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## ARTIFICIAL GENERAL INTELLIGENCE

GENERATIVE A.I. HAS THE POTENTIAL TO CHANGE THE WORLD BILL GATES



RELATIONSHIP BETWEEN ARTIFICIAL INTELLIGENCE, INNOVATION AND PERFORMANCE Oana Georgia PREDA, Ionut Marius CROITORU, Paula DRAGAN (SPIRIDON), Aylin KABAS

**DETERMINING THE KEY FACTORS INFLUENCING THE REAL ESTATE INDUSTRY**Djalal Eddine YAHIAOUI, Nor-Elhouda BELGHAZLI, Asthma Taous BENHIDJEB, Ali BELAIDI, Zohra Djihad BELGHAZLI



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### **EDITORIAL**

### **Towards Machines with Conscience**

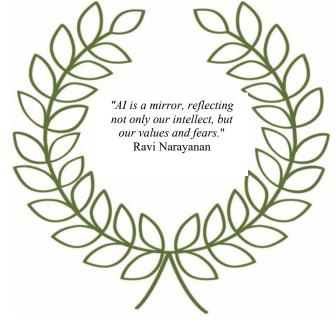
Artificial General Intelligence (AGI) was considered a theoretical ambition not long ago - a distant goal beyond the capabilities of even the most advanced machines. Today, however, AGI has moved from the margins of speculative thought into the core of strategic research in artificial intelligence. Unlike narrow AI systems, which are designed to excel at specific tasks, AGI aims to replicate the breadth and depth of human cognitive ability: the capacity to reason, learn from minimal data, adapt across unfamiliar contexts, and apply knowledge fluidly across domains. This marks not just a technological shift, but a conceptual one, challenging long-held assumptions about intelligence and decision-making.

Incremental but profound milestones have shaped the journey toward AGI - first in machine learning, then in neural networks and, more recently, in the emergence of large-scale language and multi-modal models. These systems demonstrate a growing capacity to understand and generate complex information, offering glimpses into what general-purpose cognition might look like in silicon form. While we are not yet at the point of full autonomy or understanding, the foundation has been laid. AGI is no longer an abstract possibility - it is becoming an engineering challenge.

For the field of management, and particularly for researchers and practitioners focused on intelligent

decision systems, this evolution introduces transformative possibilities. **Imagine** dynamic enterprise systems that can interpret context, simulate future outcomes, and suggest strategic actions in real time. Consider organizational tools that not only automate routine tasks but also assist in conflict resolution, innovation planning, and high-stakes decision-making. In sectors such as logistics, healthcare management, education policy, and smart governance, AGI could redefine how problems are framed and solved.

Still, the promise of AGI comes with weighty responsibilities. Critical questions remain unsolved: How can we ensure that AGI systems reflect ethical values and institutional objectives? How do we prevent misuse, reinforce accountability, and maintain human oversight? Technically, challenges such as aligning long-term goals, managing unintended behaviors, and guaranteeing transparency



persist. But the greater challenge may lie in adapting our institutions, organizations, and cultures to work effectively with systems that are not merely tools, but collaborators.

The potential upside, however, is immense. AGI may unlock new levels of productivity, uncover insights beyond human capacity, and allow organizations to operate with greater adaptability and resilience. It could democratize access to expertise and help leaders navigate complexity with clarity. For the scientific community, especially in interdisciplinary management research, AGI offers not just a technological challenge but a field-defining opportunity.

The development of AGI is not just a technological evolution - it is a challenge that requires collaboration between engineers, economists, policymakers, and managers. Also, for the scientific community, AGI represents both a technical challenge and an ethical responsibility.

As researchers, we are not merely observers of this unfolding story - we are its authors. Interdisciplinary collaboration, open dialogue, and critical scrutiny will be essential to shaping AGI not just as a technological achievement, but as a force for collective progress.

Georgiana MOICEANU Guest Editor



# Forecast of Energy Intensity in the Context of Renewables Expansion

### Ioan BITIR-ISTRATE\*, Mihaela NORISOR

National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independentei, Bucharest, Romania

The energy intensity indicator is one of the most important factors measuring energy efficiency for a country. Defined as the ratio between the energy consumed to produce a certain economic value, the indicator has seen significant variations in recent years for Romania. The aim of the article is to investigate the factors influencing the components of the indicator, their variations, and their influence on how energy intensity will evolve in the future period. The strong dynamics of renewable energy projects, the increase in the presence of electrical energy storage, and the very high number of authorized prosumers are elements that will have effects on the results of the energy intensity calculation. In turn, the economic value produced, expressed by Gross Domestic Product (GDP), has a certain variation that is very interesting in the current and future artificial intelligence context, up to 2030. The authors conducted a separate study of each factor that could significantly influence

energy intensity, then concatenate the results and have provided a prediction of the variation in energy intensity for Romania until 2030.

**Keywords:** energy intensity, prosumers, renewables, energy efficiency.

### Introduction

Energy intensity can be considered as a measure of the energy efficiency of a national economy; it measures the amount of energy used to produce a unit of GDP. There are various factors involved in improvements the energy intensity: a general shift from industry towards a service-based economy in Europe, a shift to less energy-intensive



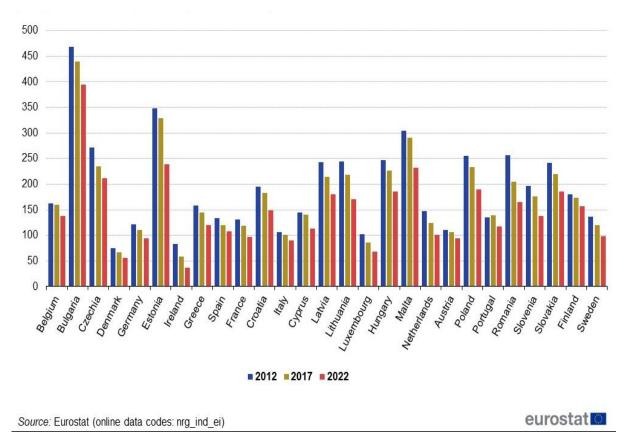
activities and production methods, the closure of inefficient factories, more energy-efficient appliances. A more efficient use of resources, including energy, contributes to greater reuse of waste generated during production activities, leading to environmental improvements, as shown by G.H.Soto (2025).

It is imperative for Europe's biggest economies to combat the climate change crisis in the long run, and it is crucial to implement and enhance energy efficiency programs, particularly targeting major industries, shows Ahmad et al. (2025).

The European metal industry (one of the major contributors to the energy efficiency present level) can become a Net-Zero sector only through deep circular economy transformations in energy and carbon intensity using cleaner production, Halkos et al. (2024)

According to Rahko (2025), while energy intensity if often taken as a proxy for energy intensity, it is also influenced by several factors other than pure energy efficiency. Energy intensity describes the relationship between energy use and economic activity. Factors like industrial structure, behavioural changes and others can influence energy intensity while leaving efficiency unaffected.

As reported by Eurostat (2024) all European countries have significant results in term of reducing energy intensity in the last decade (Figure 1).



**Figure 1** – Energy intensity evolution for European countries between 2012-2022 (kilogramme of oil equivalent per euro thousand)

It can be easily observed that there are still significant differences between countries. Bulgaria recorded the highest level, followed by Estonia and Malta. While in the latter cases, it is a matter of the

impact of the small size of the country, in the first case it is most likely a delay in implementing energy efficiency measures. Ireland, Denmark, and Luxembourg have the lowest statistical values, very likely due to the profile of the industries located in these countries, based on digital, finance, and organic agriculture sectors. Romania recorded an important reduction in energy intensity of primary resources from over 250 to 150 ktoe/th euro. The reduction in energy intensity in Romania has been primarily influenced by two key factors:

Energy efficiency measures in industry: Industrial consumption has been the target of statesubsidized energy efficiency measures. These measures aimed to reduce energy consumption and increase energy efficiency in the industrial sector, leading to a decrease in energy intensity.

Increase in energy tariffs: Border conflicts have led to an increase in energy tariffs, exerting significant pressure on consumers to find alternative solutions. One such solution has been the installation of photovoltaic projects, intended to replace grid energy with distributed renewable energy, thereby contributing to the reduction in energy intensity.

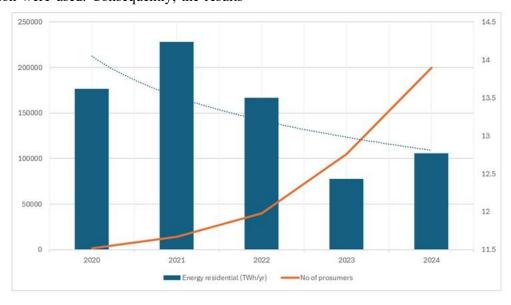
### Research Methodology

The authors of the study have identified factors that have influenced the variation in energy intensity either in real terms or statistically. For a clearer analysis, data on final electricity and gas consumption were used. Consequently, the results

of the discussions are valid and limited to the intensity of final energy consumption. Undoubtedly, the conclusions can be extended in a future study to the energy intensity of primary resources consumed in Romania.

**Prosumers impact.** More and more traditional consumers are transformed into flexible prosumers, this will lead to more random user behaviour on the demand side, inefficient management, potential conflict of interest, according to Li and Yang (2025). From the prosumers' perspective, energy storage will introduce more flexibility. Distributed energy resources along with energy storage facilities will take centre stage in the future, according to Mukherjee and al. (2025).

The impact of prosumers on a country's energy intensity is quite subtle. Typically, the meter that monitors the electricity consumption of a location is placed before the injection point of the green energy produced by photovoltaic panels FOR (free on-site renewable systems). Consequently, the entire amount of electrical energy produced and consumed internally will disappear from the statistics, not being recorded by the distribution operator. Energy intensity will be artificially affected, recording decreases related to the electricity consumption covered by photovoltaics.



**Figure 2** – Evolution of electricity consumption of residential against prosumers authorization

The decrease in Romanian residential energy consumption, especially considering the popularity of remote work in recent years, could be attributed to the effect of installing photovoltaic panels. Figure 2 presents a comparative view of the evolution of residential electricity consumption versus the increase in the number of prosumers. Note that not all residential photovoltaic projects qualified to become prosumers. The link between the two trends is clear, as a significant portion of consumption is missing from the statistics. It is not credible to attribute a sudden increase in residential consumers' preferences for energy-efficient equipment.

A similar situation can be found on a larger scale with industrial consumers who are prosumers

or just have photovoltaic projects exceeding 400 kWp. The energy produced and consumed in their own facilities is not monitored and can represent a significant portion of the total consumption. The decrease in electricity demand from the grid does not reflect the implementation of energy efficiency measures and gives a false signal by reducing energy intensity.

The use of heat pumps for the efficient heating/cooling processes in conjunction with photovoltaic projects will further accentuate the decline in energy intensity by replacing some natural gas consumptions included in statistics with hidden electricity consumptions.

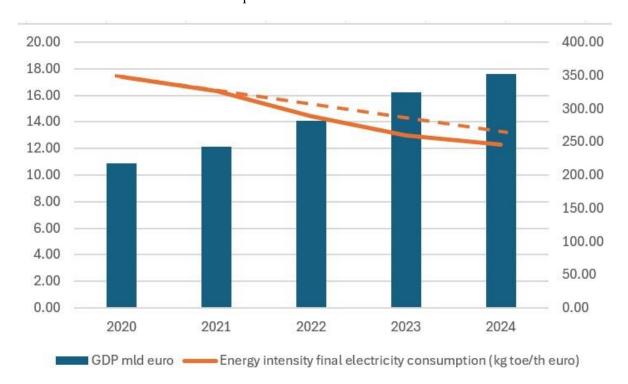


Figure 3 – Relation between the evolution of energy intensity and Romanian GDP

Figure 3 shows the decrease in the intensity of final electricity consumption compared to the evolution of GDP. It is obvious that the indicator has undergone a substantial change in trajectory

since 2021. This is exactly the moment when the increase in the number of prosumers was launched. The problem is a false image of the decrease in the intensity of final electricity consumption. This

could lead to an inhibition of the implementation of energy efficiency measures, by overlapping effects.

Storage facilities impact. A new tendance is on the market: energy storage projects have surged, with funding being provided. All prosumers and owners of small-scale photovoltaic power plants are encouraged to install batteries to avoid exporting electricity to the grid. It is reasonable to imagine that the electricity that will pass through the storage systems annually and then be consumed in internal installations will escape the statistics and will be found as a decrease in electricity consumption from the grid. Calculations show a doubling of the impact on electricity consumption monitored by meters.

Renewables and AI data-centres impact. The effect of renewable consumption on economic growth is positive and significant, and the impact coefficient in high-carbon areas is significantly larger than in low-carbon area, concluded Wang and Pang (2025). Ciobotea and al. (2024) reveals in their study a clear and growing commitment in Romania towards the adoption of alternative energy sources. According to Liu et al (2025), developed countries typically have more advanced technology and sufficient funding to promote the development of wind and solar energy, while developing countries, like Romania, face greater challenges due to the limitations in infrastructure and economic resources.

Yu et al. (2022) looked at how Renewable Energy affected Energy Intensity using the dynamic threshold regression model. According to the findings, there is a notable 2.2% drop in Energy Intensity for a country for every 10% rise in Renewable energy share.

Excellent research has been conducted by Castro et al. (2024) about data-centres energy demand. The analyse model reveals a concerning trend: despite the expansion in renewable energy capacities, they are likely insufficient to satisfy the burgeoning electricity need of the digital data sector. Future data centers designed to support AI development need cheap, green energy. The ideal

location for these new industrial energy consumers is at the edge of renewable energy projects, especially hydropower.

Romania is in the process of revitalizing old hydroelectric power projects that are in an advanced stage of execution. Once completed, they could become the ideal partner for AI servers. It is plausible to estimate that approximately 500 MW will be required for the development of AI in Romania. The essential condition for maintaining the economic efficiency of digital projects is their direct coupling with hydroelectric projects. As in the case of prosumers, the energy generated and directed to AI projects will no longer enter the grid or statistics. The GDP growth due to digitalization will not be reflected in an increase in the amount of electricity consumed and monitored.

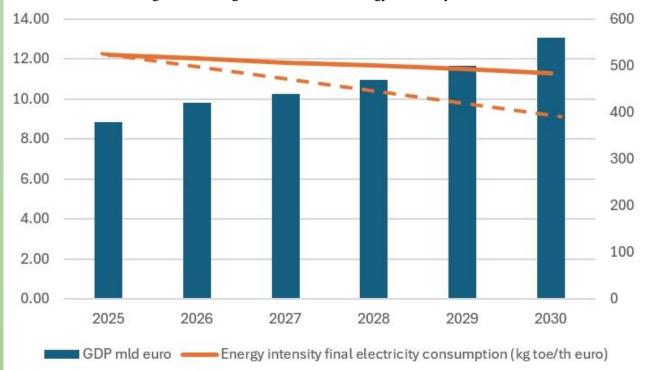
### **Research Results**

The lack of smart metering of the energy circulated between the grid, the photovoltaic panels and the consumer leads to interpretation errors and to the hiding of a part of the energy demand that disappears from the statistics. Some of the large energy consumers will think about purchasing land and building photovoltaic plants directly coupled to their industrial installations, rather than implementing energy efficiency measures.

The very dynamic development of battery storage systems may further complicate the situation by amplifying the quantities of electricity that escape the metering procedure. The solution is to rethink the method to measure energy demand considering the current realities of power supply schemes for industrial and residential consumers.

The transposition of Directive 2023/1791 on energy efficiency is expected to introduce reporting and auditing obligations for average size consumers in Romania. It is very important that these reported energy consumptions to be not affected by the presence of renewables and storage systems. Electrification as a solution for

decarbonization, the expansion of heat pumps, and electric mobility are vectors for the future increase in electricity demand in Romania. Using renewables and storage for a greener and affordable electricity supply is natural. False signals to statistics will lead to serios errors in funds programming and delays in improving energy efficiency.



**Figure 4** – Forecast of Romanian energy intensity value with and without correction of false signals

The installation of meters after the injection point of photovoltaic plants and storage facilities is the essential condition for registering real, reasonable progress in energy intensity. Figure 4 presents an expected variation in the case of eliminating unwanted influences. Additionally, with a dashed line, a trend of energy intensity variation without eliminating the effects of the factors analysed in this paper is illustrated. Energy consumption will continue to increase, but part of it will remain hidden from statistics. The difference between the two trends could reach up to 20%.

### Conclusions

Energy intensity is a very important indicator for monitoring the efficiency of energy use in an

economy. Several factors that are very present in this period can affect the accuracy of the calculation method for this indicator. Photovoltaic parks for self-consumption, prosumers, storage facilities, and digital sector consumers directly connected to the generators of hydroelectric power plants are all sources of error in the measurement and correct determination of energy intensity values. The only correct solution is the large-scale application of smart metering of electricity consumption, considering each case and the perfect isolation of consumer installations in the measurement scheme.

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# Determining the Key Factors Influencing the Real Estate Industry

Djalal Eddine YAHIAOUI<sup>1\*</sup>, Nor-Elhouda BELGHAZLI<sup>1</sup>, Asma Taous BENHIDJEB<sup>1</sup>, Ali BELAIDI<sup>1</sup>, Zohra Djihad BELGHAZLI<sup>2</sup>

<sup>1</sup>Higher National School of Management, 60 Kolea University Centre St. Tipaza, Algeria <sup>2</sup>University Of Ain Temouchent, 284 Sidi Bel Abbes Rd. Ain Temouchent, Algeria

Understanding consumer behavior and purchase intentions is essential for designing tailored offerings in the real estate market. This study examines the factors influencing these behaviors among Algerian consumers, utilizing the Theory of Planned Behavior (TPB) with its original constructs—attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC)—alongside additional extrinsic variables such as property location, financial considerations, perceived physical quality, brand image, Expenses and Timely Handover, Inside Fittings, Project Facilities, Corporate Reputation, Project duration

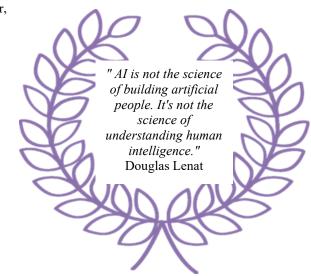
The results indicate that attitudes and perceived behavioral control significantly influence purchase intentions, while subjective norms do not. Additionally, property location emerged as a significant extrinsic factor impacting consumer purchase decisions.

These findings offer actionable insights for real estate developers, enabling them to refine their marketing strategies by addressing consumer preferences and adapting to the specific dynamics of the Algerian real estate market.

**Keywords:** Purchase intention, Theory of Planned Behavior, real estate developer

### Introduction

The global real estate sector stands as a significant contributor to the economy, with a diverse range of residential and commercial properties catering to varied consumer needs. Recent years have witnessed substantial growth in the sector, driven by factors such as urbanization, demographic shifts, and technological advancements (Pham Dinh et al., 2022). This growth underscores the vital role of real estate, including apartments and houses, in fulfilling human needs and offering opportunities for investment, security, and shelter (Ticoalu and



\*Correspondence to Djalal Eddine YAHIAOUI: yahiaouidjaleleddine@gmail.com

Tielung, 2015). Nevertheless, the real estate developers worldwide encounter intense competition (Savills, 2023). Understanding consumer behavior is therefore essential for developers to remain relevant and effectively market their properties, it also allows them to tailor their marketing strategies and offerings to better align with the evolving needs and preferences of consumers.

In this context, numerous countries and states, including Saudi Arabia (Al-Nahdi et al., 2015a), Turkey (Nakip and Gökmen, 2019), Dubai (Moawad, 2023), Surabaya (Septiani and Persada, 2020), and Vietnam (Pham Dinh et al., 2022), have conducted extensive research to comprehend the factors influencing consumer purchase intentions across diverse sectors, particularly in real estate.

The famous theory TPB is known for studying and understanding purchase intention through its three variables: attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC). However, the complexity of consumer behavior has led researchers to deviate from this theory in search of a model or theory that can fully explain these decisions (Judge et al., 2019). In this context, Septiani and Persada (2020) expanded the wellknown theory of planned behavior (TPB) by incorporating additional variables, namely cognition (P) and lifestyle (L). Their findings showed that attitude, cognition, and lifestyle were the primary drivers of purchase intention. Conversely, it was found that subjective norms and perceived behavioral control had no effect on consumers' intentions when purchasing apartments. Several other studies have also identified other variables that are crucial to understanding purchase intentions. These factors include property location (Nakib and Gokmen. 2019), financial considerations (Islam et al., 2022), perceived physical quality (Islam et al., 2022), brand (Li Huang et al., 2020), expenses and timeliness of transportation (Molah et al., 2023), interior design (Molah et al., 2009), project facilities (Li Huang, 2021), company reputation (Li Huang, 2021), and project duration (Kamal and Pramanik, 2015).

In Algeria, the real estate market presents a similar landscape of competition. In adition the market is characterized by a diverse array of housing options, with government-backed programs like AADL (National Agency for Housing Improvement and Development), LPA (Supported Promotional Housing) and LPP (Public Promotional Housing) offering affordable, subsidized, and upscale apartments, respectively. Moreover, initiatives like VSP (Sale on Plan), LSP (Participatory Social Housing) and LPL (Public Rental Housing) provide pre-construction purchase options, cooperative housing, and rental properties to cater to various needs (MHUV, 2024). This abundance of options can make it challenging for developers to differentiate their offerings and attract buyers. Therefore, gaining insights into the behavioral patterns and purchase intentions of Algerian consumers in this sector is paramount for property developers aiming to adeptly customize their offerings and strategies to meet the distinct demands of this market segment.

From this standpoint, we pose the following question search «What are the key factors influencing purchase intentions and consumer behavior of apartments from property developers in Algeria?». The objective of this research is to identify and examine the factors influencing purchase intentions and consumer behavior in the Algerian real estate market. We will specifically focus on the Theory of Planned Behavior (TPB), along with other factors that may affect the intention to purchase apartments from real estate developers. In our research, we adopt a positive epistemological stance, asserting that objective truth can be achieved through systematic observation and empirical validation. Our investigation into consumer behavior in the Algerian real estate market draws on the theory of planned behavior (TPB) and incorporates additional variables studied by other researchers, allowing for a more comprehensive identification of the factors influencing Algerian consumers' intention to purchase real estate developers.

### Literature Review

The real estate sector, deeply intertwined with global urbanization trends, has evolved into a pivotal arena for urban capital investment (Kabir and Jamal, 2023). Amidst a proliferation of real especially apartment estate ventures, construction, challenges like escalating costs and supply-demand imbalances persist (Pham Dinh et al. 2022). These challenges underscore the critical integrating consumer necessity of behavior concepts into housing research enhances understanding of decision-making within housing contexts (Sridevi and Padmaja, 2021). Also, the factors such as high costs, infrequent purchases, and perceived risks significantly influence individual decision-making, emphasizing the importance of analyzing buyer behavior for marketers (Le-Hoang, 2021).

Recent research emphasizes the paramount importance of discerning and addressing consumer needs, which encompasses factors like affordability, location, safety, and sustainability (Ezennia and Hoskara, 2019). Furthermore, understanding why consumers opt for specific products or services enables companies to tailor marketing strategies effectively, considering aspects such as brand loyalty, preferred locations, and budget considerations (Le Hoang, 2021).

Unlike business buyers procuring goods for production, individuals and households engage in property acquisition for deeply personal and intrinsic purposes (Gajera and Malek, 2018). Thus, individuals embark on a multifaceted journey of identifying needs, exploring options, and selectively choosing brands or products within the intricate landscape of real estate decisions (Nguyen Minh et al., 2023). This understanding is pivotal, as intention plays a key role in determining actual behavior (Al-nahdi et al., 2015a). In this context theoretical frameworks such as the Theory of Buyer Behavior Model, the Theory of Reasoned Action (TRA) (Young Yoo and Jeong, 2023), and the Theory of Planned Behavior (TPB) (Chia et al.,

2016), have been proposed and developed to analyze factors influencing consumer decision-making and predict purchase intention.

Interest in purchasing behavior in real estate began with the theory of buyer behavior proposed by Howard in 1963 and expanded by Howard and Sheth, integrates social, psychological, marketing influences on consumer choice, aiming to create a versatile model applicable to various buying scenarios, hence the use of "buyer" instead of "consumers" to encompass commercial purchases (Manuere and Manyeruke, 2022). Then Fishbein and Ajzen formulated the Theory of Reasoned Action (TRA) in 1975, emphasizing how beliefs shape attitudes, intentions and behaviors. TRA, stemming from attitude theory "which based either relatively stable objective associations, or temporarily constructed evaluations, which are formed through memory-based (cognitive) information processing or context - and affect based information processing" (Argyriou and Melewar, 2011), includes constructs like behavioral intention, attitude, and subjective norm (Al-Nahdi et al. 2015b).

However, researchers believe that previou theorie related to human behavior are limited (Sheppard et al, 1988). Therefore, it was suggested the Theory of Planned Behavior (TPB) was created to address this limitation (Pham Dinh et al. 2022). As Icek Ajzen (2020) emphasizes TPB's precision in defining behavior, crucial for predicting behaviors accurately, aligning with the principle of compatibility for enhanced marketers' insights. The theory emphasizes intention as pivotal in behavior, influenced by attitudes and subjective norms, as well as perceived behavioral control (Nguyen Minh et al. 2023). The latter acts as an indicator that enhances alignment with actual control and the likelihood of acting on intentions, providing a comprehensive understanding of human behavior (Hagger, 2019).

### **Research Model and Hypotheses**

Based on a range of studies, including research conducted by Judge et al. (2019), Moawad (2023), and Pham Dinh et al. (2022), it is evident attitude, subjective norms, and perceived behavioral control, have positive correlations with the purchase intention. This convergence of findings highlights the consistent impact of these factors on shaping consumer behavior and emphasizes their significance in understanding purchase decisions.

According to Pham Dinh et al. (2022), an individual's attitude towards a property significantly influences their intention to purchase it. This attitude reflects their preferences or aversions towards actions or entities, shaped by past behaviors. According to a study (Al-Nahdi et al. 2015a), they found that there is a strong correlation between a positive attitude and a higher purchase intention of real estate in Saudi Arabia. The study revealed that attitude plays a significant role in shaping purchase intention. Similarly (Zhang et al. 2020) found that attitude has a significant impact on behavior intention (BI) in China. Furthermore, a study conducted in Bangladesh showed a strong and stable relationship between attitude and buying intention, as reported by (Kamal et al. 2016).

H1: Attitude towards behavior (ATB) positively affects the intention to purchase an apartment from real estate developer.

Subjective norms play a crucial role in influencing individuals' intention to purchase apartments, indicating their significant impact on consumer behavior (Islam et al. 2022). Subjective norms (Le-Hoang et al., 2020) influenced by familial and social factors, represent customary beliefs that guide individuals' decisions about specific behaviors, including their intentions to engage in real estate transactions. A study led by Sharma and Akinwalere in 2023 in many countries such as Canada, the United Kingdom, and the United States underlines the substantial influence of

subjective norms on investment decisions. Correspondingly, Le-Hoang et (2020)discovered in their research that subjective norms effectively elucidate buying intentions in Vietnam. However, a divergent perspective emerges from Al-Nahdi et al. (2015c) study conducted in Saudi Arabia, which yielded mixed results. While the influence of family members, friends, and reference groups manifested varied impacts, the reference group component stood out as the most influential factor, despite the inconclusive influence of other social spheres.

H2: Subjective norms positively influence purchase intention an apartment from real estate developer.

Perceived behavioral control pertains to an individual's perception of how easy or difficult it is to act on their interests, based on their beliefs about what they can and cannot control, encompassing various barriers and facilitators that can influence their decision-making process (Ajzen, 2020). While individuals may feel that their behavior directly influences outcomes, factors such as time, money, product availability, skills, product knowledge, and previous purchases can significantly shape their perceived behavioral control. Additionally, the availability or scarcity of resources impacts consumer behavior, influencing aspects like consumer knowledge about the environment, cost, and access to eco-friendly, sustainable real estate, which ultimately shapes their purchase intentions for this product (Sharma and Akinwalere, 2023). Nonetheless, contrary findings from three studies by Dwi Septiani et al. (2020), Nguyen Minh et al. (2023) and Al Nahdi et al. (2015b) challenge this notion, suggesting that perceived behavioral control doesn't exert a statistically significant impact on apartment purchasing decisions across diverse locales.

H3: Perceived behavioral control positively influences purchase intention an apartment from real estate developer.

Delving into the complexities of real estate purchasing behavior, a synthesis of studies provides valuable insights into the myriad other factors influencing consumers' decisions. According to Nakip and Gökmen (2019), the locality of a property stands as the primary determinant influencing real estate purchasing behavior in Turkey. Similarly, Manoj P. K. (2014) underscores the significant impact of apartment location on customers' purchase decisions in India. Zinabu and Mitiku (2021) also highlight the critical role of location in Addis Ababa, Ethiopia. Additionally, Kumar and Khandelwal (2018) note that factors such as construction quality, ventilation, and proximity to amenities significantly homebuyers' preferences. Le-Hoang's studies in 2021 in Ho Chi Minh City, Vietnam, consistently reaffirm the crucial role of location in shaping purchase intentions. Kamal and Pramanik (2015) further demonstrate the profound effect of localization on attitudes towards purchasing apartments in Dhaka City. Overall, these studies collectively demonstrate the paramount importance of property location in driving real estate purchase decisions in many countries.

Shifting focus to the financial aspect, financial factors are identified as significant determinants of purchase intentions in various countries. Islam et al. (2022) indicate their importance in Bangladesh, while Le-Hoang (2021) finds similar results in Vietnam. Kebede, Zinabu, and Mitiku (2021) emphasize financial considerations in Ethiopia's emerging markets. Mollah et al. (2009) reveal the significant impact of apartment prices and sources of finance on purchase intentions in India, and Moawad (2023) highlights finance as a positive influencer in Dubai's residential real estate market.

Beyond location and finance, various other factors influence purchase intentions across different contexts. Perceived physical quality is crucial in Bangladesh (Islam et al., 2022), while brand image does not significantly influence apartment purchase intentions in Ho Chi Minh City,

Vietnam (Le-Hoang et al., 2020). Factors such as expenses and timely handover of properties are pivotal in shaping buying preferences across countries (Mollah et al. 2009). Inside fittings impact apartment choice decisions, indicating their influence in diverse markets. Project facilities significantly relate to buying attitudes and intentions in Vietnam, emphasizing their role in consumer perceptions (Le-Hoang, 2021). Perceived quality positively affects decisions to buy apartments in Ho Chi Minh City (Nguyen Minh et al. 2023), and corporate reputation is a significant influencer of purchase intentions in the same city (Le-Hoang, 2021). These results highlight the complexity of consumer behavior in real estate markets, which emphasizes the presence of extrinsic attributes that can influence purchase intention.

H4: The extrinsic attributes related to the property or the real estate developer influences purchase intention.

To better understand this influence, H4 is divided into the following sub-hypotheses, each addressing a specific extrinsic factor:

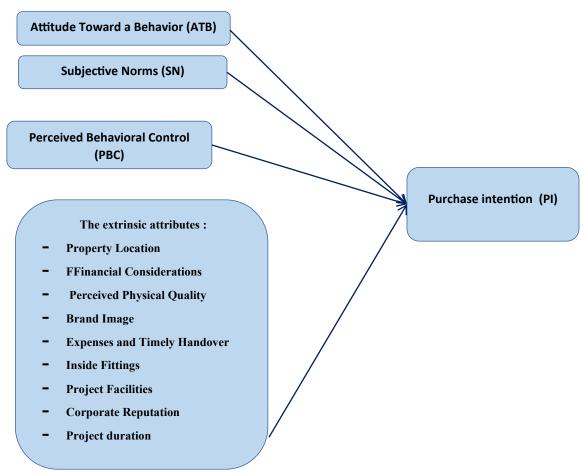
- H4a: The location of the property influences purchase intention.
- H4b: Financial considerations associated with the property influence purchase intention.
- H4c: The perceived physical quality of the property influences purchase intention.
- H4d: The brand image of the real estate developer influences purchase intention.
- H4e: Expenses and the timely handover of the property influence purchase intention.
- H4f: The quality of inside fittings in the property influences purchase intention.
- H4g: The availability of project facilities influences purchase intention.
- H4h: The corporate reputation of the real estate developer influences purchase intention.
- H4i: The project duration influences purchase intention.

From the above the conceptual framework can be visualized in a Conceptual Model (Figure 1).

### Research Methodology

This study aims to identify the factors influencing consumer behavior and purchase

intentions in the Algerian real estate market, specifically in the context of buying apartments from real estate developers. To achieve a understanding comprehensive of purchase intentions, the study extends beyond the dimensions of the TPB model by incorporating extrinsic attributes that may affect purchase intentions, as discussed in the theoretical framework.



**Figure 1** – *Conceptual Framework of the Study* 

Methodological approach. To achieve this, a quantitative approach was deemed appropriate, as it allows for effective generalization of the results. Consequently, we chose to conduct a questionnaire directed at a representative sample of a specific segment of the Algerian consumer population.

Population of atudy. The target population for this study includes individuals from various states in Algeria, aged 20 to over 60 years, who are financially capable of property acquisition or home loan payments. These individuals meet the financial threshold established by the National Statistics ONS (2024). The target segment encompasses approximately 15,628,664 individuals in the study population.

Method calculates sample and sampling. To gather data, the study employed a non-random convenience sampling technique, opting for convenience due to the difficulty in finding

individuals with the required characteristics. Filtering questions were used to eliminate unsuitable responses. This approach was chosen due to the infinite nature of the population. In determining the sample size, the website 'Survey Monkey' was utilized, specializing in questionnaire surveys. With a margin of error of 5% and a confidence interval of 95%, the estimated sample size reached 385. However, the study exceeded this target, obtaining 399 responses.

Research Method and Tools. Data was collected from respondents using a questionnaire, structured into four main sections and based on theories pertinent to this field.

• The first section focused on the dimensions of the TPB model, utilizing a Likert scale to assess these variables (Table 1).

**Table 1** – Reliability and Source Evaluation of Measurement Variables

Variable	Questions	Items	Source	Value of Cronbach's Alpha	Evaluation Schrepp.2020
Attitude Toward Behavior (ATB)	On a scale of 1 to 5, where 1 is 'strongly disagree' and 5 is 'strongly agree', please indicate the extent to which you agree with the following statements about buying an apartment from a property developer: What is your attitude towards property offered by developers?	I think it's a good idea.  I think it's a wise decision.  I think it's an admired	Pham Dinh et al., 2022	.940	Excellent
Subjective norms (SN)	Please indicate your level of motivation to buy an apartment from a property developer:	My spouse encourages me to buy the apartment.  My family expects me to own an apartment.  My friends and colleagues influenced me to buy the apartment.  The brokers/ consultants impacted me to buy the apartment.	Nguyen Minh et al., 2023	.845	Good
Perceived Behavioral Control (PBC)	Buying an apartment from a property developer offers:	Enough time to decide  Flexible financial resources.  Enough skills and knowledge about apartments to make my own decision  Total control over your purchase	Pham Dinh et al., 2020	.914	Excellent

• The second section examined the significance of extrinsic attributes for Algerian consumers when considering property purchases,

employing a metric scale from 1 to 10 to gauge the importance of each element (Table 2).

**Table 2** – Extrinsic Attributes and Their Sources

Extrinsic attributes	Source
Property Location, Financial Considerations, Perceived Physical Quality, Brand Image, Expenses and Timely Handover, Inside Fittings, Project Facilities, Corporate Reputation, Project duration	Pham Dinh et al., 2022 – Zinabu and Mitiku, 2021 – Kamal and Pramanik, 2015 – Islam et al., 2022.

• The third section evaluated the respondents' intentions to purchase an apartment from a real estate developer (Table 3).

**Table 3** – Evaluation of Purchase Intention Variables

Variable	Items	Source	Value of Cronbach's Alpha	Evaluation (Schrepp.2020)
Purchase intention (PI)	I intend to buy I am an essential person in buying	Le-Hoang. 2020	0.890	Good

### **Results and Discussion**

Demographic characteristics of respondents. Table 4 provides detailed information on the demographic profiles of the respondents, encompassing their gender, age, marital status,

occupation, and income levels. This data is crucial for understanding the characteristics of the respondents who participated in the survey aimed at predicting the purchase intention of real estate apartments through consumer behavior factors.

**Table 4** – Demographic characteristics of participants

Particulars	Items	Frequency (n = 399)	Percentage
Gender	Male	246	61,7%
	Female	153	38,3%
Age	21–30 years	131	32,8%
	31–40 years	143	35,8%
	41–50 years	82	20,6%
	51–60 years	29	7,3%
	61–Above	14	3,5%
Occupation	Employee	296	74,2%
	Own Business	67	16,8%
	Retired	36	9%
Income	20 000 - 40 000 DA	27	6,8%
	40 000 - 60 000 DA	94	23,6%
	60 000 - 80 000 DA	192	48,1%
	Above 80 000 DA	86	21,6%

The majority of respondents are male, accounting for 61.7% of the sample, while females represent 38.3%. This gender distribution could reflect the general demographics of the real estate

market or the specific characteristics of the surveyed population. The age distribution reveals that most respondents fall within the 31-40 years age range (35.8%), followed closely by those aged 21-30 years (32.8%). This indicates that the primary age group interested in purchasing real estate apartments is young to middle-aged adults, which is typical as this demographic is often in the phase of life where purchasing property becomes a priority. The occupation data indicates that a significant portion of the respondents are employees (74.2%), with a smaller percentage running their own businesses (16.8%) or being retired (9%). This distribution highlights that the employed population is the most active in the real estate market, likely due to their stable income and financial planning. Income levels vary among the respondents, with the largest group earning between 60,000 - 80,000 DA

(48.1%), followed by those earning 40,000 - 60,000 DA (23.6%). A notable portion of the sample also earns above 80,000 DA (21.6%). This income distribution is crucial as it correlates with the financial capability to invest in real estate, indicating a robust market potential among middle-to high-income earners.

**Descriptive analysis of the study.** In this section, we will present the univariate analysis of the data collected from our survey. We will start with the descriptive statistics related to respondent eligibility, followed by the descriptive statistics for the main study questions (Table 5).

Table 5 –	Descriptive	statistics	and	evaluation	of	`variables

	Mean of the variable	General standard deviation of the variable	Evaluation of the variable
Attitude towards behavior	4,23	0,76	Strongly agree
(ATB)			
Subjective Norms (SN)	3,9	0,95	Agree
Perceived Behavioral Control	4,10	0,89	Agree
(PBC)			
Purchase intention (PI)	4,27	0,799	Strongly agree

The mean and standard deviation for each variable provides insights into respondent attitude (Table 6). 'Attitude Towards Behavior' shows a mean of 4.23 with a standard deviation of 0.76, indicating strong agreement with its items. 'Subjective Norms' exhibit a mean of 3.90 and a standard deviation of 0.95, suggesting agreement

among respondents. 'Perceived Behavioral Control' records a mean of 4.10 and a standard deviation of 0.89, further reflecting agreement. 'Purchase Intention' stands out with a mean of 4.27 and a standard deviation of 0.799, indicating strong agreement regarding purchase intention.

**Table 6** – Extrinsic Attributes: Mean Scores and Evaluation

<b>Extrinsic attributes</b>	Mean of the variable	Evaluation of the variable
Property Location	8,11	Quite important
Financial Considerations	8,13	Quite important
Perceived Physical Quality	7,97	Quite important
Brand Image	7,52	Quite important
<b>Expenses and Timely Handover</b>	7,99	Quite important
Inside Fittings	7,87	Quite important
Project Facilities	7,88	Quite important
Corporate Reputation	7,86	Quite important
Project duration	7,91	Quite important

The mean ratings for these factors are all above 7: Property Location (PL) is 8.11, Financial Considerations (FC) is 8.13, Perceived Physical Quality (PPQ) is 7.97, Brand Image (BI) is 7.52, Expenses and Timely Handover (ETH) is 7.99, Inside Fittings (IF) is 7.87, Project Facilities (PF) is 7.88, Corporate Reputation (CR) is 7.86, and Project Duration (PD) is 7.91. These ratings indicate that respondents consider these aspects quite important when evaluating real estate.

Test of hypothesis. To assess the proposed hypotheses within the methodological framework and examine the influence of study variables on purchase intention, we conducted a multiple linear regression analysis. In this analysis, the dependent variable was purchasing intention, while the independent variables consisted of attitude towards behavior (ATB), Subjective Norms, perceived behavioral control (PBC) and extrinsic attributes.

Before proceeding with the multiple linear regression test, we first ensured the necessary conditions for conducting the test (Table 7).

<b>Table 7</b> – <i>Conditions</i>	and	Verif	ication	of	Mul	tipl	e Regression
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Condition	Verification	Rectification
The nature of the variables	Quantitative variables	Verfied
Dispersion linear the dependent variable and the independent variable	SPSS using scatterplots	Verified
Normal distribution	non-normality	Normalizing the data.
The multicollinearity	- The variance inflation factors (VIF) between 1,079 & 2,159 respected - The tolerance is above 0,2 respected	
Autocorrelation	The Durbin-Watson statistics 1.9>1.896 and 4-1.9>1.896 Residuals are not autocorrelated	Verified

After verifying the necessary conditions for applying multiple linear regression, all variables were standardized in order to ensure accuracy in the results.

**Result of multiple linear regression.** Following a thorough examination of the prerequisites, we transitioned to a stepwise multiple linear regression

analysis, this method allows us to identify the variables that significantly influence purchase intention, identify the most influential variables, and determine the most reliable model. Table 8 illustrates the outcomes of this stepwise multiple linear regression analysis.

**Table 8** – *Model Summary* 

Model	R	R-squared	Adjusted R-squared	R-squared change	F change	Sig
1	0,723	0,523	0,522	0,523	435,575	0,00
2	0,769	0,592	0,590	0,069	66,539	0,00
3	0,783	0,613	0,610	0,021	21,378	0,00

Table 9 presents the results of a multiple linear regression analysis with three different models. Model 3 stands out as the most reliable, demonstrating an Adjusted R-squared value of 0.610. The results of this model indicate that there is a strong relationship of 0.783 between the independent variables and the dependent variable. R

squared indicate that 61.3% of the variability in purchase intention can be explained by the inclusion of variables such as purchase intention itself. The significance level (Sig) for all three models is 0.00, confirming their statistical significance dans le interval de confidence of 95%.

Table 9 – Statistical coefficients

Model		Unstandardized	l coefficients	Standardized coefficients	t	Sig	
		В	Standard Error	Beta			
3	(Constant)	0,655	0,151		4,332	0,00	
	ATB	0,442	0,49	0,418	9,092	0,00	
	PBC	0,329	0,041	0,366	7,991	0,00	
	Property Location	0,049	0,011	0,150	4,624	0,00	

The Coefficients table presents standardized coefficients (Beta), t-values, and significance levels (Sig) for each variable in Model 3. For ATB (Attitude Towards Behavior), the standardized Beta is 0.418, indicating a positive impact on purchase intention with a significant t-value of 9.092 (Sig = 0.00). PBC (Perceived Behavioral Control) shows a standardized Beta of 0.366, also positively influencing purchase intention with a significant t-value of 7.991 (Sig = 0.00). Property Location has a standardized Beta of 0.150, demonstrating a positive impact on purchase intention with a significant t-value of 4.624 (Sig = 0.00). These findings underscore the importance of these variables in predicting purchase intention.

The study tested several hypotheses regarding the factors influencing purchase intention. The first hypothesis (H1) posited that attitude toward behavior (ATB) positively influences purchase intention, which was validated by the results. The second hypothesis (H2) suggested that subjective norms positively influence purchase intention; however, this hypothesis was not validated. The

third hypothesis (H3) proposed that perceived behavioral control positively influences purchase intention, and this was also validated. Additionally, among the extrinsic attributes examined, only the property location was found to have an impact on purchase intention. Thus, we accept the subhypothesis H4a.

The results of the multiple linear regression analysis for the third model reveal that the Subjective Norms dimension, representing the second component of the Theory of Planned Behavior (TPB), does not influence the intention to purchase real estate in Algeria. Additionally, while consumers recognize the importance of various extrinsic factors such as (Financial Considerations, Perceived Physical Quality, Brand Image, Expenses and Timely Handover, Inside Fittings, Project Facilities, Corporate Reputation, and Project Duration) these factors do not significantly impact their intention to purchase real estate from developers. This conclusion is supported by the Tvalues and significance levels are above 0.05 presented in Table 10.

Model 3	Beta included	Т	Sig	Decision
Subjective norms	0,065	1,753	0,080	H2 Rejected
Financial Considerations	- 0,004	- 0,041	0,968	H4b Rejected
Perceived Physical Quality	- 0,066	- 0,805	0,421	H4c Rejected
Brand Image	- 0,060	- 1,267	0,206	H4d Rejected
Expenses and Timely Handover	0,009	0,123	0,902	H4e Rejected
Inside Fittings	- 0,029	- 0,498	0,619	H4f Rejected
Project Facilities	0,039	0,643	0,520	H4g Rejected
Corporate Reputation	0,017	0,299	0,765	H4h Rejected
Project duration	- 0,009	- 0,138	0,890	H4i Rejected

**Table 10** – Excluded variables

### **Discussion of Results**

The results demonstrate that attitude toward behavior (ATB), and perceived behavioral control (PBC) significantly influence purchase intention from a real estate devloper. This aligns with previous research emphasizing the importance of these factors in driving real estate purchase decisions. Al-Nahdi et al. (2015) found the attitude and perceived behavioral control significant in Saudi Arabia, while Zhang et al. (2020) in China identified the significance of attitude, and Moawad (2023) in Dubai highlighted the significance of both attitude and perceived behavioral control.

The results of this study demonstrate also, the property location is predictor critical role in shaping consumer preferences and purchase intentions. This aligns with the findings of Nakip and Gökmen (2019) in Turkey and Kumar and Khandelwal (2018) in India. As consumers place significant importance on property location due to factors such as proximity to amenities, quality of the neighborhood, and accessibility, collectively enhancing the attractiveness of the property.

In the analysis results, we observed that there was not a significant relationship between subjective norms and purchase intention, which is in line with findings from some previous studies such as those by Sharma and Akinwalere (2023) across many countries including Canada, the United Kingdom, and the United States, as well as by Le-Hoang et al. (2019) in Vietnam suggesting that

subjective norms may not consistently influence purchase intention in certain contexts. In the Algerian real estate market, individual decision-making might be more influenced by personal attitudes and perceived control rather than social pressures or expectations. This deviation from the conventional TPB model implies that marketing strategies should perhaps focus more on enhancing individual confidence and perceived value rather than relying on social influence tactics.

Financial considerations, such as the availability of financing options and property affordability, are often significant in real estate purchase decisions in different contexts, as demonstrated in studies from Bangladesh (Islam et al. 2022) and Vietnam (Le-Hoang, 2020). Brand image, which reflects the reputation and credibility of the real estate developer, can strongly influence consumer trust and their intention to purchase, as highlighted in the study from Vietnam (Le-Hoang et al., 2019). Also, Project facilities, encompassing amenities and infrastructure within the property, can enhance the perceived value and attractiveness of a real estate project, as seen in studies from Vietnam (Le-Hoang, 2020; Le-Hoang et al., 2019). These variables are also important for the Algerian consumer when purchasing a real estate in general. However, they were excluded from the regression model in this study, suggesting that, in the the context of purchasing a property from a real estate devloper, these factors do not play a decisive role in shaping purchase intentions.

The results of the confirmatory analysis conducted with AI Rtutor 0.98 validate the model we derived from linear regression, confirming the validity of our findings. Based on the results of the

study, we propose a model (Figure 2) consisting of three variables that significantly impact purchase intention, which encapsulates the outcomes of our research.

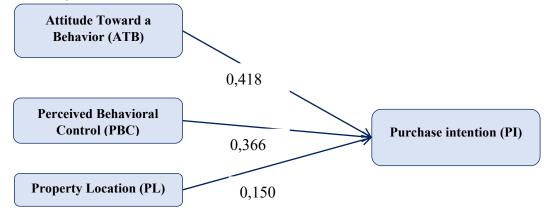


Figure 2 – The Algerian index of customer purchase intention in the real estate developer industry

### Conclusions

In conclusion, our study aimed to investigate the factors influencing consumer behavior and purchase intentions in the Algerian real estate market, specifically focusing on consumer behavior towards real estate developers. Through a quantitative approach with a sample size of 399 respondents, we collected data using structured questionnaires to analyze the impact of TPB factors and extrinsic attributes on purchase intention. Previous studies in this context indicate that the Theory of Planned Behavior (TPB) is the most appropriate theory for predicting real estate purchase intention. However, our study revealed that attitudes toward behavior and Perceived behavioral control are the basic determinants of purchase intention without the subjective norms, Additionally, the extrinsic attribute of property location has a significant effect on the purchase intention of the Algerian consumer. Our study emphasizes the importance of identifying the specific factors that influence consumer intention to purchase apartments in our target market. It highlights how these factors can vary significantly from one country to another. These findings are particularly valuable for real estate developers aiming to align their marketing strategies with consumer behavior in Algeria.

The limitation: This research relies primarily on the Theory of Planned Behavior (TPB) and incorporates additional external variables that may influence purchase intention. However, it does not explore or expand upon the broader dimensions of consumer behavior. Moreover, the study is narrowly focused on a single category of real estate: developers.

Implications for real estate developers and investors. These findings can be instrumental for real estate developers and investors seeking to gain deeper insights into consumer behavior in the Algerian market. The emphasis on strategic location and comprehensive facilities aligns closely with the identified factors influencing purchase intention. By leveraging these results, developers and investors can refine their understanding of consumer preferences and effectively tailor their projects to meet the evolving demands of the market, thereby enhancing competitiveness.

Aligning offerings with consumer expectations. By aligning project offerings more closely with consumer expectations and preferences, this approach not only enhances the developer's competitive edge but also fosters greater satisfaction among consumers. It exemplifies how a reputable developer successfully leverages key factors such as location and perceived control to drive consumer purchase intention.

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"AI will be the most transformative technology since electricity." Eric Schmidt

### \ hstract

### Adoption of Artificial General Intelligence in Business Communication

### Alexandra PUTANU

Link Group Education Services, 28 Academiei Street, Bucharest, Romania

The rapid evolution of artificial intelligence (AI), particularly in the context of digital communication, has transformed the way organizations engage with their stakeholders. In the services industry, social media platforms powered by AI algorithms play a pivotal role in shaping brand perception, optimizing content distribution, and enhancing customer interaction. However, as technological advancements move toward the development of Artificial General Intelligence (AGI), the potential implications for organizational communication become profound. This theoretical paper aims to investigate how the transition from narrow AI systems, currently employed in social media environments, to the broader, more autonomous capabilities envisioned in AGI may impact organizational communication models in the services sector. The study analyzes existing algorithmic frameworks used for personalization, recommendation, and content moderation to identify the strengths and limitations of current technologies, and explores how AGI could enable adaptive, context-aware dialogue systems and influence strategic decision-making.

Keywords: Artificial General Intelligence, Organizational Communication, Services Industry

### Introduction

The integration of Artificial Intelligence (AI) into organizational communication has reshaped the services industry, enhancing efficiency and personalization. (Brynjolfsson and McAfee, 2017). However, the emergence of Artificial General Intelligence (AGI) promises a more profound transformation, enabling machines to perform any intellectual task that humans can (Goertzel and Pennachin, 2007). This paper explores the theoretical implications of transitioning from AI to AGI in organizational communication, examining potential benefits, challenges, and ethical considerations.

In the last decade, artificial intelligence (AI) has become an integral part of digital business Correspondence to Alexandra PUTANU: alexandra\_putanu@yahoo.com



operations, especially within the services industry. From recommendation systems to automated customer interaction, AI-powered tools have redefined the boundaries of organizational communication (Anagnostopoulos et al., 2018). Social media platforms, such as Facebook, Instagram, LinkedIn, and TikTok, are now embedded with algorithms capable of analyzing user behavior, customizing content, and enhancing real-time engagement between organizations and their audiences (Beauvisage et al., 2024). These developments, while impactful, remain confined to what is commonly referred to as narrow or weak AI. systems designed for specific tasks with limited contextual understanding (Russell and Norvig, 2016).

As the field progresses toward Artificial General Intelligence (AGI), capable of autonomous learning and human-like reasoning across multiple domains, new questions emerge regarding its potential to reshape how communication is conceptualized and practiced within organizations (Goertzel and Pennachin, 2007). Unlike narrow AI, AGI systems could understand context, adapt messages to emotional states, and even participate meaningfully in strategic decision-making processes (Kaplan and Haenlein, 2019).

This article aims to explore, from a theoretical standpoint, how the transition from algorithm-driven social media strategies to AGI-based communication systems may impact the services sector. It examines the evolution of digital tools used in organizational communication, discusses the implications of AGI integration, and proposes a conceptual framework for adapting communication models to this emerging technological frontier.

The implications of this study are both theoretical and practical. It offers researchers a foundation for rethinking digital interaction frameworks in the context of AGI, and provides business leaders in the services industry with a strategic lens to anticipate and manage the potential challenges and transformations brought by AGI, including ethical dilemmas, organizational redesign, and technological readiness.

The originality of this research lies in its conceptual approach to bridging the gap between current AI applications and the emerging paradigm

of AGI within business communication. While most studies focus on narrow AI functionalities, this paper introduces a forward-looking perspective on AGI's disruptive potential, proposing a framework for strategic adaptation in organizational communication models, a topic still underexplored in the literature. My analysis offers a conceptual foundation for understanding the disruptive potential of AGI in business communication, proposing a framework for strategic adaptation in the services sector. This perspective invites researchers and managers to reimagine the future of organizational interaction in an increasingly intelligent digital environment.

### Literature Review

This research adopts a qualitative approach, conducting a comprehensive literature review of applications existing AI in organizational communication and theoretical frameworks surrounding AGI (Anatriello et al., 2024). The study analyzes peer-reviewed journals, industry reports, and academic publications to identify current trends, limitations, and prospects. Additionally, insights from the author's doctoral research provide a foundational perspective on the evolution of communication technologies in the services sector.

Artificial Intelligence (AI) refers to systems designed to perform specific tasks by mimicking human intelligence, such as image recognition, language translation, or recommendation algorithms (Russell and Norvig, 2016). These are often termed "narrow AI" due to their limited scope and task-specific nature.

In contrast, Artificial General Intelligence (AGI) denotes a form of AI with the capacity to understand, learn, and apply knowledge across a wide range of tasks, matching or surpassing human cognitive abilities (Goertzel and Pennachin, 2007). AGI systems would possess the flexibility and adaptability to perform any intellectual task that a human can, making them fundamentally different from current AI applications. While narrow AI systems are prevalent in today's technology landscape, AGI remains a theoretical construct, with ongoing debates about its feasibility and potential timelines for realization.

AI has become integral to social media platforms. enhancing user experience organizational communication through various applications like: content personalization (platforms like Facebook and Instagram utilize AI algorithms to analyze user behavior, tailoring content feeds to individual preferences, thereby engagement) (Beauvisage et al., 2024), chatbots and virtual assistants (Businesses deploy AI-powered chatbots on platforms such as Facebook Messenger to provide instant, personalized customer service, improving response times and user satisfaction) (Anatriello et al., 2024), sentiment analysis (AI tools assess public sentiment by analyzing comments, shares, and reviews, enabling brands to gauge audience perception and adjust strategies accordingly), (Bhattacharya et al., 2023), predictive analytics (by examining user data, AI predicts trends and user behavior, allowing for more targeted advertising and content strategies), (Davenport and Ronanki, 2018).

These applications demonstrate AI's significant shaping modern social communication, offering more personalized and efficient interactions between organizations and their audiences. In contemporary organizational settings, AI algorithms have become integral to communication strategies, particularly within the services industry. These algorithms facilitate various functions: content Personalization (AI systems analyze user data to tailor content, enhancing relevance and engagement), automated Customer Interaction (Chatbots and virtual assistants provide real-time responses, improving customer service efficiency), Sentiment Analysis (AI tools assess public sentiment by analyzing feedback, enabling organizations to adjust their communication strategies accordingly) (Anagnostopoulos et al., 2018).

While AI technologies offer numerous benefits, they also present certain risks and limitations like: Lack of Contextual Understanding (AI systems may misinterpret nuanced human communication, leading to misunderstandings), Ethical Concerns (the use of AI raises questions about privacy, data security, and the potential for biased decision-making), Dependence on Technology (over-reliance on AI can diminish human oversight,

potentially leading to errors in communication strategies). Addressing these challenges is crucial for the effective integration of AI into organizational communication frameworks.

### **Methodology**

This research adopts a qualitative approach, conducting a comprehensive literature review of existing ΑI applications in organizational communication and theoretical frameworks surrounding AGI. The study analyzes peerreviewed journals, industry reports, and academic publications to identify current trends, limitations, and prospects. Additionally, insights from the author's doctoral research provide a foundational perspective on the evolution of communication technologies in the services sector.

### AI vs AGI: Definitions and Distinctions

Artificial Intelligence (AI) refers to systems designed to perform specific tasks by mimicking human intelligence, such as image recognition, language translation, or recommendation algorithms. These are often termed "narrow AI" due to their limited scope and task-specific nature.

In contrast, Artificial General Intelligence (AGI) denotes a form of AI with the capacity to understand, learn, and apply knowledge across a wide range of tasks, matching or surpassing human cognitive abilities. AGI systems possess the flexibility and adaptability to perform any intellectual task that a human can, making them different fundamentally from current applications (Goertzel and Pennachin, 2007). While narrow AI systems are prevalent in today's technology landscape, AGI remains a theoretical construct, with ongoing debates about its feasibility and potential timelines for realization.

Role of AI in Social Media Communication Today

Artificial intelligence has become an essential component of social media platforms, significantly enhancing user experience and organizational communication through a variety of applications. Platforms such as Facebook and Instagram utilize AI algorithms to analyze user behavior, allowing

them to personalize content feeds according to individual preferences, which in turn increases user engagement (Backlinko, 2024). Additionally, businesses deploy AI-powered chatbots on platforms like Facebook Messenger to deliver instant and personalized customer support, resulting in faster response times and higher user satisfaction (Anatriello et al., 2024). Sentiment analysis tools powered by AI assess public perception by interpreting comments, shares, and reviews, enabling brands to better understand audience reactions and adjust their strategies accordingly (Bhattacharya et al., 2023). Furthermore, by examining user data, AI can predict trends and user behaviors, which facilitates the development of more targeted advertising campaigns and content strategies (Beauvisage et al., 2024).

These applications demonstrate AI's significant role in shaping modern social media communication, offering more personalized and efficient interactions between organizations and their audiences.

### Current Use of AI Algorithms in Organizational Communication

In contemporary organizational settings, AI algorithms have become integral to communication strategies, particularly within the services industry. These algorithms facilitate a range of functions that are crucial for modern communication strategies. One of the key applications is content personalization, where AI systems analyze user data to customize content delivery, thereby increasing its relevance and boosting user engagement. Another important function is automated customer interaction, as chatbots and virtual assistants use AI to provide real-time responses, which significantly enhances the efficiency of customer service. Additionally, sentiment analysis tools powered by AI evaluate public feedback, allowing organizations to understand audience sentiment and adapt their communication strategies accordingly. Together, these applications highlight the pivotal role of artificial intelligence in shaping contemporary organizational communication, enabling more personalized and effective interactions between organizations and their audiences.

### Risks and Limitations

Addressing these challenges is crucial for the effective integration of AI into organizational communication frameworks. While AI technologies offer numerous benefits, they also come with certain risks and limitations that must be carefully considered. One significant issue is the lack of contextual understanding, as AI systems can misinterpret nuanced human communication, which may result in misunderstandings. Additionally, the use of AI raises several ethical concerns, particularly regarding privacy, data security, and the risk of biased decision-making based on flawed or incomplete data. Another limitation is the growing dependence on technology, as excessive reliance on AI can reduce human oversight, potentially leading to mistakes in communication strategies.

### AGI Perspective and Future Implications

a. How AGI Could Impact Business Communication

Artificial General Intelligence (AGI) represents a significant leap from current AI capabilities, offering systems that can perform any intellectual task that a human can. In the context of business communication, AGI could revolutionize interactions by enabling systems to understand context, interpret emotions, and adapt messages accordingly. This would allow for more personalized and effective communication strategies, enhancing customer engagement and satisfaction.

For instance, AGI-powered virtual assistants could manage complex customer inquiries, negotiate deals, or provide strategic insights, all while learning and adapting from each interaction. This level of sophistication would surpass current AI applications, which are limited to predefined tasks and lack true understanding.

b. Autonomy, Adaptability, and Ethical Dilemmas

The integration of AGI into business communication introduces several ethical considerations. The autonomy of AGI systems raises questions about accountability, especially when decisions made by these systems have significant consequences (Russell and Norvig, 2016). Additionally, the adaptability of AGI could lead to unpredictable behaviors, challenging existing regulatory frameworks.

Organizations must also consider the implications of AGI on employment, as tasks traditionally performed by humans could be automated. Ensuring transparency, fairness, and ethical use of AGI will be crucial to maintaining trust and integrity in business practices.

### **Results and Discussion**

The analysis reveals that current AI applications, such as chatbots and recommendation systems, have improved customer interaction and operational efficiency. However, these systems are constrained by their narrow focus and inability to adapt to complex, dynamic scenarios. AGI promises to overcome these limitations by offering machines the ability to understand context, learn from experience, and make autonomous decisions. This advancement could lead to more nuanced and effective communication strategies organizations. Nevertheless, the implementation of AGI raises ethical concerns, including data privacy, decision-making accountability, and potential job displacement. Organizations must navigate these challenges carefully to harness AGI's benefits responsibly.

The adoption of AGI in business communication presents numerous strategic opportunities. Companies could leverage AGI to enhance customer experiences through more responsive and personalized interactions. Internally, AGI could facilitate better collaboration and decision-making by providing real-time insights and recommendations.

Moreover, AGI could enable businesses to analyze vast amounts of data more efficiently, identifying trends and opportunities that would be difficult for humans to discern. This could lead to more informed strategies and a competitive edge in the market.

Transitioning from current AI tools to AGI-driven systems will require significant investment in infrastructure, training, and change management. Organizations must assess their readiness for AGI integration, considering factors such as data quality, technological capabilities, and organizational culture.

Developing a clear roadmap for AGI adoption, including pilot programs and stakeholder engagement, will be essential. Additionally,

companies should establish ethical guidelines and governance structures to oversee AGI implementation and ensure responsible use.

### **Conclusions**

Artificial General Intelligence (AGI) represents a significant leap from current AI capabilities, offering systems that can perform any intellectual task that a human can. In the context of business communication. could revolutionize AGI interactions by enabling systems to understand context, interpret emotions, and adapt messages accordingly. This would allow personalized and effective communication strategies, enhancing customer engagement and satisfaction. For instance, AGI-powered virtual assistants could manage complex customer inquiries, negotiate deals, or provide strategic insights, all while learning and adapting from each interaction. This level of sophistication would surpass current AI applications, which are limited to predefined tasks and lack true understanding.

The integration of AGI into business communication introduces several ethical considerations. The autonomy of AGI systems raises questions about accountability, especially when decisions made by these systems have significant consequences. Additionally, the adaptability of AGI could lead to unpredictable behaviors, challenging existing regulatory frameworks.

Organizations must also consider the implications of AGI on employment, as tasks traditionally performed by humans could be automated. Ensuring transparency, fairness, and ethical use of AGI will be crucial to maintaining trust and integrity in business practices.

Artificial General Intelligence holds the potential to transform business communication fundamentally. By enabling systems to understand and adapt to complex human interactions, AGI could enhance both customer engagement and internal collaboration. However, the integration of AGI also presents challenges, including ethical considerations, workforce implications, and the need for robust governance. Organizations must approach AGI adoption thoughtfully, balancing innovation with responsibility to harness its benefits effectively.

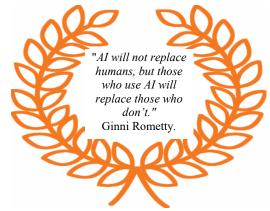
### Alexandra PUTANU

The transition from AI to AGI in organizational communication holds the potential to revolutionize the services industry by enabling more adaptive, context-aware interactions. While AGI offers significant opportunities for innovation, it also introduces ethical and operational complexities that

organizations must address. Future research should focus on developing frameworks for the responsible integration of AGI, ensuring that its deployment aligns with organizational values and societal norms.

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### STRAC

## Digital Transformation in the Waste Industry

Alexandru BADARAU<sup>1</sup>, Georgiana MOICEANU<sup>1\*</sup>, Onder KABAS<sup>2</sup>

<sup>1</sup>National University of Science and Technology Politehnica Bucharest

313 Splaiul Independentei, Bucharest, Romania

<sup>2</sup>Akdeniz University, Dumlupinar Bl. Antalya, Turkey

Through increased precision in sorting waste materials as well as optimization of collection points for garbage, greenhouse gas emissions are reduced and recycling is promoted by these forms of technology, thus empowering environmental conservation. Thus, this research examines the development of the waste industry through digital transformation. The analysis used a survey that aimed to analyze the impact and efficiency of the automated recycling bin program in Romania. This questionnaire has garnered responses from a total of 104 participants from all over the country. This sample size provides a foundation for understanding the public attitudes and experiences related to the recycling initiative. Before this, the benefits of waste digitalization are presented. Ultimately, the findings emphasized the need for continuous research in adopting new technology. There is a need for future research to focus on the impacts of digital transformation in the long run, the creation of new digital tools, and the continuous evaluation of user experiences and environmental results.

Keywords: waste industry, digital transformations, automated recycling bin

### Introduction

Integrating digital solutions with technology into every aspect of an organization is known as digital transformation. This movement forces companies to make significant changes in not only the ways that they function, but also the benefits and experiences provided to customers. As a result, it's as much a cultural revolution as it is a technological one. Digital solutions also help to augment the workforce and can lead to business process and business model transformation (SAP, 2021).

In the waste management sector, disruptive technologies, such as IoT-based waste monitoring systems and AI-driven sorting mechanisms, initially cater to niche segments but gradually gain

<sup>&</sup>quot;The future of AI is not about replacing humans, it's about augmenting human capabilities."
Sundar Pichai

prominence. These innovations, by offering efficient and cost-effective alternatives, challenge traditional waste management practices, embodying Christensen's concept of disruptive innovation (Christensen, 1997).

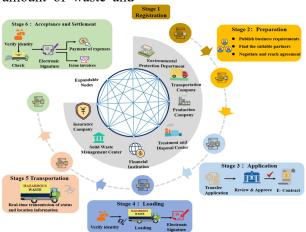
The Technology Acceptance Model (TAM), developed by Fred Davis, is instrumental in understanding the adoption of technology in organizations. According to the Technology Acceptance Model, the utilization rate of technology is mainly influenced by the perceived usefulness and ease of use that it can provide (Davis, 1989). In the waste management industry, the success of digital tools - such as waste analytics platforms and route optimization software, relies largely on their acceptance by the users - such as employees, customers, and stakeholders. In addition to their inherent qualities, these technologies must be adopted by users, which is a crucial issue that must be prioritized for broader use (Yuan, 2022).

With the use of the Internet of Things in waste management, not only is efficiency improved, but the level of environmental sustainability is also poised to increase. IoT enables the collection and exchange of data by connecting existing objects such as garbage cans and collection trucks to the Internet. Better waste management decisions are achieved through real-time monitoring of waste types, locations, and quantities made possible by this network of sensors and connected devices. Cities and businesses can collectively deploy these IoT devices to control the amount of waste and

develop efficient waste collection methods to compatibility. improve overall While GPS technology in collection vehicles helps to create the most efficient routes, saving transportation waste and carbon emissions, sensors in containers save time self-contained details of the loading process. IoT enables the collection and exchange of data by connecting existing objects such as garbage cans and collection trucks to the Internet. To have better decisions in the waste management industry, realtime monitoring of multiple variables such as waste types, locations, and quantities through the waste management networks and connected devices is needed.

Even though all kinds of parties have started to discuss the advantages of digital change, the void in empirical research addressing specific challenges and barriers faced by the waste management industry, which will be talked about extensively in this paper, still exists.

The problems encountered by the waste management industry are not only numerous, but also hefty - these include, but are not limited to financial compliance constraints, regulatory difficulties, resistance to the adoption of technology, as well as slow workforce skill development (Figure 1). The environmental, and social implications of digital transformation within this industry also remain underexplored, especially when it comes to sustainable practices waste management.



**Figure 1** – Blockchain usage in hazardous waste transfer management system (Source: Song et al., 2022)

As a result of the sources, one can believe that digitalized waste management systems provide numerous benefits over traditional methods, such as operational efficiency by optimizing collection and transportation routes, reducing fuel usage, and cutting down emissions. Automated sorting and real-time data collection improve the recycling rates amongst the population and reduce contamination. traceability through Transparency and blockchain can lead to better regulatory compliance and consumer trust. As a result of said digitalization, predictive maintenance based on data analytics is another tool that can be used to reduce equipment downtime and maintenance costs. Thus, literature emphasizes the need and success of digital transformation within the waste industry.

### Research Methodology

The goal of this study is to present the importance of effective waste management which global environmental sustainability. Before the distribution survey, first an analysis of the benefits of digital transformation within the waste industry was done.

Research design. The research design for this study employed a survey method to collect data from the waste industry. The survey focuses on gathering data on the levels of digital technology adoption, perceived benefits and challenges, as well as measurable outcomes when it comes to both operational efficiency and environmental impact. The survey included both closed and open-ended questions, allowing for a combination of quantitative data and qualitative feedback. By using this method, the study aimed to gain a comprehensive understanding of the current state of digital transformation with the waste industry.

**Data collection.** The data collection process began with a clear definition of the research objectives and the formulation of specific research questions. Thus, the questionnaire was structured to provide detailed answers to these questions, covering key aspects related to the implementation of digital transformation in the waste industry, mainly automated recycling bins.

To ensure wide reach and inclusiveness, the survey was distributed through multiple channels. Online distribution was conducted via social media platforms such as Facebook and Instagram, which are widely used in Romania. Additionally, the survey was disseminated through messaging apps like WhatsApp to reach individuals who might not be active on social media. The survey was distributed online between March 2nd and May 15th, 2024, and the respondents included various people with different backgrounds. The sample had 104 responders.

A review of the sections of the questionnaire and the specific required information from the respondents, as well as the goals or perspectives that this survey aims to gain can be found below:

- 1. Demographics
- 2. Awareness and Usage (Frequency of Use, Source of Awareness, Motivation);
- 3. Convenience (Location, Sufficiency of Bins, Ease of Use);
- 4. Efficiency (Technical Issues, Clarity of Instructions, Likelihood of Increased Recycling)
  - 5. Satisfaction (Overall Satisfaction Level)
- 6. Environmental Impact (Perceived Environmental Benefits)
- 7. Behavior and Attitude (Likelihood of Recommendation, Additional Incentives).

Validity and Reliability. To ensure validity, several steps were taken. For the quantitative part, the survey first underwent a pilot test with a small group of individuals from the targeted population. This pilot test has helped in identifying any possible issues with the survey questions, such as ambiguity or bias. As a result of this action, the act of adjusting the questions before the full-scale distribution was easier. Also, by filtering any mistakes from the survey based on the feedback received, the study ensured that the questions were clear, relevant, and capable of capturing the intended data accurately.

**Limitation.** The limitation in this research refers to the study's potential to be biased, including in the self-reported data, more specifically, in the questionnaire responses. Respondents may have over-reported their personal, socially desirable behaviors, or the opposite - under-reported undesirable ones, both cases affecting the overall accuracy of this study.

# **Research Results**

## A. The benefits of digital transformation

The waste management sector plays a critical role in intertwining with multiple players and stakeholders of the economy that are propelled by innovative technologies and changing market dynamics. It is important to be aware of these principles which can help you in turning around a significant benefit from the system. Digital transformation is reforming the waste management industry by introducing technologies that embrace key metrics such as efficiency, sustainability, and profitability. Thus, we can mention:

1. Operational Efficiency—digital technologies improve the operational efficiency of waste management systems with the help of the integration of the Internet of Things. IoT enables monitoring of waste bins through sensors in real time, making sure that the collection process is being done in a timely manner, and preventing overflows. The previously stated benefits further cascade into the optimization of collection routes, reduction of fuel consumption, and minimization of the carbon footprint of waste collection vehicles. Cities such as Melbourne have adopted smart bins equipped with sensors to enhance waste collection schedules and routes, resulting in great operational

savings and environmental benefits (EnviroWaste, 2023).

- 2. Cost Reduction implementing digital technologies results in significant cost savings for the waste management companies. Task and process automation combined with scalable cloud computing solutions help reduce costs in numerous areas of waste management operations (Lettieri, 2024). More than that, digital waste tracking systems aid businesses to identify inefficiencies in their waste processes, resulting in reduced waste disposal fees, lower material purchasing costs, and potential revenue generation from recycling and waste-to-energy initiatives. It also gives businesses an effective overview of resource allocation so that they can better establish waste generation trends (King, 2023).
- 3. *Tackling Waste Misconducts* the digital waste tracking systems play a decisive role in the possibility of intervention when it comes to waste crime rates. By providing a detailed and tamper-proof record of waste transactions, these systems can make it difficult for illegal waste activities, such as fly-tipping and unauthorized disposal, to go unnoticed. Authorities can further use this data to monitor waste flows, and enforce regulations in a more efficient manner, ensuring that as much waste as possible is being managed legally and responsibly (King, 2023).



Figure 2 – Waste management digital transformation

# B. The Case Study - Automated Recycling Bin Program in Romania

The survey conducted aims to analyze the impact and efficiency of the automated recycling bin program in Romania. This questionnaire has garnered responses from a total of 104 participants from all over the country. This sample size provides a foundation for understanding the public attitudes and experiences related to the recycling initiative. The survey also aimed to capture a comprehensive view of the demographics, awareness, convenience, efficiency, and overall satisfaction with the automated recycling bins, thereby identifying areas for improvement and potential enhancements to encourage higher recycling rates.

1. *Demographics.* The survey results show that the majority of respondents fall within the 18-24 age range, however, there is only a 0.9% difference to

the next category of age, respectively 25-34 years old. The gender distribution of the respondents was relatively balanced, with 54.8% identifying as female and 44.2% as male; the other 1% have chosen not to say. This balance suggests that the answers that can be found within this questionnaire will not indicate any significant gender disparity in the activities depicted, such as their recycling habits and participation in the automated recycling bin program.

2. Awareness and usage. The frequency of use of automated recycling bins varied, with 39.4% of respondents using them weekly, 29.8% monthly, 13.5% daily and the rest of 17.3% rarely or never. This indicates a strong weekly engagement with the recycling program, though there is still room for increasing regular use amongst all participants (Figure 3a).

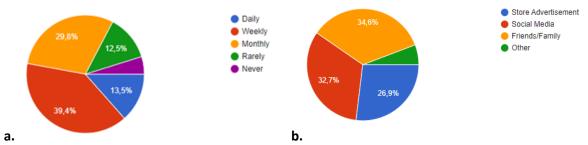


Figure 3 – Awareness among users

Most respondents first learned about the automated recycling bin program through friends or family (34.6%), followed by social media (32.7%), and store advertisements (26.9%) – 5.8% of the respondents said they have heard about the program through other channels of communication. This suggests that digital outreach and community engagement are effective strategies for promoting recycling initiatives (Figure 3b).

This agrees with other actions made by different countries to raise awareness. Public awareness campaigns through print, electronic, and social media are required to encourage people to desist from littering and follow proper waste dropping and sorting practices.

3. *Convenience*. The convenience of the location of automated recycling bins received positive feedback, with 40.4% of respondents rating

it as very convenient, 36.5% as convenient, 13.5% as neutral, and 9.6% divided between inconvenient and very inconvenient. This indicates that while most users find the bins accessible, there is room for improvement when it comes to their placement, in order to enhance the customer's convenience even further. Regarding the number of bins and their availability within he are of living, around 68.3% of respondents believe that there are indeed enough automated recycling bins in their area, while 31.7% have answered that more bins are needed for them and, consequently, for the other people residing in their area. This split suggests that while many zones are well-served, expanding the number of bins could address gaps in service and improve the overall accessibility.

4. *Efficiency*. A major need for technical improvements and better maintenance to ensure

smooth operation and user satisfaction was identified since 68.36% of responders mentioned technical issues with the automated recycling bins. Also, the instructions for using the automated recycling bins were found to be clear and easy to follow by 82.7% of respondents. However, 17.3% indicated difficulties, suggesting a need for more straightforward or multilingual instructions to cater to a broader user base.

- 5. **Satisfaction**. Overall satisfaction with the automated recycling bin program is high, with 35.6% of respondents indicating they are very satisfied and 42.3% are somewhat satisfied. Only 15.4% of respondents have chosen a neutral stance, while the rest of them have expressed dissatisfaction, suggesting the program is well-received but with some room for improvement.
- 6. *Environmental impact*. More than 87% of the responders believe that the automated recycling bin program significantly helps reduce environmental waste. This high level of belief in the program's efficacy underscores its perceived positive impact on the environment.
- 7. **Behavior and attitude.** Most respondents (83.6%) are likely to recommend the automated recycling bin program to others, indicating strong word-of-mouth potential and overall initiative approval.

## **Conclusions**

Amid technological advancements and increased concern for the environment, this paper focuses on the changes happening in waste management as a result of going through a digital transformation. This work reviews how the waste management industry aims to use computerized systems to handle garbage and recycling, their far-reaching effects, challenges faced, and future prospects. The planet's sustainability efforts largely depend on the garbage sector's ability to cope with an upsurge in trash due to rapid urbanization and consumption, hence, this study also looks into what role technology can be played by technology in this regard.

There are numerous advantages brought by changing waste management systems into digital platforms. This includes efficiency in operations, reduced costs of running such services, among others. Moreover, it enables better usage of resources while conserving the environment a large scale. For example, technologies like Internet of Things (IoT), Artificial Intelligence (AI) or Blockchain have been identified to be very useful when it comes to optimizing collection points for garbage trucks based on their fill levels, thus minimizing unnecessary stop-overs along the way during transportation, as well as streamlining sorting processes, either at recycling plants or any other place where applicable.

The success of digital technologies is heavily dependent on how well they are received by their users. The Technology Acceptance Model (TAM) places great emphasis on perceived ease of use and usefulness. The survey's empirical evidence suggests that while the majority of people consider the automatic recycling bins to be convenient, technical difficulties and limited incentives pose as obstacles against wider acceptance and usage.

For the successful adoption of digital waste management systems, education and training play a significant role. It is necessary to make known the benefits and how they should be used not only to professionals in this field but also to ordinary people who may want to employ these devices. Educational initiatives coupled with training programmes bridge the gap between those who have access to information technology and those who do not, thereby enhancing the overall digital transformation process.

Digital transformation greatly contributes to the sustainability of the environment. Through increased precision in sorting waste materials as well as optimization of collection points for garbage, greenhouse gas emissions are reduced and recycling is promoted by these forms of technology, thus empowering environmental conservation. The majority of respondents from a user feedback survey believe strongly that introducing an automated recycling bin programme has been effective in cutting down environmental waste's discarded carelessly. Several being recommendations are put forth so that benefits emanating from managing wastes using digital means can be maximized. They include regular maintenances to ensure technical dependability is upheld; extending reach & ease of use for automated recyclers; improving incentives for more recycling; wider public information campaigns aimed at creating awareness on recycling among citizens; providing clear instructions which should be multilingual so that they can be understood by diverse groups of people who might come into contact with such systems. It is also important to involve stakeholders who have interests in this matter through gathering comprehensive feedback that will foster collaborative improvements.

Regarding the interconnection of smart labs, the data analysis highlights several key findings. A positive correlation exists between lab interconnection and the perceived benefits of collaboration, particularly in data exchange and accelerated innovation. Collaboration between labs

can lead to increased productivity and improved research processes. Despite the lack of interconnection in many labs, the strong interest suggests that it is still seen as important. There is also a discrepancy between the favorable opinions of interconnection and its actual implementation, highlighting that interest does not always translate into action.

In summary, waste management's industry transformation into a digital system can change its traditional practices, leading to an efficient cost cost-effective and environmentally friendly future. However, this will only happen if the challenges are met, user adoption promoted, and all stakeholders are informed and involved sufficiently during digital

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# Abstract

# A Point of View on Side-Effects of AI - Supported Digital Transformation

Cezar SCARLAT<sup>1</sup>, Andreea-Mirela TUDOSE<sup>2\*</sup>

<sup>1</sup>National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independentei, Bucharest, Romania

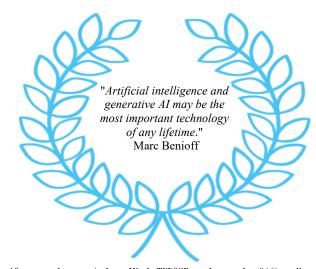
<sup>2</sup>South Muntenia Regional Development Agency, 7 Muntenia Street, Calarasi, Romania

This article aims to: (i) clarify several novel concepts related to the digitalization process in the context of emerging artificial intelligence (AI); (ii) identify side effects of the digital transformation in this perspective; and, consequently, contribute to better understanding of the digital transformation as a process. Ultimately, does it make sense to discuss intelligent digital transformation? To address these questions, mostly secondary research (recent literature survey) was used; however, practical examples and cases were identified by primary research to illustrate the theoretical discourse. A notable theoretical result is launching a provocative debate related to intelligent digital transformation (AI-based digital transformation), in the context of artificial intelligence emergence. Identification of the side effects of digital transformation has significant practical consequences in terms of organization management, specifically in human resource management, aiming to further investigate manager-employee relationships. As a pilot study, the limitations of the study are revealed, and future research paths are associated to them.

**Keywords:** Artificial intelligence (AI), Generative AI, Artificial narrow intelligence (ANI), Artificial general intelligence (AGI), Digital transformation (DT), Technostress.

# Introduction

The question posed in the title is obviously rhetorical. Currently, digitalization is growing at such pace, it is so dominant, and it is difficult to imagine a single day of digitalization without artificial intelligence. Large language models (LLMs), ChatGPT (launched in November 2022), and the scores of applications based on artificial intelligence (AI) — even remote work at its dimension of today — were not in sight before pandemic (Scarlat, 2023a; 2023b), which proved to be a turning point in digitalization.



The studies have shown that coronavirus pandemic (2020–2022) acted as a digital accelerator (Scarlat, 2023a; Scarlat et al., 2022). The Economist (2022, p. 51) reported the accelerated use of robots, so that these days it is hard to conceive of the current digitalization processes without AI support.

# Intelligence Literature Survey

Humans have always invented devices and machinery to replace and/or make their efforts easier. For many centuries the human mind has conceived mechanisms to ease their physical work or make it more pr oductive. However, only relatively late were the first programmable computers (mechanical first, then electromechanical, and electronic finally) built: The ENIAC (Electronic Numerical Integrator and Computer) was the first programmable, generalpurpose electronic computer. It was built in the USA during the Second World War. Today, parts of it (as large as library bookshelves) are exposed at the University of Pennsylvania in Philadelphia.

# Artificial intelligence: from narrow to general to universal.

To conduct a debate about the nature of intelligence is beyond the purpose of this essay. Nevertheless, it is important to admit that it is associated with humans. And intelligent humans are now capable to build programmable computers with the goal to create artificial intelligence (AI) which is "able to match or exceed human intelligence in a wide class of environments" (Hutter et al., 2024, p. 4). They also propose a typology for artificial intelligence (Table 1).

Artificial Narrow Intelligence (ANI); Artificial General Intelligence (AGI); Artificial Super Intelligence (ASI); Universal Artificial Intelligence (UAI).

Table $1 - A$	categorization	of AI	types
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Type of AI	Domains	Intelligence level	Achieved
ANI	one	limited savant	1980–1997
AGI	many to most	smart	2023–2038
ASI	some/many	genius	2038–2042
UAI	all	maximal	2000 as theory

(Source: after Hutter et al., 2024)

There are two comments to make at this point. First, while two columns in Table 1 (domains

and intelligence level) are solid guidelines for discerning AI types, the last column is a less certain timeframe (lower, more uncertain). Obviously, we were contemporary to ANI and just entered in AGI years, for sure. A good description of the path from ANI to AGI is provided by Hutter et al 2024, p. 4): "While there have been many (successful) attempts at the construction of Artificial Narrow Intelligence (ANI), an AI that performs well in a single or narrow class of domains (such as board games, vocal transcription, image recognition), the natural ultimate goal is the creation of AI which is able to match or exceed human intelligence in a wide class of environments. The term Artificial General Intelligence (AGI) is often used to describe a

hypothetical agent that can perform virtually all intellectual tasks as well as a typical human could. We use the term Artificial Super-Intelligence (ASI) to describe an agent that is on par or beyond human geniuses exceeding the cognitive performance of most humans in a reasonably broad domain." A theory of Universal Artificial Intelligence (UAI) was developed more than two decades ago by Marcus Hutter under the name of universal algorithmic intelligence.

The second comment refers to AGI. It is recommended to avoid the confusion (apparently linguistic, but mainly scientific) between AGI (artificial general intelligence) and GAI (generative artificial intelligence), also acronymized GenAI. GenAI refers to a different dimension or category of characteristics: AI capability, using un-supervised pre-training and discriminative fine-tuning, to generate solutions (i.e. answers) to "discriminative tasks such as question answering, semantic similarity assessment, entailment determination, and text classification" (Radford et al., 2018, p. 8). This category includes GPT (Generative Pre-trained Transformer), which is a type of large language model (LLM), developed by OpenAI company. So far, the OpenAI's chronological series includes:

☐ GPT-1 (Radford et al., 2018) – trained on a large corpus of books

- ☐ GPT-2 (2019) able to generate coherent text ☐ GPT-3 (2020) able to perform various tasks
- ☐ GPT-4 (2023) which is "more reliable, creative, and able to handle much more instructions" than preceding models (Wiggers, 2023).

ChatGPT is a conversational model (chatbot) that was made publicly available by OpenAI company. It can answer direct and follow-up questions, reject improper questions, admit own mistakes, even question dubitable hypotheses. Soon after OpenAI's ChatGPT, significant competitors emerged: Microsoft Copilot, Google Gemini, Mistral AI, Anthropic's Claude.

Example: The GenAI influence on company, employees and customers. Brynjolfsson and Raymond (2023), Baily, Brynjolfsson, and Korinek (2023) are interested in studying the impact of Generative AI on productivity. One of the studies investigated the effects of introducing a generative AI-based conversational assistant, collecting data from 5,179 customer support agents. They concluded that "access to the tool increases productivity, as measured by issues resolved per hour, by 14 percent on average, with the greatest impact on novice and low skilled workers, and minimal impact on experienced and highly skilled workers" and found evidence that "the AI model disseminates the potentially tacit knowledge of more able workers and helps newer workers move down the experience curve [... and ] AI assistance improves customer sentiment, reduces requests for managerial intervention, and improves employee retention" (Brynjolfsson, Li and Raymond, 2023). Brynjolfsson's opinion on AI impact on managerial jobs is unforgettable:

# AI won't replace managers, but managers who use AI will replace those who don't.

The Economist (2023) signals another notable impact of AI on the business community: "the austere spirit" of a category of startups "that is unaffected by investors' newfound stinginess: those which develop all the sought-after AI tools" (Table 2).

Startup company (profile)	Founders	Year founded	Amount raised [million USD]	Number of employees
Adept AI (AI startup)	Former employees of Alphabet's DeepMind	2022	415	37
Anthropic (AI systems)	Defectors from OpenAI (creators of ChatGPT)	2021	1,200	160
Databricks (Database maker)	Original creators of Apache Spark TM	2013	883	1,700
Klarna (Payment company)	Swedish co-founders	2005	1,200	2,700

**Table 2** – AI startups as compared to "older" IT startups

(Source: adapted by Scarlat 2025b, after The Economist 2023)

Calinescu (2024) has explored opportunities and challenges involved by the AI emergence on Romanian small and medium-sized enterprises (SMEs). Findings are of limited importance as

SMEs investigated belong to a single group. Scarlat (2023b, p. 443) presents other examples of quick adopters of AI, active internationally: the case of large law firms.

#### Digital transformation

Shoikova (2021, pp. 6–7) selected several definitions of digital transformation (DT) provided by well-known and internationally recognized organizations (Bloomberg, Forbes, OECD, European Commission). The Forbes' definition ("the creation of new business designs by blurring the digital and physical worlds") underlines a quantitative difference between a digital business and a traditional business: the speed of execution ("the speed of a digital business is as much as 5 times faster than the speed of a traditional business").

Mikalef and Parmiggiani (2022) agreed with Vial's definition that digital transformation is "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019, p. 119), and they extended Vial's work, developing a conceptual model (Mikalef and Parmiggiani, 2022, p. 4) that includes theoretical insights from the literature on digital business strategy (Bharadwaj et al., 2013) as well as organizational change management (Hanelt et al., 2021).

#### Confusion to be avoided

While it is obvious that digital transformation is a process more advanced and complex than digitization and digitalization (usually explained in English dictionaries), business digital transformation and business transformation (Radoi and Vevera, 2025) are also different: if digital transformation implies business transformation as well, the reciprocal does not necessarily stand true. This section summarized digital-related concepts as well as terms corresponding to the current stage of digitalization: AI-supported digitalization and AIsupported digital transformation (which was the first aim of our essay) – as they appear both in the literature surveyed and in practical instances.

Despite large volume of literature which is dedicated to digital transformation (Vial, 2019; Kraus et al., 2022; Raković et al., 2024), its impact (Schilirò, 2024) and positive effects reported both in business (Mikalef and Parmiggiani, 2022) and

society (Lamarre et al., 2023), the literature on sideeffects of digital transformation (Tudose, 2025a; 2025b) is rather scarce (and the literature on sideeffects of AI-supported digital transformation is even scarcer). Therefore, the remaining of this paper is structured as follows: methodology, a study of side-effects of digital transformation (which is the other main objective of this essay), results and discussion, followed by conclusions, limitations and further research.

# **Research Methodology**

This explorative study has a twofold purpose: (i) to clarify the concepts related to digitalization in general and digital transformation in particular, in the context of the AI emergence; (ii) to identify unintended, organizational and employee-related side effects of digital transformation from this perspective and, consequently, to contribute to better understanding of the digital transformation as a process. In other words, to invite to reflect on the relevance of intelligent digital transformation.

The approach used is a qualitative, exploratory one, combining secondary and primary research work. The secondary research is centered on the literature review of relevant academic and institutional sources, and the primary research consists mainly of analysis of practical cases selected from corporate practices, serving as illustrative examples of recommended policies and support measures for employee well-being, under the pressure of technostress as a side-effect of AI-supported digitalization processes.

# A study of the side effects of digital transformation

Under the surface: Unintended consequences of a digital shift

Digitalization is often considered an evolutionary process associated with many benefits, such as reducing production time, making use of resources more efficiently, simplifying employee workloads—overall increasing operational and organizational efficiency. However, a less explored

(or not fully assumed) aspect concerns the negative effects of digitalization. These mainly impact employees and ultimately have important echoes at the organizational level. Therefore, it is crucial to have concrete and targeted approaches to these issues.

While companies have embraced digital tools like automation and AI to increase productivity and streamline operations, there are often unintended repercussions on the human side. One major issue is the fear among employees of losing their jobs as technology takes over some employees' tasks, especially in the sectors where the tasks are repetitive and easily automatable. Employees with a lower level of qualification feel an increased insecurity in this sense, being more exposed to the risk of being replaced by robots or automated software (Hu et al., 2024; Kashaka, 2025). There is also the problem of lacking the skills needed for new tasks or integrating digital tools into their work. Often, workers without such skills (or ones who cannot easily adapt to new working patterns) are left behind (Acemoglu and Restrepo, 2019). Because of digitalization, such inequalities increase and influence the labour market, affecting not only employees, but also the industries and communities they are part of.

Remote work, one of the most visible results of digital transformation, offers more freedom and flexibility, but this often leads to blurred boundaries between work and personal life, especially after the COVID-19 pandemic. People end up working longer hours or find it harder to disconnect from work tasks (Messenger et al. 2020). Especially in the case of remote or hybrid work, employees may feel greater pressure from colleagues or superiors to permanently connected, to use digital technologies effectively and to adapt to new paradigms constantly and quickly (Charalampous et al., 2019), this pressure identified as technostress (Jena, 2015; Narasalagi et al., 2021).

Workplace surveillance has become a growing concern in the era of digital transformation, as companies adopt increasingly sophisticated

technologies to monitor employee performance and behavior - from keystroke tracking to location monitoring and even sentiment analysis through AI. While the implementation of these policies is justified by the desire to improve productivity, safety, and the well-being of mixed teams (especially onsite-remote employees), they have become the subject of significant concerns about privacy, autonomy, and stress among employees. According to Ball (2021), digital surveillance is reshaping power dynamics in the workplace, with management gaining unprecedented insight into workers' daily activities - often without meaningful consent or transparency.

From a legal perspective, regulations are not yet able to keep up with these trends. While some jurisdictions-such as the European Union under the Data Protection Regulation-require companies to inform workers about data collection and provide them with some degree of control, there are still many countries that do not have clear laws addressing employee surveillance in the workplace. Moreover, how they are enforced (where the laws exist) is debatable, and the idea of "consent" is arguable, because of uneven employer-employee power relations. Thus, there is an increasing need for legal and ethical frameworks to ensure that employee surveillance is transparent, ethical, and reasonable (Zuboff, 2019, p. 331–342).

Organizational responses to the side effects of digital transformation

By implementing strategic measures and policies to mitigate the negative effects of digitalization, companies can create a more sustainable and inclusive organizational culture, ensuring that the benefits of digital transformation are effectively adopted to optimize the business without compromising employee well-being.

In this regard, there is a growing concern for the development and implementation of strategies and policies aimed at mitigating the negative impact of DT on employees and, implicitly, on the organization (Table 3).

<b>Table 3</b> – Key policy recommendations to address the impacts of digital transformation.				
Policy recommendations	Description	Sources		
Investment in reskilling and upskilling programs	These represent effective solutions for ensuring a smooth transition of employees to jobs compatible with the requirements imposed by digital transformation, which leads to boosting employee confidence and increasing organizational efficiency.			
Policies on work-life balance	Policies implemented to harmonize work and private life can be useful tools in the effort to reduce occupational stress, and organizations that are actively involved in their implementation tend to register lower turnover rates and better productivity. One example refers to the "right to disconnect" granted by some companies to their employees.	Messenger, 2019		
Flexible work arrangements	These also contribute to the balance between professional life and personal life and may include options such as: the possibility of working remotely, flexible work schedules, or compressed work weeks.	Messenger, 2019		
Adoption of digital literacy programs	Digital literacy is a key factor in simplifying the transition of employees in the context of digital transformation, thus reducing the anxiety associated with the rapidly changing work environment and increasing digital resilience. Also, continuous development of digital skills contributes significantly to the psychological well-being of employee.	Raharjo, Afrianty &		
Ethical and transparent surveillance	Such practices are essential for maintaining employee trust in a harmonious work environment, and open communication regarding workplace monitoring and security contributes to increasing	Roll 2021		

**Table 3** – Key policy recommendations to address the impacts of digital transformation.

Good practices tested in the business environment

practices

employee engagement.

This section highlights two corporate examples that illustrate effective responses to the challenges of occupational stress (or employee well-being in general), especially in the context of increasingly digital work environments (Tudose, 2025a).

• Rethinking work schedules to promote worklife balance – Microsoft Japan (Paul, 2019). The initiative, known as the "Work-Life Choice Challenge," was implemented in 2019 and involved declaring Fridays a day off for a month. As a result of this policy, the company recorded a 40% increase in productivity, coupled with increased satisfaction and morale among employees. Moreover, following the adoption of this short week, administrative costs (for example, those with electricity) have been reduced. This initiative highlights how rethinking traditional work schedules can serve as a buffer against the pressures of continuous digital engagement.

• *Digital disconnection and cognitive recovery* – IBM (2024).

The company has introduced a volunteer program, which offers employees unique opportunities to disconnect for a defined period from work, and especially from digital mediae-mail, instant messaging platforms and other tools. This new approach places particular importance on the impact that digital overexposure has on the mental and psychological level, aiming to reduce employees' cognitive overload and the risk of mental exhaustion. This organizational practice, which supports better work-life balance, demonstrates that employees who are involved and connected to societal issues are also more likely to be involved in the workplace.

These measures demonstrate a proactive approach to managing the digital demands placed on employees. Consequently, the digital transformation is a contemporary phenomenon in full swing, which, besides many benefits it brings for making work more efficient, unfortunately it is associated with negative effects that are felt mainly by employees (and, implicitly, by organizations). Therefore, it is essential to implement supportive policies, such as retraining programs, work-life balance policies, and ethical oversight practices (as depicted in Table 3)—to ensure an inclusive and responsible transition in the digital age.

## Research Results

Besides the theoretical importance of correct understanding and use of novel concepts, this study has practical implications as well. Among the implications of this study, the identification of organizational side-effects of AI-supported DT (Tudose, 2025a), specifically technostress as a negative side effect of digital transformation (Tudose, 2025b) are contributions to a less investigated area of an already crowded research space. Identification of the side effects of digital transformation has significant practical consequences terms of organizational management, specifically in human resource management manager-employee (e.g., relationships), and implications are directed to both

A notable theoretical result is launching a provocative debate related to digital maturity (in

that sense of DT as a process). In the context of AI emergence, the discussion about concepts as intelligent digital maturity (AI-based digital transformation) is extremely challenging.

In addition, in the same context, the relatively old concept of technostress becomes digital technostress. What about intelligent technostress? If it is understood as AI-induced technostress, then the discussion makes sense, and the term sounds less weird

#### Conclusions

The main purpose of this essay was limited, so that reaching its two objectives is equivalent to asking new research questions and opening new paths of research. As a report associated to a larger research project, it launched several provocative questions. As a pilot study, it displays inherent limitations (too many open doors that invite exploration of what's beyond). They mark an equal number of corresponding directions for future studies.

As many studies on AI impact are on work productivity and job dynamics (e.g., displacement and reconversion)—conducted from a macroeconomic standpoint (undoubtedly useful)—it is also of interest to identify microeconomic effects of AI-supported digitalization on the workers' wellbeing, regardless of their collar colour. And, metaphorically, what colour is the managers' collar, after all? This may be an interesting path to follow, too.

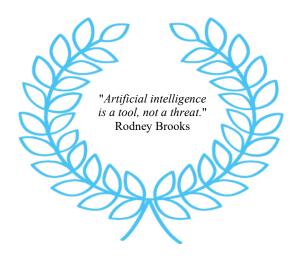
Today, digital transformation is as intelligent as its human designers and ancestors were. How it will be short is a matter of wait and see. Further research would help us to be less surprised.

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# Abstract

# Impact of Artificial Intelligence in the Automotive Industry

Rebecca-Ana-Maria CHIRITA<sup>1\*</sup>, Stefan Adrian CIOBANESCU<sup>2</sup>, Cristina-Elena UNGUREANU<sup>3</sup>, Ioana-Alexandra SBIRCEA<sup>4</sup>

<sup>1</sup>Expedicar, 44 Franceza Street, Bucharest, Romania

<sup>2</sup>National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independentei, Bucharest, Romania

<sup>3</sup>Vodafone Romania Technology, 2 București Nord Rd, Voluntari, Romania

<sup>4</sup>Procter & Gamble, 1 Mihai Viteazul Street, Urlati, Romania

This paper explores the potential impact of AGI on service quality in the automotive industry from management and employee perspectives. The automotive industry has increasingly embraced Artificial Intelligence (AI) to enhance service quality and employee performance during 2020–2025. This article examines real-world implementations of AI technologies in automotive customer service and after-sales operations across Europe, highlighting measurable improvements in efficiency, customer satisfaction, and workforce productivity. This analysis examines case studies from major European automotive firms, including Porsche Romania, highlighting the adoption of AI tools such as conversational agents, predictive maintenance, and generative AI within broader digital transformation efforts. We review current applications of Artificial Intelligence (AI) in automotive services – such as predictive maintenance, automated inspections, and customer support – to establish how they imprand customer satisfaction. This paper explores how AGI advancements may improve service efficiency by enabling greater system autonomy, while also reshaping human roles through the automation of routine tasks and support for complex decisions.

**Keywords:** Artificial General Intelligence; Service Quality; Automotive Industry

# Introduction

Service quality is a critical factor in the automotive industry, reflecting the efficiency, reliability, and overall customer experience related to vehicle maintenance, repair, and support. Maintaining high service standards is essential for customer satisfaction and loyalty, making aftersales services an increasingly important source of

"Artificial intelligence is only as smart as the data sets it is trained on."

Gary Marcus

competitive advantage for manufacturers and dealerships. In recent years, rapid progress in Artificial Intelligence (AI) has begun to reshape service delivery by enhancing speed, consistency, and operational accuracy. AI assistance enhances task efficiency and preserves service quality by supporting employees with instant access to technical information, thereby improving performance and confidence in complex service contexts (Brynjolfsson et al. 2023).

Artificial General Intelligence (AGI) represents an emerging class of AI systems characterized by their ability to perform a wide range of cognitive tasks with a level of flexibility and adaptability similar to that of human intelligence. Unlike narrow AI which is designed for specific functions, AGI is intended to operate across diverse and evolving contexts by learning continuously and applying knowledge beyond predefined boundaries. In the automotive industry, early AGI-like capabilities are increasingly integrated into service environments where multiple AI systems such as language models, vision systems, and predictive analytics work in coordination to support complex decisionmaking, optimize resource allocation, automate workflows, and enhance overall service performance in both technical and customer-facing operations (Goertzel, 2023).

As defined by Goertzel and Pennachin (2007), Artificial General Intelligence refers to a form of machine intelligence capable of performing any intellectual task that a human being can, by relying on general reasoning abilities, experiential learning and adaptive understanding of context. Unlike narrow AI systems which are designed for specific applications and operate within rigid boundaries, AGI aims to replicate the versatility and integrative thinking characteristic of human cognition. This distinction is particularly relevant in the automotive industry where the combination of various AI capabilities such as perception, natural language processing and predictive decision-making begins to reflect the core principles of AGI in real-world service operations.

The automotive industry, long recognized for its proactive embrace of automation and advanced manufacturing technologies, is now witnessing a marked shift toward the adoption of artificial intelligence—driven solutions. This renewed interest stems from both technological maturity and the increasing demand for intelligent systems capable of optimizing complex service processes. Industry experts forecast a substantial increase in the deployment of autonomous agent-based AI systems that can independently manage tasks such as diagnostics, scheduling and customer interaction. This evolution is expected to accelerate the sector's digital transformation, reshaping operational models and redefining the roles of human workers in both service and support functions.

Between 2020 and 2025, significant progress in artificial intelligence has brought technologies closer to the capabilities associated with Artificial General Intelligence. In the automotive sector, these advancements have coincided with an increasing need to improve service quality and operational efficiency across both sales and after-sales activities. Service quality, defined by customer satisfaction, responsiveness, and reliability, has become a key differentiator for automotive brands. Likewise, the performance of employees in service roles directly influences operational outcomes and customer experience. European automotive companies accelerated digital transformation, with AI at the core of their strategies. From a financial perspective, enhanced service quality operational efficiency directly support improved business performance by increasing customer retention and enabling higher service volumes without additional staffing (Motor-K, 2024).

Porsche AG serves as a prominent example of this strategic shift, having formally embedded artificial intelligence within its long-term corporate framework, as outlined in Strategy 2030. In alignment with this vision, the company established a specialized Data and Artificial Intelligence team in 2022, tasked with advancing innovation in both product development and customer service delivery. This structural investment reflects Porsche's commitment to leveraging AI as a core enabler of digital transformation across its operational and customer-facing processes (Porsche, 2023). Porsche Romania, as an integral part of the broader corporate ecosystem, has benefited from digital initiatives implemented at the group level.

The rapid adoption of artificial intelligence in the automotive industry was accelerated by the COVID-19 pandemic (2020–2021), which pushed dealerships and service centers to implement digital, contactless solutions. Tools such as chatbots, remote diagnostics, and AI-driven scheduling evolved from pilot projects to integral service components. By 2023–2024, the rise of generative AI and large language models expanded AI's functionality, enabling more versatile communication and signaling progress toward Artificial General Intelligence (AGI).

This article adopts a strictly empirical approach by focusing on real-world implementations and measurable outcomes observed between 2020 and 2025, while intentionally excluding speculative or theoretical projections. The analysis is based on documented case studies and industry data, highlighting how artificial intelligence has led to concrete improvements in automotive service environments. These include reduced service completion times, improved customer engagement, and greater operational reliability. Employee performance has also improved, as AI tools support higher productivity, reduce repetitive workloads, and increase accuracy in diagnostic and service operations. Collectively, these developments underscore the transformative impact of AI on both service quality and workforce efficiency within the automotive sector, by enabling faster service delivery, more consistent customer experiences, optimized resource allocation, and the strategic reorientation of employee roles toward higher-value tasks.

This study targets professionals employed throughout the comprehensive network of both large and small enterprises that constitute the automotive services industry, including individuals in managerial roles within administrative divisions. These stakeholders are increasingly required to engage with emerging tools and specialized knowledge. Consequently, they will be expected not only to refine existing operational procedures but also to conceptualize and implement entirely new methodologies.

Building on this foundation, we project how the evolution toward AGI could further elevate service quality by enabling more autonomous, adaptable, and intelligent service processes. We analyze real industry cases (Tesla, BMW, etc.) and qualitative data from industry reports to illustrate both the realized benefits of AI (e.g. reducservice) and the anticipated advantages of AGI.

# Research Methodology

This research employs a qualitative case study methodology to investigate the impact of artificial intelligence (AI) and emerging Artificial General Intelligence (AGI) technologies on service quality and workforce efficiency in the automotive industry between 2020 and 2025. Data was collected from a diverse array of reputable sources, including peer-reviewed academic journals, industry reports, corporate press releases, and consulting firm analyses.

Cases were selected based on two primary criteria to ensure both relevance and analytical rigor. First, the AI implementation must have taken place between 2020 and 2025, reflecting the contemporary integration of AI technologies in the automotive sector during a period of accelerated digital transformation. Second, each case had to provide verifiable and clearly documented evidence of measurable outcomes or performance enhancements directly attributable to the AI intervention.

Key outcomes include shorter service times, improved employee performance, and enhanced customer satisfaction, alongside measurable gains in efficiency or sales. Priority was given to scalable, strategically aligned implementations with crossfunctional relevance. The research prioritizes European case studies, with specific attention to initiatives led by Porsche Romania and affiliated programs within the Volkswagen Group where data availability permits. These are contextualized with select international examples. Case studies examined include original equipment manufacturers (OEMs) such as Toyota, BMW, and Škoda, as well as supplier and dealership networks, including examples such as Volvo Trucks' service programs and data analytics tools used by multibrand dealerships.

Given the characteristics of the available data, the analysis adopts a primarily descriptive and analytical approach. Rather than relying on experimental or hypothetical modeling, the study synthesizes empirical, real-world evidence to draw informed conclusions regarding the influence of AI on service quality and employee performance.

This section presents the methodological framework employed to examine real-world applications of artificial intelligence (AI) technologies within the automotive service sector during the period 2020 to 2025. The research employed a qualitative case study approach, based on the systematic analysis of real-world interventions where organizations deployed AI systems in operational contexts and documented measurable results.

Case selection was guided by the following criteria:

- The AI technology had to be actively implemented in the automotive industry between 2020 and 2025.
- The deployment produced observable and measurable effects related to service quality or employee performance.
- The implementation was supported by verifiable documentation from credible sources, such as corporate communications, media coverage, or academic and industry reports.

Each case was individually examined based on outcomes such as productivity gains, improved customer interactions, and service efficiency. The cases were then compared to identify common patterns and differences in AI's impact on service delivery and employee performance. This structured approach ensures analytical consistency while accounting for the complexity of real-world organizational contexts.

The analysis was guided by the five selection criteria outlined in Table 1. Each selected case represented a verified implementation of artificial intelligence technologies within the automotive sector during the period 2020 to 2025. A minimum threshold of evidentiary support was required; selected cases had to include either quantitative metrics, such as demonstrated improvements in productivity, or qualitative indicators, such as feedback provided by employees or clearly documented outcomes related to training programs. The analysis placed particular emphasis on use cases originating from Europe, with a specific focus on implementations involving Porsche Romania, Skoda, BMW, and Toyota Europe.

**Table 1** – Case Selection Criteria for Experimental Analysis

Criterion	Description	Justification
Timeframe	AI deployment occurred between 2020–2025	Ensures relevance and alignment with industry trends
Industry	Automotive – including OEMs, dealerships, service centers	Focusing the scope of analysis on a single sector
Measurable Outcomes	Documented improvements in employee performance or service quality	Validates impact and allows comparative assessment
Source Credibility	Verified through academic papers, official reports, or reliable industry publications	Ensures accuracy and avoids speculative content
European Relevance (Preferred)	Priority given to European use cases, especially involving Porsche Romania or VW Group	Aligns with regional focus and case availability

Table 1 illustrates the analytical framework used to assess the impact of AI technologies on workforce efficiency and service quality in the automotive sector, thereby highlighting their influence on employee performance.

# **Discussion and Results**

AI and AGI-inspired technologies have begun to yield substantial improvements in automotive service quality and employee efficiency during 2020-2025. The results span various facets of service operations – from customer-facing chatbots to back-end maintenance optimization - but all point to a common theme: AI is enabling faster, more accurate, and more proactive service, while augmenting human workers' capabilities. Table 2 provides an overview of several prominent implementations and their outcomes.

**Table 2** – *AI implementations in automotive service (2020–2025)* 

Company / Case	AI Technology Deployed	Outcomes / Impact
Toyota Europe – "eCare" Voice Assistant (Toyota	Conversational AI voice assistant that calls drivers when a warning light is	<ul> <li>Reduced staff workload: Significantly reduced operational burden for service personnel by approximately 20 minutes per incident;</li> </ul>
Deutschland, 2023)	triggered (integrated with dealer systems);	- Faster response: Eliminated customer wait times for fault clarification and service scheduling;  - Enhanced customer trust through proactive and personalized communication;
Škoda Auto –  "Laura"  Conversational Agent  ;  (Skoda Auto, 2022),  (Skoda Cognizant,  2022),	Online AI chatbot assisting customers with model selection, test drive booking across 13 countries;	- Higher customer engagement: Substantially increased the volume of test drive bookings attributable to virtual assistant interaction [6], [9];  - Successfully scaled across 13 countries and 12 languages by 2022, offering consistent and localized user experiences;
BMW Group – Proactive Care System (BMW Group, 2023),	Predictive service system using vehicle data and AI to anticipate maintenance needs and contact customers proactively;	- Improved convenience: Enabled early detection and remote resolution of technical issues, improving maintenance efficiency;  - Personalized service: Improved service personalization, contributing to higher customer satisfaction and loyalty;
Large OEM Call Center – GenAI Pilot (Brynjolfsson et al., 2023).	Generative AI assistant supporting live customer service agents;	- Higher productivity: Boosted agent productivity by 13.8% through real-time response generation;  - Quality maintained/improved: Achieved a measurable increase of 1.3% in issue resolution rates;  - Upskilling effect: Delivered the most significant performance improvements among lessexperienced agents, with a 35% gain in task completion rates;
Multi-brand Dealership Network (Motor-K, 2024),	AI-driven analytics and outreach for communication and after-sales (service and accessory offers targeted to customers);	- Increased sales: Targeted, data-driven marketing campaigns resulted in a documented conversion rate of 8–10%, which corresponded to a 25–30% increase in online aftersales service appointments and accessory sales;  - Efficiency: Improved marketing efficiency through AI-driven targeting, raising campaign conversion rates by 8–10%;

Company / Case	AI Technology Deployed	Outcomes / Impact
Volvo Trucks –	AI-based predictive	- Maximized uptime: Effectively reduced
Adaptive	maintenance scheduling and	unplanned downtime by enabling condition-based
Maintenance (Volvo	dynamic optimization of	service planning;
Trucks NA, 2024)	maintenance scheduling	- Cost savings: Lowered total maintenance costs
	(adaptive service intervals	while increasing vehicle availability and reliability;
	based on real usage data and	
	AI models);	

As evidenced by the data presented in Table 2, AI-based solutions have effectively influenced several critical aspects of service quality, with customer communication and support emerging as particularly transformative domain. widespread integration of conversational AI technologies, including both text-based chatbots embedded in websites and voice-enabled virtual assistants, became a standard feature in automotive customer service beginning in the early 2020s. These technologies have enhanced customer accessibility and responsiveness while simultaneously generating measurable improvements in business performance (Skoda Cognizant, 2022).

By automating initial customer interactions, AI systems reduce employee workload and enhance both service efficiency and responsiveness. In aftersales settings, AI-enabled customer support has also contributed to enhanced service quality. Toyota's deployment of the "eCare" voice assistant in Europe, developed in collaboration with AI company Valantic, illustrates the effectiveness of proactive, AI-guided communication. Upon detecting a critical fault or warning, the system automatically contacts the driver to explain the issue and suggest next steps, while simultaneously alerting the dealership (Toyota Deutschland, 2023).

This service innovation has effectively eliminated the customary waiting period for customers requiring clarification on warning indicators and has alleviated the burden on personnel by automating the management of routine alert-related inquiries. According to Toyota Deutschland, the implementation of the eCare

system results in an average time saving of approximately 20 minutes per case for dealers, representing a significant efficiency improvement. Furthermore, it enables technicians to commence repairs promptly upon vehicle arrival, having already been informed of the issue in advance. By resolving issues in real time and facilitating proactive service scheduling, these AI systems enhance the relationship of trust between customers, dealerships, and the brand itself, as emphasized by Toyota's management (Toyota Deutschland, 2023).

In summary, the integration of conversational AI in customer service has resulted in accelerated response times and better-informed clients, thereby enhancing perceived service quality while simultaneously reducing the workload of employees.

Another essential area is maintenance and repair operations, where AI enables predictive and efficient service delivery. The BMW Proactive Care initiative, introduced in 2023, reflects this development. Using onboard diagnostics and cloudbased AI, BMW vehicles can identify upcoming maintenance needs, such as low tire pressure or declining battery health, and automatically initiate appropriate service recommendations or remote solutions for the customer (BMW Group, 2023).

Before the implementation of Proactive Care, both customers and technicians were required to manually interpret service data and arrange appointments. The process is now becoming increasingly automated and tailored to individual needs. While BMW has not disclosed precise quantitative results, the anticipated advantages include increased first-time repair success rates, a

reduction in vehicle breakdowns, and enhanced customer satisfaction resulting from timely maintenance interventions. The integration of AI-driven predictive capabilities into the service process enables employees, such as service advisors and technicians, to operate with greater efficiency by addressing issues before they escalate and scheduling service interventions at the most appropriate times (BMW Group, 2023).

Truck manufacturers have likewise adopted AI technologies to optimize maintenance scheduling. In 2024, Volvo Trucks implemented an AI-based adaptive maintenance program that dynamically modifies service intervals according to each vehicle's specific operational data, including fuel consumption, idling duration, and oil condition (Volvo Trucks NA, 2024). This approach replaces the conventional one-size-fits-all maintenance schedules with a data-driven model that ensures vehicles are serviced at the appropriate time, avoiding premature interventions that lead to resource inefficiencies as well as maintenance that may result in mechanical failures. As a result, vehicle uptime and operational efficiency are improved, with maintenance visits consolidated and unexpected breakdowns minimized (Volvo Trucks NA, 2024).

For customers, this directly results in improved service quality through enhanced vehicle reliability. For service personnel, it provides a more predictable workflow and facilitates the advance planning of spare parts and workshop resources. Additionally, Volvo's system communicates proactively with dealerships, allowing service centers to prepare the required components and technical expertise prior to the vehicle's arrival (Volvo Trucks NA, 2024).

Enhancements in employee performance within the automotive service sector resulting from AI integration have been quantitatively validated, particularly in positions related to information processing and customer engagement. A notable study conducted in 2023 by Erik Brynjolfsson and colleagues at Stanford and MIT evaluated the use of

a generative AI assistant by customer support agents and reported an average productivity increase of approximately 14 percent (Brynjolfsson et al., 2023).

Although the study was conducted within a software company, its conclusions are relevant to automotive customer service centers that manage related to vehicle functionalities, inquiries maintenance, and technical issues. The AI assistant provided support agents with recommended responses and access to relevant information, enabling them to address a higher volume of customer requests per hour. The greatest benefits were observed among less-experienced agents, with those in the lowest performance quintile achieving a 35 percent increase in resolved inquiries. Furthermore, service quality was either maintained or slightly improved, as indicated by a 1.3 percent increase in resolution rates with AI assistance (Brynjolfsson et al., 2023). These findings indicate that AI assistance can simultaneously increase task efficiency and maintain service quality, which is essential for customer satisfaction. In automotive sector, where support agents are frequently required to respond to technical questions and manage complex repair scheduling, the presence of an AI assistant that provides immediate access to relevant information such as repair procedures and warranty conditions can substantially improve employee performance and confidence.

Practical implementations within automotive companies reflect similar outcomes. Beginning in 2023 and continuing into 2024, generative AI and large language models began to gain traction in both automotive retail and service environments. For example, in 2023, Peugeot conducted a pilot project and subsequently integrated OpenAI's ChatGPT into its in-car voice assistant, enabling drivers to receive conversational responses to questions regarding their vehicle or travel (Lopez, 2023).

Although this is primarily a customer-facing feature, it contributes indirectly to reducing the

volume of routine inquiries handled by call centers. In a similar manner, numerous dealerships have implemented AI-powered chatbots on their websites and communication platforms to manage service and frequently asked effectively always operating as digital employees These systems enhance service accessible. availability by providing immediate responses to customers. From the employees' standpoint, delegating repetitive queries to AI allows human advisors to concentrate on more complex tasks and personalized interactions, optimizing professional capabilities. Supporting this, the McKinsey Global Survey (2024) reported notable productivity gains in service and support roles, as organizations observed more efficient time management when AI tools were employed for routine operations (PwC, 2025).

Moreover, AI-driven analytics have contributed to the optimization of back-office service operations, indirectly enhancing employee performance by improving workflow efficiency. One specific area where AI has demonstrated significant impact is inventory management for spare parts. Using predictive algorithms, service history and failure trends are analyzed to ensure that frequently required components are consistently available at local service centers. This reduces delays experienced by technicians when waiting for parts and enables service managers to schedule maintenance tasks more effectively, ultimately increasing the number of vehicles processed within a given timeframe. Companies such as Porsche AG have made notable investments in data-driven decision-making systems. In 2022, Porsche established a dedicated vehicle data analytics team to leverage AI in support of product quality enhancement and customer service processes (Porsche AG, 2023). Although Porsche has not publicly disclosed specific performance indicators, industry experience suggests implementation of such AI-driven systems leads to shorter wait times for spare parts and increased firsttime fix rates, both of which are essential determinants of service quality.

From a financial standpoint, improvements in service quality and operational productivity contribute directly to stronger business performance. Increased customer satisfaction resulting from timely and proactive service fosters loyalty and repeat purchases. Simultaneously, efficiency gains enable service departments to accommodate higher workloads without expanding staff. For instance, the implementation of AI-driven workflow automation in certain European heavy-duty service centers led to double-digit increases in daily job completion rates, allowing more customers to be served without additional personnel. Furthermore, an analysis by MotorK (2024), demonstrated that personalized AIbased marketing contributed to a 25-30 percent rise in online aftersales revenue. Such outcomes directly result from AI's ability to deliver precise upselling and timely service reminders, which are difficult to replicate manually on a scale. With AI-generated insights, employees can improve sales performance, making AI a powerful enabler within the service workforce.

While AGI has not yet been implemented in automotive service, many AI solutions adopted between 2020 and 2025 demonstrate narrow intelligence that collectively supports a wide range of tasks, moving the industry closer to an AGI paradigm. The integration of various technologies—such as vision systems, language models. and predictive algorithms—is progressively automating service processes and shifting employees' roles toward supervising AIassisted workflows. As highlighted in a Porsche Consulting report, the future of automotive service lies in human-AI collaboration. By 2025, service staff are increasingly trained not only in technical skills but also in digital competencies, enabling them to interpret AI outputs and maintain humancentered service.

Although AGI has not yet been implemented in automotive service, AI technologies adopted between 2020 and 2025 already automate a wide range of tasks. By integrating vision systems, language models, and predictive algorithms, workflows are optimized, and employee roles shift from manual execution to AI supervision. As noted by Porsche Consulting, the sector's progress relies on human-AI collaboration. By 2025, staff are increasingly trained in both technical and digital competencies to interpret AI outputs and ensure service remains customer focused. Real-world cases confirm significant gains in service quality and workforce efficiency. Customers benefit from faster, more personalized support, while employees are assisted in both routine and complex tasks. Performance indicators such as throughput, resolution time, and conversion rates have improved, alongside customer satisfaction demonstrating that AI enhances rather than diminishes the human aspect of service.

## Conclusions

Between 2020 and 2025, the automotive industry has shown that AI technologies—approaching the flexibility associated with artificial general intelligence—can significantly enhance both service quality and employee performance. Evidence from European implementations highlights clear benefits: dealerships and service centers adopting AI achieved faster service turnaround, improved diagnostic accuracy, and stronger customer engagement. Simultaneously, employees experienced reduced routine workload, quicker access to relevant information, and higher productivity. Notable examples include Toyota's AI assistant that proactively manages service alerts, Škoda's multilingual chatbot increasing customer interaction and sales, and BMW's connected services that streamline maintenance operations.

A central conclusion of this analysis is that artificial intelligence delivers the greatest impact in the automotive service sector when applied as an augmentative tool rather than a replacement for human labor. Rather than displacing personnel, AI systems function as intelligent support agents—handling data-driven operations, offering evidence-

based recommendations, and operating seamlessly in the background. This allows employees to focus on higher-value tasks, including advanced diagnostics, customer engagement, and specialized technical interventions. The resulting human—AI collaboration has produced measurable business benefits. Service departments have succeeded in increasing both throughput and revenue without a corresponding rise in staffing levels, thereby enhancing operational efficiency. Concurrently, customers benefit from improved vehicle uptime and greater service transparency and proactivity, which contribute to stronger brand loyalty.

The experiences of European automotive companies highlight several critical enablers and strategic considerations for the deployment of artificial intelligence. Chief among these is strong leadership commitment and the integration of AI initiatives into the broader corporate strategy. Firms such as Porsche, which have embedded digital transformation efforts at the executive level and invested in specialized data analytics teams, have fostered a culture supportive of AI innovation and scalability. Equally important is workforce preparedness through structured training and change management. Preparing technicians to operate AI-powered diagnostic tools and encouraging service agents to engage with AIbased chat interfaces are essential measures to unlock the full potential of these technologies. Organizations that provided such support reported greater employee acceptance of AI systems and smoother implementation processes, as evidenced by the adoption of generative AI support tools, which quickly transitioned from experimental solutions to integral components of daily operations.

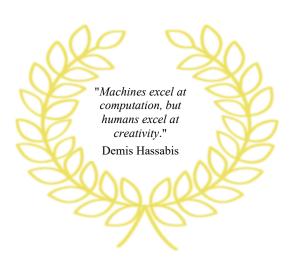
In conclusion, the influence of AI and emerging AGI capabilities on automotive service quality between 2020 and 2025 has been demonstrably positive. Organizations that have strategically integrated AI technologies report faster service delivery, reduced error rates, and higher levels of customer satisfaction, alongside a workforce that is more efficient and increasingly focused on value-added activities. The empirical evidence presented throughout this analysis affirms the role of AI as a key enabler of service excellence within the

automotive sector. Looking ahead, sustained progress will depend on the ethical and effective integration of AI, guided by a human-centered approach. The insights gained during this period

indicate that companies capable of aligning intelligent technologies with skilled human expertise will define the future standards of service performance in the industry.

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# Relationship Between Artificial Intelligence, Innovation and Performance

0ana Georgia PREDA $^1$ , Ionut Marius CROITORU $^2*$ , Paula-Paraschiva DRAGAN (SPIRIDON) $^3$ , Aylin KABAS $^4$ 

<sup>1</sup>University of Bucharest, 5, Edgar Quinet St. Bucharest, Romania

<sup>2</sup>National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independentei, Bucharest, Romania

<sup>3</sup>West University of Timisoara, 4 Vasile Pârvan Bd. Timisoara, Romania

<sup>4</sup>Akdeniz University, Dumlupinar Bl. Antalya, Turkey

Artificial intelligence (AI) has become a key technology in business, widely expected to drive innovation and improve organizational performance. This study provides a comprehensive bibliometric analysis of the academic literature (2021–2025) on the integration of AI in business, with a focus on its relationship with innovation and business performance. Using a dataset of 1,799 articles indexed on the Web of Science (open access) in the fields of business, management, and economics, we analyzed the research span through keyword co-occurrence analysis. The article analyses how the identified clusters reflect current research priorities: from understanding user acceptance factors to harnessing AI for innovation and addressing new challenges in AI-based decision-making. The conclusions point to implications for researchers and practitioners, noting that while the potential of AI to boost innovation and performance is widely recognized, implementation issues, capacity development, and ethical considerations remain at the forefront.

Keywords: Artificial Intelligence, business, performance, VOSviewer.

# Introduction

Artificial intelligence (AI) is increasingly transforming the way businesses operate, compete, and innovate. Over the past few years, organizations across industries have accelerated their adoption of AI technologies to improve decision-making, streamline operations, and drive innovation. This rapid growth in adoption underscores the perceived importance of AI, with business leaders expecting \*Correspondence to lonut Marius (ROITORU: ionut.croitoru@upb.ro

"Success in creating AI would be the biggest event in human history." Stephen Hawking generative AI to significantly impact their industries in the coming years. As such, CEOs are increasingly relying on AI insights for strategic decisions and anticipate benefits such as more data-driven, less biased decisions (Ștefan and Chivu, 2011).

Firms are implementing AI systems hoping to gain competitive advantages, develop new products or services, and increase operational efficiency (Paunică et al., 2021). Recent research provides support for these expectations. For example, Gao et al., 2025, find that the use of AI in enterprises has a significant positive effect on their innovation capabilities. AI can act as an enabler of innovation, providing new tools for product development, data analysis, and creative problem solving. At the same time, AI adoption can improve organizational performance metrics. Studies on small and mediumenterprises (SMEs) show implementations lead to substantial gains in sustainable performance, including economic and operational improvements, such as greater efficiency and cost reduction (Soomro et al., 2025). These findings align with the notion that AI, when effectively integrated, improves company capabilit ies and outcomes, from employee productivity and innovation output to revenue growth and market value (Ardito et al., 2024).

As AI permeates business functions, the academic literature on AI adoption in business contexts has expanded accordingly. Researchers have examined AI adoption from multiple angles: organizational readiness and change management, technological integration (e.g., with Big Data and the Internet of Things), strategic innovation management, ethical and societal implications, and more. The proliferation of studies, particularly in the period 2021-2025, has led to a rich but fragmented knowledge base (Ayinaddis, 2025, p 4). For example, there are separate streams investigating AI adoption in operations management, marketing, decision support, and the role of AI in driving innovation and competitive advantage (Radu et al., 2020). While there are narrative literature reviews on specific issues, such as the role of AI in

innovation management (Mariani et al., 2023) or the factors driving AI adoption in manufacturing (Heimberger et al., 2024), an integrated view of how these pieces connect is needed. A bibliometric analysis is a useful approach to inventory the structure of scientific articles specific to this research area. By quantitatively analyzing publication data, bibliometrics can uncover major themes, trends, and relationships in literature that may not be apparent from individual studies alone.

This study addresses the need comprehensive synthesis by conducting bibliometric analysis of recent research (2021-2025) on AI adoption in business. We focus on how this literature links AI adoption to innovation and business performance outcomes - a connection of great interest to both scholars and practitioners. The goal is to identify key research themes in this area, understand how they interact, and highlight emerging topics. Our analysis is based on a large dataset of academic publications from the Web of Science (WoS), filtered to reflect business and management perspectives on AI. We use keyword co-occurrence network analysis to visualize and interpret thematic clusters present in the literature. In doing so, we contribute to a structured overview of recent research: what topics are most prominent, such as "innovation" concepts "performance" are connected to AI adoption, and where potential gaps in research may exist.

#### Literature Review

Research on AI adoption in organizations has accelerated in recent years, reflecting AI's transition from an emerging technology to a mainstream business tool. Between 2021 and 2025, a substantial portion of the entire academic literature on "AI in business" was produced. This growth corresponds with real-world developments, such as advances in machine learning, the COVID-19 pandemic's push for digital solutions, and the emergence of accessible AI platforms (Stanciu and Militaru, 2023).

Commonly identified factors include perceived benefits and relative advantages of AI such as improved efficiency, better decision quality, top management support, organizational readiness (in terms of skills and IT infrastructure), and external pressures such as competition or the nature of customer demand. A study by Soomro et al. (2025) highlights those factors such as management support, employee capacity, and vendor support significantly facilitate AI adoption in SMEs. These factors reduce barriers by ensuring that the organization has the leadership vision and technical capacity needed to implement AI. The complexity of AI technology and integration concerns can slow adoption, while clear relative advantages such as demonstrable return on investment or productivity gains accelerate AI adoption (Crasoveanu et al., 2024).

The COVID-19 pandemic (2020 – 2021) has also been noted as an accelerator for AI adoption. Faced with remote work and disrupted markets, firms have turned to digital and AI-based solutions at an unprecedented pace. This has included deploying AI for online customer services (such as chatbots), optimizing the supply chain under uncertainty, and analyzing data to guide strategic pivots (Dumitrescu et al., 2023). As a result, the post-2020 literature often discusses AI adoption in the context of digital transformation. Many organizations have seen AI as essential for building resilience and flexibility during the "new normal," essentially compressing years of digital adoption into months (Agarwal et al., 2024).

An important theme is how AI adoption differs by organizational size and context. Smaller firms often face distinct challenges compared to large corporations in implementing AI, such as limited financial resources, fewer specialized staff, and higher perceived risks (Zhan et al. 2020). The literature from 2021–2025 reflects a growing interest in this dichotomy. Ayinaddis, (2025), notes a fragmented understanding of the dynamics of AI adoption between SMEs and large firms, with

research raising questions about whether AI tools and implementation outcomes differ significantly by company size. Some findings suggest that while the fundamental motivations for AI adoption (improving efficiency, innovating, maintaining competitiveness) are common, large firms typically have more capacity to invest in sophisticated AI systems and data infrastructure, while SMEs may adopt more cloud-based AI services or simpler AI applications. Moreover, large firms are often early adopters of the frontier (e.g., deploying AI at scale in R&D and analytics), while SMEs may lag and focus on specific high-impact areas, such as customer service automation or sales forecasting. Recognizing these differences, recent studies call for tailored strategies to support AI adoption in SMEs, such as government incentives, affordable AI-as-a-service offerings, and training programs to build AI capabilities in smaller businesses.

Despite the enthusiasm, the literature also documents several challenges that organizations face in adopting AI. A prominent issue is the lack of skilled human capital - many companies face a shortage of AI talent (data scientists, AI engineers) and the need to improve the workforce to work effectively alongside AI systems (Nicolae, 2010). There are also data concerns: successful AI requires high-quality data, but firms may have too large databases, privacy concerns, or insufficient data governance. Trust in AI systems is another frequently cited barrier. Users and managers may hesitate to rely on algorithmic decisions without understanding how they work, especially if AI is a "black box". This has made change management and user acceptance critical topics in the literature (Bucovetchi and Simion, 2015). Indeed, studies highlight that acceptance of AI by users – whether employees, managers or customers – is essential for realizing benefits. Factors such as transparency, justification of AI outcomes and user involvement in AI implementation can improve trust and acceptance. The literature between 2021 and 2025 shows an increase in research on ethical AI,

responsible AI and governance frameworks that aim to address these trust and ethical issues (e.g., ensuring that AI decisions are fair, avoiding bias, protecting privacy). These concerns are linked to the broader context of AI adoption: organizations need to navigate not only technical and economic factors, but also social and ethical implications (Suciu et al., 2014).

An important concept that has emerged in recent literature is how AI can enhance a firm's innovation capacity. Innovation capacity refers to the skills, processes, and resources of a company to develop new products/services and improve existing ones (Bichescu et al., 2017). Gao et al., 2025, approach this through a dynamic capabilities perspective, showing that the use of AI strengthens a firm's ability to perceive and seize innovation opportunities. They identify digital adaptability as a mediating factor - meaning that organizations that are flexible and able to adapt their processes digitally gain more innovation benefits from AI. In essence, AI provides powerful tools (such as machine learning algorithms, predictive analytics, generative design systems) that can augment human creativity and experimentation, but the firm also needs to adapt its routines and culture to effectively exploit these tools. Firms that are highly adaptable in integrating AI (in terms of technology use, skill adaptation, and market perception) see a greater boost in innovation output.

To summarize, current research (2021–2025) strongly positions AI as an engine of innovation in the business context. AI not only automates routine tasks but also expands what organizations can innovate: enabling data-driven innovation providing capabilities strategies, for experimentation, and unlocking new areas (such as AI-based products). However, these benefits depend on complementary factors such as human expertise, strategic alignment, and organizational adaptability. Thus, the conversation in the literature has shifted from "Will AI drive innovation?" to "How can we maximize the innovation potential of AI?" and "What new types of innovations emerge

from AI?". This is closely linked to the outcomes in firm performance, as discussed below.

In conclusion, the recent literature establishes that the adoption of artificial intelligence in business is generally conducive to greater innovation and can enhance performance, but achieving these outcomes requires careful attention to adoption of drivers, capacity building, and ethical implementation. Research trends from 2021 to 2025 show an evolution from studying adoption as a singular examining how to achieve event to implementation correctly and examining the broader consequences that it entails. Given this context, we proceeded to map the structure of this literature through bibliometric analysis, systematically identify key themes and their interrelationships.

# **Research Methodology**

This article is based on bibliometric analysis, which is a systematic and quantitative examination of bibliographic data from Web of Science. Bibliometric analysis is a powerful tool for organizing and understanding the knowledge present in the selection from the Web of Science database, resulting from the application of a search tag and specific filters and the use of scientific tools for processing the resulting data, such as VOSviewer software.

Starting from the current situation of preserving and archiving scientific research and the continuous increase in the number of professors and researchers, from different areas and fields of research, who want to have access to the results of scientific research, the authors intended to carry out an analysis of up-to-date open access scientific articles, using the specific Web of Science filters. The search and filtering strategy was designed to focus research at the intersection of artificial intelligence and business/management, focusing especially on the last years (2021–2025) in order to align with contemporary trends, with the following filters being applied:

- Publication years 2021-2025;
- Web of Science categories: Business, Management, Economics;
  - · Open access.

By applying the restrictions of the three filters, a number of 11,799 scientific articles resulted, which will be analyzed bibliometrically. We chose the open access filter because we wanted the word density and co-occurrence analysis through the WOSviewer software, the results of which we will rely on in this article, to have access to the abstracts of the articles and this was only certain for articles published in this format. Of course, by choosing this filter we can limit the final conclusions only to the content of the articles examined.

The analysis of the density of words and phrases associated with the keyword artificial intelligence business was performed using the WOSviewer software by applying the filter minimum number of occurrence of a keyword 25 and out of the 7,299 words/key phrases only 79 met the condition, being grouped by five clusters. To ensure the robustness of the network analysis, we experimented with several different thresholds to see if the cluster patterns were maintained. The five-cluster solution proved stable, even when including more keywords, those additional keywords tended to attach to the five clusters without introducing fundamentally new cluster. This suggests that the thematic structure we identified is not the prerogative of a certain boundary, but a consistent feature of the scientific literature on which we conducted the analysis.

The comparison between co-occurrences and the strength of the links within the clusters was undertaken, with specific graphical images presented for each cluster. Following the analysis of the links, the conclusions presented in this article were drawn. We also noted that a significant number of papers were literature reviews or conceptual papers, indicating a maturation of the research field in which knowledge synthesis has become important.

## **Research Results**

To establish the necessary database for the bibliometric analysis of how artificial intelligence (AI) is an essential component in the business field, we queried the articles on the Web of Science platform for the label artificial intelligence business, resulting in a number of 36,269 scientific articles containing this label. As our research intention was to analyze current aspects of the influence of artificial intelligence on business, we applied the first filter that the articles had been published in the last five years. Following the analysis of the Web of Science Categories, we observed that the first three areas in terms of number of articles are those specific to the business environment, so we decided to choose only the articles included in the three areas: Business, Management, Economics. The last filter chosen was that the articles be published in the Open Access system because in the analysis carried out through the WOSviewer program we wanted to have access to the article in its entirety. This decision was made to facilitate full-text analysis and transparency, and also because open access literature often reflects the rapidly evolving state of research. While this may exclude subscription-based journals, the number is sufficient for a robust analysis and includes a wide range of reputable sources. The evolution of the number of articles in the selection by successively applying filters to the 36,269 articles resulting from the application of the label artificial intelligence business is presented in Table 1, and the final number of articles on which we will apply the bibliometric analysis is 1,799:

Analyzing the annual distribution over the five years of the applied filter of scientific articles, we can observe an increase in interest during the period 2021-2024, which leads us to the idea that the topic addressed in the article is growing in interest within the existing scientific articles based on the Web of Science.

Number of items Number of Filter applied Filter subcategory Filter articles after filter application subcategory Publication years 2021-2025 21,016 524 **Business** 455 Web of Science Categories Management 4,605 203 **Economics** 

**Table 1 -** The order of the Web of Science filters used when querying the database

For 2025, we only have a first quarter. Focusing on this five-year window captures the increase in publications because of the rapid advances in artificial intelligence and digital acceleration in the

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pandemic era, providing an updated picture of the scientific literature on business development. The evolution is presented in Table 2.

1,799

**Table 2 -** Distribution of the 1799 articles by year

Year	2021	2022	2023	2024	2025
Number of articles	286	358	447	580	128

After seeing that the subject addressed has growing trends in interest, we wanted to see if the interest in the topic addressed is also distributed worldwide. In Figure 1, we presented, using the analysis of bibliometric results from the Web of Science database, the density of the countries of origin of the authors, the first 11 countries according to the number of articles in the database subject to our research, and we note that they are states from four continents and the states in Europe predominate.

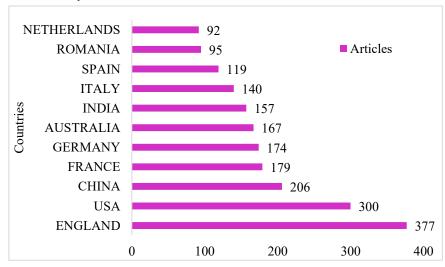


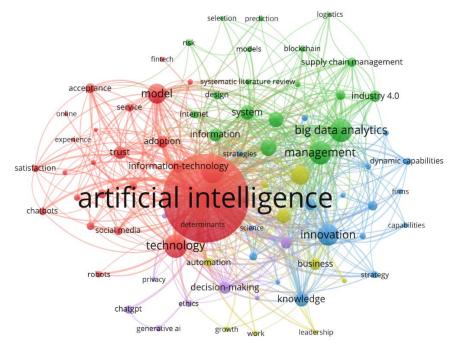
Figure 1 – Classification of authors' countries of origin

The analysis of the density of the phrases or words used was carried out using the WOSviewer software by applying the minimum filter number of occurrences of a keyword 25 and only 79 key

words/phrases out of the 7299 in the selection met the condition, these being grouped by five clusters. We also used a thesaurus file so that the density of the appearance of the words/phrases would not be affected due to different writing in the articles. This filtering of minimum 25 occurrences eliminated some of the less frequent keywords, while

preserving the core concepts. The included keywords collectively appear hundreds of times and form the backbone of the discourse on the adoption of AI in business.

Figure 2 shows the distribution and connections between words/phrases in the five clusters after applying the minimum occurrence filter 25.



**Figure 2** – The density of phrases/words that have at least 25 occurrences

After processing the data with the help of the VOSviewer program, the words and phrases with the highest density are artificial intelligence, management, big data analytics, impact, technology, innovation, performance, model. From the analysis of the predominant phrases in this analysis, we can clearly state that the articles in the

selection deal with how the adoption of AI can trigger innovation and stimulate performance in the business environment by offering models, systems and networks adapted to new challenges. Also, with the VOSviewer program, the classification of words according to total link strength is available, these being highlighted in Table 3.

**Table 3** – *Link strength between articles analyzed by Keyword* 

Keyword	Occurrences	Total link strength
artificial intelligence	1,111	3,528
management	205	966
big data analytics	207	962
impact	203	883
technology	211	874

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artificial intelligence	1,111	3,528
management	205	966
big data analytics	207	962
impact	203	883
innovation	189	779
performances	166	704
exemplary	167	672
framework	121	542
Syst	114	513
knowledge	111	503

The words/phrases contained in the five clusters are listed in Table 4. Each cluster represents a set of topics that are frequently discussed together in literature, which can often correspond to a research

subdomain or a certain angle of AI in business. Thus, these bibliometric maps give us a unique picture of the themes and orientations existing within scientific articles.

**Table 4** – VOSviewer clusters and related colors

Cluster 1 (24 items)		Cluster 2 (19 items)		
acceptance adoption antecedents artificial intelligence behavior chatbot consumer Engagement experience fintech impact information technology	deliberately exemplary online perceptions quality robots satisfaction serving social media technology trust user acceptance	blockchain covid-19 design framework industry 4.0 information Internet logistics machine learning	management models prediction risk choose supply chain management sustainability Syst systematic literature review	
Cluster 3 (18	-	Cluster 4 (10 items)	Cluster 5 (8 items)	
analytics bibliometric analysis capabilities digital transformation digital transformation dynamic capabilities firm performance companies governance	innovation knowledge literature review organizations science strategies strategy technology transformation	ENTREPRENEURSHIP future	algorithms challenges chatgpt decision-making ethics generative of opportunities privacy	

In the next stage of the research, we will analyze each cluster, as well as the entire network by examining the common thread between them and the other elements in each cluster. For unambiguity, the keywords of each cluster have been presented in Table 4.

Within Cluster 1 we can see that the focus is on technology adoption and user acceptance. This cluster, which contains 24 keywords, is centered around the artificial intelligence node itself and includes terms that relate to how users and organizations adopt and experience AI. The key terms in this cluster are adoption, acceptance, trust, behavior, intent, satisfaction and user acceptance, along with various application contexts such as chatbots, robots, fintech, social media and general terms such as technology and models. The presence of words such as acceptance, intention, trust and user satisfaction clearly indicates that this cluster deals with the human and organizational aspects of AI adoption – essentially the theme of technology acceptance. This includes studies on user perceptions of AI systems, factors leading to acceptance, and the impact on user satisfaction or experience. For example, chatbots appearing here suggest research on customer acceptance of AI chatbots in service settings (and their effect on satisfaction). Fintech and social media imply contexts in which AI adoption is studied (fintech services using AI or AI in social media marketing, which involve user engagement). The content of this cluster aligns with research investigating the antecedents of AI adoption and the consequences for individuals, satisfaction, and engagement. The juxtaposition of artificial intelligence with these terms indicates that many papers discuss AI adoption in terms of these behavioral or experiential outcomes. For example, several papers may explore "AI adoption and user trust in technology" or "AI chatbots and customer satisfaction," thus linking those keywords to the literature. The inclusion of generic terms such as model and information technology suggests that some adoption studies involve proposing models or referring to the broader field of IT adoption. In general, Cluster 1 reflects the micro- and organizational-level adoption user/organizational perspective, emphasizing readiness and responsiveness to AI.

Within Cluster 2, which contains 19 keywords, we have as our area of coverage AI in operations and technology management. We can say that this cluster represents the intersection of AI with other advanced digital technologies and operational contexts. Representative keywords include big data analytics, blockchain, industry 4.0, internet, logistics, supply chain management, sustainability, covid-19, risk, framework, analysis literature and framework. The presence of big data analytics, blockchain, industry 4.0, internet signals that this cluster is about technology ecosystems and integration - AI as part of the broader Industry 4.0/digital transformation in operations and supply chains. Many of these terms appear together, as papers in this topic often discuss multiple technologies together (e.g., how AI and big data analytics are improving supply chain management, or how Industry 4.0 technologies including AI, the internet, and blockchain collectively impact operations). The inclusion of logistics and supply chain management indicates a strong focus on supply chain management, with AI being used for demand forecasting, route optimization, risk management in supply chains, etc. Risk and selection may refer to issues of risk management and technology selection in operations (possibly AI solution selection or project risk assessment). The term framework suggests that many papers propose frameworks for implementing AI with other technologies. The appearance of covid-19 here is revealing; it most likely reflects studies on how the pandemic has spurred the adoption of AI and related technologies in operations/supply chains to mitigate disruptions. Also, the keyword systematic literature review in this cluster indicates that several review papers focused on AI in operations/supply chain have been published. Therefore, this cluster represents an operations and systems management perspective on AI adoption: it covers research on AI enabling smarter manufacturing (Industry 4.0), AI in logistics, AI for operational sustainability, and the integration of AI with other emerging technologies (such as blockchain for secure transactions or data collection). It is a more technical and meso-level cluster (company processes and technology integration), in contrast to the user-level focus of Cluster 1. Many of these

studies have a practical direction: the design or evaluation of AI-based systems in real operational contexts. The co-occurrence of management and models here also suggests scientific models of management or decision models that incorporate AI. In conclusion, Cluster 2 captures the scholarly literature addressing how AI is being adopted alongside other digital technologies to transform operations, supply chains, and enterprise systems, including considerations of specialists and impact during recent disruptions during the pandemic.

Cluster 3 comprises 18 keywords that revolve around organizational capabilities, strategy, and outcomes such as innovation and performance. Key terms in this Cluster 3 include innovation, company performance, capabilities, digital transformation, knowledge, governance, strategies/strategy, organizations, bibliometric analysis, literature review, and transformation. This cluster is strongly aligned with the strategic management and innovation management literature on AI. The emergence of innovation with company performance and capabilities suggests that many studies consider how AI influences innovation and how it, in turn, affects performance - essentially the trio of AI, innovation capability, and performance outcomes, similar to the framework discussed by Gao et al., (2025).

Digital transformation digitization and transformation show that AI is often discussed as part of a broader digital transformation journey for companies. The inclusion of knowledge, strategies, organizations, and governance indicates high-level organizational considerations: how AI adoption is strategically managed, how it organizational knowledge management, and how governance structures (such as data governance, AI governance) are established - all of which impact innovation and performance. It is noteworthy that governance appears here (potentially referring to IT governance or AI governance in firms). The presence of bibliometric analysis and literature review in this cluster might initially seem strange (since these are methodology terms), but it probably means that a number of bibliometric studies or reviews have been conducted on subtopics such as AI and innovation, for example, the bibliometric review by Mariani et al., (2023). Thus, the cluster

studies also encompasses meta-level that summarize this field, suggesting a mature area with reflective analyses, which can be interpreted as focusing on innovation and strategic outcomes based on artificial intelligence. It is about how the adoption of AI transforms organizations (digitally), how it demands new capabilities and strategies, and how it ultimately correlates with firm performance and competitive advantage. The themes of this cluster are very much at the heart of our research question - they directly link the adoption of AI to innovation and performance, providing evidence that in the specialized literature these concepts are closely intertwined. The co-occurrence patterns here likely come from studies examining, for example, "AI and company performance" or "AI and innovation strategy," etc., linking these keywords together frequently. So, Cluster 3 is the macro-level strategic perspective on AI adoption: it links technology adoption to organizational innovation, capabilities, and measurable performance outcomes.

Cluster 4 comprises 10 keywords and includes terms such as automation, business, performance (the generic term, not specifically firm performance as in Cluster 3), entrepreneurship, leadership, growth, future, work, determinants and outlook. This cluster seems to capture broader discussions about the future impact of AI on business and work, as well as the factors and perspectives on AI adoption. Words such as future, work, automation, leadership and entrepreneurship suggest a process about how AI is influencing the organizational future and leadership approaches. For example, the future of work is a phrase that most likely underlies this cluster, reflecting research on how AI-based automation is changing jobs, work design and organizational structures. Leadership indicates studies on how leaders manage AI adoption or how AI affects leadership roles (some papers discuss the need for AI leadership or how executives perceive AI). Entrepreneurship could indicate interest in how startups or entrepreneurs use AI or how AI encourages the creation of new ventures (perhaps linking to the idea of business model innovation or new digital startups). The term determinants likely refer to studies on the determinants of AI adoption (which could also fit into Cluster 1), but here perhaps in the context of strategic determinants or environmental factors. Perspective may come from papers that provide an "inspection" on AI (e.g., point of view articles or concept pieces). The presence of business and performance (generic) in this cluster, separate from firm performance in Cluster 3, suggests that some literature uses the term performance in a broad sense (perhaps organizational performance or task performance) and the grouping has separated the more strategyoriented performance discussions (Cluster 3) from others. Cluster 4 seems to function as a somewhat eclectic but coherent grouping around the theme of the strategic and societal implications of AI for business, especially regarding the future. It includes perspective terms (future, growth), managerial roles (leadership, entrepreneurship) and holistic terms (business, work). For example, we can imagine papers on "the future of work in the AI era" or "AI and the new normal for business growth" - these would contain several of these keywords together. This cluster could also capture work on the macroeconomic view of the impact of AI on growth and entrepreneurship, and conceptual discussions of what the widespread adoption of AI means for the nature of business (hence "outlook" "determinants" in the broad sense). In essence, Cluster 4 highlights that, beyond immediate implementation, researchers are concerned with the long-term strategic implications and conditions of AI in business: how it shapes leadership, what it means for entrepreneurs, and how it will drive or hinder future business and workforce growth.

Cluster 5 is a smaller cluster with eight keywords, but it is still very relevant. Its keywords are decision-making, algorithms, ethics, privacy, challenges, opportunities, generative AI, and ChatGPT. This cluster clearly captures the new wave of AI discussions in 2023–2025 – the presence of generative AI and ChatGPT (which became prominent after OpenAI's ChatGPT launch in late 2022) firmly dates this cluster to the latest trend. Thematically, these terms revolve around the implications and issues of advanced AI algorithms in decision-making contexts. Decision-making, as the central term here, indicates research focused on how AI systems either support or automate decision-making processes within organizations.

This can range from decision-making support systems to fully autonomous decision agents. The words challenges and opportunities often accompany discussions of implementing such AI – acknowledging the benefits (opportunities) of data-driven, AI-enhanced decisions, as well as the obstacles (challenges) such as trust, complexity, or ethical dilemmas. Ethics and privacy appearing in this group highlight the fact that a significant portion of recent literature is devoted to the ethical aspects of AI in business. This can include ensuring that algorithms are fair, impartial, transparent, respecting user privacy and ethical governance around the use of AI in businesses.

Cluster 5 thus addresses the cutting-edge technological and ethical frontier of AI adoption: it highlights that as AI systems become more autonomous and powerful (algorithms assuming decision-making roles), businesses and researchers are faced with maximizing opportunities (improved decision quality, efficiency) while mitigating challenges (ethical human pitfalls, loss). The emergence of this cluster in our data reflects the most recent academic attention (2023-2024), which aligns with real-world developments, where many companies have begun pilot projects with generative AI and simultaneously established AI ethics boards. It is likely that papers in this cluster will have titles on "AI ethics in business," "decision-making with AI," "algorithmic decisionmaking," or "using ChatGPT for management" frequently combining these keywords, hence the tight cluster.

Combining the information from the five clusters, we observe some general patterns:

- Innovation and performance as central outcomes: Clusters 3 and 4 explicitly include innovation and performance, and these concepts also connect to Clusters 1 and 5. This highlights that innovation is a key analysis through which AI adoption is studied – many authors frame their research in terms of how AI enables innovation of new products, services, processes, and how this leads to performance gains. Business performance, whether company performance, growth, or efficiency, is the ultimate dependent variable of interest in a multitude of studies, making it a unifying theme.

- Adoption factors remain essential: The prominence of Cluster 1, with the most keywords, indicates that despite the maturity of the field, understanding the human and organizational factors in AI adoption is still a major concern. Without user acceptance, AI projects fail; therefore, trust, satisfaction, and behavioral research remain vital. The large size of this cluster suggests that a significant portion of research is devoted to the theory of technology adoption applied to AI.
- Integration with other technologies is defined in Cluster 2 which shows that AI is rarely studied in isolation in operational contexts; it is part of a suite of Industry 4.0 technologies. This reflects real-world enterprise strategies where AI and data analytics are implemented together to transform business processes. It also shows interdisciplinarity for example, operations research and information systems fields overlap. The presence of several glowing reviews in this cluster indicates that it is an area where knowledge consolidation was needed (because so much was happening so quickly, for example, many papers on AI in SCM prompted reviews to make sense of it all).
- Ethical and societal dimensions cannot be ignored: the cluster dedicated to ethics, decision-making and emerging technology, Cluster 5, highlights that the community is actively considering the risks and governance of AI. This is an important finding: it demonstrates that, alongside performance and innovation, responsibility is a key pillar of discourse. Business professionals are asking not only "how do we adopt AI", but also "how do we adopt AI responsibly and what are the new challenges?" The emergence of this cluster with terms such as generative AI also indicates how quickly literature is reacting to technological breakthroughs.
- Bibliometric and review studies are part of the development of the literature: it is noteworthy that terms such as "systematic literature review" and "bibliometric analysis" that appear in Clusters 2 and 3, indicate a meta-reflection of the community. Our article is one of several that attempts to map the field, which means that the field has grown to a stage where such a synthesis is valued. This provides some validation that our approach is aligned with the way the field organizes itself —

through periodic reviews to highlight progress and identify gaps.

## **Conclusions**

The bibliometric analysis we have conducted mapped recent research on AI adoption in business, highlighting how this literature converges on the themes of innovation and business performance. Our study analyzed 1,799 publications published between 2021–2025, analyzing five thematic clusters that together characterize the field:

- Technology adoption and user acceptance: emphasizing the human and organizational factors that enable AI adoption (trust, satisfaction, behavioral intention). This theme emphasizes that successful innovation with AI begins with people users, employees, managers accepting and effectively using AI systems (Mateescu, Neagu, 2014). A direct implication is that companies need to address factors such as organizational culture, staff training, and building trust alongside technology implementation.
- AI in operations and technology management: integrating AI with other digital technologies (Big Data, blockchain) to transform processes such as supply chain management, especially under pressures such as pandemic disruptions. The dominance of this theme implies that businesses see AI not as a stand-alone tool, but as part of a broader digital toolkit for efficiency and resilience. The implication for practice is that firms should develop integrated digital transformation strategies rather than deploying AI in isolation. For academia, convergence of technologies means interdisciplinary research, combining operations management, information systems being fruitful particularly for understanding the operational impact of AI.
- Using strategic and dynamic capabilities to leverage AI for innovation and improved company performance. AI adoption delivers results at the firm level, confirming that when firms adapt effectively (develop digital capabilities, knowledge and strategies), AI contributes to greater innovation and competitive performance.
- Strategy, Leadership, and the Future of Work addressing macro-level and perspective issues,

including leadership roles in AI adoption, entrepreneurial opportunities, and broader socio-economic changes (future of work, impact of automation). The adoption of AI can redefine job roles, require new leadership skills (such as data-driven decision-making and AI oversight) and even change the entrepreneurial landscape by generating new ventures.

- Emerging AI Technology and Ethical Decision Making, focusing on the latest developments in AI and their ethical, governance, and decision-making implications. The clear implication is that ethical adoption of AI is paramount: organizations are advised to establish AI ethics guidelines, governance committees, and transparency measures as they launch AI solutions. For researchers, this theme suggests expanding work on frameworks for ethical AI, studies on consumer and employee trust in algorithmic decisions, and interdisciplinary collaboration with ethicists and law specialists to guide corporate regulations and policies. It also implies that any claimed performance gains from AI should be weighed against potential risks and unintended consequences (Lascu et al., 2021).

Taken and corelated together, the clusters suggest a narrative: organizations are adopting AI (Cluster 1) and integrating it into their operations (Cluster 2) in pursuit of innovation and superior performance (Cluster 3), while leaders are strategizing for long-term impact (Cluster 4) and managing the new challenges posed by advanced AI (Cluster 5). When all these aspects are addressed in an integrated manner, AI can fulfil its promise of innovation and performance improvement.

Our bibliometric approach provides a structured overview that complements previous narrative reviews. By quantitatively identifying clusters, we provide evidence of how topics cluster together. This provides several new insights, such as the strong clustering of AI with other technologies in Industry 4.0 (indicating the convergence of previously separate literatures) and the coalescence of generative AI with ethical concerns in the very recent literature.

Despite the comprehensive nature of our analysis, several limitations should be acknowledged:

- we relied only on the Web of Science database and an open access filter, which may exclude some relevant publications, for example, those in Scopus or works without open access. Future studies could expand the dataset (including Scopus, Google Scholar) or compare multiple databases to ensure wider coverage;

- bibliometric analyses often have a slight lag in the analysis of events. Even though we have included partial data from 2025, it is possible that some very new developments are not yet reflected in the published literature or keywords. Our Cluster 5 captures the beginning of this wave; a year later it might appear more developed or even divided into subthemes.

Despite these limitations, we believe the analysis is robust enough to provide a meaningful overview.

Based on this study, future research can delve deeper into each cluster or explore the connections between them. Another area is comparative studies: do certain industries (finance, healthcare, manufacturing) experience AI-based innovation and performance gains differently? The clusters in our analysis were generally cross-sectoral, but a sectoral bibliometric analysis might reveal different cluster patterns or key terms.

Additionally, future studies could use citation analysis or bibliographic linkage in addition to keywords to identify influential papers or schools of thought in this field. Our study focused on keywords to map themes, but citation network analysis could show which papers are most central or which groups of authors exist (for example, perhaps a group of researchers focusing on SMEs versus those on large technology firms). This could complement our findings by adding an understanding of thought leadership and collaboration patterns in the field.

Regarding the interconnection of smart labs, the data analysis highlights several key findings. A correlation exists between positive interconnection and the perceived benefits of collaboration, particularly in data exchange and accelerated innovation. Collaboration between labs can lead to increased productivity and improved research processes. Despite the lack interconnection in many labs, the strong interest suggests that it is still seen as important. There is also a discrepancy between the favourable opinions

of interconnection and its actual implementation, highlighting that interest does not always translate into action.

Drawing from the findings of this study and aligning them with the literature, successful collaboration between smart labs requires a sustainable network collaboration model. These results contribute to the growing body of research by emphasizing that effective smart lab collaboration is dependent on a structured and well-integrated approach, where standardized protocols, interoperability frameworks, and resource-sharing

mechanisms play a pivotal role. Furthermore, they highlight the importance of aligning institutional policies with best international practices to ensure seamless communication and technological compatibility.

The study's limitations include a small sample size of only 43 respondents, which may not fully represent the broader population of smart lab users and developers. With 71% of respondents from academic institutions, the findings may not be generalizable to other sectors like industry or government labs.

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# In Memoriam Professor Stana COSTOIU

At the end of March, we bid farewell to Professor Stana Costoiu (1932-2025), who dedicated 45 years to advancing management education at the Polytechnic University of Bucharest.

Mrs. Costoiu was a remarkable figure in the academic community, remembered not only for her pedagogical skills but also for her genuine camaraderie and leadership within her department. Under her stewardship, the environment fostered collaboration, productivity, and a distinctive sense of community among colleagues and students alike.

Professor Costoiu's exceptional presence—both physically and intellectually—coupled with her vigorous work ethic, distinguished her as a beacon of grace in her teaching practice. Over the course of her career, she influenced more than 40

generations of students at the Faculty of Management, nurturing their academic and professional growth with an unwavering dedication to their success, devoid of any negativity.

Her contributions extended beyond teaching; she was a pioneering researcher in the field of management, even in the era when the term was not mainstream. Professor Costoiu's scholarly work and postgraduate courses were instrumental in elevating the understanding of management principles in Romania, thereby enhancing the reputation of the Department of Organisation. Her expertise facilitated numerous collaborations with industries in Bucharest and the surrounding areas, leading to significant improvements in production processes and productivity.

The collective efforts of Professor Costoiu and her colleagues significantly contributed to the establishment of the Management Department at the Polytechnic University post-2000, as well as the Faculty of Entrepreneurship, Engineering, and Business Management in 2012, a venture in which she played a vital role in initiating.

Despite her retirement, she maintained a profound connection to the institution, deriving joy from her educational roots at the former Faculty of Economic Engineers at the Polytechnic, which was active until the 1955s. The substantial knowledge encapsulated in her writings—both in books and academic articles—has enduring relevance, particularly given the challenges of scholarly publication prior to 1990. The favourable conditions that arose thereafter have enabled the dissemination of her work, which continues to provide foundational insights into effective organisational management.



In the book *Problems of Organization and Management of Enterprises* (1987), some solutions for optimizing decisions and resource allocation are published. In the book *Problems of Industrial Management* (1990), methods for determining the size of industrial units, designing organizational structures, and using dynamic programming for optimizing processes are indicated.

In the book *Industrial Management* from 1993, the professor presents a synthesis of management schools, the systemic approach to organizations, the development of objectives, some modern management methods, the legislation on commercial companies, business organization, the development of a general plan for an enterprise, the organization of the logistics system, the placement of equipment in the production flow, the development of feasibility studies.

A few years ago, out of generosity, she offered her library of management books to the Department of Management at Polytechnic University of Bucharest..

Professor Stana Costoiu was a great person and a dedicated teacher. We will keep an indelible memory of her.

Sorin IONESCU SCIENTIFIC DIRECTOR

"Those who know, do. Those who understand, teach."

Aristotle



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