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The Acceptance of Innovative Technologies in Civilian and Military Domains

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Technological development is one of the primary driving forces of human society and the economy, thus enabling market transformations and the emergence of new business models and industries. The past century has introduced numerous technological innovations that have become indispensable in modern life. Examples are the proliferation of computers, the internet, mobile phones, radio, television, and the advent of artificial intelligence. The widespread adoption of digital technology over the past few decades has ushered in a new era, fundamentally transforming communication and work practices. As technology advances exponentially, the nature of these challenges continues to evolve. While NATO's 2017 report identified key technological challenges such as high rates of technological advancement, access to technology, the expansion of global networks, the dominance of the commercial sector in technological developments, and increasing technological dependence, by 2023, the focus shifted to the age of artificial intelligence (emerging and disruptive technologies). This study focuses on examining the adoption of artificial intelligence as an innovative technology in both military and civilian domains.

Keywords: artificial intelligence, military domain, civilian domain, innovative technology, acceptance

1. Introduction

Technological development is one of the main driving forces of human society, continuously shaping our lives, economies, cultures, and social networks. The previous century brought forth numerous technological innovations that have become essential parts of everyday life (Keszey–Zsukk 2017). These include computers, internet, mobile phones, television, and the increasingly significant spread of artificial intelligence (Orova 2006).

The effects of technological development can be observed not only at the economic level but also in social, cultural, and security policy contexts. Over the past few decades, the spread of digital technology has ushered in a new era that has fundamentally changed interpersonal communication, work habits, and access to information. The proliferation of the internet, smart devices, and cloud-based systems has enabled instant communication, rapid access to information, and has significantly altered consumer behavior. From the industrial revolution to the digital age, innovative technologies have transformed nearly every aspect of human activity (Orova 2006). These new devices systems, and ways of thinking have made human labor faster, more efficient, and often more convenient, but at the same time, they raise countless new challenges and ethical questions – such as issues related to data security, privacy, and ethical norms – creating new demands for solutions in both civilian and military/defense contexts.

In order to comprehensively study the effects of technological development, it must be considered that the development and application of new appliences (and services) are not only tied to civilian and economic spheres but also play a crucial role in military and defense areas. Defense technology has always been associated with innovation: many civilian inventions originally started as military developments, such as GPS (Nguyen 2024). The application of innovative technologies is a defining element in the operation of modern armed forces (Lele 2019). Thus, technological innovation not only enhances productivity and social well-being but can significantly influence national security, military strategic thinking, and even global power dynamics.

We contend that the comparative examination of the civil and military spheres remains an underexplored domain within the context of innovative technologies acceptance. Existing scholarship frequently focuses exclusively on either the civil or the military dimension, while systematic juxtaposition of the two is seldom undertaken. This study therefore seeks to compare the application areas of artificial intelligence across multiple dimensions. The dimensions identified provide a comparative framework that facilitates a structured interpretation of the similarities and differences between civil and military applications, and may serve as a foundation for subsequent academic inquiry as well as for informed policy-making.

For comparability purposes, this paper defines the civilian sphere as the non-military parts of society, including business enterprises and industrial sector actors, while the military sphere includes the armed forces, defense-related organizations, and actors in the defense industry, including operational support areas such as logistics. The study examines the acceptance and application possibilities of technological innovation – particularly artificial intelligence – in both civilian and military spheres, aiming to provide a comprehensive overview of the diverse roles innovation plays in 21st-century society.

2. The Conceptual Framework of Innovation

The concept of innovation was first conceptualized by Schumpeter in his book published in 1939. According to him, innovation includes (Schumpeter 1939) the following dimensions:

- the creation of a new product previously unknown to the consumer,
- the introduction of a new procedure not yet utilized in the field,
- the creation of a new market in which the given country had not been present before,
- the development of new sources for raw materials or semi-finished products,
- the establishment of new organizations.

The concept introduced by Schumpeter serves, in the context of this study, as a bridge between the classical understanding of innovation and the contemporary technological environment. From a Schumpeterian perspective, innovation is the primary driver of economic development, encompassing the creation of novel products, processes, markets or business models. In today's technological

landscape, however, innovation is increasingly data-driven: organizations leverage large volumens of structured and unstructured data to identify opportunities, support decision-making, and enhance product and service development. Data-driven innovation can reduce uncertainty and generate more evidence-based outcomes (Luo 2022).

In the comparative context of civil and military domains, data-driven innovation is particularly relevant, as both sectors generate substantial amounts of data, yet their utilization, analysis, and integration into innovation processes often follow distinct logics. In the civil sector, data-driven innovation primarily targets consumer demands, market trends and efficiency gains (Kusiak 2009), whereas in the military sector, emphasis is placed on strategic advantage, risk mitigation and rapid responsiveness (Pijpers et al. 2023).

The concept of data-driven innovation thus complements the Schumpeterian framework, as it enables the identification of novel forms of innovation, such as systems generated through algorithms and artificial intelligence, which can induce transformative changes not only in products but also in processes and organizational structures (Luo 2022).

In competitive environments companies aim to deliver the best performance to earn the trust of their consumers. To achieve this, they must offer a product or service that provides more than what their competitors offer. The end product of innovation can often be useful for the company, for example, by simplifying the production process. However, it does not exclusively serve corporate interests – it often benefits the consumers as well. Typically, "nonbusiness" innovations aim precisely at this direction. Innovation can be of outstanding importance not only to the business sector but also to the public, civil, and military spheres. In the public and civil sectors, innovation does not aim at profit but at solving societal problems, serving the common good, or improving social well-being (Dinya 2015). In the military sector, innovation efforts typically aim to increase security and efficiency – for example, by supporting decision-making, developing military technology, or automating military operations (Lele 2019). Technological innovations realized in this field are often dual-use – civilian and military (Boulanin 2016) – and can have significant impacts on national security and, indirectly, on the sense of security and stability of civil society.

Rogers (1983), in his theory on the diffusion of innovations, defines innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers 1983, p. 11). That is, according to Rogers, any idea that appears new to an individual can be considered an innovation, regardless of whether it is objectively new.

Rogers (1983) examined the process of innovation diffusion, their acceptance, and the reactions of different individuals and groups. The definitions and theoretical approaches used by Rogers do not consider innovation solely as technical characteristics, but rather as any new idea or practice that deviates in some way from the current norms and behavioral patterns of society. Thus, the diffusion of innovations refers not only to the spread of technological novelties but also to the dynamics of acceptance and integration of novel ideas and practices (Orova 2006).

The acceptance of innovations does not always occur seamlessly, even if the new technologies undoubtedly offer advantages (Keszey–Zsukk 2017). Consumers often resist novelties and, in many cases are only willing to accept them over time (Rogers 1983). Several factors may lie behind this, including distrust, inconvenience, costs, and social and psychological factors. Today, we may find it hard to imagine life without our smartphones – this single device can provide answers to our questions, allow us to shop, remotely activate household appliances, and pay from anywhere. However, the spread of smartphones was initially slow. The first devices offering mobile internet access appeared in the early 2000s, and smartphones became available in 2002, yet widespread adoption only began after 2008, following the launch of Apple's first iPhone (La Rue et al. 2010). Until then, many consumers continued to prefer traditional mobile phones, which were simpler and easier to use. Additional features such as touchscreen interfaces and app installations initially seemed complicated to many users. Moreover, people often fear the unknown, and this fear is especially true in the case of technological innovations. The spread of new technologies is often intertwined with social, economic, or ethical issues, which cause consumers to approach them with distrust. Although self-driving cars offer significant potential (e.g. improving traffic safety and efficiency), consumers are still wary of them (Wan–Peng 2024).

According to Rogers (1983), the diffusion of innovations within a society does not occur at the same pace for everyone. The rate and extent of acceptance can be divided into different groups depending on how willing individuals are to quickly adopt new ideas or technological innovations. The so-called S-curve illustrates the diffusion and acceptance of innovations over time. Acceptance typically starts slowly, then suddenly accelerates, and once the technology is accepted by the majority, the rate of acceptance slows down again. Rogers (1983) identified the following groups:

- *Innovators:* The first to try new technologies or ideas; willing to take risks. Represent 2.5% of adopters.
- *Early adopters*: Those who accept new ideas quickly and often play a leadership role in their communities. Represent the next 13.5%.
- *Early majority*: Those who hesitate but eventually adopt the innovation once it proves useful. Represent 34%.
- *Late majority*: Those who only accept new technologies after they have become widely adopted. Represent another 34%.
- *Laggards*: The last to adopt new ideas, often resisting them until the final moment. Represent the remaining 16%.

Rogers (1983) believes that innovations which offer advantages, are easy to implement, and are simple, spread faster and gain acceptance more quickly than those that are complex or difficult to understand.

3. The Acceptance of Artificial Intelligence as an Innovative Technology

One of the most significant technological breakthroughs is occurring in the field of artificial intelligence and machine learning. In recent years, the application of this technology has gained momentum across various industries, becoming a critical element in business operations. Furthermore, academic literature discussing this topic has also proliferated.

We often encounter several definitions of artificial intelligence. McCarthy (2007) identified it as the science and engineering of creating intelligent machines. According to Tegmark (2017), it refers to non-biological intelligence. Shariati et al. (2019) state that it involves the use of coded computer algorithms that can perform tasks – based on specific instructions – which typically require human cognitive abilities.

Nowadays, there is tremendous attention directed toward the application possibilities and fields of artificial intelligence. Developers are trying to find effective solutions to consumer problems across a range of industries and technologies.

3.1. Acceptance and Application Possibilities of Artificial Intelligence in the Civilian Sector

In civilian environments, artificial intelligence is primarily applied to improve quality of life, increase economic efficiency, and develop digital solutions that assist in everyday life. However, technological development not only enhances life quality but also raises new types of social problems. Changes in the labor market, automation, and the proliferation of artificial intelligence suggest that many jobs may become obsolete (Yadav et al. 2024). At the same time, it may also offer new opportunities in areas such as advanced data analysis, decision support, medical diagnostics, education, and customer service. However, the pace and extent of change demand significant societal adaptation.

In the economic sphere, decision-makers face additional difficulties due to skepticism and fears surrounding the topic – namely, that the spread of robots could increase unemployment (Lacity–Willcocks 2016). Initially, artificial intelligence was only capable of performing repetitive, routine tasks, but thanks to rapid technological progress, it can now perform increasingly precise tasks (Lu et al. 2020). Some studies suggest that AI is capable of outperforming human activity in many areas, yet experts agree that human expertise remains indispensable in decision-making (Selamat et al. 2022). Trust has become an increasingly important issue for both employees and consumers (Balmer et al. 2020). According to Lu et al. (2020), artificial intelligence is generally suitable for tasks requiring low emotional presence. For those demanding high emotional input, human labor remains essential.

The process of accepting technological innovations is often nonlinear, and many factors influence when and how consumers adopt new tools (Orova 2006). Comfort, economic, social, and psychological factors all play a role, and, in many cases, the new technology only becomes widely adopted once initial problems and resistance are overcome. Low acceptance can reduce AI usage among consumers, which can lead to underutilized resources, the obsolescence of AI tools, and the potential decline of innovative technologies.

3.2. Acceptance and Application Possibilities of Artificial Intelligence in the Military Sector

The fourth industrial revolution brings with it the exponential acceleration of technological development, with disruptive innovations emerging one after another, while economic and social systems struggle to keep up (Dinya–Klausmann-Dinya 2019). These rapid technological changes also affect defense domains. Cyberspace has emerged as a new battlefield, accelerating the escalation of conflicts. Moreover, groups employing irregular war cultures use the opportunities provided by technology to serve their own goals (Porkoláb 2020).

While NATO in 2017 highlighted expected challenges such as high rates of technological advancement, access to technology, the development of global networks, the dominance of the commercial sector in technological progress, and technological dependency (Strategic Foresight Analysis 2017), by 2023 the focus shifted. In the category of "the age of artificial intelligence," it identified the lack of regulation and standardization, the impact of AI on industry and the labor market, continuous technological transformation, rapid innovation and low entry costs, cooperation between public and private sectors, digital divide and social inequalities, as well as cognitive warfare as key challenges for the coming period (Strategic Foresight Analysis 2023, p. 5).

It is in the fundamental interest of a country's military to use the latest, most advanced technologies, equipment, devices, and procedures to effectively carry out its tasks. However, this also presents decision-makers with new challenges. In a military context, the acceptance and integration of innovations largely depend on how well the new technology aligns with organizational culture, how quickly it can be adapted, how controllable it is (Hill 2015), and how its benefits compare to its costs (Schuur 2025). These benefits are not necessarily related to the direct financial costs of the technology but rather the utility it offers, based on which the user decides to adopt it. Acceptance is hindered when considerable energy and/or financial resources have already been invested in the older, yet reliable technologies to be replaced (Rodriguez 2020). Furthermore, the introduction of new technology often requires changes within the military, including in organizational culture, training, and logistical support (Dombrowski–Gholz 2009, Hill 2015).

With the increasing use of artificial intelligence, additional important factors have emerged that influence acceptance. Researchers studying AI-based applications identify challenges such as vulnerability (Svenmarck et al. 2018, Porkoláb–Porkoláb-Minarik 2025), transparency (Svenmarck et al. 2018), the availability of suitable data for training and implementation (Svenmarck et al. 2018, Porkoláb–Porkoláb-Minarik 2025), overestimation of AI's autonomous capabilities (Porkoláb–Porkoláb-Minarik 2025), access to raw materials necessary for producing new tools (Lele 2019, Pavel et al. 2020), and the reliability of supply chains (Sobb et al. 2020, Calcara et al. 2023).

Despite these dilemmas, AI offers numerous advantages to armed forces. Autonomous weapons systems and aerial, ground, maritime (and underwater) vehicles are capable of making decisions and executing tasks in environments that are otherwise inaccessible or extremely risky for humans (Lele 2019, Johnson 2019, Johnson 2024, Morgan et al. 2020, Goldfarb–Lindsay 2022, Bistron–

Piotrowski 2021, Wan–Peng 2024). The fast processing and analysis of large amounts of data support intelligence and reconnaissance operations (Svenmarck et al. 2018, Johnson 2019, Johnson 2024, Morgan et al. 2020, Rashid et al. 2023), effective decision-making (Lele 2019, Johnson 2019, Johnson 2024, Morgan et al. 2020, Goldfarb–Lindsay 2022, Rashid et al. 2023), and the resolution of cybersecurity issues (Svenmarck et al. 2018, Lele 2019, Bistron–Piotrowski 2021, Rashid et al. 2023). Reality-simulating technologies (VR, AR, MR) are available to support training (Lele 2019, Rashid et al. 2023, Porkoláb–Porkoláb-Minarik 2025). In logistics, AI supports inventory optimization, planning secure transport routes, forecasting maintenance and repair needs, and automating warehousing and transport processes through data collection and real-time information sharing (Lele 2019, Lacroix 2023, Andrii et al. 2024).

It is critically important to consider the legal and ethical concerns related to the military application of AI. Applications and systems using these technologies – such as autonomous weapons – do not necessarily operate under human control (Morgan et al. 2020, Galliot–Scholz 2020, McFarland 2022, Mayer 2023, Petruska 2024). As a result, unexpected events during their operation may raise not only ethical but also legal accountability issues (Petruska 2024). These concerns encompass dilemmas related to control, safety (including the potential for errors), and data protection (Morgan et al. 2020, Galliot–Scholz 2020, Goldfarb–Lindsay 2022, Négyesi 2023, Wan–Peng 2024, Petruska 2024, Porkoláb–Porkoláb-Minarik 2025).

Based on the foregoing, the acceptance of new technologies in military fields differs significantly from that in civilian domains. The adaptation of a given innovation is the result of a complex decision that involves legal, ethical, organizational, and financial considerations.

3.3. Dual-Use AI Technologies: Comparing Civilian and Military Applications

The expansion of artificial intelligence has not only accelerated the pace of technological innovation but has also redefined the boundary between the civilian and military spheres. At the current rate of technological progress, it is becoming increasingly difficult to draw a clear line between industrial innovation and defense development. For example, the same algorithm that analyzes customer behavior in e-commerce can be used in a different environment for intelligence gathering or threat identification. This versatility and dual-use characteristic have become one of the most defining features of artificial intelligence.

As we referenced in earlier chapters, the objectives and operational logic of the two domains under examination – civilian and military – differ significantly. Nonetheless, many technological solutions are found in both sectors, albeit serving different functions.

Table 1 provides an overview of how artificial intelligence is applied in different dimensions, depending on the specific goals of the domain, highlighting in both domains the role of data-driven innovation based on the processing of large volumes of data.

Table 1. Comparison of civil and military application areas of artificial intelligence along different dimensions

Application Area	Civilian Domain	Military Domain
Data Mining and Analysis	Customer behavior analysis, market trends, business intelligence	Intelligence analysis, mission planning, threat detection
Autonomous Systems	Self-driving cars, industrial automation	Autonomous weapons, unmanned vehicles
Image and Voice Recognition	Facial recognition, voice assistants, product quality control	Target identification, Intelligence, Surveillance, and Reconnaissance
Cybersecurity	Intrusion detection, fraud prevention	Information protection, cyber defense
Predictive Maintenance	Equipment monitoring, failure prediction	Weapon system diagnostics, military equipment predictive maintenance
Decision Support	Business strategy, resource optimization	Tactical and strategic decision-making, situational awareness
Ethical and Legal Compliance	GDPR compliance, risk management	Law of armed conflict compliance, ethical decision-making

Source: own construction

Artificial intelligence in the civilian sector most commonly serves business and economic purposes. Companies strive to gain a competitive advantage through measuring customer satisfaction, identifying market trends, and utilizing business intelligence systems. Increasingly, organizations are employing intelligent chatbots and automated customer service systems (Cranor et al. 2003, Beckert 2021). A major advantage of AI-based chatbots is their 24/7 availability (Satheesh–Nagaraj 2021). They can receive customer inquiries, interpret their questions, and provide appropriate responses (Bagó 2023). In healthcare, for example, patients can receive instant answers to their questions related to medications or medical information. AI can also be applied for diagnosing diseases, conducting screenings, and monitoring conditions (Tisóczki 2022). In the banking sector, it can assist in faster and more accurate evaluation of loan applications, analysis of credit history and income, and identification of risks (Dubey 2019). In contrast, military applications primarily serve strategic and tactical objectives, such as processing intelligence data (Svenmarck et al. 2018, Johnson 2019, Johnson 2024, Morgan et al. 2020, Rashid et al. 2023), mission planning, and identifying and forecasting various threats (Lele 2019, Johnson 2019, Johnson 2024, Morgan et al. 2020, Goldfarb–Lindsay 2022, Rashid et al. 2023).

In the field of autonomous systems, the civilian sector focuses on self-driving vehicles (e.g., Tesla) and industrial robotics (e.g., Bosch or Audi assembly lines). In a military context, autonomous systems are used to gain battlefield superiority, increase efficiency and precision, and protect own forces on land, in the air, on water,

or underwater (Lele 2019, Johnson 2019, Johnson 2024, Morgan et al. 2020, Goldfarb–Lindsay 2022, Bistron–Piotrowski 2021, Wan–Peng 2024).

Image and voice recognition technologies appear in civilian applications such as facial recognition (e.g., phone unlocking, airport security systems) or voice-activated assistants (e.g., Apple Siri, Google Assistant, Amazon Alexa, Microsoft Cortana, Samsung Bixby). These technologies also serve security purposes by reducing the risk of unauthorized access and increasing identification reliability. Cybersecurity, in fact, plays a highly important role. Beyond image and voice recognition systems, civilian solutions also exist that can analyze transactions and detect unusual or suspicious activities – those that traditional systems may easily overlook (Bagó 2023, Umamaheswari–Valarmathi 2023). In the banking sector, this can help effectively identify fraud and enable immediate responses: for instance, alerts can be sent to the appropriate personnel, passwords can be automatically reset, and transactions can be halted. These systems can also be used in other sectors to detect suspicious emails and websites or identify phishing attacks (Bagó 2023, Umamaheswari–Valarmathi 2023). In the military context, cybersecurity efforts focus on information security, intelligence acquisition, and reconnaissance. The role of artificial intelligence in these activities is becoming increasingly prominent (Svenmarck et al. 2018, Johnson 2019, Johnson 2024, Lele 2019, Morgan et al. 2020, Bistron–Piotrowski 2021, Rashid et al. 2023).

Predictive maintenance in the civilian sector serves to monitor the condition of equipment and forecast failures. It is typically used by large companies such as GE or Siemens, which rely on sensor data to predict breakdowns. In contrast, military applications aim to forecast and monitor the maintenance needs of various devices – such as fighter jets and tanks – and prevent major malfunctions. This area is generally part of military logistics support (Lele 2019, Lacroix 2023, Andrii et al. 2024).

Decision support systems are present in both civilian and military sectors. In the civilian sphere, they are used in business strategy development and resource optimization, while in the military environment, they support tactical and strategic decision-making and enhance situational awareness (Lele 2019, Johnson 2019, Johnson 2024, Morgan et al. 2020, Goldfarb–Lindsay 2022, Rashid et al. 2023).

The question of ethical and legal compliance is always crucial but is approached from different perspectives. In civilian contexts, the focus is mostly on data protection (e.g., GDPR) and risk management, whereas in military applications, adherence to international legal norms governing armed conflict and ethical decision-making are of paramount importance (Morgan et al. 2020, Galliot–Scholz 2020, Goldfarb–Lindsay 2022, McFarland 2022, Mayer 2023, Négyesi 2023, Wan–Peng 2024, Petruska 2024, Porkoláb–Porkoláb-Minarik 2025).

4. Conclusion

The findings of this study suggest that the application of artificial intelligence within the civil and military domains is governed not merely by divergent operational logics but also by distinct societal and strategic imperatives. In the civilian sector, artificial intelligence is predominantly oriented toward satisfying consumer demands,

responding flexibly to market dynamics, and enhancing organizational efficiency. These objectives are frequently pursued through data-driven innovation, which capitalizes on the extensive availability of information to inform decision-making, optimize processes, and facilitate the creation of novel services. By contrast, in the military domain, the emphasis is placed on securing strategic advantage, mitigating risks, and enabling accelerated, real-time decision-making. Here, data-driven innovation assumes a different function: strengthening situational awareness, supporting predictive modeling, and augmenting operational effectiveness. This duality underscores the fundamentally distinct conditions under which artificial intelligence adoption and implementation unfold, thereby rendering a comparative analysis of innovation trajectories across the civil and military spheres indispensable.

The relentless pace of technological advancement confronts both individuals and societies with recurrent choices. Each innovation raises questions regarding its potential benefits and drawbacks for individuals, communities, and institutions alike. Drawing on an extensive review of the academic literature, the present study has demonstrated that the acceptance or rejection of emerging technologies – in this case, AI-based systems – is mediated by heterogeneous considerations across different societal contexts.

Although the boundaries between civilian and military applications are often blurred by the activities of economic actors, the two domains may nevertheless be distinguished under specific conditions. Our comparative analysis revealed that in the civilian sphere, the advantages of AI – including speed, accuracy, and enhanced efficiency in both professional and everyday settings – are widely recognized. However, these advantages are tempered by persistent concerns, particularly those relating to the displacement of human labor and the substitution of human judgment by automated systems. Such apprehensions exert a significant influence on the societal reception and acceptance of AI technologies.

In the military sphere, the advantages associated with AI lie primarily in the pursuit of technological superiority, the safeguarding of personnel, and the improvement of decision support and logistics systems capable of delivering real-time intelligence. Nevertheless, the integration of AI in this domain is embedded within a more intricate decision-making environment. Beyond the challenge of overcoming organizational cultural constraints, the perceived utility of adopting AI must be shown to justify the substantial financial investments required. Moreover, ethical and legal concerns loom large, including questions surrounding the extent of human oversight over autonomous systems and the secure, transparent deployment of technologies, particularly with respect to data protection and vulnerability management.

In conclusion, the comparative exploration of AI applications across the civil and military spheres reveals that identical technological innovations may assume markedly different functions and trajectories depending on their societal context. Consequently, the issue of acceptance must be addressed through a multidimensional lens. The findings also indicate that the future evolution of AI is likely to accentuate the divergence between these two domains: whereas in the civilian context issues of social legitimacy, data governance, and labor market transformation will remain central, in the military context ethical and legal dilemmas are expected to play a decisive role. We contend that analyzing the differentiated logics of AI adoption is of

significance not only for academic inquiry but also as a basis for informed policymaking.

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