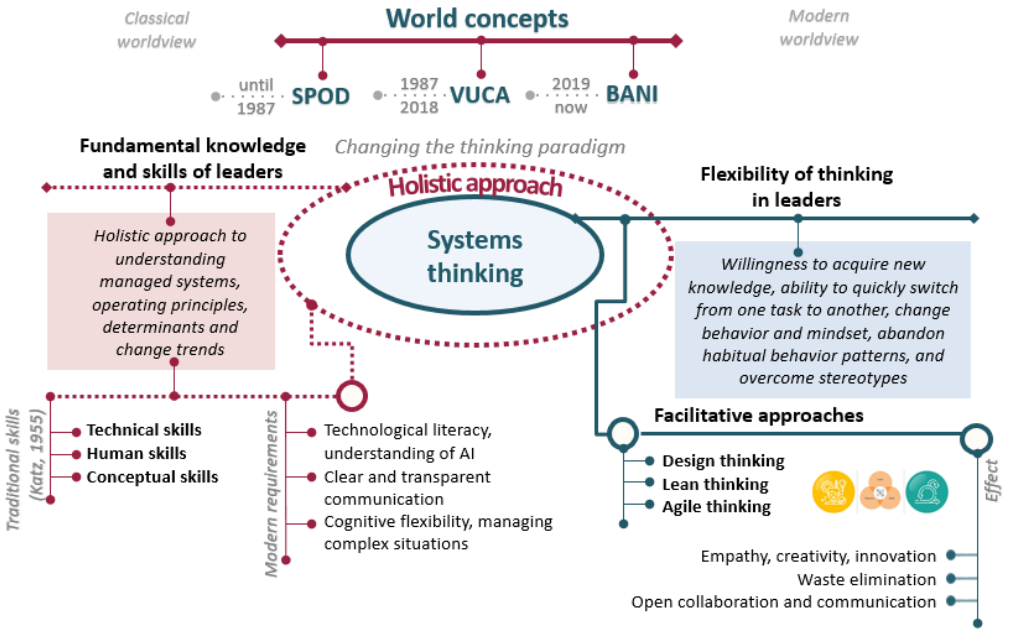

Figure 1. Research design (created by the authors)

The fundamental knowledge and skills of a leader, as well as the requirements for them, are constantly evolving along with changes in technology, the economy and society. These changes contribute to the transformation of management practices. For example, in the industrial era, the emphasis was placed on the organization of production and workforce management (Kohnová & Salajová 2019), while in the digital era, skills in strategic thinking, innovation management and digital technologies came to the fore (Sacavém et al. 2025). The rise of large manufacturing organizations has placed emphasis on efficiency, process standardization and technical control. In addition, organizational and technical knowledge gained special importance in solving certain problems (Okolie & Oyise 2021). Later, as the environment and work organization became more complex, the importance of communication, motivation and management skills increased. Effective management required an understanding of human behavior, the promotion of teamwork and the development of interpersonal competencies (Idogawa et al. 2023). Today, rapid technological change, globalization, and a turbulent environment require adaptive skills, emotional intelligence, and flexible leadership. Leaders must combine technical knowledge with the ability to communicate, inspire, and

adapt to new environmental challenges (Sott & Bender 2025). Despite the changing world, there are fundamental knowledge and skills that remain relevant: understanding business processes, people management (Sinnaiah et al. 2023), and strategic decision-making (Deep 2023).

To effectively lead a team to achieve organizational goals, any leader must deeply understand their role, be able to inspire and motivate employees, and make informed decisions in uncertain circumstances. In this regard, fundamental knowledge and skills are the foundation on which a leader's confidence, ability to take responsibility, and build trusting relationships with their team are based.

The author of the Three-Skill Approach to Leadership, Robert L. Katz (1955) emphasizes that every leader must possess three main basic skills: technical skills, human skills, and conceptual skills. He believed that the main leadership skills are not innate personality traits. These skills can and should be developed by leaders by providing them with the appropriate knowledge base and the means to acquire this knowledge. In order for leaders to effectively fulfill their duties, they need specific leadership knowledge. Technical skills are defined by Katz (1955) as the ability to perform specific activities that require specialized tools, methods, processes, procedures, techniques, or knowledge. Human skills are defined as the ability to cooperate with others, communicate effectively, resolve conflicts, and be a member of a team. Conceptual skills, on the other hand, are defined as the ability to see the organization as a whole, forming a systemic perspective (Katz 1955). It follows that while technical skills focus on things and human skills on people, conceptual skills focus on ideas and concepts.

Similarly, Katz (1955) points out that the set of all these skills is important at all levels of management (top, middle and bottom). Conceptual thinking skills are more important at the top level of management compared to human skills (middle management) and technical skills (bottom management). It is emphasized that today the requirements for effective leaders have increased, but all of them are mentioned within the framework of the classification, for example, digital skills (technical), emotional intelligence (human), flexibility and creativity (conceptual) (Pramila 2025; Sacavem et al. 2025). Some practical studies show that top management values traditional leadership skills (e.g., leadership experience, strategic thinking) more than flexibility, creativity, and even emotional intelligence (Half 2024). Modern leadership will continue to require in-depth and broad skills and experience in strategic thinking, effective communication, and problem solving (Half 2024). Speaking of today, in 2025, leaders must combine the use of technology with a people-centered approach, which means that human skills and emotional intelligence become a competitive advantage (Staut 2025).

Analyzing the knowledge and skills of a modern leader through the theory of Katz (1955), it should be noted that leaders must have: technological literacy and understanding of artificial intelligence and its capabilities (technical skills); the ability to create clear and transparent communication to promote team trust and cohesion and effectively manage change (human skills); the ability to analyze complex situations, anticipate changes, and think strategically (conceptual skills) (Staut 2025).

As the world changed and the concepts of it evolved, the requirements for the typology of fundamental knowledge and skills of leaders remained unchanged. However, different periods of time dictated their own rules and requirements for management. An analysis of the scientific literature provides an understanding of how the fundamental knowledge and skills of a leader change and which of them become the key to successful management in each time period (see Table 1).

Table 1

Evolution of fundamental knowledge and skills of a leader within different world concepts (Kok & van den Heuvel 2019; Hrynchak & Motuzka 2023; Schlegelmilch 2023; Schreiber 2023; Sinnaiah et al. 2023; Aref'ev et al. 2024; Botea-Muntean et al. 2024; Olkowicz et al. 2024; Dubey 2025; Robinson 2025)

Fundamental knowledge and skills of a leader	**World concepts**		
	SPOD **(Stable, Predictable, Ordinary, Definite)** **until 1987**	**VUCA** **(Volatile, Uncertain, Complex, Ambiguous)** **1987-2018**	**BANI** **(Brittle, Anxious, Nonlinear, Incomprehensible)** **2019-now**
Context	Industrial economy, mass production	Globalization, digital transformation, internet spread, big data	Artificial intelligence, data chaos, pandemic, geopolitical instability
Strategic thinking	Linear, long-term planning based on predictable trends; emphasis on stability and order	Flexible planning; rapid response to environmental volatility and uncertainty; managing complexity	Emphasis on resilience and adaptability to nonlinear, unexpected changes; continuous learning and exploration; overcoming chaos
Decision-making	Rational decisions based on data and clear causality	Fast, iterative decisions with short feedback loops; managing uncertainty and complexity; risk-taking	Adaptive, sometimes ambiguous decisions; emotional intelligence prioritized; managing fragile systems; taking responsibility
Leadership	Hierarchical, directive leadership; focus on control and efficiency	Participative leadership; fostering trust and openness; emphasis on communication and adaptability; coaching	Managing anxiety; psychological support; promoting collective intelligence; lifelong learning
Knowledge management	Focus on structured, standardized	Emphasis on dynamic knowledge sharing,	Focus on continuous trend sensing; managing

	knowledge bases and formal processes	rapid information flow, and flexibility; knowledge as a strategic asset requiring agility	fragmented, incomplete, and ambiguous knowledge; promoting innovation and collective intelligence
Technological competence	Use of stable technologies supporting efficiency and daily operations	Implementation of flexible digital tools; data-driven decision making; technology as a facilitator of agility and responsiveness	Deep digital literacy; resilience against technological disruptions; understanding emerging technologies (AI, big data); design thinking

In summary, the SPOD world characterized by stability and order, required from leaders stable and standardized knowledge; rational decisions with clear causal relationships, as well as linear and directive people management. In turn, the VUCA world emphasized flexible planning and quick decisions; participatory people management, as well as the need for flexibility and adaptability in knowledge management, technological competence and learning. In turn, BANI emphasizes resilience and adaptability to nonlinear changes; adaptive decisions; deep digital skills and the development of emotional intelligence. An analysis shows a clear transition from order and predictability (SPOD) through flexibility and adaptability (VUCA) to resilience, innovation and emotional intelligence (BANI) in the knowledge and skills of a leader.

3. A HOLISTIC APPROACH TO UNDERSTANDING MANAGED SYSTEMS

In today's increasingly interconnected world, understanding different processes is difficult and sometimes too complex. Problems are becoming multi-layered, isolated solutions are ineffective, globalization increases interdependence – all of which require a holistic perspective, a perception of a single system, and an understanding of the interconnectedness of processes. Unlike traditional approaches (e.g., reductionism, analysis), which break down complex problems into smaller, simpler parts (Minati 2024), holism offers a broader scope (Comstock 2024). Instead of analyzing individual elements in isolation, a holistic approach focuses on the whole system, how its elements interact, and how each part influences the behavior of the entire system.

Holism comes from the Greek word *holos*, which means "whole". Holism is a philosophical belief that the parts of a system cannot be understood separately, but only in relation to the system as a whole (Sheposh 2023). It is one of the main, dominant elements of systems thinking. Sun (2024) referring to the ancient Greek philosopher Aristotle, emphasizes in his study that "the system as a whole takes priority over its constituent parts, with the parts only gaining significance when they contribute to the purpose of the whole". In turn, systems thinking is a conceptual approach to understanding, analyzing and solving complex problems that takes into account the context and the relationships, interactions and dynamics of the system elements (Bertalanffy 1968). Therefore, it can be argued that in the context of systems thinking, holism

refers to the understanding of systems as a complete whole that cannot exist in isolation. Richmond (2006) emphasizes that those who practice systems thinking "are able to see both the forest and the trees: structurally, they see both the whole and its parts, behaviorally – both the action pattern and the event and its consequences".

In the context of management, a holistic approach means:

- recognizing the multi-level interconnectedness of all system elements;
- understanding that changes in one area have consequences in another;
- taking into account the qualitative and quantitative indicators of the interaction of system elements;
- focusing on understanding the entire system, rather than solving individual problems (SIM 2021; Savory Institute 2022; Sun 2024; Ellis 2025).

A holistic approach helps leaders recognize patterns and structures that influence system behavior, shifting attention from reactive problem solving to proactive development of flexible and adaptive systems. A holistic approach integrates various aspects – decentralized management, decentralized decision-making, feedback, customer focus, innovation and sustainability. Holistic management prefers decentralized structures, promoting cooperation between departments and levels. The organization operates as a cohesive system, in which each structure understands its role in fulfilling the overall mission (HolacracyOne 2023; Rossingol 2023). This model proposed by the authors supports flexible decision-making, enabling employees at all levels to contribute to achieving organizational goals. Anthony Hsieh, former CEO of Zappos, argues that holistic approach "enables employees to act more like entrepreneurs and self-direct their work instead of reporting to a leader who tells them what to do" (Rossingol 2023).

While traditional hierarchical organizations centralize decision-making in top management, which often leads to delayed reactions to change (Butsch et al. 2025), when applying a holistic approach, decisions are made at all levels of the organization, including balancing the interests of all internal and external stakeholders – employees (e.g., work regime, remuneration), shareholders (e.g., investment size, payback period), customers (e.g., product quality, delivery options), suppliers (e.g., cooperation period, payment terms) and society (e.g., environmental protection, labor protection) (Koeswayo et al. 2024). Such decisions are not oriented towards short-term profit, they are aimed at long-term sustainability and ethical responsibility. In addition, constant feedback between the contact audiences ensures coherence and better adaptability. It should be noted that a certain autonomy in decision-making positively influences employee behavior and their willingness to engage in work. Schell & Bischof (2019) in their study, referring to Brian J. Robertson, an expert on organizations that practice a holistic approach, emphasize that a holistic approach is a great benefit for organizations, because autonomy in decision-making provides greater clarity and flexibility to their operations. Moreover, it is necessary for all organizations to survive, yet many of them suffer from its lack.

A holistic approach prioritizes a customer-centric approach, aligning products, services, and communications with customer needs and values. A holistic approach recognizes the interconnectedness of all aspects of an organization – strategy, operations, customer service, and employee engagement – and aligns them with a common goal: achieving customer satisfaction and loyalty (Selementrix 2025). This approach is based on a customer-centric mindset that emphasizes understanding customers' evolving needs and wants and meeting them at every stage of service delivery. By integrating customer insights into decision-making processes, an organization can create more personalized experiences that drive customer engagement and loyalty. Organizations that implement a customer-centric strategy deliver, on average, 30% higher total returns and

nearly twice the shareholder value of their industry peers (Bough et al. 2023). In addition, this strategy allows the organization to derive greater value from its existing customer base, which translates into tangible financial results (Bough et al. 2023).

When it comes to innovation, a holistic approach promotes continuous improvement of the system and new ideas (Qirko 2019). By giving employees the opportunity to take initiative and experiment within their roles, organizations can take into account different ideas and perspectives. Dynamism of roles allows employees to quickly test and implement new concepts, encouraging a proactive approach to problem solving. This experimental environment can lead to revolutionary innovations and improvements (Han et al. 2023). In addition, decentralization of decision-making accelerates the pace of innovation. Such an innovation culture improves the competitiveness of the organization and makes it an attractive place for the best talent. Qirko (2019), Senior Vice President of Cambridge Consultants, recognizes that "there is not just one approach to innovation; the key to success is to take a holistic approach".

In terms of sustainability, a holistic approach recognizes that no organization can operate in isolation – it is closely linked to environmental, economic and social systems. It considers the broader impacts of decisions and seeks to create long-term value for all stakeholders, including employees, ecosystems and future generations (Torelli & Balluchi 2022). This approach combines strategic planning, sustainable resource use and stakeholder engagement, seeking to align operational objectives with sustainable development goals, such as the 17 Sustainable Development Goals (SDGs) of the United Nations (United Nations 2025). Furthermore, holistic practices emphasize continuous learning, enabling organizations to respond effectively to a complex and dynamic environment (Mustafa & Lleshi 2024). Organizations that adopt a holistic approach to sustainable development report improved operational efficiency, lower costs, better talent attraction and retention, effective risk management, and better responsiveness and adaptability to changing environment (Kaizen Institute 2025).

To sum up, the holistic approach to the managed system is in contrast to the traditional approach, as it emphasizes the interconnectedness of system elements and the creation of long-term value. Organizations that adopt a holistic approach are better prepared for innovation, they are able to more effectively align their economic, social and environmental interests, and they are also more proactive in change management.

4. FLEXIBLE THINKING AND ITS FACILITATING APPROACHES

A holistic approach to understanding helps a leader develop flexible thinking by providing him with a comprehensive, interrelated view of organizational and environmental factors. This view allows a leader to recognize multiple environmental challenges, perceive operational, social, ethical, as well as emotional aspects, and at the same time effectively change his approaches and strategies.

Flexible thinking, or cognitive flexibility, is a person's ability to adapt to new circumstances; the ability to quickly switch from one topic to another, change behavior and way of thinking depending on the situation, and abandon behavioral habits (Eikenberry 2025a). A person with cognitive flexibility works better in multitasking mode and switches between different activities faster, sees more alternatives, and perceives changes more easily. The lack of cognitive flexibility is called cognitive rigidity, which is associated with strong resistance to change. It is thinking that is based on uniform or standard ideas, proposals, and judgments that are constantly repeated. A person with rigid thinking is characterized by the inability to

recognize and change psychological attitudes; "such a person can't admit his mistake, he will rather blame other people for wrong and unreasonable actions" (Vēbers 2024).

Responding to the changing and complex environment, today's leader requires an agile mind that can recognize change, balance priorities, and make decisions within the constraints of limited information. Notably, the 2025 World Economic Forum report, which examined the future of jobs in the world's major economies, placed greater emphasis on cognitive abilities, namely the ability to think analytically, systematically, and creatively. The three main core competencies that are highly valued among leaders today are: analytical thinking (69%), resilience, flexibility, and agility (67%), and leadership and social impact (61%) (WEF 2025).

Kevin Eikenberry (2025a), author of the timely new book "Flexible Leadership: Navigate Uncertainty and Lead with Confidence", believes "leaders must finally shed their comfortable habits if they want to remain effective". He argues convincingly that leadership effectiveness is not about finding the right answer, but about choosing the best response to the needs of the moment. The author acknowledges that today's leaders operate in an environment full of uncertainty and contradictions, yet "many of them instead of adapting use old methods." He also adds that "hard policies work well when the world is predictable, but in complex environments, hard approaches are ineffective" (Eikenberry 2025a). Eikenberry (2025b) proposes a flexible leadership framework through three main components:

- mindset: leaders need to start questioning their comfortable assumptions and habits; "awareness and intention come first"; if a leader cannot adjust his mindset, nothing else matters;
- skill set: the knowledge of how to be flexible in one's actions is not innate; it is a learned skill; leaders need to develop new skills to recognize complexity, accurately assess situations, and respond with genuine flexibility;
- habit set: "knowledge is pointless without action"; the leader needs to develop new flexible behavior until it becomes a habit; it is important to make this habit reflexive.

The scientific literature offers various approaches to developing agile thinking in leaders. Several scientific sources often mention such mindsets as Design, Lean and Agile, which effectively fit into modern management philosophies (Schneider 2017; deRaedemaecker et al. 2020; Weiss & Connors 2021; Wangsa et al. 2022). These approaches emphasize customer value, iterative learning and adaptive problem solving, which are essential traits of an agile leader. **Design thinking** is an empathetic approach to creative problem solving that focuses on the creative process rather than critical analysis. It allows you to go beyond the obvious and formulate non-standard ideas and alternatives through experimentation. **Lean thinking** focuses on continuous improvement and waste elimination, teaching leaders to critically analyze processes and seek effective, value-based solutions. **Agile thinking** promotes better response to change through iteration and frequent feedback cycles. Agile thinking values the human aspect of teamwork; it gives the team the opportunity to make decisions, share ideas and take responsibility for their work, which ultimately leads to a more motivated and committed team. Together, they teach them to balance different perspectives and integrate cross-functional collaboration. Thus, by combining empathy, experimentation, and efficiency, these approaches help leaders be flexible, resilient, and innovative. The symbiosis of these mindsets helps leaders effectively adapt strategies and promote continuous organizational growth, taking into account the volatility and complexity of the environment (see Fig. 2).

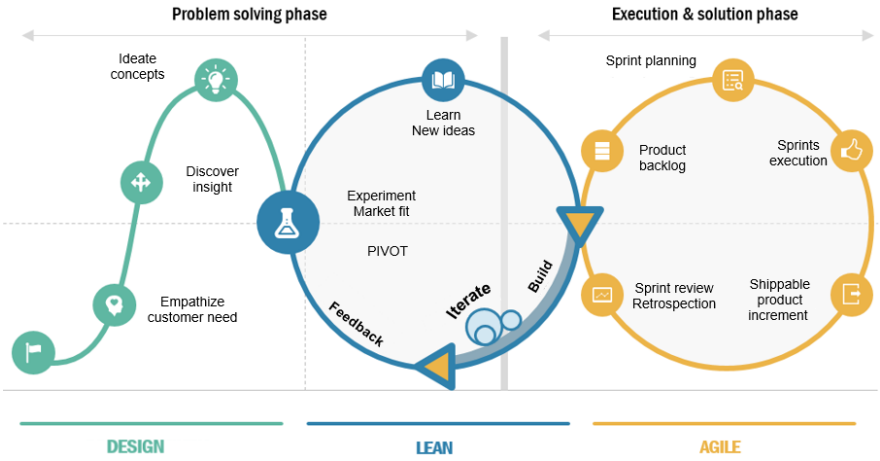

Figure 2. Symbiosis of Design, Lean and Agile thinking (adapted from Patel 2021)

On the whole, Design, Lean and Agile are different ways of thinking, but they complement each other: Design thinking understands user problems and develops innovative solutions, Lean thinking eliminates waste, optimizes value and flow, Agile thinking manages iterations and adapts to a changing environment. To gain a broader insight into the mentioned mindsets, they were analyzed according to several aspects: focus, thinking vector, leader's role, decision-making, change management, etc. (see Table 2).

Table 2

Comparison of Design, Lean, and Agile mindsets (Schneider 2017; de Raedemaecker et al. 2020; Weiss & Connors 2021; Wangsa et al. 2022; Digital Leadership AG 2024)

Aspect	**Mindset**		
	Design	**Lean**	**Agile**
Focus	Understanding problems and creating solutions (prototypes)	Waste elimination, flow optimization	Task prioritization, short work cycles (sprints, iterations), feedback, rapid value creation
Thinking vector	Empathy, exploration, creativity	Continuous improvement (Kaizen), efficiency	Customer needs, team collaboration, flexibility
Leader's role	Fostering creativity and empathy, supporting cross-functional collaboration	Focus on adaptive leadership rather than control	Promoting cooperation, adaptability, and quick response to change

Table 2 Continued

Aspect	Mindset		
	Design	**Lean**	**Agile**
Decision making	Based on customer feedback	Data- and value-stream-driven	Iterative, collaborative with the team
Change management	Creative, tailored to changing conditions	Incremental improvement	Dynamic, rapid adaptation
Risk management	Early prototype development and testing	Loss and error elimination	Short iterations
Key tools	Empathy maps, ideation workshops	Value stream mapping, 5S, root cause analysis	Scrum, Kanban, sprints
Performance indicators (KPIs)	Number of ideas, customer satisfaction	Lead time, proportion of losses	Speed, team productivity, customer feedback
Best execution of functions	Solving ambiguous and complex customer problems, innovation development	Optimization of proven processes	Fast product development, adapting to customer feedback
Main areas of the best execution of function	Product design, service innovation	Manufacturing process	Software and IT product development

Summarizing the key characteristics of the Design, Lean, and Agile mindsets, it can be concluded that leaders who practice all three mindsets are able to respond flexibly to environmental challenges.

Each mindset offers unique opportunities for solving different problems, and their skillful integration promotes innovation and continuous organizational improvement. The analyzed mindsets are not the only factors that provide flexible thinking to the modern leader: for example, the ability to work with artificial intelligence, the ability to manage big data, as well as the ability to question any assumptions and think critically could be integrated into the current management philosophy to achieve success in an era of increasing complexity.

CONCLUSIONS

1. The evolution of the concept of the world led humanity from the plane of certainty into multidimensional chaos: SPOD → VUCA → BANI:
    - SPOD world required stable and standardized knowledge from leaders;
    - VUCA world emphasized quick decisions, participatory management, technological competence and learning;
    - BANI emphasizes adaptive decisions, deep digital skills and emotional intelligence.
2. Organizations that adopt a holistic approach are better prepared for innovation, they are able to more effectively align their economic, social and environmental interests, and they are also more proactive in change management.
3. Leaders who practice Design, Lean, and Agile thinking:
    - explore and understand the problems that arise (Design thinking);
    - use various improvement tools and optimize problem-solving processes (Lean thinking);
    - adapt problem solutions iteratively (Agile thinking).
4. To be flexible, a leader must be able to: develop his awareness, apply a systems approach to analyzing global changes, learn to work in a team and make joint correct decisions.

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CONCLUSIVE ACTIONS IN THE ORGANIZATION OF LABOR RELATION

КОНКЛУДЕНТНЫЕ ДЕЙСТВИЯ В ОРГАНИЗАЦИИ ТРУДОВЫХ ОТНОШЕНИЙ

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Abstract

Cooperation between employers and other labour market participants often depends not only on words, but is sometimes expressed through behaviour or silence. The article examines the types of conclusive actions, their legal basis, and the specific features of their practical application in the organization of labour relations. A conclusive action is the action that is associated with an unspoken willingness to conclude, continue, change or terminate a contract. Conclusive actions are recognized and used in many countries, with their application varying depending on local legal systems, judicial practices, and traditions. They constitute a significant element of labour relations and provide a flexible mechanism for the conclusion, interpretation, and execution of employment contracts.

The use of conclusive actions helps employers manage the work process more effectively; however, misinterpretation of such actions may lead to employer errors, non-compliance with employment contracts, and economic losses.

Keywords: *conclusive actions, legal basis, non-verbal communication, labour relations, employment contract*

ВВЕДЕНИЕ

Цель данной статьи – рассмотреть понятие и виды конклудентных действий, их влияние на эффективность трудовых отношений и особенности использования их основными субъектами трудового права. Взаимодействие работодателей, работников, клиентов и других участников трудового рынка зачастую зависит не только от выраженных ими вербально предложений и ответов, но и от особенностей их поведения и даже молчания. Подавляющее большинство работодателей – это коммерсанты, материальной основой деятельности которых являются договора. Конклудентные действия проявляются в невербальной готовности заключить, продолжить, изменить или расторгнуть договор. В том числе трудовой. Подобные действия применяются в самых различных отраслях, и их использование является неотъемлемой частью современного бизнеса, поскольку они позволяют определять и интерпретировать правоотношения даже при отсутствии формального соглашения (Graustiņš G., 2020). С экономической точки зрения конклудентные действия являются важным правовым инструментом в трудовых отношениях, как вида коммерческих отношений, поскольку позволяют предпринимателям совершать сделки без необходимости оформления каждого действия (How to conclude a contract: everything you need to know, 2023; Kenton Will, 2024). Например, если работник исправно выполняет свои трудовые обязанности и получает за них вознаграждение, это считается конклудентным действием, подтверждающим продолжение трудовых отношений (Men & Verčič, 2021). Применение такого действия относится к ситуациям, когда стороны действуют или ведут себя так, как если бы между ними был заключен письменный договор, а это означает, что договор или соглашение могут считаться заключенными не только в письменной или устной форме, но и посредством действий или поведения сторон. Однако встречаются случаи, когда конклудентная форма заключаемого договора используется недобросовестными предпринимателями для достижения своих целей противозаконными методами (Fridrihsone M., 2017). В случае спора при трудовых отношениях невербальные действия имеют важное значение, поскольку могут быть свидетельством заключения трудового договора и принятия условий договора, даже если не было явного формального соглашения (устного или письменного). А в случае отказа одной из сторон (чаще всего работодателем), от исполнения своих договорных обязательств совершенные действия могут служить доказательством заключения договора и обязывать сторону исполнить свои обязательства.

Исторически конклудентные действия применялись еще в древности - в Греции и Риме заключение договоров происходило не только в устной или письменной форме, но и посредством молчаливого согласия или действия: «manu datio» — передача предмета и «stipulatio» — посредством односторонних действий, например, клятва или рукопожатие (Apsitis K., 2015; Quick Summary of Datio, 2024). Такая традиция сохраняется и в наше время - римское право влияет на латвийское законодательство. В частности, Закон о труде Латвии предусматривает, что трудовые отношения могут быть прекращены и на основании фактических действий работника и работодателя, а не только на основании письменного соглашения (Darba likums, 115.ст.5.ч.).

Необходимость отдельного рассмотрения использования конклудентных действий в организации трудовых отношений вызвана следующими причинами:

1) наличие психологических и юридических недостатков при применении конклудентных действий
2) особые требования к нормативно-правовому регулированию
3) ошибки, допускаемые законодателями и судьями в конфликтных ситуациях при определении наличия, видов и допустимости конклудентных действий
4) существующие трудности у работодателей и работников с определением ситуативного характера конклудентной деятельности
5) особенности конклудентных договоров (виды, содержание, заключение, изменение, прекращение)
6) ошибки участников трудовых отношений в определении - являются ли действия их контрагентов действительно конклудентными
7) особенности взаимодействия конклудентных договорных отношений с «традиционными» (письменными и устными) договорами.

ПОНЯТИЕ КОНКЛУДЕНТНЫХ ДЕЙСТВИЙ

Понятие конклудентных действий подробно рассмотрено автором ранее (Mašošins J., 2024). Если коротко, то конклудентные действия – это особенности поведения, заменяющие собой вербальное (устное или письменное) выражение воли лица. Ученые и словари используют термины «конклудентные действия», «конклюдентные действия» и «конклудные действия». Данные термины фактически являются синонимами и не имеют правовых различий. Как отмечает М.Пахомов, термин «конклудентные действия» используется в гражданском праве как характерный признак одной из форм заключения сделок (Pahomovs M., 2011). Контракт обычно заключается путем предоставления явного согласия, например, путем его подписания. Но заключение или исполнение договора возможно и без слов, действиями или молчанием, и такие действия считаются одним из способов заключения договора. Это означает, что договор считается заключенным или исполненным на основании поведения сторон, даже если не было использовано ни устных, ни письменных соглашений (Implied contract, 2021). Согласно определению, данному в толковом словаре «Тезаурус», «Конклудентное действие – это действие, следствием которого является заключение договора; проявляется в невысказанной готовности заключить договор» (Tēzaurs, 2024). В других словарях можно встретить и следующее определение: «Конклудентные действия — в гражданском праве - действия лица, выражающего свою волю к установлению правоотношений (например, совершить сделку), но не в форме устного или письменного волеизъявления, а поведением, из которого явно следует такое намерение (Словарь юридических терминов. Конклюдентные действия, 2023). Можно также говорить о невысказанной готовности заключить договор и косвенном выражении воли стороны сделки (Kas ir pārliecinošas darbības un kad tās apstiprina darījumu? 2023), или о том, что это «действия без слов или других прямых средств выражения, из которых можно заключить существование воли» (Milberga K., 2020). Таким образом, в определенных ситуациях работа должна быть начата до заключения письменного договора (Immediate action agreements and conclusive actions, 2022). Нередко такая ситуация возникает при организации сезонных работ по сбору урожая.

Конклюдентные действия - (от лат. заключение, заключать) - действия (и бездействие) лиц (в трудовых отношениях – работодателя и работника), при которых в их поведении проявляется желание и намерение вступить в определенные правоотношения, но не путем выражения своей воли устно или письменно, но по такому поведению можно сделать вывод о таком намерении. Подобная

концепция, как отмечают Э.Чернова и Д.Малиновскис, относится к самой сложной в регулировании части сделки – стадии до заключения договора (Černova E., Malinovskis D., 2018: 309). Сложность этого этапа заключается не только в его неопределенности, но и в постоянно меняющихся условиях окружающей среды. Такое поведение может иметь такую же обязательную силу, как и письменное соглашение. На это указывают Г.Хадсонс, Г.Мартиньш, Дж.Смит, В.Белов, М.Пахомов, М.Джонсон, С.Браун (G.Hadsons, G.Mārtiņš, J.Smith, V.Belovs, M.Pahomovs, M.Johnson, S.Brown).

Внешним проявлением конклудентных действий являются:

1) невербальные формы коммуникации: жесты (например, рукопожатие), мимика, пантомима, взгляд, внешний вид, в определенных ситуациях и молчание
2) особенности поведения лица (лиц), тесно связанные с конкретными договорными отношениями, например, выплата зарплаты или соблюдение графика работы без заключения письменного трудового договора или дополнительного напоминания

Как отмечает Г. Лобанов, молчание считается конклудентным действием, если оно предусмотрено законом, практикой делового оборота или вытекает из предыдущих деловых отношений сторон (Lobanovs G., 2024). Действие, считающееся молчаливым выражением воли, должно быть таким, чтобы из него можно было достоверно заключить существование такой воли (Civillikums, 1428.p.). Молчание является одной из самых сложных форм конклудентных действий. В этой связи в Латвии было принято постановление Кабинета Министров о плане действий по внедрению и применению принципа «молчание-согласие» в административной практике ответственных учреждений (Ministru kabineta rīkojums Nr.264, 2012), поскольку по Гражданскому закону молчание не является собственно согласием или несогласием (1430.p.) или, как говорят во Франции: «ça dépend».

СУЩНОСТЬ КОНКЛУДЕНТНЫХ ДЕЙСТВИЙ

Психологически эти действия основаны на принципах доверия и ожидания, и по сути конклудентные действия в трудовых отношениях можно рассматривать как:

• молчаливое заявление о волеизъявлении или выражение воли, приведшее к соглашению сторон и началу трудового процесса

• одна из форм заключения трудового договора, как правило, предшествующая подписанию письменного договора, при которой работник действует так, как если бы он уже согласился на определенные условия

• поведение работодателя и работника, из которого явно вытекает намерение заключить договор, взять на себя конкретные обязательства и получить определенные права

• юридический инструмент, обеспечивающий выполнение обязательств и защиту прав сторон даже без заключения письменного договора

• ситуация, когда трудовые правоотношения созданы или изменены на основании действий обеих сторон, но стороны действовали так, как если бы это было зафиксировано «на бумаге». Так, письменная форма договора считается соблюденной, в том числе и при внесении изменений, когда письменное предложение заключить договор принято в соответствии со статьями 39 и 41 Закона о труде Латвии, либо, к примеру, как у наших соседей: пункт 3 статьи 408 Гражданского Кодекса Республики Беларусь, из которого следует, что совершение лицом, получившим оферту, в срок, установленный для ее акцепта, действий по выполнению указанных в ней условий договора (выполнение работ и т.д.) считается акцептом, если иное не предусмотрено законодательством или не указано в оферте (Kas ir “konkludas darbības” un to īstenošanas iespēja, grozot līgumus?, 2024)

• принцип молчаливого согласия, позволяющий определять наличие договорных обязательств на основе фактического поведения лиц (получение зарплаты, ношение форменной рабочей одежды, средств защиты, соблюдение графика работы и т.п.)

• юридическая категория, которая относится к заключению договоров и, следовательно, к созданию обязательств между их участниками

• юридическое понятие, обозначающее ситуации, когда действия или молчание работника могут считаться согласием на заключение, продолжение или изменение договора

• юридический факт (возникновение, поддержание, окончание трудовых отношений)

Как правовое понятие, конклудентные действия интерпретируются и применяются по-разному в различных правовых ситуациях, регионах и системах.

Конклудентными действия могут быть не только у частных лиц (работодатели «физики»), но и у юридических лиц (работодатель - предприятие). Однако на государственных предприятиях этот феномен встречается значительно реже.

ВИДЫ КОНКЛУДЕНТНЫХ ДЕЙСТВИЙСреди конклудентных действий можно выделить следующие:

• по форме невербальной коммуникации: зрительные и слуховые действия: жесты, сигналы. Улыбка, рукопожатие, кивок и уважительное поведение — все это играет важную роль в общении, в мотивации трудовой деятельности. Трудно обойтись без жестикуляции в работе биржевого маклера. А «большой палец вверх» используется не только как значок в электронной среде, но и как жест одобрения в реальной жизни (Budkēviča K.I., 2023). В строительстве, при погрузо-разгрузочных работах постоянно применяются жесты, обозначающие «вира» и «майна» (вверх, вниз). И вообще, пальцы и ладони используются в самых разных ситуациях для профессиональных, характерных и недвусмысленных положительных и отрицательных жестов

• по месту в механизме правового регулирования: в целях заключения, продления, изменения и расторжения договора

• методу консолидации в существующей правовой системе:

1) обязательные конклудентные действия, предусмотренные правовыми актами. Например, если работодатель разрешает работнику продолжать работу после окончания его смены, он не может впоследствии заявить, что не желает платить работнику, поскольку отработанное время превысило согласованную смену (Darba likums, 68.p.). Либо, согласно Гражданскому закону молчаливо принятая компенсация работы хранителя, если по обстоятельствам бесплатное хранение не предполагалось (Civillikums, 1969.p.).

2) конклудентные действия, совершаемые в соответствии с правовым обычаем. В частности, размер комиссии за работу маклера, являющийся «обычным» в данном регионе. Право на такое вознаграждение у маклера возникает в момент заключения сделки даже без упоминания о нем (Komerclikums, 70.pants, 1.daļa). Например, в рижском регионе размер вознаграждения составляет месячную арендную плату при сьеме жилья, либо 3% при сделках купли-продаже. Правовые обычаи, являющиеся основой конклудентных действий, законодатель часто переводит по прошествии времени в нормы законов или правила кабинета министров

- молчание работника можно считать согласием, если его действия свидетельствуют о том, что он понимает и согласен с предложенными условиями договора (Richard Austen-Baker, Qi Zhou., 2023), а поведение работодателя «говорит» о том, что он принимает выполненную работу. Молчаливо может происходить и заключение договора доверенности, если кто-либо умышленно позволяет третьему лицу управлять своими делами (Civillikums, 2290..p.). Если человек знает. что ему необходимо заниматься делами другого человека, но он не возражает против этого, то это означает его согласие заключить данный договор

• возможно деление и на «подвиды»: конклудентные действия, конклудентное поведение и конклудентный обман. Конклудентное поведение может привести к заключению трудового договора или иного соглашения. При конклудентном обмане лицо намеренно вводят в заблуждение без устных заявлений. Человек лжет не буквально и словесно, а посредством действий и косвенных выражений обмана, например, о действительном качестве выполненной работы

• конклудентные действия часто встречаются в мобильных и компьютерных программах, в которых пользователи, используя функции приложения или платформы, совершают действия, свидетельствующие об их согласии с условиями или договорами с разработчиком или оператором приложения. Когда пользователь загружает приложение и создает учетную запись, это обычно включает принятие условий приложения и политики конфиденциальности (Mobilo aplikāciju droša izmantošana, 2017). Последующие действия пользователя, такие как вход в систему или регулярное использование, дополнительно подтверждают это согласие. Например, платформы «Uber» и «Bolt»

выполняют функции реальных работодателей, а водители – не «партнеры», как заявляют разработчики этих платформ, а обычные наемные работники

• использование работниками правильного дресс-кода в одежде также может иметь большое значение, так как показывает отношение к потенциальным клиентам: желание общения и заключения договора. Подобный конклудентный прием в своей «работе» используют и преступники. Например, мошенник для вхождения в доверие использует форму представителя определенной профессии (моряка, полицейского, военного и т. п.), а вор для проникновения в дом – форму сантехника, почтальона

• неисполнение работником своих трудовых обязанностей либо неспособность работодателя обеспечить оплату его труда считаются достаточным основанием для прекращения трудовых отношений (Civillikums, 2193 ст.; Darba Likums, 10 ст.1.ч.).

ПРОБЛЕМЫ ИСПОЛЬЗОВАНИЯ КОНКЛУДЕНТНЫХ ДЕЙСТВИЙ

Конклудентные действия применимы не во всех случаях. Как и письменные или устные договоры, конклудентные договоры должны соответствовать определенным требованиям законодательства, быть четко понятными и доказуемыми. Если трудовой договор был заключен с помощью конклудентных действий, то обычно проблем не возникает до тех пор пока стороны договора выполняют все его условия.

Но возможными проблемами могут быть:

1) конклудентные действия могут быть истолкованы по-разному. Это зависит от конкретной ситуации, субъективных намерений обеих сторон и норм Гражданского Закона и Закона о труде. Неверное истолкование невербальных сигналов работником может привести к недоразумениям, конфликтам, неэффективному исполнению трудового договора, а также к неправильному применению законодательства и вызвать затруднения в трудовых правоотношениях

2) конклудентные действия часто подвержены неоднозначности. Споры могут возникнуть относительно того, действительно ли работник согласился с условиями трудового договора, если согласие не было четко выражено, а сам договор еще не был подписан. Например, жесты или выражения лица, которые имеют одно значение в данной культуре, могут быть интерпретированы совершенно по-другому в иной культуре. В частности, кивок головы в Латвии и в Болгарии являются совершенно противоположными по значению (кросс-культурные проблемы)

3) если конклудентные действия не были выражены достаточно ясно, суд может не признать трудовой договор заключенным между сторонами и он не будет иметь юридическую силу

4) некоторые невербальные сигналы могут вызывать у клиентов негативные ассоциации, что может сказаться на имидже компании. Неправильно выбранный тон голоса, неуместная мимика или неподходящая одежда работника могут создать у клиента впечатление непрофессионализма или даже вызвать недовольство

5) если законом установлена определенная форма соглашения, то волеизъявления, совершенного молча, даже если оно совершенно ясно, недостаточно. Так Закон о труде Латвии однозначно определяет необходимость письменной формы трудового договора (Darba Likums, 40 ст.)

6) применение конклудентного действия может потребовать дополнительных разъяснений, в результате чего заключение договора может быть отложено или даже отменено.

7) конклудентные действия могут быть основанием для трудовых споров, когда возникают вопросы о том, достаточны ли они для заключения/расторжения либо изменения договора

8) в случае возникновения спора сложнее доказать и судить о действительности и правомерности совершения работ, осуществленных на основании конклудентной деятельности

9) иногда возникают споры о том, являются ли такие действия доказательными или доказуемыми, и какие ситуации считаются уместными для данного понятия

10) если смысл конклудентных действий отличается от подписанного трудового договора, они также могут быть основанием спора между работодателем и работником и создать необходимость принятия решения суда о правомерности толкования таких действий и условий применении договора

11) конклудентные действия не основаны на четко определенных нормах законов или правил. Это порой приводит к правовой неопределенности и нестабильности из-за отсутствия ясных формулировок относительно того, какое именно поведение можно считать конклудентным и основой заключения, изменения или даже расторжения договора.

МЕТОДЫ РЕШЕНИЯ ПРОБЛЕМ. СВЯЗАННЫХ С ИСПОЛЬЗОВАНИЕМ КОНКЛУДЕНТНЫХ ДЕЙСТВИЙ В ТРУДОВЫХ ОТНОШЕНИЯХ

Основой применения данного вида действий в коммерческой деятельности и в трудовых отношениях, как уже отмечалось, являются доверие и понимание. Они позволяют совершать конкретные действия по созданию прав и обязанностей работодателей и работников и значительно повышать эффективность трудовой деятельности. Но есть и «подводные камни». Чтобы предотвратить или хотя бы уменьшить возможные негативные последствия применения конклудентных действий, существуют различные методы, которые можно использовать в практике трудовых отношений. А именно:

1) тщательное определение и фиксация условий трудового договора и использование дополнительной документации. Это позволяет доказать существование договора и сослаться на его содержание в случае разногласий, трудовых споров или запросов суда

2) для присвоения конклудентным действиям формы акцепта необходимо, чтобы они были совершены на условиях, указанных в договоре

3) в целях надежности следует убедиться в согласии всех участников соглашения на использование конклудентных действий и в их взаимопонимании

4) судебная практика и юдикатура являются существенным элементом процесса правового толкования конклудентных действий. Решения суда по трудовым спорам и создание прецедентов помогают понять, какие ситуации считаются конклудентными и каковы критерии использования конклудентных действий

5) работники и работодатели должны быть проинформированы о приемах коммуникации во избежание недоразумений и дальнейших судебных разбирательств. Этому может быть уделено внимание во время вводного или очередного инструктажа. Чтобы успешно использовать конклудентные действия, важно не только уметь распознавать и интерпретировать невербальные сигналы, но и умело корректировать свое общение и взаимодействие в соответствии с ситуацией

6) суд часто опирается на прошлую историю взаимоотношения сторон трудового договора. Если их взаимодействие продолжается в течение достаточно длительного времени, и обе стороны удовлетворены таким развитием событий, суд может посчитать, что имеет место конклудентный договор о существовании и продолжении такой деятельности

7) для успешного преодоления проблем и рисков, связанных с применением конклудентных действий, особое внимание следует уделять культурным и кросс-культурным особенностям, а также регулярному обучению персонала эффективному невербальному общению, в т.ч. профессиональным жестам и навыкам коммуникации в процессе трудовой деятельности

8) необходима объективная оценка конкретных ситуаций и обстоятельств, в которых имели место совершаемые конклудентные действия. Это включает в себя оценку контекста поведения работника или работодателя, а также учет таких факторов, как правила и нормы закона, обычаи, судебная практика и правовые прецеденты

9) наличие прямых и косвенных доказательств может быть использовано для разрешения спора о наличии и обязательности конклудентного действия. Сюда могут входить письменные договоры, накладные, отметки в учетных журналах, записи камер видеонаблюдения, показания свидетелей, выполненная работа

10) существуют юридические способы защиты участников трудового договора от возможных негативных последствий конклудентных действий:

- предварительное соглашение об использовании таких действий
- изучение и применение известной информации о конклудентных действиях и последствиях их применения

• юридическая помощь и консультации юристов, социальных психологов и специалистов по кросс-культурным вопросам.

Это позволит принимать правильные решения о действиях, которые можно считать конклудентными, и понимать юридические последствия и риски, связанные с такими действиями.

11) во избежание неясностей и недопониманий следует использовать регулярное общение между субъектами трудовых отношений

12) значение конклудентных действий зависит от конкретных обстоятельств каждого дела и требуют тщательной оценки фактических и правовых аспектов, а именно, в какой ситуации имели место данные действия и как они могут повлиять на правоотношения и результаты труда

13) разумное использование искусственного интеллекта для анализа и интерпретации конклудентных действий, повышения точности и предотвращения их неправильного применения.

ЗАКЛЮЧЕНИЕ

1) конклудентные действия являются существенным элементом трудовых отношений и обеспечивают гибкий механизм заключения и толкования трудовых договоров

2) благодаря конклудентным действиям работодатели могут обеспечить эффективное управление трудовым процессом. Такие действия способствуют поддержанию прочных трудовых отношений, которые важны для качественного и быстрого решения рабочих вопросов

3) хотя конклудентные действия признаны и используется во многих странах, их применение может варьироваться в зависимости от местных правовых систем, судебной практики и традиций. Также важно учитывать культурные особенности и контекст, в котором происходит взаимодействие, поскольку некоторые жесты или высказывания могут интерпретироваться по-разному в различных культурах и странах. Но вне зависимости от правовой системы конклудентные действия являются важным инструментом упрощения и ускорения трудовых процессов

4) целесообразно внести изменения в статью 1428 Гражданского Закона Латвии «Воля может быть выражена как явно, так и молча». Из этой статьи исключить слово «молча» и дополнить эту статью словами «конклудентными действиями»

5) использование конклудентных действий в трудовых отношениях имеет большой положительный эффект, однако необходимо учитывать возможные негативные последствия и применять эти действия законно (конклудентные действия – это открытое правовое понятие) и разумно, чтобы избежать возможных трудовых споров в будущем. Обратной стороной является то, что они могут привести к юридическим проблемам, если их использовать вне правовых и культурных норм

6) разрешение споров между работодателем и работником относительно использованных конклудентных действий обычно осуществляется через государственную трудовую испекцию, суд или иной орган разрешения споров с учетом наличия доказательств и сути проблемы. Эти действия значимы, поскольку могут быть свидетельством заключения трудового договора или принятия/непринятия изменения его условий

7) для предотвращения или уменьшения возможных негативных последствий неправильного использования конклудентных действий в трудовых отношениях могут использоваться различные методы и приемы, такие как дополнительная письменная документация, профессионально осуществляемый инструктаж перед началом трудовых операций и расширенное общение между работодателем и работником.

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REPORTING AND TRANSPARENCY AND SOME ISSUES OF THE GREEN ECONOMY IN THE MODERN WORLD

ОТЧЕТНОСТЬ И ПРОЗРАЧНОСТЬ И НЕКОТОРЫЕ ВОПРОСЫ ЗЕЛЕНОЙ ЭКОНОМИКИ В СОВРЕМЕННОМ МИРЕ

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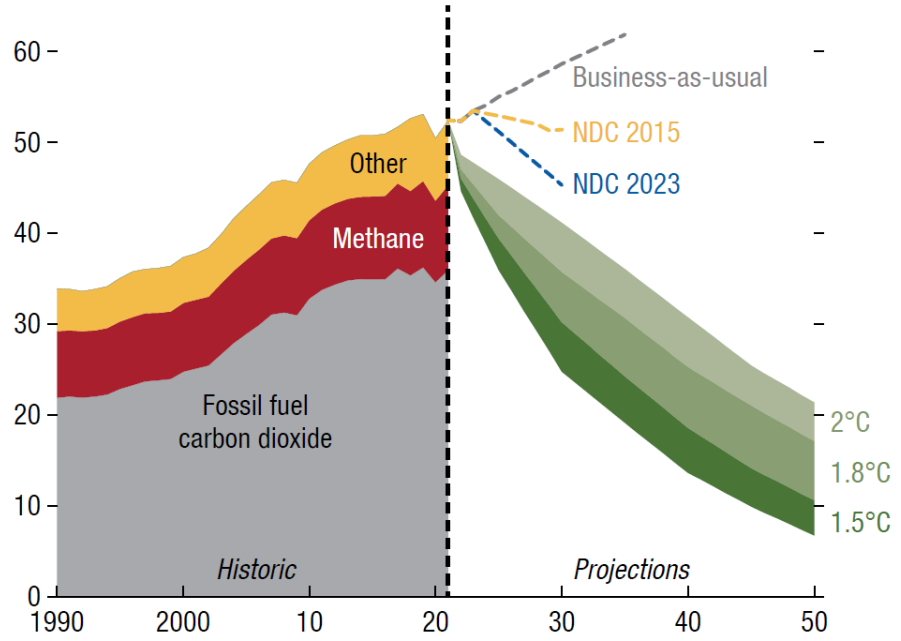
«За каждым богатством кроется преступление,
а за большим богатством, большое преступление»
О.Бальзак

По Марксу существует диалектический антагонизм между капиталистом и нанятым работником, потому что капиталист пытается купить все рабочее время сотрудника и нерабочее тоже, тогда как сотрудник хочет продать только продукт своей работы, а не само время, что является его собственностью и он прав распоряжаться им, как он соизволит.
Лозунги фирм красноречиво сами говорят за себя, например «для нас главное твое развитие», что на самом деле является кардинальной сменой понятий по Херцбергу, ведь было время в 80-ых годах, когда выпускались специальные книги про сотрудников для топ-менеджеров корпораций, что им надо давать зарплату своим сотрудникам в конвертах потому что, как говорилось в тех самых книгах «обезьяны очень любят, когда их кормят с рук».
И именно в этом направлении сегодня идет весь мир из-за международных прав человека или же сотрудника выраженных в Международном пакте об экономических, социальных и культурных правах (**ICESCR**) и Международном пакте о гражданских и политических правах (**ICCPR**). Их также часто называют «Международными пактами».
На партийном конгрессе в Бухаресте в 2012 году ЕНП приняла свой политический манифест. Он, в частности, перечисляет следующие основные ценности ЕНП:
«Солидарность в помощи нуждающимся, которые, в свою очередь, также должны приложить усилия для улучшения своего положения», что точь-в-точь повторяет фразу "от каждого по способностям, каждому по потребностям" (нем. Jeder nach seinen Fähigkeiten, jedem nach seinen Bedürfnissen) и является лозунгом, который популяризировал Карл Маркс в своей работе "Критике Готской программы" 1875 года. Этот принцип подразумевает, что в коммунистическом обществе, люди будут вносить свой вклад в общее производство в соответствии со своими возможностями, а получать блага в соответствии со своими потребностями.

Таким образом, сегодня весь мир, ведомый прогрессивной Европой, а точнее Евросоюзом, который является на сегодняшний день локомотивом прогресса движется в направление социализма через зеленую повестку и борьбой против глобального потепления.
Выбросы парниковых газов, измеряемые в метрической тонне эквивалента CO2 составляют:
• > 50 млрд метрических тонн (1990–2020 гг.)
• > 3 т метрических тонн (с момента первой промышленной революции до наших дней)
Сочетание двух предыдущих дает, что сегодня температура на планете на 1,5 градуса Цельсия выше, чем в конце XIX века.
К 2100 году температура на планете может быть на 3,0–4,5 градуса Цельсия выше, чем в начале индустриализации.

Необходимо сократить выбросы углерода на 80% к 2050 году (и полностью прекратить их к 2100 году), чтобы предотвратить наиболее драматичные последствия изменения климата, однако даже при большей эффективности рост населения и услуг означает, что выбросы вместо этого вырастут на 50%.
«Пока выбросы не сойдут на ноль, достичь этого просто невозможно», — говорит Гейтс.
P x S x E x C = CO2 (выбросы углекислого газа).
• P = численность населения; S = объем услуг, потребляемых людьми;
• E = объем энергии, необходимой для обеспечения этих услуг; C = объем углекислого газа, произведенного этой энергией.



Billions of tons of CO2 emissions equivalence
Annual Global GHGe, 1990-2050

И ничего не предвещает, что динамика процесса изменится.
Так, CNN: заявил в Южной Азии и на Среднем Западе в США станет невозможно жить из-за жары.5

В ближайшие годы в Западной Африке, Южной Азии и на среднем Западе США станет невозможно жить из-за сильной жары.

Учеными названы регионы Земли, в которых нельзя будет жить из-за жары после того, как климат на планете изменится.
Исследователи провели моделирование на основе данных об изменении климата и волнах аномальной жары на планете.
По данным Всемирной организации здравоохранения, уже сейчас около 489 тысяч человек ежегодно умирают от последствий жары.
Nature: повышение температуры выше 1,5°C на Земле вызовет климатический перелом

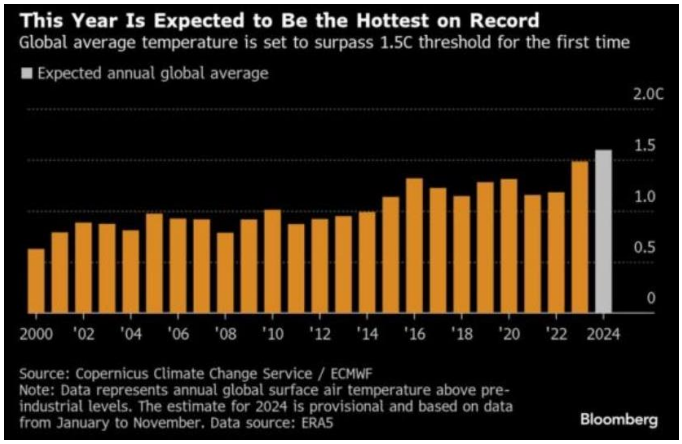
Повышение температуры на Земле выше ожидаемой вызовет серьезные климатические изменения.

[5] https://lenta.ru/news/2024/07/29/nazvany-neprigodnye-dlya-zhizni-v-buduschem-regiony-mira/?utm_source=yxnews&utm_medium=desktop

Риск также будет увеличиваться при повышении температуры на каждые 0,1 градуса по Цельсию после преодоления порога в 1,5 градуса, — говорится в материале журнала.

Ученые отмечают, что если климатические тенденции сохранятся, риск переломного момента в развитии климата уже в этом столетии составит 45 процентов.

Для того, чтобы не допустить «переломного момента», необходимо к 2100 году достичь и поддерживать нулевой уровень выбросов парниковых газов, заявили авторы исследования, опубликованного в журнале Nature Communications.



А рост населения к 2100 году выглядит просто пугающе и угрожающе.

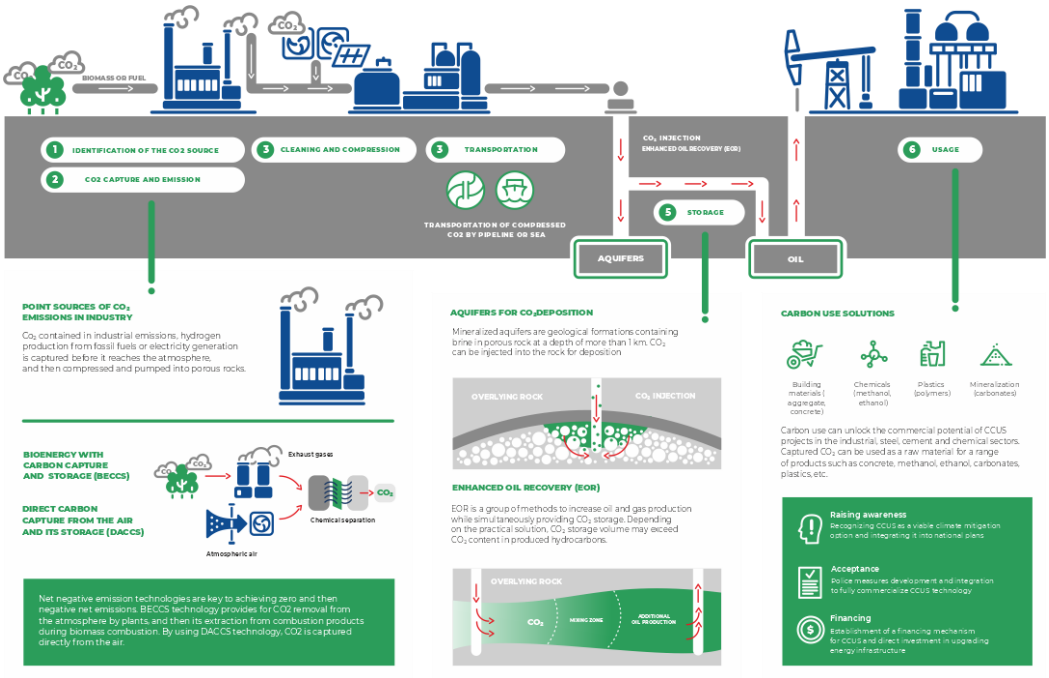
Поэтому в направлении зеленой энергетики работают многие страны мира. В частности, Грузия планирует реализацию перспективного по итогам исследования проекта прокладки высоковольтного электрокабеля по дну Черного моря.

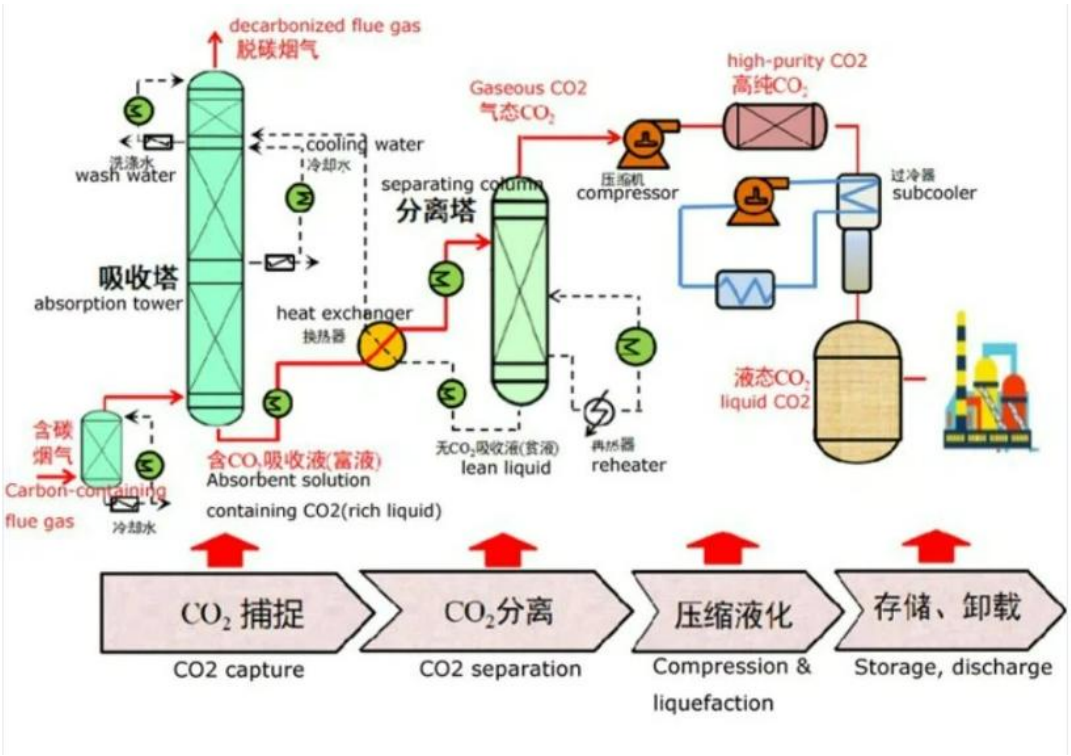
Технико-экономическое исследование было проведено по заказу "Государственной электросистемы Грузии", при поддержке Минэкономики и при финансовой помощи Всемирного банка.

В рамках достигнутого соглашения ожидается строительство подводного электрического кабеля Black Sea Energy мощностью 1 тыс. МВт и протяженностью 1 195 км. Кабель будет предназначен для поставок зеленой электроэнергии, производимой в Азербайджане, через Грузию и Черное море в Румынию для последующей транспортировки в Венгрию и остальную часть Европы.

«Бизнес-обоснование устойчивого развития» — это понятие, которое часто упоминается в литературе по корпоративному устойчивому развитию и корпоративной социальной ответственности. В то время как некоторые рассматривают устойчивость и экономическое обоснование как противоречия и, таким образом, подчеркивают наличие компромиссов, другие подчеркивают, как (потенциальные) бизнес-обоснования могут быть созданы путем управления экологическими, социальными и экономическими аспектами. Обе точки зрения объединяет то, что «экономическое обоснование» неявно или явно рассматривается как создание финансовых показателей, часто только для одной группы заинтересованных сторон. Тот факт, что бизнес-кейс не является каким-то конкретным явлением, а должен создаваться совместно в результате обмена вкладами между различными заинтересованными сторонами, до сих пор глубоко не анализировался. Принимая во внимание теорию заинтересованных сторон, расширяются существующие исследования о том, что такое бизнес и бизнес-кейсы, и анализируется понимание бизнес-кейсов устойчивости и того, как они могут быть созданы с участием заинтересованных сторон.

Улавливание и хранение двуокиси углерода (CO2) — УХУ — это процесс, включающий отделение CO2 от промышленных и энергетических источников, транспортировку к месту хранения и долгосрочную изоляцию от атмосферы.


BIOMASS OR FUEL
1 IDENTIFICATION OF THE CO2 SOURCE
2 CO2 CAPTURE AND EMISSION
3 CLEANING AND COMPRESSION
3 TRANSPORTATION
TRANSPORTATION OF COMPRESSED CO2 BY PIPELINE OR SEA
CO2 INJECTION ENHANCED OIL RECOVERY (EOR)
5 STORAGE
6 USAGE
AQUIFERS
OIL
POINT SOURCES OF CO2 EMISSIONS IN INDUSTRY
CO2 contained in industrial emissions, hydrogen production from fossil fuels or electricity generation is captured before it reaches the atmosphere, and then compressed and pumped into porous rocks.
BIOENERGY WITH CARBON CAPTURE AND STORAGE (BECCS)
DIRECT CARBON CAPTURE FROM THE AIR AND ITS STORAGE (DACCS)
Exhaust gases
Chemical separation
Atmospheric air
Net negative emission technologies are key to achieving zero and then negative net emissions. BECCS technology provides for CO2 removal from the atmosphere by plants, and then its extraction from combustion products during biomass combustion. By using DACCS technology, CO2 is captured directly from the air.
AQUIFERS FOR CO2DEPOSITION
Mineralized aquifers are geological formations containing brine in porous rock at a depth of more than 1 km. CO2 can be injected into the rock for deposition
OVERLYING ROCK
CO2 INJECTION
ENHANCED OIL RECOVERY (EOR)
EOR is a group of methods to increase oil and gas production while simultaneously providing CO2 storage. Depending on the practical solution, CO2 storage volume may exceed CO2 content in produced hydrocarbons.
OVERLYING ROCK
CO2
MIXING ZONE
ADDITIONAL OIL PRODUCTION
CARBON USE SOLUTIONS
Building materials (aggregate, concrete)
Chemicals (methanol, ethanol)
Plastics (polymers)
Mineralization (carbonates)
Carbon use can unlock the commercial potential of CCUS projects in the industrial, steel, cement and chemical sectors. Captured CO2 can be used as a raw material for a range of products such as concrete, methanol, ethanol, carbonates, plastics, etc.
Raising awareness
Recognizing CCUS as a viable climate mitigation option and integrating it into national plans
Acceptance
Police measures development and integration to fully commercialize CCUS technology
Financing
Establishment of a financing mechanism for CCUS and direct investment in upgrading energy infrastructure


decarbonized flue gas
脱碳烟气
洗涤水
wash water
cooling water
冷却水
吸收塔
absorption tower
heat exchanger
换热器
separating column
分离塔
Gaseous CO2
气态CO2
压缩机
compressor
high-purity CO2
高纯CO2
过冷器
subcooler
液态CO2
liquid CO2
含碳烟气
Carbon-containing flue gas
冷却水
含CO2吸收液(富液)
Absorbent solution containing CO2(rich liquid)
无CO2吸收液(贫液)
lean liquid
再热器
reheater
CO2 捕捉
CO2 capture
CO2分离
CO2 separation
压缩液化
Compression & liquefaction
存储、卸载
Storage, discharge

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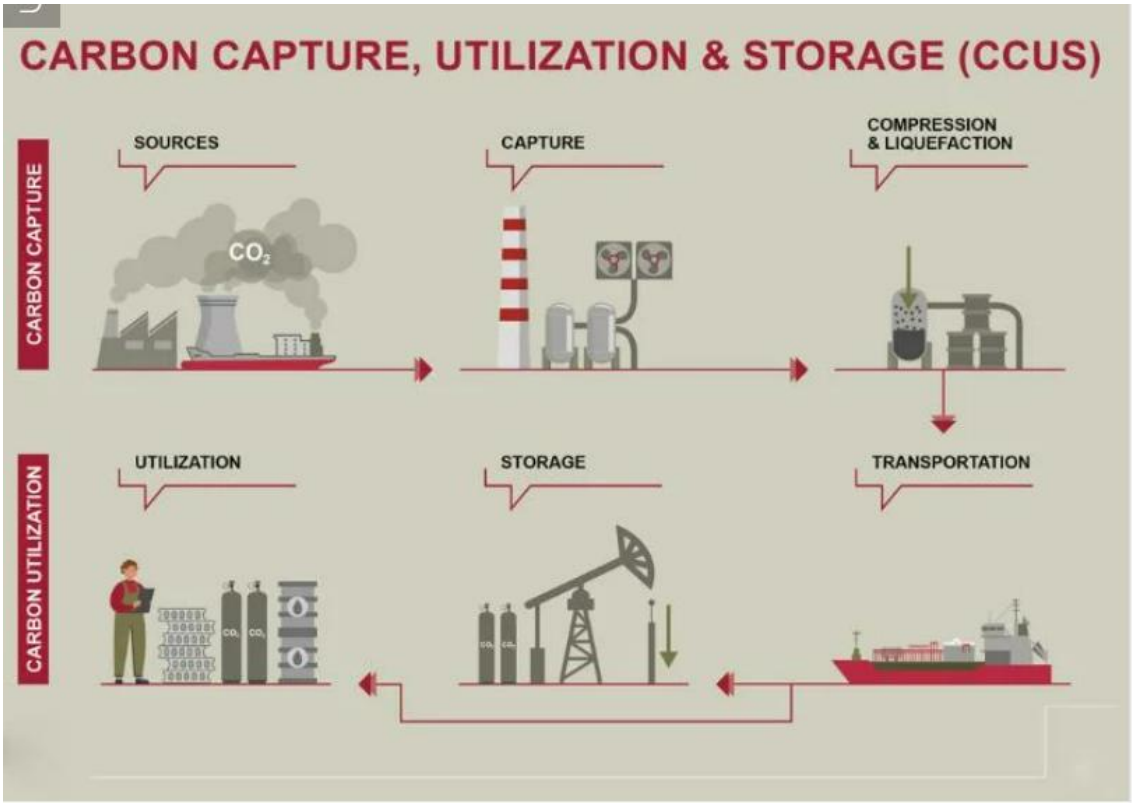
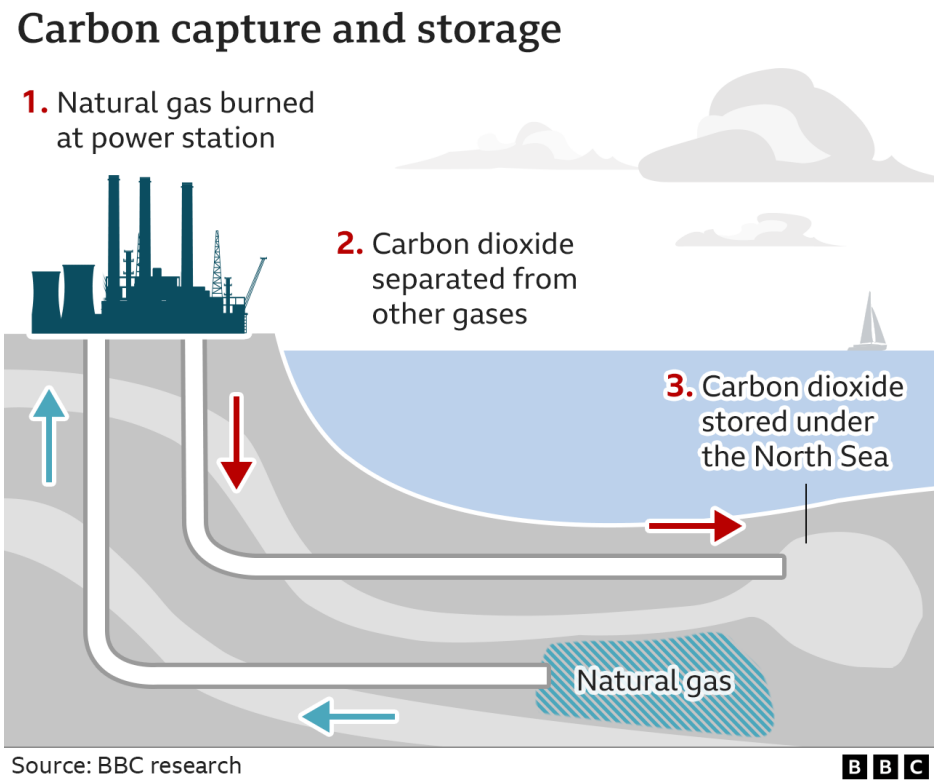




Это все делается для того, чтобы к 2050 году на земле больше не было бы мелкого сельскохозяйственного производства в собственных целях и таким образом снизить выделение CO2 и парникового эффекта и таким образом достигнуть «net zero emission».
А для этого нужно, чтобы люди сами для себя тоже не могли бы ничего производить съедобного из за выбросов метана иначе логика процесса теряет смысл, что должно завершиться прямыми выборами Президента Европейской Коммисии, как заяввлено в основных целях Европейской Народной Партии принятых в рамках политического манифеста на партийном конгрессе ЕНП в Бухаресте в 2012 году.
Чтобы покрыть весь мир зеленой повесткой вводятся такие категории, как:
- Экстерриториальность
• Влияние CSRD на предприятия, не входящие в ЕС. CSRD применяется ко всем предприятиям ЕС, включая дочерние компании материнских компаний, не входящих в ЕС, которые либо имеют ценные бумаги, котирующиеся на ЕС, либо являются крупными.
• Иностранным банкам, котирующимся на Лондонской фондовой бирже, вероятно, придется соответствовать стандартам ISSB.
- Отчетность о цепочке создания стоимости
• Компании, не входящие в ЕС, будут все чаще просить предоставлять данные об устойчивом развитии (иногда с гарантией) крупным компаниям и банкам ЕС.
В частности также вводится термин капитала за пределами «земля, труд, капитал» Маркса.

- Первая область раскрытия информации об устойчивом развитии предполагает:

Вероятное положительное или отрицательное влияние на будущие потоки денежных средств от активов и обязательств, которые признаны или могут быть признаны, в результате прошлых событий, но с влиянием на будущие потоки денежных средств, которые не отражены (или еще не отражены) в финансовой отчетности (первичной отчетности или примечаниях), включая приведенный ниже критерий «скорее, чем нет».
Данное заявление относится к рассмотрению потенциального положительного или отрицательного воздействия на будущие денежные потоки, связанные с активами и обязательствами. В нем подчеркивается необходимость раскрытия информации в отчетах об устойчивом развитии, проводя различие между ситуациями, которые скорее вероятны, чем нет, и ситуациями, которые скорее не вероятны, чем нет. Раскрытие информации должно охватывать как вероятные, так и менее вероятные сценарии, предоставляя дополнительную информацию помимо той, которая сообщается в финансовой отчетности.
В первой области раскрытия информации об устойчивом развитии могут возникнуть две ситуации:
(a) Ситуации, которые более вероятны, чем нет: сюда следует включать ситуации вероятного уменьшения (или увеличения) генерирования денежных потоков от активов или обязательств, которые рассматриваются или еще не рассматриваются в целях бухгалтерского учета как генерирующие отрицательный (или положительный) чистый денежный поток в будущих периодах.
(b) Ситуации, скорее не вероятные, чем да: сюда следует включать ситуации, когда вероятность ниже критерия «скорее, чем нет» (даже если она носит субъективный характер), но все же является значительной и когда раскрытие информации должно идти на шаг дальше того, что отражено в финансовой отчетности, охватывая менее вероятные (не более вероятные, чем нет) сценарии, связанные с активами/обязательствами, которые признаны или еще не признаны.

- Вторая область раскрытия информации об устойчивом развитии:

Возможные финансовые риски или возможности, влияющие на признанные активы или обязательства (т.е. вероятное положительное или отрицательное влияние на будущие денежные

потоки), которые могут возникнуть в результате будущих событий; их влияние на будущие денежные потоки еще не признано (поскольку они не являются следствием прошлых событий).

- Третья область раскрытия информации об устойчивом развитии:

Раскрытие информации об используемых в настоящее время «капиталах», которые способствуют созданию/поддержанию стоимости предприятия. Они не соответствуют бухгалтерскому определению активов (обязательств) и/или критериям признания, но связаны с прошлыми событиями.

- Четвертая область раскрытия информации об устойчивом развитии:

Раскрытие информации о будущих ожидаемых изменениях (связанных с будущими событиями) в отношении использованного «капитала», который способствует созданию/поддержанию стоимости предприятия.

Рассмотрим список «капитала» более детально:

1. Интеллектуальный капитал: нематериальные активы, такие как патенты, товарные знаки, авторские права и запатентованные технологии.
2. Человеческий капитал: навыки, знания, опыт и знания сотрудников компании.
3. Социальный капитал: Отношения, сети и связи с заинтересованными сторонами, такими как клиенты, поставщики, сотрудники, сообщества и другие внешние партнеры.
4. Природный капитал: Природные ресурсы, экосистемы и экологические активы, которые поддерживают деятельность компании.
5. Культурный капитал: ценности, нормы, организационная культура и институциональные знания, которые формируют идентичность компании и способствуют устойчивости.
6. Финансовый капитал: средства и финансовые ресурсы, доступные для инвестирования в инициативы по операционной деятельности, росту и устойчивому развитию.
7. Производственный капитал: физическая инфраструктура, машины, оборудование и другие промышленные активы, поддерживающие деятельность.

Конкретными примерами «капитала» могут являться экспертиза сотрудников (что выводится за гранью зарплаты и превращается в актив наподобие игроков в футбол), тренинги (инвестиции в CPD), отношения (со всеми стейкхолдерами так, как экономические отношения это человеческие отношения), инфраструктура (зачастую государственная и общественная), R&D (часто исследования являются частью только расходов, но развитие тоже может быть расходной частью до капитализации), нематериальные активы (различные интеллектуальные активы и лицензии и разрешения пользования природными ресурсами неподдающиеся, или пока еще неподдающиеся признанию в активной части).

Как мы видим понятие капитала охватывает все, что выходит за рамки баланса, что входит или даже не входит в расходную часть.

Для понимания, что является реальным капиталом для предприятия и что нет, вместо подхода SMART при оценке капитала помимо активов и обязательств может быть более полезно учитывать такие критерии, как:

1. Существенность: оцените значимость и актуальность различных форм капитала для деятельности компании, создания стоимости и интересов заинтересованных сторон.
2. Актуальность для деятельности: оцените, как каждая форма капитала способствует достижению стратегических целей компании, целей устойчивого развития и долгосрочной устойчивости.
3. Контекст: рассмотрите более широкий социально-экономический, экологический и управленческий контекст, в котором работает компания, чтобы понять важность различных форм капитала.

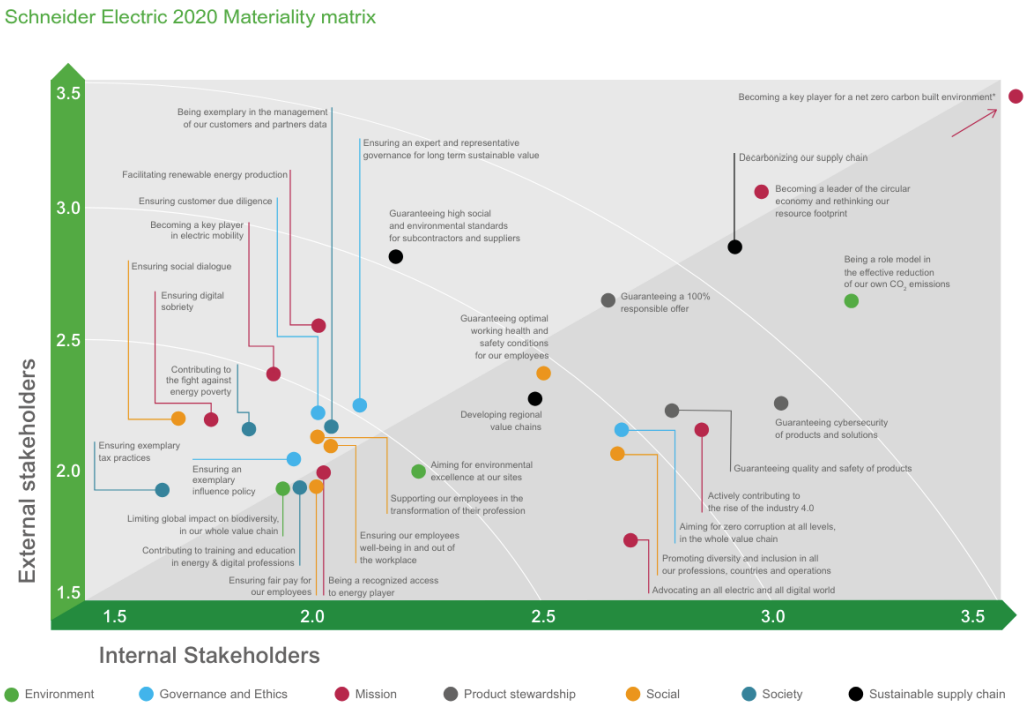
4. Точка зрения заинтересованных сторон: Принимайте во внимание перспективы и ожидания ключевых заинтересованных сторон, включая инвесторов, клиентов, сотрудников, сообщества и регулирующие органы, в отношении управления компанией и использования капитала.
5. Влияние на устойчивое развитие: Оцените экологические, социальные и экономические последствия, связанные с каждой формой капитала, как положительные, так и отрицательные, а также их влияние на показатели устойчивого развития.
6. Интеграция: Оцените степень, в которой различные формы капитала интегрированы в процессы принятия решений компании, методы управления рисками и системы отчетности.
7. Стратегическая направленность: привести раскрытие информации о капитале в соответствие со стратегическими приоритетами, целями и инициативами компании. Это может включать в себя выделение инвестиций в конкретные области, такие как развитие человеческого капитала, охрана окружающей среды, социальная ответственность или инновации.
Что касается областей раскрытия информации об устойчивом развитии, существенность может быть оценена на основе различных качественных факторов, таких как:
1. Стратегическая важность. Насколько раскрытые капиталы актуальны для общей бизнес-стратегии, целей и долгосрочного успеха компании? Капиталы, которые тесно связаны со стратегическими приоритетами компании, можно считать более существенными.
2. Ожидания заинтересованных сторон. Что ключевые заинтересованные стороны ожидают или считают важным с точки зрения воздействия компании, рисков и возможностей, связанных с различными формами капитала? Понимание точек зрения заинтересованных сторон может помочь определить материальный капитал для раскрытия.
3. Репутационные риски. Существуют ли потенциальные риски для репутации или бренда компании, связанные с использованием или управлением определенными формами капитала? Капиталы, которые оказывают существенное влияние на репутацию или стоимость бренда, могут считаться более существенными.
4. Нормативные требования. Существуют ли нормативные требования или отраслевые стандарты, которые определяют определенные капиталы как существенные для раскрытия? Соблюдение законодательных или нормативных требований может повлиять на существенность раскрываемого капитала.
5. Операционные последствия. Как раскрытые данные о капитале влияют на деятельность, производительность и устойчивость компании? Капиталы, которые оказывают существенное влияние на операционную эффективность, производительность или управление рисками, могут считаться более существенными.

Существенные области охватывают точку зрения как компании, так и ее внешних заинтересованных сторон.

Для понимания данной парадигмы смещения приоритетов надо понимать, что главное не сохранение ценности и богатства акционеров, будучи краткосрочной ориентацией, а сохранение того, что живо. Посему концепция двойной материальности может способствовать развитию экономики, более уважительной к природе и человеку.
Компания представляет собой коллектив, в котором участвуют несколько заинтересованных сторон, и участие в акциях следует рассматривать как поддержку общего проекта, что, кстати, и составляет ее

историческую функцию («Компания, Объект коллективного интереса» 2018 г., основа закона PACTE 2019 г.) .

Также надо помнить, что весь управленческий учет компаний, обеспечивающий их повседневную деятельность, никоим образом не основан на акционерной стоимости. Так же как влиятельным фактором для бизнеса на сегодня являются заинтересованные стороны бизнеса:



Так, как любой перекос в одну или другую сторону ведет к неравенству:

Income inequality	Gender inequality
Excess consumption	Energy poverty
Pollution	Limited access to quality education
Unequal access to basic services	Unequal access to natural resources
Discrimination of various social groups	Damage to natural ecosystems
Corruption	Poor and/or unsafe working conditions
Limitation of free speech	And many more…

Таким образом сегодня главное не только флора и фауна, но и вся экосистема:
Климат, использование энергии и выбросы парниковых газов; загрязнение воздуха, воды и почвы; биоразнообразие; вода; использование ресурсов, циркулярная экономика, утилизация отходов и т. д.
Это и есть социализм. А мы знаем, что абсолютное планирование при социализме невозможно.
Нельзя все планировать, сколько производить трусов и колготок, так как хотя капитализм можно уничтожить на уровне производства, но его невозможно уничтожить на уровне потребления.
Хотя можно наверно все планировать на уровне крупного производства, тогда как малое и микро-предпринимательство должны быть абсолютно частным и мелкобуржуазно-собственническим.
Хотя надо отметить, что капитализм без дотаций с государства более накопительный нежели социализм:

- *«Владельцы капитала будут стимулировать рабочий класс покупать всебольше и больше дорогих товаров, зданий и техники. Толкая их тем самым длятого, чтобы они брали все более дорогие кредиты, до тех пор, пока кредиты не станут невыплачиваемыми. Невыплачиваемые кредиты ведут к банкротству банков, которые будут национализированы государством, что в итоге и приведет к возникновению коммунизма.»* (Карл Маркс, Капитал, том 1, глава 32).

Но это все делается за счет ЕС, так Макрон сурово предупреждает о возможном отставании ЕС от США и Китая. «ЕС может умереть», — заявил он. Наша прежняя модель устарела. Мы чрезмерно регулируем и недостаточно инвестируем. Если мы будем следовать нашей классической программе, через два-три года мы выйдем с рынка» (см. таблицу внизу).
Но это идет вразрез с основным мировым трендом.
На парламентских выборах во Франции в 2024 году, основатель левой партии «Непокорённая Франция» (НФ) Жан-Люк Меланшон с одобрением отнёсся к известиям о досрочных выборах, написав в социальной сети X, что Макрон «больше не обладает легитимностью для проведения своей политики социальных злоупотреблений, климатического бездействия и разжигания войны». Реагируя на роспуск парламента Франсуа Рюффен призвал лидеров всех левых политических сил (включая «Экологистов») объединиться для участия в выборах в широкую коалицию «Новый народный фронт». С аналогичными призывами также выступили руководители Французской коммунистической партии (ФКП; Фабьен Руссель), «Экологистов» (Марин Тонделье) и Социалистической партии (СП; Оливье Фор).
Например, вот что пишет в своем твиттере Президент США Байден:
«Вчерашнее решение Верховного суда о приостановке экспорта сжиженного природного газа невероятно разочаровывает. Я продолжу делать все возможное, чтобы защитить нашу окружающую среду и наши сообщества, одновременно обеспечивая энергетическую безопасность Америки», — говорится в сообщении.
Комиссия за выбросами CO2 сообщает, что некая пиццерия в Торонто взимает с клиентов «комиссию за выбросы CO2» в размере 2% как компенсацию за их «углеродный след»:
«То, что мы едим, способствует изменению климата. Прибавка 2% к каждому счету в ресторане на инвестиции в улавливание CO2 поможет компенсировать наш углеродный след».

2022	$16,761.50B	$37,467	3.48%
2021	$17,315.13B	$38,721	6.01%
2020	$15,381.42B	$34,357	-5.65%
2019	$15,694.05B	$35,081	1.81%
2018	$15,981.45B	$35,753	2.07%
2017	$14,765.88B	$33,091	2.84%
2016	$13,888.83B	$31,175	1.97%
2015	$13,553.90B	$30,488	2.31%
2014	$15,651.37B	$35,283	1.60%
2013	$15,294.85B	$34,565	-0.08%
2012	$14,641.63B	$33,169	-0.70%
2011	$15,765.16B	$35,767	1.90%
2010	$14,556.12B	$32,966	2.23%
2009	$14,762.84B	$33,481	-4.35%
2008	$16,295.39B	$37,044	0.64%

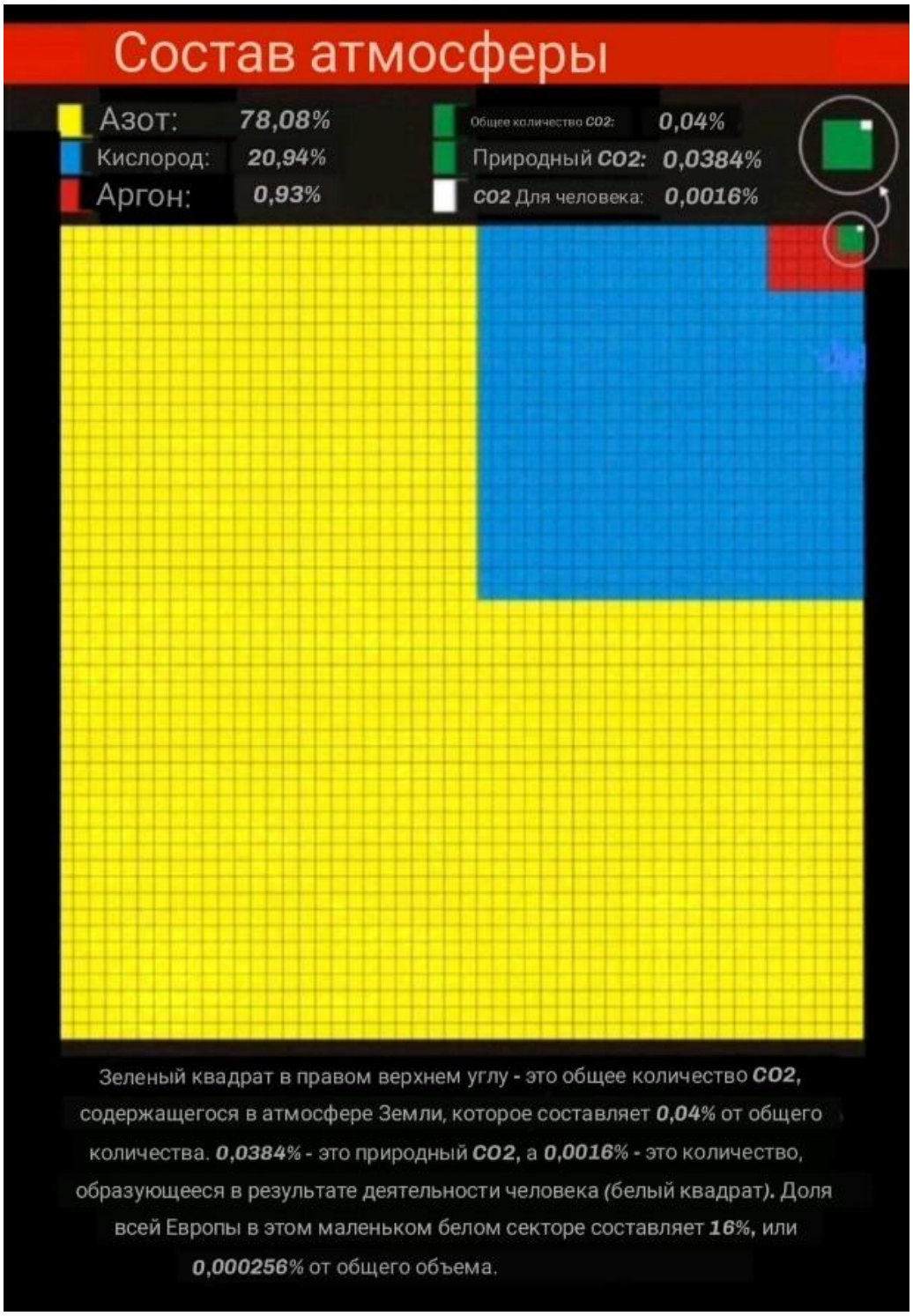
European Union GDP - Historical Data 2008-2022

Также надо учесть, что по некоторым заявлениям экспертов: последствия "зеленой энергетики" могут быть ужасны и доля CO2 в амтосфере на самом деле мизерная (см. диаграму внизу), не говоря о том, что выбросы CH4, N2O и Фторированных газов добавляют около 0.3% CO2-эквивалента к общему количеству CO2. Это можно считать вполне приемлемой погрешностью отчётности, поэтому их невозможно рассчитать и сообщить (см. Global Warming Potentials for CH4 and N2O, IPCC’s 6th Asses undertakingnt Report, Chapter 7SM).

Их аргументы сводятся к тому, что допустим, что мы можем построить такие возобновляемые всякие зеленые электростанции, которые позволят нам забирать столько энергии из земли, ветра, солнца, приливов и всего прочего, но так как закон сохранения энергии по трем законам термодинамики никто не отменял, то мы энергию откуда будем изымать?

Получается, что мы будем изымать ее непосредственно из климата. Энергия солнца, которая падает на землю, энергия всего прочего и перерабатывается в энергию океанов, приливов, течений, дождей, погоды и всего на свете.

Вы будете изымать ее оттуда, то есть вы будете воздействовать на климат непредсказуемым способом прямо сейчас. Не добавляя проценты к газу, содержание, которого в атмосфере меньше полпроцента, когда, как говорится, даже «меньше багажа означает меньше углекислого газа», а изымать будете ее прямо сейчас.



И если уж при выработке энергии, при определенного рода КПД, который все-таки существует, какая-то часть энергии пропадала, эта и есть та энергия, которая до постановки панели нагревала

почву, участвовала в процессе водно-солевого обмена, ветра и так далее. То есть нарушается естественная природная цепочка.
Представим, что мы просто поставили ветряки и отобрали столько энергии сколько нужно, чтобы запитать хотя бы один крупный город в мире и вы увидете, что вы возможно существенно повлияете на климат всего континента.

Депутат Европарламента от Великобритании Годфри Блум заявил в Европарламенте об афере с искусственным глобальным потеплением...
- «Все это — обман, эта фальшивая гипотеза, эта нелепая чушь о том, что антропогенный CO2 вызывает глобальное потепление».
- «Разве речь на самом деле не идет только о том, чтобы государство могло залезть в карманы брюк простых людей и украсть у них еще больше налогов?»
- «Разве все это не вопрос политического контроля?»
- «Достаточно, пожалуйста, пока мы не нанесли непоправимый ущерб мировой экономике».

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IMPLEMENTATION OF INNOVATIVE TECHNOLOGIES AS A KEY FACTOR IN INCREASING THE COMPETITIVENESS OF FOREIGN ENTERPRISES

ВНЕДРЕНИЕ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ КАК КЛЮЧЕВОЙ ФАКТОР ПОВЫШЕНИЯ КОНКУРЕНТОСПОСОБНОСТИ ИНОСТРАННЫХ ПРЕДПРИЯТИЙ

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Abstract

In the context of rapid technological progress, companies need to adapt to new market realities and ensure a sustainable competitive advantage. This paper examines the introduction of innovative technologies as a key factor in increasing the competitiveness of foreign companies, using the example of NFC Kazakhstan LLP. The factors influencing the company's market positioning are analyzed, and areas that can strengthen its competitive advantages are identified. The proposed technological solutions are focused on digital transformation, process automation, and improving project management efficiency.

The results of the study confirm the relevance of integrating modern technologies into the activities of industrial enterprises striving for leadership at the national and international levels.

В условиях ускоренного технологического прогресса предприятиям необходимо адаптироваться к новым реалиям рынка и обеспечивать устойчивое конкурентное преимущество. В данной работе рассматривается внедрение инновационных технологий как ключевой фактор повышения конкурентоспособности иностранных компаний на примере деятельности ТОО «NFC Kazakhstan». Проведен анализ факторов, влияющих на позиционирование компании на рынке, и выделены направления, способные усилить её конкурентные преимущества. Предложенные технологические решения ориентированы на цифровую трансформацию, автоматизацию процессов и повышение эффективности управления проектами. Результаты исследования подтверждают актуальность интеграции современных технологий в деятельность промышленных предприятий, стремящихся к лидерству на национальном и международном уровнях.

Ключевые слова: инновационные технологии, конкурентоспособность, цифровизация, строительство

1. ВВЕДЕНИЕ

В условиях стремительного развития мировой экономики и нарастающей глобализации ключевым приоритетом для иностранных предприятий становится обеспечение устойчивого конкурентного преимущества. Одним из важнейших факторов, определяющих успех компаний на международных рынках, выступает внедрение инновационных технологий. В современной деловой среде инновации перестали быть исключительно инструментом модернизации; они становятся стратегическим ресурсом, способным трансформировать бизнес-модели, оптимизировать производственные процессы, повышать качество продукции и услуг, а также эффективно реагировать на быстро меняющиеся требования потребителей. Использование передовых технологических решений позволяет предприятиям не только укреплять свои позиции на рынке, но и выходить на новые сегменты, адаптируясь к условиям цифровой трансформации и технологической конкуренции. Таким образом, исследование влияния инновационных технологий на уровень конкурентоспособности иностранных компаний приобретает особую актуальность, обусловленную необходимостью выработки эффективных подходов к управлению инновационной деятельностью в условиях высокой динамики внешней среды.

2. МАТЕРИАЛЫ И МЕТОДЫ

Исследование основано на комплексном анализе внутренней среды компании ТОО «NFC Kazakhstan» и внешних факторов, влияющих на её деятельность в контексте повышения конкурентоспособности. Методологическая база включает контент-анализ научной и отраслевой литературы, обобщение практического опыта компании, сравнительный анализ реализованных проектов и экспертную оценку инновационного потенциала. Применялись методы аналитического обобщения, табличного моделирования и SWOT-анализа для оценки текущего уровня технологического развития и выработки рекомендаций по его улучшению. Использование качественных и количественных методов позволило обоснованно выделить приоритетные направления внедрения инноваций.

3. РЕЗУЛЬТАТЫ И ОБСУЖДЕНИЕ

Современное развитие мировой экономики характеризуется усилением влияния научно-технической революции, углублением интеграционных процессов и обострением конкуренции, распространяющейся на новые сферы социально-экономической деятельности. В этих условиях конкурентоспособность приобретает глобальное значение и становится определяющим фактором достижения успеха на международной арене. В научной литературе под конкурентоспособностью в широком смысле понимается способность субъекта достигать поставленных целей в условиях активного противодействия со стороны других участников рынка. При этом, несмотря на существование множества подходов к определению данного понятия, единая методологическая основа до настоящего времени не выработана. Преобладающее число трактовок сосредоточено на товарной составляющей конкурентоспособности, что приводит к ее чрезмерному упрощению и игнорирует сложность и многогранность данного феномена.

С точки зрения современных исследователей, таких как Т.Т. Ли и М. Икрам, конкурентоспособность следует рассматривать как динамическую характеристику, формирующуюся под воздействием как внутренних, так и внешних факторов. К числу таких факторов относятся условия функционирования предприятия, активность конкурентов и рыночное соотношение спроса и предложения [1, с.585]. Изменение любого из этих элементов способно привести к существенным колебаниям конкурентных позиций компании. Таким образом, обеспечение высокого уровня конкурентоспособности представляет собой необходимое условие для стабильного получения прибыли и достижения устойчивых позиций в долгосрочной перспективе [2, с.69].

В условиях современной экономики инновации играют ключевую роль. Иностранные предприятия стремятся адаптироваться к быстрым технологическим изменениям. Внедрение инновационных технологий становится основой конкурентной стратегии компаний [3, с.107].

Инновационная деятельность позволяет оптимизировать бизнес-процессы и снизить издержки. Предприятия, активно использующие технологические новшества, быстрее реагируют на рыночные изменения. Это обеспечивает им устойчивое положение в глобальной экономике.

Инновации также способствуют созданию уникальных продуктов и услуг. Они усиливают позиции компаний в международной конкурентной борьбе. Таким образом, инновационное развитие становится важнейшим элементом корпоративного роста [4, с.67].

На примере ТОО «NFC Kazakhstan» (дочерняя компания Китайской международной инженерно-строительной компании цветной металлургии China Nonferrous Metal Industry’s Foreign Engineering and Construction Co., Ltd.) рассмотрим какие технологии можно внедрить для повышения конкурентоспособности. За более чем десятилетний опыт хозяйственной деятельности компания зарекомендовала себя как надежный партнер и подрядчик в области строительных и инженерных работ, получив лицензии первой категории на строительно-монтажные работы, а также лицензии третьей категории на проектную и изыскательскую деятельность [5].

Анализ факторов, влияющих на конкурентоспособность ТОО «NFC Kazakhstan» показан в таблице 1.

Таблица 1.

Анализ факторов, влияющих на конкурентоспособность ТОО «NFC Kazakhstan»

Факторы	Описание фактора	Оценка (1-10)
Техническое оснащение	Высокий уровень технической оснащенности, включая современное строительное оборудование и технику.	9
Квалификация персонала	Высококвалифицированный персонал, способный выполнять сложные инженерные и строительные задачи.	8
Опыт реализации крупных проектов	Успешный опыт строительства промышленных объектов и крупных инфраструктурных проектов.	9
Инновационные технологии	Применение современных технологий в строительстве и проектировании, включая инженерные решения.	8
Финансовая устойчивость	Устойчивое финансовое положение благодаря значительным инвестициям и высокой эффективности работы.	7
Партнерские отношения	Наличие стратегических партнеров, таких как КазМинералс, ERG и КазМунайГаз.	9
Соблюдение стандартов и норм	Соответствие казахстанским и международным стандартам в строительной отрасли.	8
Доступ к сырьевым и трудовым ресурсам	Широкий доступ к трудовым и материальным ресурсам в регионах реализации проектов.	7
Примечание – составлено автором на основе источника [5]		

ТОО «NFC Kazakhstan» обладает значительными конкурентными преимуществами, включая современное техническое оснащение, высокую квалификацию персонала и успешный опыт реализации масштабных проектов. Стратегические партнерства с ведущими предприятиями страны и внедрение инновационных технологий обеспечивают компании прочные позиции на рынке. При этом дальнейшее укрепление финансовой устойчивости и расширение доступа к ресурсам могут усилить конкурентоспособность компании в долгосрочной перспективе.

Корпоративная философия компании «NFC Kazakhstan» основывается на принципах честности, ориентации на инновации и постоянном совершенствовании профессиональных методов реализации проектов. Деятельность компании охватывает все этапы выполнения крупных инфраструктурных проектов в области цветной металлургии, начиная от проектирования и технического консультирования до пусконаладочных работ, эксплуатации объектов и подготовки квалифицированного персонала. Такой комплексный подход позволяет обеспечивать высокое качество услуг и эффективное управление проектами различной сложности, что укрепляет позиции компании на рынке инженерных решений.

Одним из наиболее значимых достижений компании стало строительство Казахстанского электролизного завода в городе Павлодар, завершённое в 2010 году. Данный объект приобрёл ключевое значение для промышленного потенциала страны. В дальнейшем компания успешно реализовала ряд проектов, направленных на развитие металлургической и нефтехимической промышленности, включая строительство медных обогатительных заводов и модернизацию установок на Павлодарском нефтехимическом заводе. Эти проекты подтверждают высокий уровень технической и организационной подготовки компании, а также её способность осуществлять масштабные задачи в условиях сложной промышленной среды. Инвестиционная деятельность предприятия сопровождается существенным экономическим вкладом в национальную экономику, выраженным в крупных финансовых поступлениях и значительных налоговых отчислениях. Эффективность работы компании получила признание на государственном уровне, что подтверждается полученными наградами и профессиональными достижениями руководства.

Существенным направлением развития компании выступает проект по строительству ствола «Воздухоподающий-Клетевой» на Артемьевском руднике в Восточно-Казахстанской области. Данный проект, реализуемый в формате полного цикла, направлен на повышение производственных мощностей подземной добычи, улучшение условий вентиляции и обеспечение эффективной логистики внутри рудника. Строительство вертикального ствола глубиной более семисот метров и диаметром семь метров требует высокотехнологичных инженерных решений, соответствующих казахстанским нормативным требованиям. Рабочая документация разрабатывается при участии отечественных проектных организаций, обладающих компетенциями в области горнорудной и металлургической промышленности. Реализация данного проекта служит примером эффективной интеграции международного инженерного опыта и локальных практик, способствуя укреплению промышленной инфраструктуры региона и повышению конкурентоспособности предприятия на внутреннем рынке.

Компании стоит более активно использовать инновационные технологии для повышения её конкурентоспособности (таблица 2).

Таблица 2.

Предлагаемые инновационный технологии для компании «NFC Kazakhstan»

Технология	**Текущее состояние**	**Предлагаемое нововведение**	**Ожидаемый эффект**
Цифровое моделирование (BIM/3D-моделирование)	Используется частично в проектировании	Внедрение полного BIM-цикла во всех этапах проектной работы	Повышение точности планирования, снижение издержек, сокращение сроков строительства
Системы управления строительством на основе IoT	Ограниченное применение на отдельных участках	Интеграция IoT-сенсоров на всех объектах и этапах работ	Мониторинг в реальном времени, повышение безопасности и эффективности процессов
Использование дронов для технадзора и картографии	Внедрено точечно	Масштабное применение дронов на всех строительных объектах	Снижение затрат на мониторинг, ускорение контроля качества и документооборота

Анализ текущего уровня технологического развития компании «NFC Kazakhstan» позволяет утверждать, что внедрение инновационных решений является стратегически важным направлением повышения её конкурентоспособности. Использование цифровых и интеллектуальных технологий, ориентированных на автоматизацию, оптимизацию и повышение эффективности производственных процессов, способствует укреплению рыночных позиций предприятия. Полноценная интеграция передовых инструментов управления строительством и проектированием обеспечивает не только рост производительности и качества выполняемых работ, но и снижение операционных издержек. Таким образом, активное внедрение инновационных технологий формирует основу для устойчивого развития компании в условиях динамичной конкурентной среды.

4. ЗАКЛЮЧЕНИЕ

Результаты проведенного анализа подтверждают, что активное внедрение инновационных технологий представляет собой неотъемлемую составляющую стратегического развития иностранных предприятий в условиях усиливающейся конкуренции. В случае ТОО «NFC Kazakhstan» использование цифрового моделирования, систем на базе IoT и дронов в строительной деятельности открывает новые возможности для повышения производственной эффективности, качества выполняемых работ и управляемости проектами. Такие технологические решения

позволяют не только оптимизировать ресурсы и процессы, но и формируют устойчивую платформу для дальнейшего роста. Следовательно, инвестиции в технологическое обновление и цифровую трансформацию следует рассматривать как один из приоритетов для укрепления рыночных позиций компании в долгосрочной перспективе.

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