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Economics and Organization of Logistics

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Last-mile logistics: between consumer expectations and the illusion of sustainable development

Logistyka ostatniej mili: między oczekiwaniami konsumentów a iluzją zrównoważonego rozwoju

Abstract. The article addresses the issue of last-mile logistics in the context of the dynamic growth of e-commerce and the influence of economic, technological, and social megatrends. The starting point is the identification of the growing role of e-commerce in shaping new patterns of consumption and the related consumer expectations – concerning the speed and flexibility of delivery, process transparency, as well as the ecological character of services. The subsequent sections discuss key pro-environmental solutions applied by logistics enterprises, including fleet electrification, the introduction of electric bicycles, the development of parcel locker networks, and the use of packaging made from recycled materials. It is emphasized that these activities are of both operational and reputational significance, becoming an important element of building competitive advantage in the market. However, the analysis revealed that there are sometimes significant discrepancies between corporate declarations and actual environmental outcomes. In this context, the phenomenon of greenwashing is examined, understood as the ostensible engagement in environmental issues that is not reflected in operational practice. It is underlined that growing consumer awareness necessitates the transparent reporting of activities and the presentation of measurable indicators of emission reduction and environmental impact mitigation. The conclusions drawn from the study indicate that the future of last-mile logistics will depend on the ability of enterprises to translate pro-environmental strategies into tangible, measurable results. Only such an approach will allow companies to avoid the risk of greenwashing and to establish the foundations for genuinely sustainable development in the e-commerce sector.

Keywords: last-mile logistics, e-commerce, e-consumer, megatrends, sustainable development, greenwashing

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Synopsis. Artykuł podejmuje problematykę logistyki ostatniej mili w kontekście dynamicznego rozwoju handlu elektronicznego oraz oddziaływania megatrendów gospodarczych, technologicznych i społecznych. Punktem wyjścia jest wskazanie rosnącej roli e-commerce w kształtowaniu nowych wzorców konsumpcji oraz związanych z nimi oczekiwań konsumentów – dotyczących szybkości i elastyczności dostawy, transparentności procesów, a także ekologicznego charakteru usług. W dalszej części omówiono kluczowe rozwiązania proekologiczne stosowane przez przedsiębiorstwa logistyczne, w tym elektryfikację flot, wdrażanie rowerów elektrycznych, rozwój sieci paczkomatów oraz stosowanie opakowań z materiałów wtórnych. Zwrócono uwagę na fakt, że działania te mają znaczenie zarówno operacyjne, jak i wizerunkowe, stając się istotnym elementem budowania przewagi konkurencyjnej na rynku. Analiza wykazała jednak, że między deklaracjami firm a realnymi efektami środowiskowymi występują niekiedy znaczące rozbieżności. W tym kontekście podjęto dyskusję nad zjawiskiem greenwashingu, czyli pozornego zaangażowania w kwestie ekologiczne, które nie znajduje odzwierciedlenia w praktyce operacyjnej. Podkreślono, że rosnąca świadomość konsumentów powoduje konieczność transparentnego raportowania działań oraz przedstawiania wymiernych wskaźników redukcji emisji i ograniczania wpływu na środowisko. Wnioski płynące z artykułu wskazują, że przyszłość logistyki ostatniej mili zależeć będzie od zdolności przedsiębiorstw do przekucia strategii proekologicznych w faktyczne, mierzalne rezultaty. Tylko takie podejście pozwoli uniknąć ryzyka greenwashingu i stworzyć podstawy dla realnie zrównoważonego rozwoju w sektorze e-commerce.

Słowa kluczowe: logistyka ostatniej mili, e-commerce, e-konsument, megatrendy, zrównoważony rozwój, greenwashing

JEL codes: R41, L81, O33, Q01, M14

Introduction

E-commerce represents one of the most dynamically developing segments of the contemporary economy. Its expansion is the result of the synergy of several processes – the widespread availability of Internet access, the growing digitalization of everyday consumer practices, as well as social and demographic changes that foster greater openness to new forms of shopping. Online purchases are becoming not only a convenient alternative to traditional sales channels but, in many cases, the primary form of acquiring goods and services. Increasingly, e-commerce is no longer regarded as a supplement to the retail market but as a distinct ecosystem in which new patterns of consumption, logistics models, and customer service standards are being shaped.

This phenomenon is accompanied by growing consumer awareness, with individuals attaching increasing importance not only to the product itself but also to the quality of the entire purchasing process. Crucial factors include the speed and timeliness of delivery, the possibility of choosing a flexible place and time of receipt, service transparency, and compliance with environmental and social values. The last-mile delivery stage becomes particularly critical – it closes the logistics chain and directly influences the final consumer experience. It is precisely at this stage that both opportunities for building customer loyalty and risks associated with dissatisfaction materialize.

These requirements pose growing challenges for enterprises operating in the e-commerce sector. Global megatrends – such as advancing digitalization and automation, the green transformation of the economy, regulatory pressure regarding environmental protection, and changing models of work and consumption – create new conditions for the functioning of logistics. Companies are compelled to combine cost efficiency with operational flexibility and ecological responsibility. Moreover, in an era of intensifying competition and consumer pressure, declarations concerning "green logistics" and pro-environmental solutions increasingly fall within the scope of critical debate on the authenticity of corporate actions, with the phenomenon of greenwashing becoming one of the key reference points in the analysis of contemporary market practices.

The purpose of this article is to provide a critical analysis of last-mile delivery processes in e-commerce, both from organizational and consumer perspectives. Particular attention is devoted to identifying the megatrends shaping delivery models, examining e-consumers' preferences regarding parcel collection methods and packaging, as well as assessing the significance of solutions associated with sustainable development. The article attempts to juxtapose market declarations with the actual practices of enterprises in order to evaluate the extent to which the green narrative of logistics is reflected in operational reality.

On this basis, the following research questions have been formulated:

– What technological, social, and environmental megatrends are currently influencing the shaping of last-mile delivery models?
– In what way do e-consumers' preferences regarding deliveries and packaging redefine service standards in e-commerce?
– Do practices described as sustainable represent a genuine factor influencing consumer purchasing decisions, or do they serve primarily a marketing function, reflecting the phenomenon of greenwashing?

Challenges of business development in a dynamic environment – sectoral context

Contemporary enterprises operate under conditions of rapid volatility and unpredictability. The energy transition, geopolitical tensions, advancing digitalization of processes, and rising consumer expectations increasingly render classical models of organizational management inadequate. In their place emerges the necessity of continuous adaptation, flexibility, and anticipatory responses to disruptions and ongoing changes. In logistics – serving as the backbone of the modern economy – environmental volatility translates into operational and strategic challenges related to costs, delivery times, supply chain structures, and the growing importance of the ecological dimension. The expanding share of e-commerce, the shortening of product life cycles, the progression of urbanization, and ESG requirements impose entirely new demands on logistics enterprises [Ejdys et al. 2023, p. 19].

A characteristic feature of the modern market environment is its complexity and the difficulty of unambiguously predicting the direction of change. This is commonly referred to as VUCA conditions – volatility, uncertainty, complexity, and ambiguity [Gao et al. 2021, p. 467]. Enterprises must operate in the context of ongoing transformations

and numerous external shocks. Examples include disruptions to global supply chains during the COVID-19 pandemic, the consequences of the war in Ukraine, and climate change effects impacting transport infrastructure.

The ongoing digital transformation is also of considerable significance. It represents one of the main currents of change, introducing technologies such as the Internet of Things (IoT), blockchain, predictive analytics, artificial intelligence, and operational automation into the economy – including logistics sector. Their application enables route optimization, inventory management, real-time temperature monitoring, and forecasting of delivery disruptions. These technologies also open broad opportunities for managing customer relations, for instance in terms of monitoring delivery times or tracking shipment routes [Nowicka 2025, p. 4–5]. At the same time, however, such technologies generate new challenges. They require investment, process redesign, digital competencies, and cybersecurity measures. Many logistics operators, particularly in the SME sector, lack the resources to fully implement digital solutions, which deepens the divide between transformation leaders and entities with limited flexibility. The ability to meet the demands of digital transformation may thus be one of the key aspects influencing the competitive potential of enterprises providing logistics services, especially those catering to individual consumers. This approach assumes an understanding of a company's competitiveness in a dynamic dimension – the fundamental capacity to perceive changes both in the external and internal environment and to adapt to them in such a way that the resulting profit flows ensure the long-term functioning of the enterprise [Garelli 2003, p. 5].

Another element determining the operating conditions of enterprises, including those in the logistics sector, is regulation. The European Union is implementing ambitious climate goals under the Green Deal and the "Fit for 55" package. The transport and logistics sector is one of the main sources of greenhouse gas emissions, which results in pressure for decarbonization and the adoption of a circular economy model. Operators must adapt their fleets to new requirements (e.g., electric vehicles, biofuels), develop return and recycling systems, and report their environmental footprint [Pilszyk et al. 2024, p. 13]. In this context, rising consumer environmental awareness may also be of significance, as it often compels producers or service providers to adopt specific behaviors. In the broadly understood logistics industry, consumer expectations are increasingly driving the provision of green delivery options (e.g., parcel lockers, low-emission vehicles) [Sallnäs, Björklund 2020, p. 1177].

With the digitalization and automation of logistics, there also arises the necessity to change organizational structures and work culture. Traditional hierarchical models are giving way to flexible project teams operating within so-called adaptive architectures – ready to respond immediately to environmental changes. The capacity for experimentation, iterative development, and real-time testing of solutions is becoming one of the fundamental competencies of future-oriented firms [Senge 1990, pp. 4–5, 17–18]. Although such aspects may be invisible from the customer's perspective, they nonetheless shape the final offer that responds to contemporary market challenges. This, for instance, may involve the need to develop so-called green competencies, which, depending on the sector of activity, may take different forms [Grabowski et al. 2025, pp. 6–8].

Parallel to the transformational challenges of ecology and digitalization, serious social challenges are also emerging – related to courier working conditions, job automation,

and growing employment instability. Work in the so-called last mile is increasingly based on civil law contracts, which reduces job security and lowers workers' sense of social safety [Fairwork 2024, pp. 7–8, 16–17]. Customer pressure for low prices and fast deliveries translates into cost pressure on employees.

Importantly, individual customers are increasingly guided by social and environmental values when choosing service providers. Transparency, ethical certifications, zero-emission operations, and even the working conditions of couriers may become decisive criteria for consumer loyalty [infuture.institute 2024].

In summary, it can be indicated that logistics enterprises, operating in a dynamic environment, must redefine their roles by transforming from operators of physical processes into complex organizations managing risk, data, and customer experience. Development in this sector is not about geographical expansion – it is about profound adaptation to megatrends, social expectations, and standards of responsibility.

Megatrends as determinants of business decisions

Management under conditions of uncertainty requires a strategic orientation toward the future. One of the fundamental analytical tools used for this purpose is the identification of megatrends – long-term, global forces of change that shape markets, social behaviors, and business models [Przybylski 2019, p. 233]. In the logistics sector, the role of megatrends is particularly significant, as this industry constitutes the direct interface between technology, the economy, and the consumer.

Megatrends operate with great inertia, yet their consequences are difficult to ignore. According to the latest analyses by infuture.institute presented in the "Trend Map 2024" [infuture.institute 2024], the most important trends influencing logistics include: digitalization and automation, electromobility, decentralization, the redefinition of work, data transparency, the economy of time, personalization, urbanization, and the green transformation. These are systemic factors that permanently alter companies' operational models and modes of business decision-making.

One of the most dominant technological megatrends is digitalization. In the logistics sector, it signifies not only the introduction of digital technologies into selected processes but, above all, the transition to real-time data management, system integration, and event prediction. Technologies such as AI, IoT, machine learning, and predictive analytics enable data-driven decision-making [Aryal et al. 2020, p. 141]. In practice, this translates into dynamic route planning, warehouse automation, inventory optimization, the identification of supply chain risks, and customer service supported by chatbots. Digital logistics allows companies to better manage risk, reduce operating costs, and shorten order fulfillment times. Moreover, digitalization has also become the foundation of operational transparency and an element of building trust with customers.

A second important trend is automation. This aspect can influence various industries to differing degrees, depending on the technological processes applied. In logistics, automated warehouse systems, autonomous guided vehicles (AGVs), drones, and robotic sorting stations are particularly significant. These technologies increase efficiency and reduce errors, but also require a redesign of warehouses' physical and process archi-

tecture [Ellithy et al. 2024, p. 16]. Examples of implementing such solutions can be found among global logistics operators, who, thanks to automation, are able to handle millions of shipments daily while maintaining high quality standards. Automation may also extend to customer service processes, enabling clients to manage deliveries without the involvement of employees, for instance, by selecting delivery locations or scheduling delivery times.

The third pillar of technological transformation is data integration and security. In an era of rising cyberattacks, logistics companies must safeguard information concerning shipments, customers, contractors, and operations. The application of blockchain in logistics enhances the security and immutability of information while also enabling the automation of certain processes [Ran et al. 2024, p. 152873]. Transparency thus becomes a market value in its own right. It should be noted, however, that the implementation of these technologies is not free from challenges. It requires substantial investment, new expertise, the transformation of management models, and the reorganization of entire operating systems. Frequently, the key barrier lies not in the technologies themselves but in organizational culture and the absence of a strategic vision for integrating megatrends into corporate activity.

Beyond technological megatrends, social and environmental megatrends are increasingly influencing business decisions in the logistics sector. These processes affect the values, expectations, and attitudes of both consumers and employees – redefining the foundations of market relations and organizational models. One of the most influential trends is the transformation of consumption. Consumers increasingly expect fast, inexpensive, and environmentally friendly deliveries, while at the same time becoming more socially and environmentally conscious. There is growing acceptance of de-consumption models based on minimalism, reuse of resources, and localism, as well as of strategies that appeal to consumer emotions by aligning with their worldview [Jasiulewicz 2015, p. 420]. In logistics, this may translate into customer expectations that deliveries be carried out sustainably – using low-emission vehicles, biodegradable packaging, and solutions that reduce the carbon footprint.

Equally important is the economy of time. This phenomenon leaves its mark on virtually every sphere of life, epitomized by the common phrase that "the world has accelerated". In the logistics context, the economy of time manifests itself in consumers valuing not only delivery speed but also the ability to select time windows, track shipments precisely, and access flexible collection channels (e.g., parcel lockers, click & collect). Personalization and delivery control are becoming key factors of customer satisfaction, forcing logistics operators to invest in predictive systems, real-time communication, and automated interactions [Meidutė-Kavaliauskienė et al. 2014, p. 338]. This trend is reinforced by urbanization and changes in household structures. Last-mile delivery is becoming the most costly yet also the most socially sensitive link in the entire logistics process. Challenges such as restricted access to city centers, increasing traffic congestion, legal constraints, and environmental pressures necessitate new solutions – such as microhubs, bicycle deliveries, shared vehicles, and logistics models based on shipment consolidation [Fegde 2025, p. 1].

Environmental megatrends, such as climate change, rising air pollution, and the need for decarbonization, directly influence the investment priorities of logistics firms. Com-

panies are implementing CO_2 reduction strategies, transitioning fleets to electric or hydrogen vehicles, utilizing renewable energy in warehouses, and investing in zero-emission solutions. Some logistics operators are establishing their own packaging recycling centers or return programs, thereby supporting the circular economy [Kedla et al. 2025, pp. 57–59].

An equally important megatrend is the redefinition of work. The labor market is changing under the influence of automation, demographics, and new generational expectations. Younger generations demand flexibility, a sense of purpose in work, diversity, and transparent employment conditions. Logistics companies must respond to these needs by offering new models of collaboration, investing in organizational culture, and implementing sustainable HR standards [Grabowska, Jastrzębowska 2024, pp. 35–37].

At the intersection of technological, social, and environmental megatrends, new business models are emerging. Increasingly, logistics is described as a hybrid service – combining physical transport, digital experiences, and ethical values. The future of the industry depends not only on innovation but on the ability to integrate it with market expectations and responsibility toward the environment. Dynamic technological, social, and environmental transformations are redefining the foundations of logistics enterprises. Whereas competitive advantage was once primarily based on scale, costs, and delivery speed, today it depends more on operational flexibility, the capacity to absorb innovation, openness to megatrends, and sensitivity to consumer needs. From the end customer's perspective, it is no longer just about whether a parcel arrives, but also how, when, in what form, and with what environmental and social consequences. Consumers expect the logistics process to be not only fast and inexpensive but also transparent, environmentally responsible, and consistent with their values. The phrase "fast, cheap, sustainable" is therefore not merely a slogan – it represents the actual matrix of expectations within which logistics companies must now operate.

An integrated approach to megatrends requires that companies' strategic decisions are not made solely in response to short-term market signals, but on the basis of deep analysis of long-term processes. Critical here is the implementation of foresight mechanisms – that is, the systematic identification and interpretation of signals of change and their transformation into concrete action strategies [Rohrbeck 2010, pp. 6, 15–18]. Companies that successfully integrate megatrends into their operational models – both technological and organizational – gain not only a competitive advantage but also systemic resilience. Examples can be found among operators that have transformed their distribution centers into automated predictive logistics hubs, deployed zero-emission fleets, or established networks of urban micro-logistics centers supporting bicycle deliveries. Importantly, this approach should not be reserved exclusively for large corporations. An increasing number of medium-sized firms and local operators are implementing micro-innovations – for example, flexible delivery slot systems, integration with e-commerce platforms, route optimization based on weather data, or infrastructure sharing with other entities. The future of logistics lies not in centralization but in the intelligent distribution of responsibility and knowledge.

Finally, we observe a transition from logistics being perceived as a technical service to logistics as a component of the consumer journey. Delivery becomes the final and often

the most crucial touchpoint with a brand. Negative experiences in this area may undermine the positive perception of the entire commercial offering [Fakher 2025, pp. 1–3, 6–7]. Therefore, adaptation to megatrends cannot be selective. Only enterprises that treat them as an integrated system of interdependencies – encompassing technology, people, values, and the environment – will be able to meet the rising demands of the market. As one of the sectors most exposed to change and social expectations, logistics today faces a choice: either become a creator of sustainable, fast, and inclusive solutions, or be pushed aside by more flexible and attentive players.

The consumer in the e-commerce market

The contemporary consumer market is increasingly shifting toward the digital space, with online shopping becoming a daily practice for a significant portion of society. E-commerce is no longer a complement to traditional sales channels – it has become an equivalent and, in many areas, a dominant model for the exchange of goods and services. Global forecasts indicate that in the coming years, e-commerce will be one of the key drivers of the digital economy, contributing to the redefinition of relationships between providers and consumers. In Poland, similar tendencies are observed: broader Internet access, growing digital competencies, and changing lifestyles mean that online shopping now spans diverse social groups and is becoming an element of everyday consumption [GUS 2024, pp. 109, 124].

One of the evident patterns is that e-consumption is most strongly associated with the level of educational capital. Individuals with higher education are significantly more likely to shop online than other groups, which may be linked to greater openness to technological innovations as well as better financial conditions enabling access to devices and stable Internet connections. At the same time, there is a gradual increase in participation among those with lower educational attainment, suggesting that e-commerce is becoming increasingly inclusive, although it still does not fully eliminate the barriers of digital exclusion [GUS 2024, pp. 109, 124].

Equally clear is the relationship between consumer age and the intensity of online shopping. Younger generations – raised in a digital world and treating online shopping as a natural way of acquiring goods – are the most strongly represented. This group shapes market standards, forcing companies not only to digitalize processes but also to introduce solutions that enhance the convenience, speed, and personalization of deliveries. Middle-aged individuals are increasingly adopting these patterns, which points to the growing universality of e-commerce in society. Older age groups remain less active; however, even within this segment, participation is gradually increasing – partly due to simpler shopping tools and partly as a result of social and family pressures [GUS 2024, p. 124].

Occupational activity is another factor differentiating consumer behavior online. The most active participants remain employees and students, for whom the Internet is an integral part of daily life and work. E-commerce enables them to manage time flexibly and adapt shopping to their fast-paced lifestyles. Self-employed individuals also make use of online shopping, though their growth dynamics are weaker – potentially reflecting

more traditional business models or preferences for direct purchasing. Among the economically inactive and retirees, interest in e-commerce is noticeably lower, confirming the thesis that digital competencies and socio-economic capital are key to adapting to new forms of consumption [GUS 2024, p. 124].

Interesting regularities can also be observed with respect to the place of residence. While city dwellers have long been the natural target group for e-commerce, the growing availability of the Internet and logistics infrastructure means that residents of smaller towns and rural areas are increasingly engaging in online shopping. This phenomenon points to a progressive homogenization of the market – e-commerce is gradually ceasing to be the domain of urban centers and is becoming a standard accessible nationwide. At the same time, regional differences persist, which may result from varying levels of development in local courier services, logistics, or consumer awareness [GUS 2024, pp. 125–126].

The structure of online purchases highlights further characteristic features of the e-consumer. The greatest interest is shown in products that are easy to present online and relatively simple to handle logistically, such as clothing, footwear, cosmetics, or household accessories. Consumers simultaneously expect convenience, flexibility in the choice of delivery options, and the possibility of quick returns. There is also a noticeable rise in the importance of non-price factors: transaction security, transparency of the purchasing process, and the alignment of seller practices with social and environmental values. E-consumers are becoming more conscious – treating a purchase not only as the acquisition of a product but also as an experience that should align with their expectations, lifestyle, and beliefs [Jaciow, Wolny 2011, pp. 12–13].

In summary, the development of the e-commerce market in Poland is shaped by processes deeper than the mere growth in the number of transactions. Educational, age, and occupational factors, as well as place of residence and digital competencies, play a key role. Online trade, on the one hand, promotes the democratization of access to goods, while on the other hand, it reveals disparities in the adoption of new forms of consumption. Enterprises operating in this field must therefore not only invest in technology and logistics but also understand the complex needs and preferences of diverse customer groups. The e-consumer is no longer just an anonymous recipient of an offer – they are becoming an active market participant whose expectations redefine business models, logistics processes, and communication methods. Addressing these expectations is a prerequisite for maintaining competitiveness in an increasingly demanding digital environment.

The specificity of the last-mile delivery process and consumer trends

Until recently, last-mile delivery was analyzed primarily in the context of B2B relations, that is, between enterprises. With the growth of online commerce, however, the service of individual customers (B2C) has gained increasing importance. The key element of this stage is the final segment of the supply chain – from the moment an order is placed

to the delivery of the product at the location chosen by the consumer [Lim et al. 2018, p. 310].

This process is considered the most demanding element of logistics service. This results from the diversity of shipments, the growing intensity of orders, and the need to adapt services to the individualized expectations of recipients. Logistics experts emphasize that last-mile delivery generates the highest costs within the entire logistics chain and, at the same time, is particularly burdensome for the environment [Smyk 2017, p. 1529; Gevaers 2009, p. 4]. This stage involves specialized courier companies and express parcel operators, forming the CEP (courier, express, parcel) segment [Książkiewicz 2011, p. 89].

In the scientific literature, last-mile delivery is primarily analyzed in three dimensions: effectiveness, costs, and environmental sustainability [Mangiaracina et al. 2019, p. 4]. Consumer expectations toward this stage of the process are constantly increasing – they now encompass not only delivery speed and flexibility but also convenience, ecological responsibility, and alignment with a particular lifestyle. Dissatisfaction at this stage may result in the loss of customer loyalty, making it a strategic area for entities operating in e-commerce.

Research indicates that a key factor encouraging online shopping is the availability of convenient delivery options. The most popular solutions are those that provide flexibility of collection – above all, parcel lockers, which allow consumers to decide on the time and place of pickup. Ranked lower are courier deliveries directly to the home or workplace and collections at partner points. Solutions that require the customer's presence at a specific time and place – such as traditional delivery by postal worker or in-store pickup (click & collect) – are less favored [Gemius 2024, p. 109].

Among additional factors motivating online purchases, consumers primarily highlight the proximity of pickup points, the ability to track shipments in real time, flexibility regarding delivery times and days, and the option of managing shipments through a mobile application. Contactless pickup, which increases users' sense of safety and convenience, is also gaining importance. Although mentioned less frequently, the ecological aspect has its place in the hierarchy of expectations – most often in the form of preferences for parcel locker deliveries, which are perceived as more environmentally friendly [Gemius 2024, pp. 121, 145–146].

These preferences translate into the actual choice of delivery options. Parcel lockers remain the most frequently selected solution, developing extremely dynamically in Poland and becoming a part of the everyday landscape. The popularity of this option stems both from its widespread availability and from the ability to align parcel collection with one's daily schedule. Consumers are increasingly reluctant to treat a personal receipt from a courier as a convenient solution – especially in situations where working or study hours prevent them from being at home at the time of delivery [Gemius 2024, p. 115].

Another area of growing expectations is delivery speed and cost. Customers expect free or low-cost shipping while simultaneously demanding that orders be fulfilled as quickly as possible – often even on the same day. This combination of price and time pressures creates significant challenges for logistics companies, which must reconcile economic efficiency with high service quality.

Packaging is also an important element of the last-mile process. It serves not only a protective function but also marketing and aesthetic purposes, influencing the customer

experience. In an era of rising environmental awareness, consumers increasingly expect eco-friendly solutions – biodegradable packaging, reusable materials, or options suitable for repurposing. Packaging thus becomes not only a practical carrier but also a tool for building customer relationships and confirming the values that guide the company [Szymonik, Nowak 2018, p. 96; Mruk 2012, p. 126].

In summary, last-mile delivery in the B2C market is becoming a space where technology, logistics, ecology, and consumer expectations converge. This stage is particularly sensitive – even small shortcomings can determine customer satisfaction and future brand loyalty. The ability to shape this process in a flexible, convenient, and sustainable way is emerging as one of the key determinants of competitiveness in the rapidly developing e-commerce sector.

Research methodology

The article has a theoretical-analytical character and is based on the method of content analysis and literature synthesis. The starting point was the identification of the conditions shaping the functioning of logistics processes in e-commerce, with particular emphasis on last-mile delivery, considered a key element of the consumer experience. Both academic studies in logistics, management, and marketing and industry reports, public statistics, and consumer research findings published by institutions such as the Central Statistical Office (GUS) and international analytical firms were taken into account.

The research procedure comprised three stages. The first involved a review of academic and industry literature, with particular attention to publications on economic megatrends, urban logistics, digitalization, and sustainable development. The second stage consisted of an analysis of statistical reports and empirical research results on e-consumer behavior, preferred delivery methods, ecological and packaging expectations, and factors influencing consumer loyalty. In the third stage, a synthesis of the collected data was conducted, combining conclusions from quantitative studies with a qualitative interpretation of values, attitudes, and market narratives.

A critical approach was applied in the analysis, meaning that not only the declared practices and strategies of logistics companies were verified, but also their consistency with actual activities. Particular attention was paid to discrepancies between market communication and the actual level of process sustainability, with the phenomenon of greenwashing analyzed in this context. This made it possible to identify situations in which marketing strategies associated with ecology may play a merely superficial role, without full reflection in operational practice.

The selection of source material was purposeful – focusing on publications and reports that present the latest trends in e-commerce in Poland and worldwide, as well as those that allow the capture of transformational processes in logistics. A comparative analysis of international and domestic data made it possible to place Polish experiences within the broader context of global megatrends.

The adopted methodology enabled the formulation of conclusions at both the practical level, concerning consumer preferences and market development directions, and the critical level, addressing ecological and social consequences. Thus, the article combines

a desk research perspective with theoretical reflection on the role of last-mile delivery processes in building competitive advantage and corporate credibility in the eyes of contemporary consumers.

Practical ecological solutions in the last-mile delivery process to end consumers

In this part of the analysis, the focus is placed exclusively on the ecological aspects of last-mile logistics. Earlier sections of the article also addressed other megatrends, such as digitalization, automation, personalization, and the redefinition of work. However, environmental issues were selected for in-depth analysis, as in recent years they have been particularly emphasized both in the strategies of logistics enterprises and in consumer expectations. Ecology is also an area where the discrepancy between corporate marketing declarations and actual practices is most evident. Concentrating on this dimension, therefore, allows not only the examination of specific actions but also a critical reflection on the risk of so-called greenwashing.

The implementation of ecological solutions has become one of the key activities of logistics enterprises. A strategic orientation toward sustainable development stems not only from environmental and regulatory requirements but also from economic and reputational considerations. Companies strive to present their positive environmental impact as an element of building competitive advantage and a source of customer loyalty. For this reason, ecology is becoming an integral part of the communication policy and CSR strategies of many operators.

One of the most important ecological solutions in last-mile logistics is the reduction of transport-related emissions. In practice, this translates into the electrification of vehicle fleets and experiments with alternative means of transport, such as electric bicycles. In recent years, Poland's largest logistics companies have been consistently implementing such investments. For instance, InPost currently operates nearly 1,300 electric vehicles, DHL around 400, and DPD Polska approximately 500. Electric bicycles are also being tested – five pilot routes have been selected to examine how bicycles may facilitate deliveries to hard-to-reach locations. Earlier, DPD Polska had already expanded its DPD Pickup Urban Branch network, where parcels are delivered on foot, by bicycle (including cargo bikes), or by scooter[1].

The development of electric fleets, however, requires significant financial investment, making it difficult at present to determine what percentage of total vehicles in individual companies are electric. Nevertheless, most companies' strategic documents highlight objectives related to reducing CO_2 emissions and investing in eco-friendly transport solutions. It should also be stressed that the real environmental impact of electric vehicles depends on the energy sources used for charging. Only when powered by renewable energy can they be considered fully zero-emission. Logistics companies increas-

[1] https://inpost.pl/sites/default/files/docs/dla-prasy/20240828_InPost_powiekszyl_swoja_flote_o_250_elektrycznych_Fordow_E_Transit.pdf; https://www.dhl.com/pl-pl/ecommerce/o-dhl-ecommerce/zrownowazony-rozwoj.html; https://fleetlog.pl/aktualnosci/500-samochodow-elektrycznych-w-dpd-polska/; https://www.dpd.com/pl/pl/o-dpd/o-dpd-polska/ [accessed: 16.09.2025].

ingly report data on the share of renewables in their energy mix. InPost, for example, declared that in 2024 renewables accounted for 45% of its energy consumption, representing a 10-percentage-point increase compared to the previous year. The company also reported that its absolute greenhouse gas emissions had decreased by 15% compared to 2021, with a long-term goal of achieving climate neutrality across the entire value chain by 2040 [InPost 2025, pp. 8, 28, 138]. Similar commitments are announced by other operators – the owner of DPD Polska, Geopost Group, declares its pursuit of carbon neutrality, while DHL Group has set 2050 as its target year for reaching net-zero emissions[2] [Geopost 2024, p. 11].

The second key ecological solution in the area of last-mile logistics is the development of parcel locker networks. These systems allow shipments to be consolidated and delivered to a single location, thereby reducing the number of courier trips and, consequently, emissions. According to InPost data, deliveries to parcel lockers can reduce CO_2 emissions by as much as 75% compared to direct home deliveries [InPost 2025, p. 23]. By the end of the first quarter of 2025, there were approximately 53.7 thousand parcel lockers operating in Poland, more than 25.7 thousand of which belonged to InPost. Other operators – such as DPD, Orlen, DHL, Allegro, and Poczta Polska – are also expanding their own networks[3]. However, for parcel lockers to fulfill their ecological role, they must be used appropriately – shipments should be collected "on the way", for example, on the commute to work or during daily shopping trips, and the distance from the consumer's home should allow for access on foot or by bicycle. InPost reports that 64% of parcel lockers in Poland are located within a 7-minute walking distance, with this figure reaching nearly 90% in urban areas [InPost 2025, p. 26].

Another important area of ecological initiatives concerns packaging. Companies aim to ensure that packaging is recyclable, produced from secondary materials, and, in some cases, reusable for other purposes. DHL, for instance, offers packaging that is fully recyclable and made entirely or largely from recycled materials (e.g., cartons, poly mailers, envelopes)[4]. InPost applies similar solutions, declaring that its packaging is also derived wholly or partly from recycled sources [InPost 2025, p. 153].

Pro-ecological solutions also include other operational measures, such as reducing energy consumption in sorting centers through process automation or the use of energy-efficient lighting. Additional initiatives worth mentioning serve both environmental and branding purposes. DHL, for example, runs the "PaczULE" project, under which five beehives (a total of 250,000 bees) were installed at the company's headquarters in Warsaw. The company also participated in tree planting with the Klub Gaja initiative – planting 250 pine trees in the Bogatki Forest District. Furthermore, DHL highlights its possession of certifications confirming compliance with energy management (ISO 50001) and environmental management standards (ISO 14001)[5]. InPost, within its sustainable development programs, implements initiatives such as eco-returns, the InPost Green City program, the installation of parcel lockers in hospitals and airports, participation

[2] https://group.dhl.com/en/sustainability/sustainability-roadmap.html [accessed: 16.09.2025].
[3] https://www.cashless.pl/16806-automaty-paczkowe-liczba-1-kwartal-2025 [accessed: 20.07.2025].
[4] https://www.dhl.com/pl-pl/ecommerce/o-dhl-ecommerce/zrownowazony-rozwoj.html [accessed: 16.09.2025].
[5] Ibid.

in clean-up campaigns in the Polish mountains and the Baltic Sea, testing of packaging return systems, and other activities. The company also holds ISO 14001:2015 certification for environmental management[6].

To systematize the examples of environmental activities presented and indicate their broader strategic context, the key megatrends affecting last-mile delivery models are summarized below. The table organizes both the main directions of change in the technological, social, and environmental spheres, as well as their practical implications for the logistics sector. It also includes examples of solutions implemented by companies operating on the Polish market and the potential risks associated with their implementation, including the phenomenon of greenwashing, which increasingly undermines the authenticity of pro-environmental declarations. This overview shows that last-mile delivery processes are at the intersection of real transformation and marketing narratives, and their effectiveness depends on both technological innovation and the credibility of communication with stakeholders.

The summary presented in the table confirms that pro-environmental activities in last-mile logistics should be analyzed in the broader context of technological, social, and environmental megatrends. The solutions implemented – from fleet electrification to the development of eco-packaging – are an important step towards reducing the negative impact of last-mile logistics on the environment, but their actual effectiveness depends on their consistency with the company's long-term strategy and the scale of implementation. In many cases, green initiatives are fragmented and focus on areas that are most visible to the customer, which helps to build a positive image but does not always translate into measurable environmental results. Therefore, when assessing the effectiveness of pro-environmental measures, attention should be paid not only to their communicative appeal, but above all to actual data on emissions reduction and resource consumption. Only such an approach will allow us to distinguish genuine sustainable development practices from those that are part of greenwashing rhetoric.

When considering the environmental aspects of logistics, it is therefore essential to remember the need to take a holistic view of the product life cycle. Pro-environmental actions must encompass not only the operational phase but also production and subsequent disposal. At the same time, consumer behavior plays a critical role, such as collecting parcels in environmentally friendly ways (e.g., on foot), proper segregation of packaging, or its reuse.

In summary, the range of ecological initiatives in last-mile logistics is broad, covering investments in transport infrastructure and devices, changes in packaging, and internal operations. However, the question of their actual impact remains open. Are these measures implemented on a scale sufficient to bring about genuine environmental improvement, or do they primarily serve a communication function? To avoid accusations of greenwashing, logistics enterprises must demonstrate not only appealing initiatives but, above all, measurable effectiveness in reducing emissions and lowering their environmental footprint.

[6] https://inpost.pl/strategia-esg; https://inpost.pl/sites/default/files/docs/dla-prasy/2024-04-17_Paczkomat_InPost_w_szpitalach.pdf; https://inpost.pl/sites/default/files/docs/regulaminy/certyfikat-iso-9001-2015-iso-14001-2015-922272.pdf [accessed: 20.09.2025].

Table 1. Megatrends influencing last-mile delivery models and their implications for logistics practices
Tabela 1. Megatrendy wpływające na modele dostaw na ostatniej mili i ich implikacje dla praktyk logistycznych

Megatrend area	Key phenomena/ directions of change	Impact on last--mile delivery models	Examples of solutions in practice	Potential risks/challenges (including greenwashing)
Technological	Digitalization of processes, internet of things (IoT), artificial intelligence (AI), automation, predictive analytics, blockchain	Improved route planning and monitoring, warehouse automation, real-time data integration, enhanced customer service	InPost – automated sorting centers; DHL – predictive systems; DPD – parcel tracking apps	High implementation costs, lack of system interoperability, cybersecurity threats, dependency on technology providers, risk of superficial "innovation"
Social	Urbanization, time economy, service personalization, lifestyle changes, redefinition of work	Growing demand for fast and flexible deliveries, development of pickup point networks and parcel lockers, need for better customer communication	Partner points (Żabka, Orlen, Ruch); Click & Collect; mobile parcel management apps	Cost pressure, courier over-exploitation, work-life imbalance, "green consumer paradox" – eco-declarations without behavioral change
Environmental	Green transition, decarbonization, circular economy, ESG reporting	Fleet electrification, expansion of parcel locker networks, use of eco-packaging, carbon footprint reduction initiatives	InPost – 1,300 electric vehicles, Green City program; DPD – 500 electric vehicles, cargo bikes; DHL – GoGreen program, ISO 14001 and 50001 certificates	Risk of greenwashing (claims without data), limited scale of pilot projects, lack of unified emission measurement methods, selective reporting of achievements
Consumer (interdisciplinary)	Growing environmental awareness, demand for transparency, personalization of shopping experience	Shaping standards of "fast, cheap, and eco-friendly" delivery, focus on convenience and delivery control	Widespread use of parcel lockers, shipment tracking options, development of eco-returns	Inconsistency between declarations and actual behavior (e.g., home delivery instead of parcel locker), image-driven rather than substantive change

Source: own elaboration
Źródło: opracowanie własne

Conclusions

The analysis of last-mile logistics processes shows that the shaping of delivery models is now largely determined by technological, social, and environmental megatrends. Ongoing digitalization and automation of transport processes, urbanization, and increas-

ing regulatory pressure regarding climate protection compel enterprises to redefine their strategies. Fleet electrification, the testing of electric bicycles, and the development of parcel locker networks are responses to the need to reduce emissions, while at the same time serving as tools for building competitive advantage and shaping the image of companies as socially responsible entities.

In this process, the preferences of e-consumers play an increasingly important role. Expectations regarding the speed and flexibility of deliveries, as well as growing emphasis on ecological and packaging aspects, are redefining service standards in e-commerce. Consumers demand transparent information, the ability to track shipments, convenient access to parcel lockers, and packaging that can be reused or recycled. At the same time, actual consumer choices – such as the preference for free home deliveries instead of consolidated pickup points – reveal a paradox: pro-environmental declarations do not always translate into real behavioral changes that support sustainable development.

Finally, the analysis exposes a tension between corporate declarations and the actual effects of their actions. Some initiatives are limited to pilot projects or symbolic CSR activities, whose environmental impact is difficult to measure. In such cases, ecological narratives serve primarily a marketing function, fitting into the phenomenon of greenwashing. This risk undermines the credibility of the entire sector if pro-environmental claims are not supported by transparent data and long-term emission reduction strategies.

In conclusion, the future of last-mile logistics will depend on the ability of enterprises to authentically integrate sustainable practices into operational models, along with a parallel shift in consumer attitudes. Only then will green logistics cease to be an element of PR narrative and become a real factor influencing purchasing decisions, as well as a tangible contribution to environmental protection.

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Organizational adaptability through artificial intelligence

Zdolność adaptacyjna organizacji dzięki sztucznej inteligencji

Abstract. In the face of dynamic market changes, growing uncertainty, and increasing digitization, the adaptability of organizations is becoming a key factor in their survival and growth. Artificial intelligence (AI) is increasingly acting as a tool to support the operational flexibility and crisis resilience of businesses. The purpose of this study was to identify how AI affects the adaptability of companies and what benefits and challenges are associated with its implementation. The study is based on an analysis of quantitative data obtained from a survey of company representatives from various industries and positions. The respondents assessed the degree of implementation of AI solutions, the scope of business processes supported, and the barriers encountered. The results indicate that AI most often supports decision-making, operations automation, and data analytics, which directly translates into increased adaptability for organizations. The main benefits are streamlined processes, greater efficiency, and the ability to respond quickly to changes in the environment. AI can significantly enhance an organization's adaptability, provided it is properly implemented and strategically aligned with business goals.

Keywords: intelligent systems, flexibility of enterprises, digital transformation, innovation

Synopsis. W obliczu dynamicznych zmian rynkowych, rosnącej niepewności oraz postępującej cyfryzacji zdolność adaptacyjna organizacji staje się kluczowym czynnikiem ich przetrwania i rozwoju. Sztuczna inteligencja (AI) coraz częściej pełni funkcję narzędzia wspierającego elastyczność operacyjną i odporność kryzysową przedsiębiorstw. Celem niniejszego badania było zidentyfikowanie, w jaki sposób AI wpływa na adaptacyjność firm oraz jakie korzyści i wyzwania wiążą się z jej wdrażaniem. Badanie opiera się na analizie danych ilościowych uzyskanych na podstawie ankiety przeprowadzonej wśród przedstawicieli firm z różnych branż i na różnych stanowiskach. Respondenci oceniali stopień wdrożenia rozwiązań AI, zakres wspieranych procesów biznesowych oraz napotykane bariery. Wyniki wskazują, że AI najczęściej wspiera procesy decyzyjne, automatyzację operacji i analitykę danych, co bezpośrednio przekłada się na zwiększenie zdolności adaptacyjnej organizacji. Główne korzyści to: usprawnienie procesów, większa efektywność

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oraz możliwość szybkiego reagowania na zmiany otoczenia. Sztuczna inteligencja może istotnie wzmacniać zdolność adaptacyjną organizacji pod warunkiem jej właściwego wdrożenia i strategicznego dopasowania do celów biznesowych.

Słowa kluczowe: sztuczna inteligencja, zdolność adaptacyjna organizacji, transformacja cyfrowa, innowacje

JEL codes: M15, O31

Introduction

Dynamic technological changes, increasing unpredictability of the market environment, and intensive digitization of business processes are driving organizations to seek new tools to increase their resilience and flexibility of operations [Gasz 2024]. One of the most promising directions for supporting an organization's adaptability is the use of artificial intelligence (AI) [Gocko 2025], which, through advanced data analysis algorithms, enables faster decision-making, automation of repetitive processes, and accurate prediction of market changes [Jabłoński & Jabłoński 2023, Chen et al. 2023].

Previous research indicates that AI is applied in many areas of business operations – from human resource management and financial analysis to customer service and marketing strategy [Patra et al. 2024, Bielińska-Dusza 2022]. The literature also increasingly emphasizes the impact of AI on strategic processes [Janik et al. 2023, Huber & Alexy 2024] and the ability of organizations to transform under conditions of market volatility and disruption [Rajagopal et al. 2022, Kotte 2025].

Despite the growing number of publications in this area, there is still a research gap regarding a comprehensive assessment of both the benefits and barriers surrounding the implementation of AI in the practice of organizations. In particular, there is a lack of analysis that takes into account industry diversity and the actual experiences of respondents from different levels of management.

The purpose of this article is to examine the impact of implementing AI-based solutions on an organization's adaptability, with a focus on perceived benefits, areas of application, and difficulties accompanying implementation. The paper contributes to the existing state of knowledge by providing results based on a representative sample of respondents from various economic sectors.

Materials and methods

The article uses a quantitative research method, based on analysis of data from a survey of 192 respondents representing various industries and positions. The survey was conducted from 1 March to 30 April 2025, using the Computer-Assisted Web Interviewing (CAWI) method. A link to the questionnaire was emailed to 250 randomly selected companies (in industry proportions consistent with the data from the Central Statistical Office of Poland) and shared in closed industry groups on LinkedIn. A total of 192 completed surveys were received, corresponding to a return rate of 76.8%. The study was exploratory in nature; therefore, an equal number of respondents from individual occupa-

tional groups was not assumed. The structure of the sample presented in the charts reflects the actual responses obtained in the survey rather than the proportions of invitations sent. The aim was to capture the real opinions and experiences of those who chose to participate in the study, particularly those directly involved in the processes of AI implementation.

With this sample size and the assumption of a large ($N > 10{,}000$) population of companies actively using digital technologies in Poland, the maximum estimation error is 7 p.p. at a confidence level of 95%, so the results can be considered representative of the analyzed segment.

The questionnaire consisted only of closed questions (single- or multiple-choice and five-point Likert scales), which made it possible to directly codify responses and use chi-square tests of concordance. Before the actual survey, a short pilot study was conducted on 10 respondents, which served to clarify the instructions and eliminate unclear wording.

The purpose of the paper was to identify the impact of implementing AI-based solutions on an organization's adaptability and to identify the key benefits and difficulties associated with their implementation.

Two research hypotheses were posed:

H1: The implementation of AI in organizations is associated with a significant increase in perceived operational benefits.

H2: High implementation costs and difficulties in integrating with existing systems are the most important barriers to the implementation of AI in organizations.

To verify the hypotheses and response distributions, chi-square tests of concordance were used to assess the statistical significance of deviations from random distributions. The tests were conducted for such variables as: position, industry, implementation of AI in the organization, benefits and difficulties of implementing AI, and business processes supported by the technology. In addition, tests for the significance of differences in proportions (z-score) were used in order to indicate which responses were significantly different from expectations.

The research results were presented in the form of tables and graphs, which enabled the clear presentation of statistically significant trends. The analytical methods used allowed for the identification of areas where AI contributes to an organization's adaptability (e.g., automation, cost optimization, service personalization) as well as the ones that pose the greatest challenges (e.g., systems integration, lack of competence, implementation costs).

The entire analysis was based on an empirical approach, enriched by the interpretation of quantitative data in an organizational and technological context. As a result, the study provides both specific statistical conclusions and practical implications for companies considering implementing AI as a tool to support their adaptation capacity.

Research results and discussion

In the first step of the analysis, the consistency of the distributions of responses to the question about the position held was verified. For this purpose, a chi-square test of concordance was performed. The results obtained indicated that the distribution of positions in the study group differed significantly from the random distribution ($\chi^2(5)$

= 16.56; p = 0.005). It turned out that among the respondents, there were significantly more IT specialists (Z = 2.65; p = 0.008) and significantly fewer data specialists (Z = –2.83; p = 0.005). No statistically significant differences in numbers were observed for other positions. The analysis results are illustrated in Figure 1.

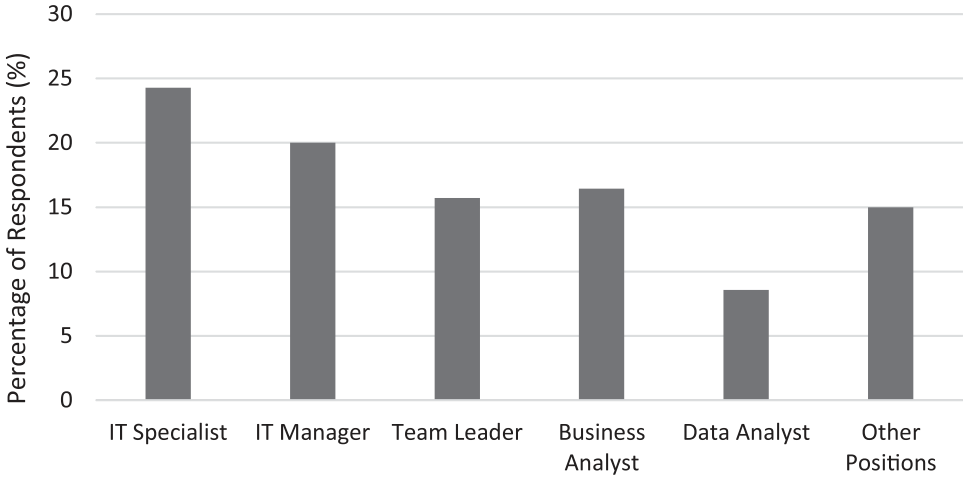

Figure 1. Structure of positions of the respondents participating in the survey (N = 192)
Rysunek 1. Struktura stanowisk respondentów biorących udział w badaniu (N = 192)

Source: own research
Źródło: badania własne

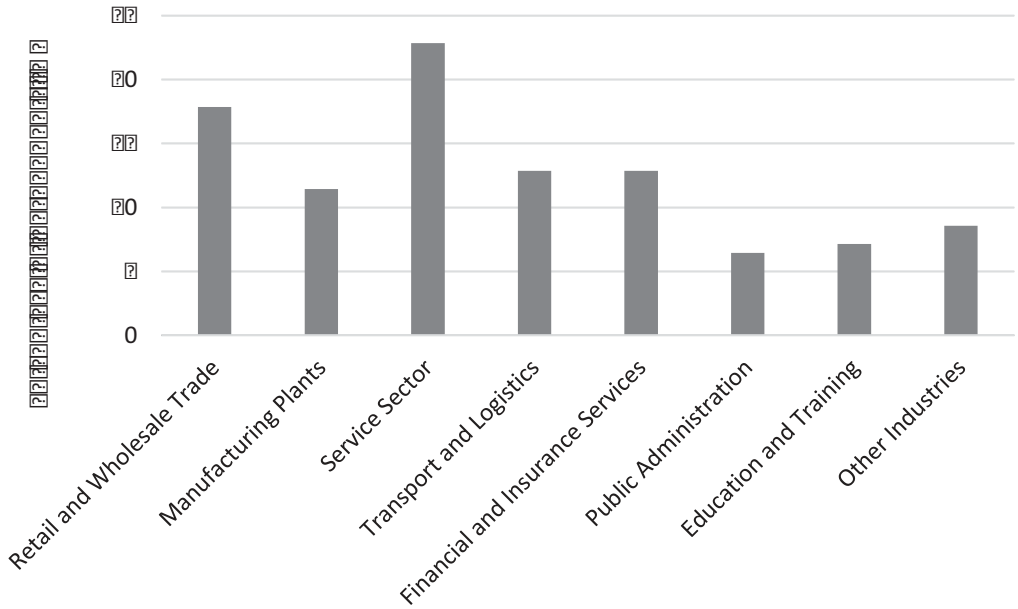

Figure 2. Distribution of respondents by industry (N = 192)
Rysunek 2. Klasyfikacja respondentów według sektorów działalności (N = 192)

Source: own research
Źródło: badania własne

Next, the concordance of the distributions of responses to the question about the industry was analyzed. For this purpose, a chi-square test of concordance was performed. The results indicated that the distribution of industries in the study group differed significantly from the random distribution ($\chi^2(7) = 34.00$; $p < 0.001$). It was also determined that there were significantly more service industry ($Z = 4.08$; $p < 0.001$) and trade ($Z = 2.04$; $p = 0.041$) employees among the respondents, and significantly fewer employees of the public sector ($Z = -2.45$; $p = 0.014$) and of the education and training sector ($Z = -2.04$; $p = 0.041$). No statistically significant differences in numbers were observed for other industries (Fig. 2).

In the next step of the analysis, the concordance of the distribution of responses to the question about the implementation of AI-based solutions in the organization was verified. For this purpose, a chi-square test of concordance was performed. The results indicated that the distribution of responses in the study group differed significantly from the random distribution ($\chi^2(1) = 70.08$; $p < 0.001$). Among respondents, there were significantly more people indicating that AI-based solutions should be implemented in their organizations (Fig. 3).

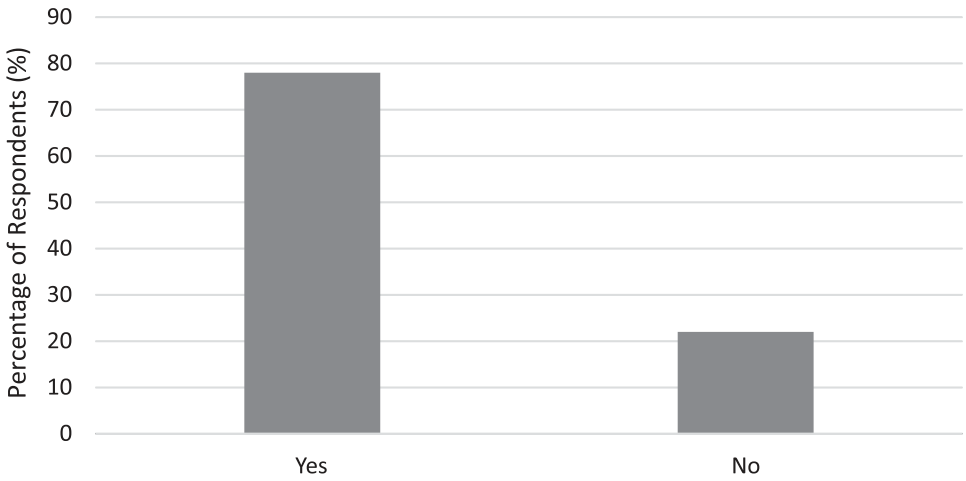

Figure 3. Validity of implementing artificial intelligence in organizations ($N = 192$)
Rysunek 3. Korzyści płynące z wdrażania sztucznej inteligencji w firmach ($N = 192$)
Source: own research
Źródło: badania własne

The consistency of the distributions of responses to the question about the benefits of implementing AI was then verified. For this purpose, a chi-square test of concordance was performed. The results of the analysis are shown in Table 1.

The respondents were significantly more likely to point to benefits such as reduced process execution time, reduced human error, optimized operating costs, and automation of repetitive tasks, and significantly less likely to point to such benefits as increased precision of market forecasts, improved human resource management, increased organizational flexibility, better strategic decision-making, and increased competitiveness. It was further noted that improvements in customer service were indicated with a frequency close to random.

Table 1. Results of the chi-square test of concordance for responses to the question about the benefits of implementing artificial intelligence (N = 192)

Tabela 1. Wyniki analizy testu chi-kwadrat dla pytania dotyczącego korzyści z zastosowania sztucznej inteligencji (N = 192)

Benefits of implementing artificial intelligence	Yes		No		$\chi^2(1)$	p
	N	%	N	%		
Accelerating the execution of business operations	151	78.57%	41	21.43%	63.02	**<0.001**
Reducing human errors	137	71.43%	55	28.57%	35.02	**<0.001**
Reducing operating costs	142	74.11%	50	25.89%	44.08	**<0.001**
Improving standards and efficiency in dealing with customers	86	44.64%	106	55.36%	2.08	0.149
Improving the accuracy of market forecasts	53	27.68%	139	72.32%	38.52	**<0.001**
Replacing routine tasks with automated systems	122	63.39%	70	36.61%	14.08	**<0.001**
Streamlining employee recruitment, evaluation, and development processes	41	21.43%	151	78.57%	63.02	**<0.001**
Providing greater ability to adapt to change	51	26.79%	141	73.21%	42.19	**<0.001**
Supporting in making management decisions	50	25.89%	142	74.11%	44.08	**<0.001**
Strengthening the company's position in the market	33	16.96%	159	83.04%	82.69	**<0.001**
No noticeable effects	3	1.79%	189	98.21%	180.19	**<0.001**

Source: own research

Źródło: badania własne

The next step in the analysis was to verify the concordance of distributions of responses to the question about business processes supported by AI. For this purpose, a chi-square test of concordance was performed. The results of the analysis are shown in Table 2.

The results confirmed that respondents were significantly more likely to indicate processes such as office process automation and personalization of customer service, and significantly less likely to indicate processes such as analysis and prediction of market trends, customer relationship management, recruitment and data analysis in the area of HR management, financial analysis, development of marketing strategies, monitoring and optimization of production processes, supporting innovation and new product development, and others. It also showed that optimization of logistics and supply chain management was indicated with a frequency close to random.

The final stage of the study was to determine the concordance of the distributions of responses to the question about the difficulties encountered in implementing AI. For this purpose, a chi-square test of concordance was performed. The results of the analysis are shown in Table 3.

Table 2. Results of the chi-square test of concordance for responses to the question about business processes supported by artificial intelligence ($N = 192$)

Tabela 2. Wyniki analizy testu chi-kwadrat dla odpowiedzi na pytanie o procesy biznesowe wspierane przez sztuczną inteligencję ($N = 192$)

Applications of artificial intelligence in enterprises	Yes		No		$\chi^2(1)$	p
	N	%	N	%		
Streamlining office tasks	135	70.54%	57	29.46%	31.69	**<0.001**
Effective transportation and delivery planning	87	45.54%	105	54.46%	1.69	0.194
Customization of services to meet individual customer needs	129	66.96%	63	33.04%	22.69	**<0.001**
Forecasting market changes and behaviors	79	41.07%	113	58.93%	6.02	**0.014**
Customer relationship management	41	21.43%	151	78.57%	63.02	**<0.001**
Support in the selection and evaluation of employees	57	29.46%	135	70.54%	31.69	**<0.001**
Evaluation of financial performance and risks	55	28.57%	137	71.43%	35.02	**<0.001**
Designing of campaigns and promotional activities	72	37.50%	120	62.50%	12.00	**<0.001**
Overseeing production efficiency and quality	77	40.18%	115	59.82%	7.52	**0.006**
Stimulating the creation of innovative solutions	45	23.21%	147	76.79%	54.19	**<0.001**
Others	3	1.79%	189	98.21%	178.26	**<0.001**

Source: own research

Źródło: badania własne

Table 3. Results of the chi-square test of concordance for responses to the question about difficulties encountered during the implementation of artificial intelligence ($N = 192$)

Tabela 3. Wyniki analizy testu chi-kwadrat dla odpowiedzi na pytanie o trudności napotkane podczas wdrażania sztucznej inteligencji ($N = 192$)

Challenges of implementing artificial intelligence	Yes		No		$\chi^2(1)$	p
	N	%	N	%		
High implementation costs	118	61.61%	74	38.39%	10.08	0.001
Lack of competence in the team	91	47.32%	101	52.68%	0.52	0.470
Difficulty integrating with existing systems	111	58.04%	81	41.96%	4.69	**0.030**
Limited acceptance among employees	63	33.04%	129	66.96%	22.69	**<0.001**
Insufficient data to train AI models	106	55.36%	86	44.64%	2.08	0.149
Problems with adapting AI to industry specifications	48	25.00%	144	75.00%	48.00	**<0.001**

Source: own research

Źródło: badania własne

The analysis showed that respondents were significantly more likely to point to difficulties such as high implementation costs and difficulties integrating with existing systems, and significantly less likely to point to difficulties such as limited acceptance among employees and problems adapting the AI to industry specifications. It proved that lack of competence in the team and insufficient data to train AI models were indicated with a frequency close to random. The results of the analysis are illustrated in Figure 4.

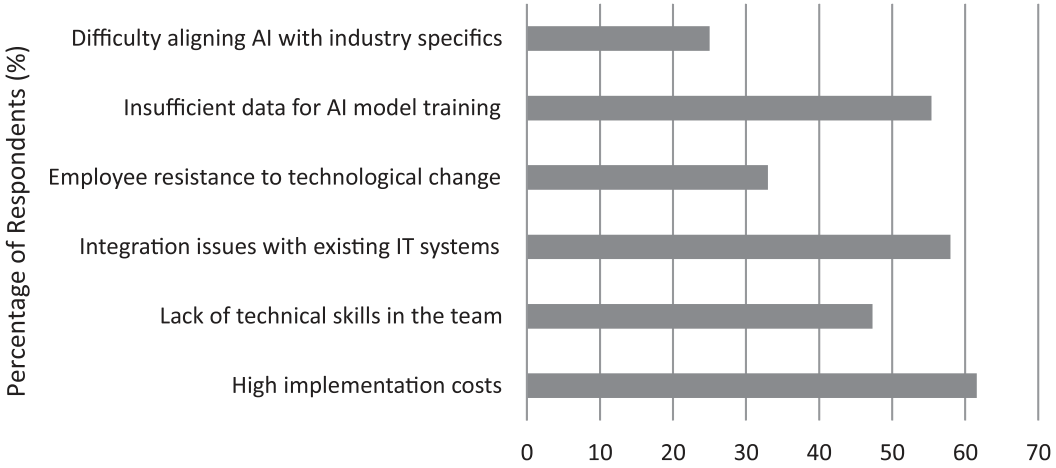

Figure 4. Barriers encountered in implementing artificial intelligence (N = 192)
Rysunek 4. Bariery przy wdrażaniu sztucznej inteligencji (N = 192)

Source: own research
Źródło: badania własne

The results of the survey provide important information on how AI is perceived and implemented in various sectors of the economy. Statistical analysis showed that the structure of respondents' positions and industries was not a coincidence – IT professionals and representatives of the service and trade industries dominated, which may indicate that these environments are more open to technological innovation.

The vast majority of respondents (78%) indicated that AI-based solutions have been implemented in their organizations. This indicates the growing adoption of this technology in business practice [Dinu 2024]. Moreover, the results clearly show that the implementation of AI is associated with a number of specific operational benefits – in particular, speeding up process execution, reducing human errors, and lowering operational costs [Subhani 2024, Panek 2024]. These findings are consistent with previous research in the literature, which indicates that AI acts as a catalyst for organizational productivity and efficiency.

At the same time, data shows that not all of the expected benefits of AI are widely recognized [Rahman et al. 2024]. Only a small percentage of respondents noted improvements in areas such as strategic decision-making, increased competitiveness, or organizational flexibility. This may indicate that AI implementations often focus on operational rather than strategic aspects of the business. Another possible explanation is the immaturity of implementations – organizations may still be in the early stages of adaptation, which limits the full potential of AI.

The results on AI-supported business processes are also interesting. Automation of administrative tasks and personalization of customer service were by far the ones cited most frequently. Less common were applications in financial analysis, creating marketing strategies, or supporting innovation. This may suggest that companies are primarily focused on implementing solutions with a quick and measurable return on investment, avoiding more complex and long-term transformation projects.

In turn, the analysis of barriers to AI implementation confirmed the significant challenges faced by organizations. The most common reasons cited were the high cost of implementation and the difficulty of integrating with existing IT infrastructure. Although the literature also often emphasizes the importance of team competence or acceptance of change among employees [Myszak et al. 2025], the results of the study suggest that these factors are not perceived as critical to the same extent. This may be due to the fact that respondents mainly represented sectors with higher levels of digitization, where cultural and competence barriers are lower.

In conclusion, the analysis of the results indicates that AI is an important tool to support the development of organizations, especially in operational areas. At the same time, it reveals the need for a systemic approach to its implementation – taking into account both technological and organizational aspects. In the future, it is worth conducting further comparative studies to assess the differences between industries and the maturity stages of AI implementations, depending on the size and type of organization.

Conclusions

The results of the survey clearly confirm that AI plays an important role in strengthening the adaptability of organizations, especially in operational and analytical areas. Identified benefits, such as process automation, reduction of human error, and cost optimization, indicate that AI can realistically increase the efficiency of companies' operations and their ability to respond quickly to changes in the environment. At the same time, data analysis reveals that the strategic capabilities of AI – such as supporting management decisions, enhancing competitiveness or organizational flexibility – are still being used to a limited extent. This may indicate that organizations are at an early stage of digital maturity, or they lack the resources to make full use of the potential of this technology.

Although the survey was based on a representative sample of 192 respondents from various industries, some limitations should be noted. First of all, representatives of the service industry and IT departments dominated among the respondents, which may have influenced the perception of both the benefits of and barriers to AI implementation. In addition, the cross-sectional nature of the study does not allow for the analysis of the long-term effects of implementing this technology.

Despite these limitations, the study makes an important contribution to the literature by providing empirical evidence of the relationship between AI implementation and increased operational flexibility of organizations. It also indicates that the key barriers to AI implementation remain the high cost of implementation and the difficulty of integrating new solutions with existing IT systems. These results are important both in theoretical terms – confirming the assumptions of dynamic capability theory – and in practical

terms, providing guidance to managers on where to place resources and what risks to take into account in the implementation process.

The data collected can also be useful for public institutions and policymakers who design programs to support the digital transformation of businesses. Knowledge of actual implementation barriers and areas with the greatest potential for adaptation can be used to shape effective strategies to support the development of innovation and the competitiveness of companies.

It is recommended that further research focus on observing the long-term impact of AI on the development of organizations. It is also worth conducting an in-depth analysis of cross-industry differences and analyzing the impact of the size of an organization and its level of digital sophistication on the effectiveness of using AI.

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Q-commerce w Polsce – model konceptualny funkcjonowania ultraszybkich dostaw w warunkach wysokiej konkurencji detalicznej

Q-commerce in Poland – a conceptual model of ultra-fast delivery operations in a highly competitive retail environment

Synopsis. Działalność q-commerce różni się od tradycyjnej sprzedaży internetowej ze względu na wymagającą logistykę ostatniej mili. Artykuł przedstawia model konceptualny polskiego q-commerce i odpowiada na pytania, jakie modele biznesowe charakteryzują polski rynek i czy strategie elastyczne mają przewagę nad „czystym" modelem opartym wyłącznie na dark stores.
Analiza objęła osiem przedsiębiorstw działających w latach 2020–2025: wciąż aktywnych operatorów (Glovo, Wolt, Żabka Jush, Carrefour, Lisek) oraz firmy, które wycofały się już z polskiego rynku (Gorillas, Jokr, Swyft). Badanie wyodrębniło trzy modele różniące się pod względem własności infrastruktury IT oraz źródła kompletacji zamówień: pure play – oparty na własnych dark stores i aplikacji, hybrydowy – łączący sklepy stacjonarne z własną aplikacją oraz platformowy – bazujący na współpracy z partnerami, bez własnych aplikacji.
Badanie potwierdza hipotezę o przewadze modeli elastycznych – prawie wszystkie analizowane przedsiębiorstwa pure play zakończyły działalność, natomiast modele wykorzystujące istniejącą infrastrukturę wykazują większą trwałość. Paradoksalnie najtrudniejszą strategią okazał się „czysty" q-commerce, co może wynikać z wyjątkowo dużej gęstości polskiego handlu detalicznego (130 500 sklepów FMCG) utrudniającej osiągnięcie progu rentowności (600–1500 zamówień dziennie przypadających na 1 dark store).

Słowa kluczowe: q-commerce, e-commerce, modele biznesowe, dark stores, model platformowy, model hybrydowy, omnichannel, e-grocery

Abstract. Q-commerce operations require demanding last-mile logistics that distinguish them from traditional e-commerce. While international literature emphasizes dark stores as the typical q-commerce model, this study examines whether

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such pure play strategies succeed in Poland's exceptionally dense retail environment (130,500 FMCG stores). The research question asks: which business models characterize Polish q-commerce and do flexible strategies outperform pure dark-store approaches?
Analysis of eight enterprises operating between 2020–2025 – active operators (Glovo, Wolt, Żabka Jush, Carrefour, Lisek) and market exits (Gorillas, Jokr, Swyft) – maps order fulfilment processes from user interface through picking to delivery. The study identifies three models distinguished by IT infrastructure ownership and order fulfilment sources: pure play utilizing proprietary dark stores and applications, hybrid combining retail stores with proprietary apps, and platform-based relying on partner networks without proprietary apps.
Results confirm the hypothesis that flexible models demonstrate superior market resilience – nearly all pure play operators ceased operations while infrastructure-leveraging models persist. Paradoxically, "pure" q-commerce proves the most challenging strategy, likely because Poland's retail density (130,500 stores) prevents reaching the profitability threshold (600–1,500 daily orders per dark store). The study shows that international q-commerce typologies require adaptation to local retail structures, with IT infrastructure control serving as a key distinguishing criterion alongside physical logistics.

Keywords: q-commerce, e-commerce, business models, dark stores, platform model, hybrid model, omnichannel, e-grocery

Kody JEL: L81, M15, R40, L25, O33

Wstęp

Sprzedaż produktów żywnościowych online pozostaje wyzwaniem z uwagi na specyficzną logistykę ostatniej mili (ang. last mile delivery) – finalnego etapu dostawy od centrum dystrybucji bezpośrednio do klienta. Etap ten stanowi najbardziej kosztowną i czasochłonną fazę całego łańcucha dostaw w e-commerce [Capgemini 2021]. Dodatkowo sklepy spożywcze online muszą sprostać rosnącym oczekiwaniom nabywców. Chcą oni bowiem otrzymywać zamówienia w ciągu już nawet nie godzin, ale minut. Dostępność, koszt, czas i wygoda to obszary, które firmy handlu detalicznego żywnością muszą dziś szczególnie kontrolować, aby utrzymać się na rynku [Gund i Daniel 2024].

Funkcjonowanie q-commerce w Polsce wspiera transformacja miejska obejmująca nie tylko modernizację infrastruktury miejskiej, ale również wdrażanie rozwiązań smart city, takich jak cyfrowe systemy zarządzania miastem, inteligentne systemy transportowe i platformy e-usług. Koncepcja 15-minutowego miasta – zakładająca dostęp do wszystkich podstawowych usług w zasięgu 15-minutowego spaceru lub jazdy rowerem – dodatkowo wzmacnia ten model [Pomianek 2023], tworząc warunki dla lokalnych usług szybkich dostaw wykorzystujących gęstą sieć miejską jako podstawę logistyczną.

Z drugiej strony w Polsce jest bardzo dużo sklepów detalicznych. Portal Poradnik Handlowca informuje, powołując się na dane Dun & Bradstreet, że w 2024 roku działało w naszym kraju ponad 130 500 sklepów FMCG (Fast Moving Consumer

Goods – produkty szybko rotujące, głównie artykuły spożywcze i codziennego użytku) [Walkowiak 2025]. To znacznie więcej niż w Niemczech, gdzie jest ok. 58 000 sklepów spożywczych [Cyganek 2025] i gdzie mieszka ponad dwukrotnie więcej osób. Zatem liczba tradycyjnych sklepów detalicznych istotnie odróżnia polski rynek od niemieckiego [Kokoszkiewicz 2021] i może być traktowana jako bariera dla rozwoju q-commerce w Polsce.

Przegląd literatury

Quick commerce definiuje się jako e-commerce z dostawami krótszymi niż 60 minut. Część autorów łączy q-commerce z własnymi dark stores [Gund i Daniel 2024; Chavan i Gujarathi 2025], czyli magazynami stworzonymi wyłącznie do obsługi zamówień internetowych. Nie jest to jednak jedyny model. Schorung [2024] wyróżnił trzy typy operatorów w metropoliach zachodnich, którzy różnią się konfiguracją zasobów logistycznych – model platformowy, personal shopping oraz pure play, czyli model oparty na dark stores. Verdin i in. [2023] przedstawili typologie modeli q-commerce w kontekście europejskim, analizując wpływ regulacji miejskich na funkcjonowanie poszczególnych strategii. Patryarcha [2021] opisała polski rynek, identyfikując podział na platformy współpracujące z sieciami handlowymi oraz operatorów własnych magazynów. Brakuje jednak systematycznej analizy łączącej kluczowe procesy realizacji zamówień z różnorodnymi modelami biznesowymi w kontekście specyfiki lokalnego rynku oraz ich graficznej prezentacji jako spójnego modelu konceptualnego.

Dane rynkowe zawarte w raporcie „Dark Store Market Overview, 2025–30" [Research and Markets 2025] wskazują na znaczącą skalę globalnej transformacji w handlu detalicznym, szacując wartość światowego rynku dark stores na ponad 20,73 mld USD w 2024 roku. Dokument ten identyfikuje kluczowe technologiczne innowacje zwiększające efektywność operacyjną, w tym inteligentne systemy kompletacji zamówień, prognozowanie popytu oparte na AI oraz dynamiczne zarządzanie zapasami. Według raportu, głównymi czynnikami napędzającymi rozwój q-commerce są: rosnące oczekiwania konsumentów dotyczące dostaw w ciągu 30 minut, ekspansja sprzedaży artykułów spożywczych online oraz strategiczne lokowanie mikrocentrów realizacji zamówień w obszarach o wysokiej gęstości zaludnienia. Jednocześnie zidentyfikowano istotne wyzwania dla modelu pure play, w tym wysokie koszty działalności w centrach miast oraz ograniczenia regulacyjne, szczególnie w Europie, gdzie lokalne społeczności i władze miejskie coraz częściej przeciwdziałają ekspansji dark stores w przestrzeniach mieszkalnych i handlowych [Van Campenhout 2023].

Cel i metodyka

Celem artykułu jest klasyfikacja głównych modeli biznesowych oraz przedstawienie modelu konceptualnego polskiego rynku szybkich dostaw q-commerce. Postawiono pytanie: jakie modele charakteryzują polski rynek q-commerce w warunkach wysokiej konkurencji tradycyjnej sprzedaży detalicznej? Przyjęto również hipotezę, że modele elastyczne, czyli hybrydowe i platformowe, mają w Polsce przewagę nad „czystym" modelem

q-commerce, to znaczy opartym wyłącznie na własnej infrastrukturze i wykorzystującym logistykę dark stores. Opracowanie odpowiada na pytanie, czy model ten sprawdza się w polskich warunkach.

Studium przypadku obejmowało osiem przedsiębiorstw q-commerce działających na polskim rynku w latach 2020–2025 (Glovo, Wolt, Żabka Jush, Lisek, Gorillas, Jokr, Swyft, Carrefour). Pominięto usługę Barbora Express, ponieważ była ona tylko w fazie pilotażu, po której podjęto decyzję o niewchodzeniu na polski rynek q-commerce [Jachowski 2022]. Carrefour jest w fazie transformacji w kierunku modelu omnichannelowego – pod koniec października 2025 roku zostanie uruchomiona aplikacja mobilna Mój Carrefour zintegrowana ze sklepem internetowym, co pozwoli na połączenie zakupów stacjonarnych z szybkimi dostawami online. Zdecydowano się włączyć ten przypadek do niniejszej analizy ze względu na jego istotną odmienność od pozostałych modeli oraz reprezentatywność dla strategii omnichannelowej w warunkach polskich.

Przeanalizowano przedsiębiorstwa spełniające trzy kryteria:

– obecność na polskim rynku w latach 2020–2025, niezależnie od dalszej działalności;
– zróżnicowanie pod względem miejsc kompletacji zamówień (dark stores, sklepy partnerskie, sieci detaliczne) oraz typów zasobów transportowych (flota własna, kontraktorzy zewnętrzni);
– dostępność informacji o modelu biznesowym z publicznie dostępnych źródeł.

Klasyfikacja modeli opiera się na dwóch kryteriach:

– własność infrastruktury IT – określa, czy przedsiębiorstwo kontroluje interfejs użytkownika poprzez własną aplikację i platformę e-commerce. Modele różnią się pod względem tego, które procesy są realizowane we własnym zakresie, a które przez partnerów zewnętrznych;
– źródło kompletacji – wskazuje, czy zamówienia realizowane są we własnych dark stores, własnych sklepach stacjonarnych czy w sklepach partnerskich. Kombinacja tych kryteriów wyznacza trzy odrębne modele biznesowe, których architektura została przedstawiona w modelu konceptualnym.

Analizie poddano osiem przedsiębiorstw, które łącznie obejmowały dominującą część polskiego rynku q-commerce w badanym okresie (tab. 1).

Model konceptualny zbudowano w czterech etapach:

1. identyfikacja faz realizacji zamówienia: od jego złożenia przez klienta po finalną dostawę;
2. klasyfikacja zasobów: źródła kompletacji (dark stores, sklepy partnerskie, sieci detaliczne) i rodzaje transportu (flota własna, kontraktorzy);
3. grupowanie przedsiębiorstw według konfiguracji zasobów w oparciu o klasyfikację Schorunga [2024], z weryfikacją za pomocą typologii Patryarchy [2021], z wyodrębnieniem trzech modeli: pure play, hybrydowy i platformowy;
4. graficzna prezentacja modelu konceptualnego rynku q-commerce.

Badanie ma kilka ograniczeń. Próba badawcza obejmuje główne modele działania q-commerce, jednak ograniczona liczba analizowanych przedsiębiorstw oraz duża dynamika rynku (wiele firm już nie funkcjonuje) utrudniają weryfikację trwałości poszczególnych strategii. Kolejnym ograniczeniem jest brak dostępu do danych wewnętrznych przedsiębiorstw, co uniemożliwiło pogłębioną analizę ekonomiczną poszczególnych modeli.

Tabela 1. Modele biznesowe firm e-commerce na rynku polskim
Table 1. Business models of e-commerce companies in the Polish market

Przedsiębiorstwo	Model działania	Opis i uwagi
Żabka Jush, Lisek	Pure play (dark stores)	Błyskawiczne dostawy z własnych minimagazynów (dark stores). Posiadają własne aplikacje, własną flotę kurierów i ograniczony asortyment. Lisek działa głównie w Warszawie, Żabka Jush w kilku dużych miastach Polski. Deklarowany czas dostawy: 15 minut.
Carrefour	Hybrydowy (omnichannel)	Posiada własną aplikację Mój Carrefour do zamówień online. Realizuje zamówienia bezpośrednio z istniejących sklepów stacjonarnych (ship from store). Łączy tradycyjną infrastrukturę sklepów z funkcjonalnością zakupów online. Dodatkowo współpracuje z Glovo przy dostawach ekspresowych.
Glovo, Wolt	Platformowy (marketplace)	Oferują zakupy z różnych sieci handlowych (np. Biedronka – BIEK, Carrefour, Żabka). Zamówienia realizują kurierzy będący kontraktorami, a nie pracownikami. Nie posiadają własnych zapasów, ale zarządzają logistyką ostatniej mili. Glovo współpracuje z BIEK (Biedronka).
Gorillas, Jokr, Swyft	Pure play (dark stores) – wycofane z rynku	Operatorzy, którzy próbowali wejść na polski rynek q-commerce z modelem opartym na własnych dark stores, ale się wycofali. Gorillas planował wejście do Polski, jednak nie udało mu się trwale zaistnieć na naszym rynku. Swyft działał kilka miesięcy w 2021 roku. Jokr funkcjonował od połowy 2021 roku i wycofał się w marcu 2022.

Źródło: opracowanie własne

Source: own study

Modele biznesowe w q-commerce

Klasyfikacja modeli biznesowych umożliwia ocenę efektywności różnych podejść do q-commerce. Wyróżniono trzy dominujące modele. Każda z wyróżnionych strategii różni się sposobem organizacji zasobów zarówno w ramach infrastruktury IT, jak i w obszarze logistyki.

Pure play q-commerce

Model pure play (czysty, niezintegrowany z tradycyjnym handlem detalicznym) charakteryzuje przedsiębiorstwa, które opierają swoją działalność na dark stores. Produkty są w nich zorganizowane pod kątem szybkiego kompletowania, a kurierzy dostarczają zamówienia w ciągu 10–60 minut. Przykładami firm stosujących ten model w Polsce były lub są: Gorillas, Lisek, Jokr [Patryarcha 2021]. Wszystkie, z wyjątkiem Liska, zakończyły już działalność: Swyft po kilku miesiącach w 2021 r., Jokr w marcu 2022 r., a Barbora Express jesienią 2022 r. [Pallus 2023].

Jedynym funkcjonującym przedsiębiorstwem pure play pozostaje Lisek, działający jako sklep internetowy oferujący ekspresowe dostawy produktów codziennego użytku. Model pure play charakteryzuje się następującymi cechami:

– Własna infrastruktura logistyczna. Firma dysponuje siecią dark stores oraz własnymi kurierami. Cały proces od złożenia zamówienia do dostawy jest kontrolowany przez jednego operatora.

– Ekspresowa realizacja zamówień. Podstawowym wyróżnikiem jest szybkość dostaw – nawet w 15 minut w głównych obszarach działania.
– Własny interfejs cyfrowy. Lisek działa poprzez swoją stronę internetową i aplikacje mobilne na iOS i Android, zachowując pełną kontrolę nad doświadczeniem użytkownika i danymi klientów. Firma jest też obecna na platformach partnerskich (Uber Eats, Wolt), co stanowi dodatkowy, uzupełniający kanał dystrybucji.

W Europie największym przedsiębiorstwem tego typu był Getir, który w 2022 roku wykupił Gorillas. Jednak w 2024 roku firma wycofała się z rynków zachodnich i skoncentrowała na rodzimym rynku tureckim [Tuncay 2024].

Omnichannel

Model łączący sieć istniejących sklepów stacjonarnych z funkcją realizacji szybkich dostaw online. Sklepy stają się lokalnymi centrami dystrybucji, wykorzystując zarówno infrastrukturę tradycyjną, jak i przeznaczoną wyłącznie dla q-commerce. Czas dostawy jest zazwyczaj nieco dłuższy niż w przypadku dark stores [PAP 2025].

Empirycznym przykładem tego modelu jest Carrefour, który w 2025 roku rozszerzył funkcjonalność własnej aplikacji mobilnej o możliwość zamawiania produktów online [Carrefour Polska 2025]. Model ten charakteryzuje się następującymi cechami:

– Integracja infrastruktury fizycznej i cyfrowej. Zamówienia online są realizowane w istniejących sklepach stacjonarnych, co eliminuje konieczność budowy odrębnej infrastruktury dark stores. Własna aplikacja mobilna i platforma e-commerce zapewniają kontrolę nad interfejsem użytkownika i danymi klientów.
– Integracja kanałów. Model łączy doświadczenia zakupowe z kanałów online i offline. Dane transakcyjne pochodzące ze sklepów stacjonarnych są dostępne w aplikacji. Zarządzanie promocjami obejmuje oba kanały sprzedaży. Zamówienia można składać przez aplikację mobilną i stronę internetową mające jednolitą politykę cenową.
– Personalizacja oferty. Integracja danych pochodzących z zakupów stacjonarnych i online umożliwia dostosowywanie rekomendacji produktowych i promocji do profilu klienta.

Model hybrydowy może być odpowiedzią na wyzwania polskiego rynku charakteryzującego się dużą liczbą sklepów detalicznych. Detaliści tacy jak Carrefour wykorzystują własne sieci sklepów jako centra realizacji dostaw online, eliminując konieczność budowy odrębnej infrastruktury. Model ten umożliwia integrację działań w różnych kanałach – od wspólnego zarządzania promocjami po wykorzystanie danych z zakupów stacjonarnych do personalizacji oferty online.

Model platformowy

Schorung [2024] rozróżnia modele „3-stronny" i „personal shopping", które w kontekście polskim realizują podobne zadania. Przedsiębiorstwo działa jako platforma łącząca użytkowników z różnymi sklepami i niezależnymi kurierami – kontraktorami, bez konieczności posiadania własnych magazynów ani floty. Pozwala to wyeliminować koszty stałe infrastruktury, przenosząc odpowiedzialność za logistykę na partnerów.

Empirycznym przykładem takiego modelu działania jest Glovo, ale też Wolt. Model platformowy charakteryzuje się następującymi cechami:

– Partnerstwo z sieciami handlowymi. Współpraca z największymi detalistami (Biedronka, Auchan, Carrefour) umożliwia dostęp do szerokiego asortymentu bez konieczności utrzymywania własnych magazynów. Oferta obejmuje nie tylko artykuły spożywcze, ale również szeroki zakres produktów FMCG – od zabawek po leki.
– System kurierów – kontraktorów. Kurierzy działają jako niezależni kontraktowcy, korzystający z własnych środków transportu (rowery, skutery, samochody) i samodzielnie decydujący o godzinach pracy. Platforma współpracuje z kurierami bezpośrednio lub za pośrednictwem partnerów logistycznych, którzy rozliczają się z platformą.
– Koordynacja przepływów. Platforma zarządza przepływem zamówień między sklepami partnerskimi a kurierami, zachowując model zdecentralizowany, bez własnej infrastruktury magazynowej i transportowej.
– Brak kontroli nad zasobami fizycznymi. Kompletacja zamówień odbywa się w sklepach partnerskich, transport realizują kontraktorzy. Przedsiębiorstwo obsługujące zamówienie pełni funkcję koordynatora logistycznego, nie mając bezpośredniej kontroli nad procesami fizycznymi. Przykładami są Glovo i Wolt.

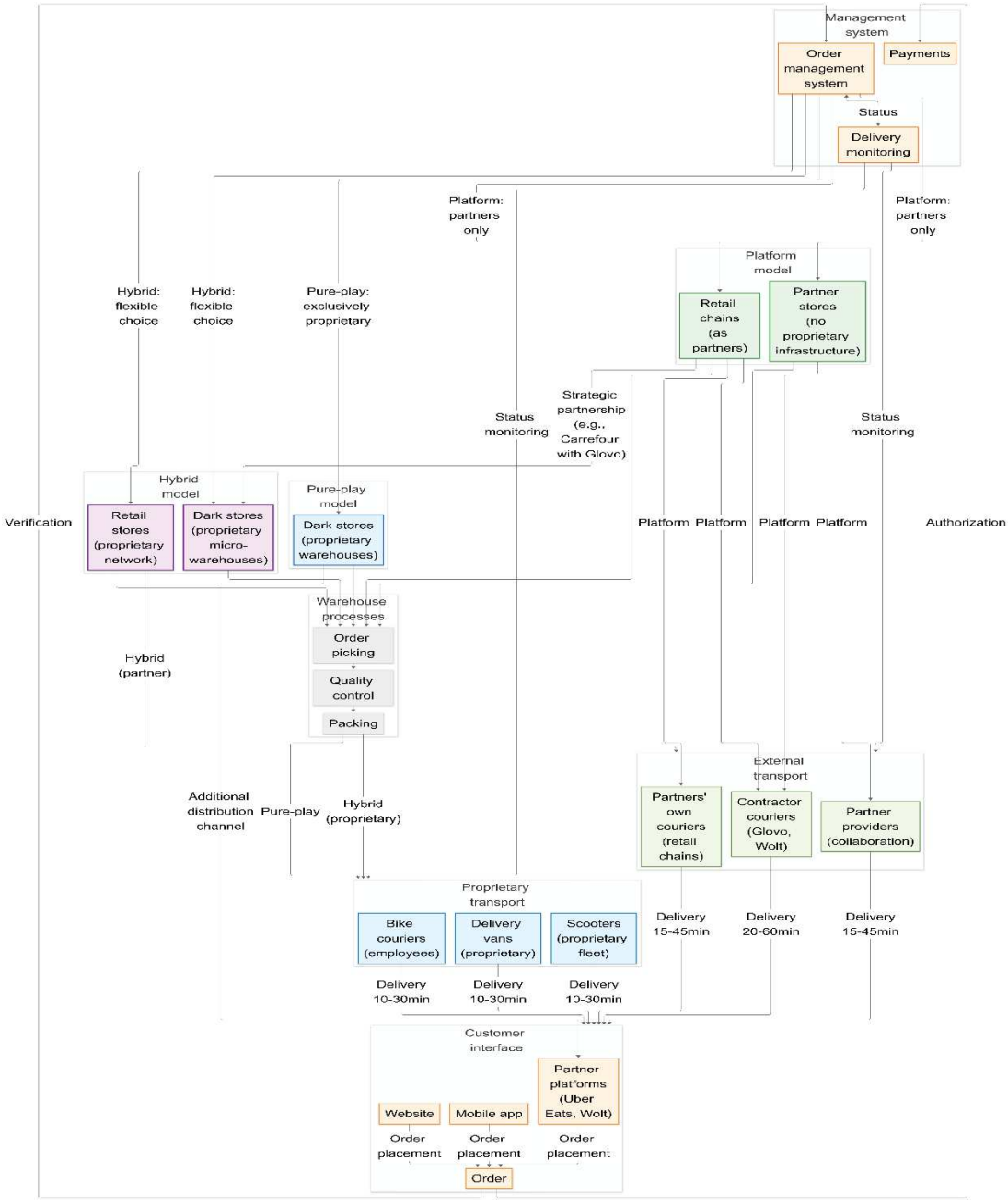
Tabela 2. Porównanie modeli biznesowych e-commerce
Table 2. Comparison of e-commerce business models

Obszar	Model pure play	Model hybrydowy (omnichannel)	Model platformowy
Źródła kompletacji zamówień	Wyłącznie własne dark stores	Kombinacja własnych mikromagazynów i sklepów stacjonarnych własnej sieci	Wyłącznie zewnętrzne; sklepy partnerskie i sieci handlowe
Zasoby transportowe	Wyłącznie własne; kurierzy rowerowi (pracownicy), skutery i samochody dostawcze (własna flota)	Mieszane; transport własny oraz współpraca z dostawcami zewnętrznymi	Wyłącznie zewnętrzne; kurierzy – kontraktorzy, dostawcy partnerów i kurierzy sieci handlowych
Przepływ zamówienia	Scentralizowany system zarządzania; dark stores, transport własny	Elastyczny system zarządzania; wybór między własnymi magazynami a sklepami; wybór rodzaju transportu	Zdecentralizowany system zarządzania; partnerzy zewnętrzni, transport zewnętrzny
Kontrola nad łańcuchem dostaw	Pełna kontrola nad całym procesem (własna infrastruktura)	Częściowa kontrola (pełna nad własnymi zasobami, ograniczona nad zewnętrznymi)	Ograniczona do koordynacji (brak własnych zasobów fizycznych)
Procesy magazynowe	Standardowe (kompletacja, kontrola jakości, pakowanie) we własnych obiektach	Standardowe procesy realizowane w różnych lokalizacjach (własne magazyny i sklepy)	Standardowe procesy realizowane przez partnerów
Monitoring dostaw	Bezpośredni nadzór nad własnymi zasobami transportowymi	Mieszany nadzór: bezpośredni nad własnymi i pośredni nad zewnętrznymi	Pośredni nadzór poprzez systemy śledzenia kontraktorów i partnerów

Źródło: opracowanie własne

Source: own study

Klasyfikacja zamieszczona w tabeli 2 wyodrębnia dominujące cechy poszczególnych modeli, jednak przedsiębiorstwa często łączą elementy różnych strategii w poszukiwaniu przewagi konkurencyjnej i wzrostu sprzedaży. Lisek, klasyfikowany jako pure play, jest obecny na platformach partnerskich. Carrefour współpracuje z Glovo, ale utrzymuje własny interfejs cyfrowy zintegrowany ze sprzedażą detaliczną, podczas gdy BIEK – usługa Biedronki – funkcjonuje wyłącznie w aplikacji Glovo (model platformowy). Kontrola



Rysunek 1. Model konceptualny rynku q-commerce
Figure 1. Conceptual model of the q-commerce market

Źródło: opracowanie własne

Sorce: own study

nad interfejsem użytkownika stanowi tu kluczowe kryterium rozróżnienia, podczas gdy elastyczność kanałów dystrybucji służy optymalizacji zasięgu.

Realizacja zamówienia w każdym modelu wykorzystuje inną konfigurację zasobów w jego środkowej warstwie (rys. 1). W modelu pure play zamówienie z interfejsu trafia bezpośrednio do najbliższego dark store, gdzie jest kompletowane przez pracowników i dostarczane przez własnego kuriera – cały proces przebiega w ramach jednej organizacji. W modelu platformowym system kieruje zamówienie do wybranego sklepu partnerskiego, a jego realizacji podejmuje się niezależny kurier – kontraktor; przedsiębiorstwo pełni funkcję koordynatora niesprawującego fizycznej kontroli nad procesem. Model hybrydowy wykorzystuje algorytmy wyboru źródła kompletacji (własny magazyn lub sklep) oraz dostępnego środka transportu (własny albo zewnętrzny), co zapewnia elastyczność przy zachowaniu częściowej kontroli.

Wspólna infrastruktura cyfrowa (interfejs użytkownika, system zarządzania) przy różnorodności rozwiązań fizycznych (źródła kompletacji, zasoby transportowe) wskazuje, że konkurencja w q-commerce nie dotyczy już technologii, ale głównie organizacji zasobów logistycznych. Model pokazuje również konwergencję strategii – operatorzy dark stores wykorzystują platformy partnerskie jako dodatkowe kanały dystrybucji, a sieci handlowe nawiązują współpracę z operatorami dark stores. Granice między modelami ulegają zatarciu w poszukiwaniu przewagi konkurencyjnej opartej na elastycznej integracji zasobów.

Dyskusja

Badania Schorunga [2024] prowadzone w Paryżu, Londynie i Nowym Jorku wskazują, że model pure play wymaga obsługi 600–1500 zamówień dziennie przez jeden dark store dla osiągnięcia rentowności. W warunkach polskich duża gęstość sklepów detalicznych utrudnia osiągnięcie takiej skali zamówień. Lisek pozostaje jedynym funkcjonującym obecnie w kraju przedsiębiorstwem pure play. Obsługa miliona zamówień w 2022 roku [Pallus 2023] pozwoliła mu prawdopodobnie przekroczyć próg krytyczny dla rentowności, podczas gdy pozostali gracze (Gorillas, Jokr, Swyft) wycofali się z polskiego rynku przed osiągnięciem takiej skali.

Również we Francji przedsiębiorstwa pure play (Gorillas, Flink, Getir) wycofały się z rynku, podczas gdy platformy łączące się z istniejącymi sieciami detalicznymi, takie jak Uber Eats i Deliveroo, utrzymały swoje pozycje [Mordor Intelligence 2025]. Jednak w tym przypadku decydującym czynnikiem były regulacje miejskie, które klasyfikowały dark stores jako magazyny wymagające specjalnych zezwoleń, zmuszając operatorów do relokacji poza centra miast [Verdin i in. 2023, s. 25]. Przewagę modeli wykorzystujących istniejącą infrastrukturę potwierdzają badania konsultingowe. Analiza McKinsey pokazuje, że fizycznie istniejące sklepy generują wyraźnie wyższy wzrost obrotów e-commerce w porównaniu z obszarami pozbawionymi ich fizycznej obecności, co sugeruje komplementarność, a nie substytucyjność kanałów online i offline [McKinsey 2021].

Na niektórych rynkach model pure play rozwija się dynamicznie. W Niemczech Flink posiada 146 magazynów dark stores, osiąga przychody w wysokości 600 mln USD rocznie i planuje otwarcie kolejnych 30 lokalizacji [Prabhu 2024]. Z kolei

w Indiach model pure play rośnie o 77% rok do roku [Joshi 2025]. Rozwój ten napędzają czynniki demograficzne i technologiczne: populacja miejska w Indiach wzrosła z 511 mln w 2022 roku do 523 mln w 2023 roku, a mieszkańcy miast stanowią 36,36% całkowitej populacji [Nexdigm 2024]. Badania Agarwala i Singha [2024] wykazują, że w warunkach indyjskich model oparty na dark stores skutecznie optymalizuje koszty logistyki, wykorzystując gęstość zaludnienia do osiągnięcia rentownej skali operacji. Sukces modelu pure play jest silnie uwarunkowany lokalną strukturą konkurencji detalicznej – w warunkach mniejszej gęstości tradycyjnego handlu model ten może osiągnąć krytyczną skalę zamówień niezbędną do przetrwania i ekspansji.

Wnioski

Badanie potwierdza hipotezę o przewadze modeli elastycznych nad pure play w polskich warunkach. Prawie wszystkie przedsiębiorstwa oparte wyłącznie na dark stores (Gorillas, Jokr, Swyft, Barbora Express) zakończyły działalność w ciągu dwóch lat od wejścia na rynek. Jedynym funkcjonującym przykładem pozostaje Lisek, który osiągnął milion zamówień w 2022 roku [Pallus 2023], prawdopodobnie przekraczając próg rentowności. Tymczasem modele hybrydowy (Carrefour) i platformowy (Glovo, Wolt) wykazują stabilność i ekspansję. Przyczyna leży w specyfice polskiego rynku – funkcjonowanie 130 500 sklepów FMCG utrudnia osiągnięcie skali zamówień niezbędnej dla uzyskania rentowności dark stores (600–1500 zamówień dziennie według Schorunga [2024]). Modele elastyczne przekształcają tę barierę w atut, wykorzystując istniejącą infrastrukturę, zamiast z nią konkurować poprzez budowę nowych magazynów.

Przedstawiona w opracowaniu klasyfikacja rozwija typologię Schorunga [2024] w dwóch wymiarach. Po pierwsze, wyodrębnienie modelu hybrydowego jako osobnej kategorii jest próbą wypełnienia luki w klasyfikacji międzynarodowej, gdzie strategia omnichannelowa jest jedynie wzmiankowana (Schorung wspomina o „warestores"), ale nie skonceptualizowana jako pełnoprawny model biznesowy. Po drugie, wprowadzono kryterium własności infrastruktury IT jako wyznacznika rozróżnienia modeli. Schorung koncentruje się na organizacji fizycznej (dark stores, kurierzy), podczas gdy z perspektywy e-commerce kontrola nad interfejsem użytkownika jest równie istotna – determinuje ona dostęp do danych klientów, możliwość personalizacji oferty oraz niezależność od platform zewnętrznych. To kryterium pozwala rozróżnić przypadki pozornie podobne: Biedronka współpracująca z Glovo (model platformowy, brak kontroli nad interfejsem) i Carrefour z własną aplikacją (model hybrydowy, pełna kontrola). Dodatkowo hierarchia modeli różni się w zależności od kraju – w metropoliach zachodnich – model pure play pozostaje punktem odniesienia, natomiast w warunkach polskich staje się strategią marginalną.

Rynek q-commerce w Polsce wciąż poszukuje optymalnej konfiguracji modelu biznesowego. Współpraca Biedronki z Glovo (BIEK) pokazuje możliwość łączenia strategii – tradycyjna sieć detaliczna wykorzystuje platformę dostaw bez inwestycji we własną infrastrukturę logistyczną. Model ten oferuje niski próg wejścia i umożliwia szybkie osiągnięcie dużej skali, co czyni go atrakcyjnym dla innych dużych detalistów. Alternatywnie część graczy rynkowych może wybrać większą kontrolę nad całością logistyki, rozwija-

jąc własne rozwiązania na wzór sieci Carrefour. Dotychczasowe doświadczenia rynkowe kwestionują efektywność ekonomiczną modelu pure play w polskich warunkach – prawie wszystkie przedsiębiorstwa tego typu zakończyły działalność.

Przyszłe badania powinny określić liczbowe progi rentowności dla różnych modeli w zależności od gęstości handlu detalicznego. Porównanie z krajami Europy Środkowo-Wschodniej o podobnej strukturze mogłoby przynieść odpowiedź na pytanie, czy mechanizm obserwowany w Polsce ma charakter regionalny. Dostęp do danych finansowych przedsiębiorstw umożliwiłby precyzyjną analizę czynników wpływających na sukces poszczególnych strategii.

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Poland as a strategic logistics hub on the New Silk Road

Polska jako strategiczny węzeł logistyczny na Nowym Jedwabnym Szlaku

Abstract. The aim of the study is to identify contemporary challenges and prospects of transport and logistics between China and Poland, with particular emphasis on oversize transport and Poland's role as a key link on the New Silk Road. The article focuses on Poland, which, thanks to its geographical location, is gaining importance as a key logistics hub within the Belt and Road Initiative (BRI). Situated between the East and the West, it acts as an important bridge connecting Asia with Europe, which is conducive to the development of transport and logistics. Poland is a central point for many transport corridors, and its role in international trade, especially with China, is growing significantly. The article discusses the development of transport infrastructure, including rail and sea connections, and plans for the development of logistics centers in Poland. Challenges related to customs procedures and international cooperation aimed at simplifying formalities and improving logistics efficiency are also discussed. The future of Poland as a key node in the global supply chain depends on further investments in infrastructure, the development of intermodal transport, and the improvement of customs and administrative processes.

Keywords: New Silk Road, Poland, China, logistics

Synopsis. Celem opracowania jest rozpoznanie współczesnych wyzwań i perspektyw transportu i logistyki pomiędzy Chinami a Polską, ze szczególnym uwzględnieniem przewozów ponadnormatywnych i roli Polski jako kluczowego ogniwa Nowego Jedwabnego Szlaku. Artykuł koncentruje się na Polsce, która dzięki swojemu położeniu geograficznemu zyskuje na znaczeniu jako kluczowy węzeł logistyczny w ramach Inicjatywy Pasa i Szlaku (BRI). Usytuowana pomiędzy Wschodem a Zachodem, pełni funkcję ważnego mostu łączącego Azję z Europą, co sprzyja rozwojowi transportu i logistyki. Polska stanowi centralny punkt wielu korytarzy transportowych, a jej rola w handlu międzynarodowym, szczególnie z Chinami, znacząco rośnie. W artykule opisano dotychczasowy rozwój infrastruktury transportowej, w tym połączeń kolejowych i morskich, oraz plany rozwoju

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centrów logistycznych w Polsce. Uwzględniono również wyzwania związane z procedurami celnymi oraz współpracą międzynarodową mającą na celu uproszczenie formalności i poprawę efektywności logistycznej. Przyszłość Polski jako kluczowego ogniwa w globalnym łańcuchu dostaw zależy od dalszych inwestycji w infrastrukturę, rozwoju transportu intermodalnego oraz usprawnienia procesów celnych i administracyjnych.

Słowa kluczowe: Nowy Jedwabny Szlak, Polska, Chiny, logistyka

Kody JEL: F15, L91, O18, R42, F10

Introduction

China is a growing economic and manufacturing power that is trying to find attractive markets for its products, including in Europe. As part of the Belt and Road Initiative (BRI), numerous infrastructure projects are being developed to improve connections between Asia and Europe, and one of their important elements is the so-called New Silk Road. Poland, due to its purchasing power, is not a prominent target market for China, but in terms of logistics, it is attractively located on the way to richer and more developed European economies such as Germany or France [Kalinowska 2011]. Thanks to the development of transport and logistics, Poland can use its location, not only in developing trade relations with China, but also in becoming a significant hub on a European scale. Poland has a strategic location in the center of continental Europe, neighboring Russia, Lithuania, Belarus, Ukraine, Slovakia, the Czech Republic, and Germany. Poland is a transit country for the main transport corridors between Asia and Europe [Doński-Lesiuk 2022]. Economic relations between China and Poland have been revived since President Bronisław Komorowski signed a strategic partnership agreement with China in 2011. Transport and logistics between China and Poland are more than just infrastructure. They are also advanced technologies, supply chain optimization, and international cooperation that support the economic development of both countries. The dynamic development of these areas is a foundation for further trade expansion, contributing to the growth of Poland as a key logistics partner of China in Europe [Bachulska 2017].

Oversize transport, also known as out-of-gauge or heavy haulage, involves the transportation of cargo that exceeds standard dimensions and/or weight limits. Its importance is growing in China–Poland logistics, especially for goods such as wind power plant components, large construction machinery, or industrial infrastructure modules [Klepacki 2021]. Oversize transport requires detailed planning – from permits and pilot escorts to the coordination of various transport modes (rail, road, sometimes inland waterways). Polish terminals, especially in Małaszewicze, are increasingly handling this type of cargo, and the development of infrastructure dedicated to oversize transport has become one of the investment priorities [Jakubowski 2020].

It is also important to note the obstacles facing oversize transport, including infrastructural limitations (bridge clearance, condition of local roads), complex administrative procedures, and the need for coordination at borders. Both on the Chinese and Polish sides, logistics operators and local authorities are working to simplify these procedures and adapt routes and terminals for oversize cargo handling.

Research aim and methodology

The aim of the study is to assess Poland's role in the transport system connecting China and the European Union, with particular emphasis on the conditions and development prospects of oversize (out-of-gauge) transport. The article also seeks to identify the key factors determining Poland's competitiveness as a logistics hub within the Eurasian supply chain network.

The research is based on a review of academic literature, strategic policy documents, and statistical data on rail, sea, and road transport between China and Poland. A comparative assessment of selected efficiency and cost indicators was also conducted, enabling the formulation of both theoretical and practical conclusions.

Analysis results

Poland and China are working to strengthen their logistics links, primarily through the development of transport infrastructure and trade agreements. Poland is investing in transport infrastructure, including road and rail networks, to increase connectivity with China. The development of efficient transport links is crucial to facilitating the flow of goods between the two countries.

Belt and Road Initiative (BRI)

Poland has expressed interest in participating in China's BRI, a global infrastructure development strategy. The initiative aims to improve trade connectivity between China and various countries, including Europe. The Belt and Road Initiative [Chen & Li 2021], also known as the New Silk Road, is a global infrastructure and economic project launched by China in 2013 by President Xi Jinping. The initiative aims to strengthen trade, investment, and infrastructure links between China and the rest of the world, building on the historic Silk Road that connected China with Europe and the Middle East [Jakimowicz 2017].

This initiative focuses on two main aspects: the Silk Road Economic Belt and the 21st Century Maritime Silk Road. The first of these aims to connect China with Central Asia, the Middle East, Russia and Europe. For this purpose, land connections such as rail and road networks are being created. The 21st Century Maritime Silk Road focuses, as the name suggests, on the development of sea routes. It focuses on ports and infrastructure in Southeast Asia, East Africa, and Europe.

The main goals of this initiative are [Szymańska & Wielechowski 2019]:

1. Infrastructure development,
2. Facilitating international trade,
3. Strengthening cooperation with participating countries in many fields,
4. Diversification of routes.

The initiative has been joined by 150 countries and international organizations from Asia, Europe, Africa, and Latin America. The participants include both developing and developed countries. Poland has also joined the initiative and, as a country located at the crossroads of important trade routes, it plays an important role in the BRI. The rail terminal in Małaszewicze is one of the key points in the transport of goods between

China and Europe. Poland plays a strategic role in the BRI, mainly due to its geographical location as a gateway to Central and Western Europe. It is an important point on the transport map connecting Asia with Europe, which has a positive impact on the development of the economy, infrastructure, and international relations.

Trade relations

Trade relations between Poland and China have been developing dynamically since the 1990s, and after Poland joined the European Union in 2004, they gained even greater importance. Currently, China is one of Poland's most important economic partners in Asia, and Poland plays a key role in China's relations with the entire Central and Eastern Europe. Poland and China are working to expand their trade relations. They are developing dynamically, offering both great opportunities and challenges [Kolodko 2017]. This includes not only the exchange of goods, but also cooperation in various sectors, such as technology and innovation. Currently, Poland cooperates with China not only within the previously mentioned BRI, but also within the 16+1 format. This initiative is a cooperation of 16 European countries with China, which supports the development of infrastructure projects, cooperation in trade and investment, as well as political and cultural dialogue [Andrzejczak 2023].

Table 1. Oversize transports on the China–Poland Route in 2023
Tabela 1. Przewozy ponadgabarytowe na trasie Chiny–Polska w 2023 r.

Type of cargo	Number of shipments	Average weight [tons]	Mode of transport	Main routes
Industrial machinery	112	45	rail-road	Xi'an – Małaszewicze – Łódź
Wind turbine parts	48	32	road	Shanghai – Gdańsk – Poznań
Construction modules	67	28	intermodal	Chongqing – Gdańsk – Wrocław

Source: own study
Źródło: badania własne

Ensuring smooth logistics connections also includes addressing customs and regulatory issues. Both countries can work on simplifying and harmonizing procedures to facilitate trade. In order to fully exploit the potential of trade cooperation between Poland and China, it is necessary to simplify customs and administrative procedures. Complex formalities, as well as differences in regulations and lengthy customs clearance processes, can lead to delays and increased logistics costs, thus reducing trade profits. Streamlining customs and other regulations would allow for faster flow of goods, reducing bureaucracy and improving the efficiency of the entire supply chain. Introducing uniform standards and digitalizing customs processes, along with mutual recognition of certificates and trade documents, could significantly increase the competitiveness of Polish and Chinese companies on international markets. The simplification of procedures would also support increased investment and the creation of new business opportunities for companies operating in the transport and logistics sector [Antonowicz 2023].

An important thread of this study is the analysis of oversize transport (out-of-gauge or heavy haulage) between China and Poland. Despite the growing importance of this segment, it is often marginalized in the literature, even though oversize transport presents significant infrastructural and procedural challenges. It requires special approaches in route planning, customs clearance, and international cooperation.

Important means of transport

Freight train connections between China and Poland have developed dynamically in recent years. In December 2012, the Chengdu–Łódź rail link was inaugurated, making Łódź an important hub that connects China with various European destinations. The expansion continued in October 2013, when another rail connection between the two countries was launched. After a journey of 14 days, the first freight train from China reached Warsaw, operating under the name SU-MENG-EU. On November 21, 2019, DCT Gdańsk introduced the first regular Euro China Train service, which now runs from Xi'an in China, passing through the Adampol Małaszewicze land terminal and arriving at the DCT container terminal in the Port of Gdańsk. Rail container transport from China to Poland has proven to be cost-competitive, a result of flexible and well-adapted logistics planning. Furthermore, rail transport is perceived as a reliable and safe mode of shipping, unaffected by current geopolitical conflicts, thus ensuring stable supply chains [Gan 2022].

Sea transport also plays a crucial role in the movement of cargo between China and Poland. Goods shipped from the eastern coast of China to Western Europe typically spend about 35 to 40 days at sea. The coastal city of Gdańsk is increasingly recognized for its potential to become a major logistics hub, as evidenced by the growing volume of container shipments handled at its port. Over recent years, the Port of Gdańsk has experienced a significant increase in transshipment, underlining its expanding role in European logistics. Notably, in 2021, the port achieved a record throughput of 53.2 million tons of cargo, marking an 11% increase compared to the previous year and the highest figure in its history.

Road transport is another vital component of Poland's logistics network with China. In November 2018, the first TIR truck shipment from China to Europe successfully completed its 7,000-kilometer journey, entering Kazakhstan at the Khorgos border and traveling through Russia and Belarus to reach Poland in just 13 days. The efficiency of this mode, both in terms of travel time and cost, makes it a strong competitor to air and rail transport. The increasing emphasis on expanding e-commerce across Europe has drawn Chinese companies to invest in Polish logistics connections, and further Chinese investment in logistics services in Poland is expected to grow in the coming years.

Logistics centers in Central and Eastern Europe

Countries such as Poland, due to their central location in Europe, serve as important logistics centers. Cities such as Warsaw, Wrocław, and Łódź have well-developed transport infrastructure and logistics facilities that facilitate the flow of goods. There is another logistics center of great importance for the trade connection between China and Poland.

On every Chinese logistics map of Eurasia, Małaszewicze is placed as one of the most important nodes [Bartosiewicz and Szterlik 2020]. The international situation after the outbreak of the war in Ukraine did not discourage Chinese companies from launching container trains to Europe via Małaszewicze. Małaszewicze is the most important route for the Chinese, and it is necessary to prepare the infrastructure to improve transshipment and adapt it to modern technologies. Both countries are examining the possibility of establishing logistics centers to improve the flow of goods. These centers can serve as strategic points for storing, processing, and distributing products. Bartosz Zakrzewski writes about their potential development:

Despite trade difficulties of a political nature, transshipment at the border railway station reached 7 million tons of cargo per year. The excellent geographical location of Małaszewicze, unfortunately reinforced by the limitation of international transport with Ukraine via the Żurawica-Medyka station in the zone of communication corridor no. 4, currently results in increased interest of large logistics companies in the border infrastructure of this area. A terminal capable of handling 100 thousand containers (TEU) per year, belonging to a Czech operator, was built. PKP Cargo purchased a 30 ha plot of land in the Free Customs Zone WOC Małaszewicze-Terespol in order to create a comprehensive infrastructure supporting transport in relations with the Far East. Talks with Chinese partners allow us to hope that Małaszewicze will become an important element of the so-called Silk Road – a large, strategic Euro-Asian project supported by the Chinese authorities [Zakrzewski 2016].

As the author of the text predicts, Polish logistics centers have their future in cooperation with China. The current situation, despite certain difficulties, offers many promising projects. Zakrzewski notes that the key to potential development is to raise the standards of road infrastructure in the eastern part of Poland. The creation of new logistics centers alone will not be sufficient to use the full potential of this region.

The economic analysis of freight transport between China and Poland must take into account the specific cost structures and efficiency indicators characteristic of rail, sea, and road transport, as these modes constitute the main arteries of the Sino-Polish logistics corridor.

Costs and efficiency assessment

Rail transport stands out for its balanced ratio of operational cost to delivery speed. The primary cost components include infrastructure access fees, locomotive and wagon leasing or depreciation, fuel (or electricity), labor, terminal handling charges, and border crossing fees. According to recent operational practices, the rail transport of containers from China to Poland, particularly via the Chengdu–Łódź and Xi'an–Gdańsk routes, is competitive largely due to flexible route planning and high cargo consolidation, which optimize train utilization. Cost per container decreases with increased train load and frequency. Additional expenses are related to transshipment at border terminals (e.g., gauge change at Małaszewicze), as well as customs clearance procedures. While geopolitical tensions may affect route selection, they do not significantly increase direct costs, as rail remains less exposed to sudden price fluctuations than road or sea transport [McCaleb 2021].

Sea transport is generally the most cost-effective option in terms of unit price per ton-kilometer, especially for bulk and high-volume shipments. Key cost components include bunker fuel, port charges, vessel operation and maintenance, insurance, and handling fees at ports of origin and destination. The Port of Gdańsk has registered an 11% year-on-year increase in cargo throughput, indicating growing economies of scale and improving cost efficiency. However, sea transport is associated with longer delivery times (35–40 days from China to Europe), which may result in higher inventory holding costs for shippers [Pendrakowska 2018].

Road transport, while offering the greatest flexibility, is typically the most expensive per ton-kilometer for long-distance trans-Eurasian shipments. Its cost structure is dominated by fuel, driver wages, tolls, vehicle maintenance, insurance, and administrative permits, especially for oversize cargo. The recent success of TIR truck shipments covering 7,000 kilometers in just 13 days demonstrates the speed advantage, but the economic feasibility is highly dependent on full vehicle utilization, regulatory restrictions, and infrastructure conditions across transit countries.

For each mode, efficiency can be assessed using key performance indicators such as average transit time, cost per container, capacity utilization, and punctuality rate. Rail transport currently achieves average transit times of 14 days from China to Poland, with high reliability and stable supply chains, making it attractive for time-sensitive goods. Sea transport, despite lower costs, offers less predictability due to possible port congestion and weather-related delays. Road transport achieves the shortest transit times but is less scalable and more susceptible to delays at borders [Pugacewicz 2022].

Comparing the three main modes, rail is often the preferred solution for balanced shipments that prioritize both time and cost. Sea transport remains unrivaled for large-scale, low-value cargo where cost minimization is the overriding goal. Road transport, including for oversize shipments, is justified when delivery speed or last-mile flexibility is critical, or when cargo characteristics (e.g., out-of-gauge dimensions) preclude the use of standard intermodal units.

Development opportunities

Poland can enhance its transportation and logistics capabilities, making the flow of goods between China and Poland more efficient and smoother, in particular, through the following measures:

1. Investing in infrastructure.
   Poland should continue to invest in and modernize its transport infrastructure, including roads, railways, and ports. It is particularly important to support the development of infrastructure in eastern Poland to facilitate transport to and from the borders with Belarus and Ukraine, which are key transit points in trade with China. Modern intermodal terminals, i.e., platforms enabling transshipment, connected to TEN-T transport corridors, can raise the standard and speed of handling goods [Brona & Kruk 2012].
2. Promoting intermodal transport.
   Intermodal transport is one that combines rail, road, and sea transport, allowing for more efficient management of the flow of goods. Poland should develop a network of intermodal terminals, as well as deal with logistics projects that facilitate

fast transshipment between different means of transport. These actions may include the introduction of uniform operational standards, raising the standard of warehouse infrastructure, and digitalization of logistics processes, which will reduce downtime and costs [Chorośmrozowska 2019].

3. Making e-commerce logistics easier.
   The focus should be on developing efficient logistics solutions to support cross-border e-commerce between Poland and China. The dynamic development of e-commerce between Poland and China requires efficient logistics solutions. Investing in the development of distribution centers and warehouses supporting e-commerce will ensure fast order processing and delivery. It is also important to streamline customs procedures through automation and digitalization, which will shorten the clearance time of goods and reduce operating costs for companies [Wiewiór 2021].
4. Promoting technology integration.
   Adopt and invest in logistics technologies such as IoT, blockchain, and data analytics to increase visibility, traceability, and overall efficiency in the supply chain. These technologies support real-time monitoring of shipments, giving the possibility of better logistics control and reducing the risk of delays. Investments in the digitalization of logistics processes and warehouse automation contribute to increasing the efficiency and competitiveness of Poland as a logistics hub [Wołek 2018].
5. Cooperation within the Belt and Road Initiative (BRI)
   Engaging in regular dialogues between countries, along with Poland's active participation in the BRI, can bring benefits in the form of access to new markets and increase the country's importance as a major transport hub in Europe. Regular dialogues with China and other countries participating in the BRI will improve transport and logistics policies, supporting the development of integrated transport corridors and facilitating trade.

In the highly specialized market of oversize transport, competition is driven by several key factors that go beyond the basic provision of transport services. One of the most important ways companies compete is through investment in modern, specialized equipment capable of handling heavy and non-standard cargo. This includes extendable trailers, modular platforms, cranes, and escort vehicles, all of which are essential for the safe and efficient movement of oversize loads. The ability to offer tailored transport solutions – such as designing optimal routes, arranging for special permits, and managing pilot car escorts – provides companies with a significant competitive advantage.

Poland's role in oversize logistics

Another crucial aspect is the development of strong relationships with local authorities and border agencies. Navigating the complex regulatory environment for oversize shipments requires not only deep expertise but also established connections that can help expedite permits and border crossings. Companies that are able to streamline administrative processes and minimize delays are better positioned to attract clients with time-sensitive cargo.

Moreover, technology and digitalization play an increasing role in market competition. Leading operators utilize advanced route planning software, real-time cargo monitoring systems, and digital document management platforms to enhance transparency, safety,

and reliability. Providing customers with the ability to track their shipments and access documentation online builds trust and adds value to the service.

Finally, many companies compete by offering comprehensive, door-to-door logistics solutions that include not just transportation, but also warehousing, customs clearance, and value-added services such as cargo insurance and risk assessment. In such a demanding market, flexibility, reliability, and the capacity to manage highly complex projects are the hallmarks of the most competitive players.

A comprehensive analysis of China–Poland freight transport from the Polish perspective reveals a set of unique opportunities and challenges that are often underrepresented in broader, internationally focused studies. Poland's geographical position as a gateway to the European Union gives it a strategic advantage, enabling the country to play a pivotal role in the New Silk Road and the Belt and Road Initiative. The development and modernization of key border terminals – such as Małaszewicze – not only facilitate efficient transit of Chinese goods into the EU but also have substantial local and national economic impacts, including job creation, regional development, and increased tax revenues.

From the Polish point of view, logistical investments are not solely about accommodating growing East-West trade volumes. They also serve as a catalyst for domestic innovation and capacity building within the logistics sector. Polish transport and logistics companies face the dual challenge of meeting international service standards while simultaneously navigating national administrative and regulatory frameworks. The Polish government's efforts to streamline customs procedures, invest in intermodal infrastructure, and foster the digitalization of logistics processes demonstrate a commitment to strengthening Poland's role as a regional logistics leader.

However, the Polish perspective also highlights certain vulnerabilities, such as dependence on geopolitical stability in Eastern Europe and the need for continuous infrastructure modernization. Moreover, there is a strategic imperative to balance the benefits of transit trade with the development of value-added services and domestic supply chains.

Summary

Transport and logistics cooperation between Poland and China plays an important role in the global supply chain, and in particular, the developing Belt and Road Initiative (BRI) should be noted, which aims to deepen trade relations between Asia and Europe. Poland, due to its geographical location, connects the East with the West. This means that Poland is playing an increasingly important role as a transit hub, facilitating the flow of goods on a large scale.

This is associated with numerous development opportunities that can contribute to strengthening its position as one of the important logistics centers in Europe. However, this potential requires consistent actions, including further investments in transport infrastructure, such as modernization of the rail network, development of intermodal terminals, and smoothing of customs processes. Openness to international dialogue should also not be forgotten, which serves to build lasting trade relations and allows for effective adaptation to the changing reality. By combining investment in infrastructure with active diplomatic and economic cooperation, Poland will be able to fully develop and become one of the most important elements of the global supply network.

Oversize transport is currently one of the most important segments in the expanding logistics exchange between China and Poland. The growing number of infrastructure investments (e.g., wind farms, factories) necessitates the intensification of oversize shipments. Proper modernization of infrastructure, digitalization of procedures, and effective cooperation between border and logistics authorities are key factors for the further development of this sector. Thanks to its geographical location, Poland has the chance not only to be a transit country but also to become a center for oversize transport services for the entire Central and Eastern Europe.

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Green transformation of logistics through technological innovations to reduce CO_2 emissions in courier companies – case study

Zielona transformacja logistyki dzięki innowacjom technologicznym ograniczającym emisję CO_2 w firmach kurierskich – case study

Abstract. The study aimed to evaluate how technological innovations drive the green transformation of logistics in courier companies and reduce CO_2 emissions in last-mile delivery. The research focused on three operators – Amazon, DHL, and InPost – representing different operational scales and technological maturity. A comparative case study was conducted, combining quantitative benchmarking of emission indicators (CO_2e per parcel, EV fleet share) with qualitative assessment of ESG reporting, climate policies, and technology integration. The analysis covered 2023–2024 data from verified corporate and institutional sources, including sustainability reports and EU databases. The results show that companies achieving the highest emission reductions are those integrating technological, organizational, and environmental dimensions. InPost's parcel-locker model generated up to 75% lower emissions per parcel compared to DHL's traditional door-to-door system, confirming the ecological efficiency of consolidated, network-based deliveries. Company size proved less significant than the coherence between digitalization, automation, and ESG management. The paper's novelty lies in linking fleet electrification indicators with technological and organizational maturity, creating a new analytical framework for assessing the environmental effectiveness of logistics transformation. Practically, the findings can support logistics operators, city planners, and policymakers in developing decarbonization strategies that prioritize scalable technologies, data-driven fleet management, and standardized ESG report-

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ing. Future research should include life-cycle assessments and explore emerging solutions such as hydrogen propulsion, autonomous delivery systems, and AI-based route optimization to advance climate-neutral logistics by 2040.

Keywords: green logistics, CO_2 reduction, last mile delivery, ESG, electric vehicles, digital transformation, sustainability

Synopsis. Celem badania była ocena, w jaki sposób innowacje technologiczne napędzają zieloną transformację logistyki w przedsiębiorstwach kurierskich oraz przyczyniają się do redukcji emisji CO_2 w dostawach ostatniej mili. Analiza objęła trzech operatorów – Amazon, DHL i InPost – reprezentujących różne skale działalności oraz poziomy dojrzałości technologicznej. Zastosowano metodę porównawczego studium przypadku, łącząc ilościowe benchmarki wskaźników emisji (CO_2e przypadający na jedną przesyłkę, udział we flocie pojazdów elektrycznych) z jakościową oceną raportowania ESG, polityk klimatycznych oraz integracji technologii w procesach operacyjnych. Analiza obejmowała dane z lat 2023–2024 pochodzące ze zweryfikowanych źródeł korporacyjnych i instytucjonalnych, w tym raportów zrównoważonego rozwoju oraz baz danych UE. Wyniki badań wskazują, że najwyższą redukcję emisji osiągają przedsiębiorstwa integrujące technologiczne, organizacyjne i środowiskowe aspekty transformacji. Model logistyczny InPostu oparty na sieci paczkomatów generował do 75% niższe emisje za przesyłkę w porównaniu z tradycyjnym systemem „door-to-door" DHL, co potwierdza efektywność ekologiczną skonsolidowanych, sieciowych rozwiązań dostawczych. Wielkość firmy okazała się mniej istotna niż spójność między cyfryzacją, automatyzacją i zarządzaniem ESG. Nowością naukową artykułu jest powiązanie wskaźnika elektryfikacji flot z poziomem dojrzałości technologicznej i organizacyjnej, co pozwoliło stworzyć nowy model oceny efektywności środowiskowej transformacji logistycznej. W wymiarze praktycznym wyniki mogą wspierać operatorów logistycznych, urbanistów i decydentów politycznych w opracowywaniu strategii dekarbonizacji opartych na skalowalnych technologiach, zarządzaniu flotą z wykorzystaniem danych oraz standaryzowanym raportowaniu ESG. W przyszłych badaniach zaleca się uwzględnienie analiz cyklu życia (LCA) oraz eksplorację nowych rozwiązań, takich jak napęd wodorowy, systemy dostaw autonomicznych i optymalizacja tras z wykorzystaniem sztucznej inteligencji, aby przyspieszyć realizację celów logistyki neutralnej klimatycznie do 2040 roku.

Słowa kluczowe: zielona logistyka, redukcja emisji CO_2, dostawy ostatniej mili, ESG, pojazdy elektryczne, transformacja cyfrowa, zrównoważony rozwój

JEL codes: Q57, L94, O18, R42

Introduction

Logistics plays a key role in the global economy, ensuring the smooth flow of goods and services. However, the intensification of logistics activities, fueled by the growth of e-commerce and increased consumer expectations for speed and delivery availability, brings serious environmental consequences [Kalkha et al. 2023; Risberg 2023]. Particularly acute are the carbon dioxide (CO_2) emissions generated by road transportation,

especially the so-called "last mile" segment, which is characterized by high fragmentation and energy intensity. Today, couriers and logistics operators are forced to look for solutions to maintain service efficiency and meet increasingly stringent environmental standards [Ha et al. 2023; Silva et al. 2023; Mohammad et al. 2023; Masłowski et al. 2023].

In response to these challenges, increasing attention is being paid to the green transformation of logistics, with technological innovation at its core. The deployment of electric delivery vehicles, innovative route optimization platforms, real-time data-driven fleet management systems, and automation of warehouse processes are just some of the tools supporting emission reductions. Despite the dynamic development of these technologies, their actual environmental impact, efficiency of deployment, and scalability of solutions in different business models remain issues that require in-depth analysis [Erdem, Dogan 2023; Liu et al. 2024; Dzwigol et al. 2021].

The issues addressed in this paper focus on assessing how technological innovations contribute to CO_2 reduction in courier companies and comparing decarbonization strategies implemented by companies of different scales of operations. Key research questions include the effectiveness of the solutions used, the level of technology integration with existing operational systems, and the implementation barriers encountered by companies operating locally and globally.

Despite the growing interest in sustainable logistics, the current state of research shows several important gaps. First, there is a paucity of comparisons between companies operating in different scales and market contexts, making it difficult to identify success factors for green transformation. Second, analyses to date are often limited to declarative data in ESG reports, omitting quantitative assessment of deployed technologies' effectiveness in real emission reductions.

Additionally, most studies focus on global operators (e.g., DHL, FedEx), marginalizing regional or national companies that can implement more flexible, locally tailored innovations (e.g., InPost). Meanwhile, juxtaposing micro- and macro-scale models can provide the most valuable insights into optimal decarbonization strategies in the logistics sector.

Therefore, this work intends to fill this gap through a detailed, comparative analysis of three courier companies – Amazon, DHL, and InPost – taking into account their environmental strategies, fleet structure, technology investments, and measurable emissions reductions between 2023 and 2024.

The aim of the study was to identify how the integration of modern technological and organizational solutions within courier companies supports the reduction of greenhouse gas emissions, and to determine the factors that enhance or limit the effectiveness of green transformation in last-mile logistics. The research was intended to provide practical insights into how different business models and environmental strategies influence the real outcomes of decarbonization efforts in the courier sector. The research methodology is based on analyzing vehicle fleet structures, ESG (Environmental, Social, and Governance) policies, emissions data, and investments in integrated logistics systems with varying levels of technological advancement. The analysis includes data from 2023 and 2024, sourced from the latest publicly available environmental reports as well as annual and quarterly statements of Amazon, DHL, and InPost, and European institu-

tions such as the ICCT (International Council on Clean Transportation) and the European Environment Agency. The use of these data enables an assessment of the current level of implementation of decarbonization strategies and a comparison of the outcomes of innovation deployment in last-mile logistics.

Materials and methods

The study was based exclusively on publicly available, primary and secondary institutional and corporate sources concerning the activities of Amazon, DHL, and InPost, and regulatory and market conditions in the EU. The core corpus consisted of: the 2023 Amazon Sustainability Report [Amazon 2024], the DHL Group 2023 Annual Report (including ESG modules) [DHL 2024], the InPost Group Annual Report 2023 [InPost 2024], as well as studies by the European Environment Agency [2024], ICCT [2021; 2023] and Transport & Environment [2024]. All documents cited in the article's bibliography were used as source material for indicator extraction, data verification, and cross-company comparisons. The data acquisition date was set at 15 May 2025, in line with "accessed" notes in the bibliography.

The object of the study was the decarbonization strategies and technological innovations applied in last-mile logistics by three courier companies: Amazon (global operator), DHL (global operator), and InPost (regional operator expanding in the EU). The analysis covered: the structure and scale of low-emission fleets (number/share of EVs), last-mile operating models (door-to-door vs. parcel locker networks), environmental policies (climate neutrality targets, SBTi compliance), ESG reporting scope and standards, and emission indicators (per parcel and/or total).

The substantive scope covered CO_2 reduction technologies in last-mile deliveries (fleet electrification, parcel lockers, energy management, digitization, and route optimization). The time horizon of the analyzed data was mainly 2023–2024 (corporate reporting), complemented with 2020–2025 for trends in EV fleet development and charging infrastructure in Europe (EEA, ICCT, T&E).

A comparative case study approach was applied, combining desk research and descriptive-quantitative analysis:

1. Identification of indicators and definitions – a standard set of measures was derived from the bibliography and article content: CO_2e/parcel, total CO_2e, number of EVs, EV share in fleet, climate targets (year), SBTi status, ESG standards (GRI/TCFD/other), features of the last-mile operating model.
2. Data extraction – numerical and declarative values were drawn from company reports [Amazon 2024; DHL 2024; InPost 2024] and macro-context from EEA/ICCT/T&E (EV registration shares, charging points, emission trends of LCVs). When a single source did not provide complete information, triangulation with other cited sources was used.
3. Verification and consistency – in case of discrepancies, priority was given to: (i) externally verified data (SBTi/GRI/ISO), (ii) audited sections of annual reports, (iii) institutional sources (EEA/ICCT/T&E). Unit consistency (year, region, scope) was ensured for cross-company comparisons.

4. Normalization and calculations – to ensure comparability, the following procedures were applied:
   – "per parcel" standardization: if only total emissions and parcel volumes were reported, the indicator CO_2e/parcel = total CO_2e/number of parcels was calculated; when company indicators were available, reported values were used;
   – generalization of EV share: calculated as EVs/last-mile fleet vehicles on the given market if reported; in cases of differing denominators, this was noted in tables;
   – qualitative categorization for policies/standards: SBTi (yes/no), ESG (GRI/TCFD/other), linkage of climate goals with incentive systems (yes/no).
5. Synthesis and presentation – results were summarized in tables (Tables 1–5 in the article) covering: fleet electrification in Europe in the years 2020–2025, EV volumes and shares, emission indicators, ESG declarations and verifications, and differences in last-mile models.

A comparative analysis (benchmarking) was applied in two dimensions:

– Quantitative – comparison of CO_2e/parcel, total CO_2e, EV numbers and shares, y/y dynamics, and position relative to EU trends (EV van registrations, charging infrastructure density); simple descriptive statistics (means, percentage differences, y/y indices) were used without inferential tests due to heterogeneous reporting methods.
– Qualitative – assessment of climate policy maturity through: presence of neutrality targets, SBTi status, ESG standards (GRI/TCFD), transparency of KPIs, and integration with corporate governance (linking environmental goals to incentive systems). These criteria and assignments were reflected in comparative tables.

Extraction and calculations were done in a spreadsheet (MS Excel or equivalent). Source data were archived with metadata (title, year, report section, page/chapter). The calculation path (formula, assumptions, volume source) was documented for estimated values.

Assumptions and limitations:

(1) The heterogeneity of reporting methods among companies limits the possibility of causal estimation – hence, the analysis is a descriptive benchmark, not an econometric model.
(2) Geographic differences in operations (global vs. regional) influence unit emissions.
(3) Data availability – some indicators were declarative or only partially verified; the tables clearly noted such cases.
(4) No sensitive or confidential data were used – the study relied exclusively on public sources.

The concept of ecologistics in sustainable logistics management

The term ecologistics refers to an integrated approach to logistics that combines operational objectives with environmental priorities. Ecologistics constitutes a significant area of interest within the field of logistics [Ližbetinová et al. 2022, pp. 4379–4403], defined as waste logistics, disposal, reuse, recycling, as well as the post-sale supply chain [Andrzejczyk, Rajczakowska 2020]. This concept emphasizes reducing the negative environmental impact of logistics processes while maintaining efficiency and compet-

itiveness. Ecologistics, understood as a set of multidirectional and complex initiatives related to the organization and optimization of waste removal chains, seeks environmentally friendly procedures in the areas of collection, storage, transportation, recovery, and neutralization of waste [Rybaczewska-Błażejowska, Masternak-Janus 2015]. Key components of ecologistics include [Baraniecka 2015]:

– electrification of the transport fleet,
– delivery route optimization,
– automation and digitization of logistics processes,
– integration with renewable energy sources,
– waste and emission minimization within the supply chain,
– design of sustainable packaging.

In the literature, ecologistics is considered part of the broader concept of green logistics [Tokarski et al. 2024], which integrates environmental, social, and economic considerations. Models such as "3P" (People, Planet, Profit) and circular economy approaches form the foundation of modern logistics strategies [Walczyński, Kanciak 2023, p. 155], particularly in the area of last-mile delivery, which has the highest environmental impact.

The last mile is the final stage of the logistics process within the supply chain, encompassing the physical delivery of a parcel from a warehouse, distribution center, or transfer point to the final recipient – either an individual customer or a pick-up point. This stage is considered one of the most complex and costly logistics phases due to the necessity of fulfilling individualized deliveries to a broad and thus highly diverse customer base [Masłowski, Kulińska 2019]. Final recipients are often located in urban, suburban, or rural areas characterized by significant dispersion. The last mile includes not only parcel delivery but also handling of returns, complaints, or misdeliveries. From the perspective of courier companies, it is a crucial area for building customer experience and competitive advantage, especially in light of increasing expectations regarding the speed, flexibility, and convenience of deliveries [Kaźmierczak, Szymczyk 2021].

Legal and regulatory framework

The green transformation of logistics is strongly supported and driven by international, EU, and national legislation. Key acts and initiatives include [Cheba et al. 2022]:

– European Green Deal – an EU strategy aiming to achieve climate neutrality by 2050 [Smolaga 2021, pp. 47–74]. Road transport is expected to reduce emissions by 90%.
– Fit for 55 package – a set of legislative proposals intended to reduce greenhouse gas emissions by at least 55% by 2030 [Gilewski et al. 2024].
– Corporate Sustainability Reporting Directive (CSRD) – requiring more companies to report ESG (Environmental, Social, and Governance) data, including carbon footprint and decarbonization strategies [Wiącek 2025; Farzaneh, Jung 2023].
– Regulations on CO_2 emission standards for commercial and light-duty vehicles.

At the national level, many countries are introducing additional incentives to support ecological restructuring: subsidies for electric vehicles, tax reliefs, funding for charging infrastructure development, clean transport zones in urban areas, and subsidies for renewable energy.

Technological progress forms the foundation for achieving environmental goals in logistics [Kacprzak et al. 2023, p. 93]. Key technologies enabling courier companies to adapt to new requirements include:

- electric and hydrogen vehicles, which reduce CO_2 emissions at the operational level, especially in urban last-mile transport;
- fleet management systems based on GPS and artificial intelligence (AI), enabling route optimization, driving style monitoring, and fuel and energy savings [Potdar, Parikh 2025];
- warehouse automation (robots, sorters, high-bay storage), which shortens parcel processing times and reduces energy consumption and operational losses [Mardeusz 2021, pp. 9–18];
- parcel lockers and click and collect solutions, which eliminate a large portion of individual deliveries and thus significantly reduce emissions from the so-called last mile [Guzowski et al. 2024];
- IoT and blockchain solutions, which enhance transparency, carbon footprint tracking, and emission traceability across the supply chain [Kashem et al. 2024], facilitating compliance with regulations such as the CSRD;
- predictive and cloud platforms (such as Amazon Web Services, DHL Smart Logistics), supporting automated demand forecasting, load optimization, and delivery scheduling [Guzenko & Guzenko 2022];
- AI for packaging size adjustment, reduction of empty runs, and efficient planning of the logistics network.

By implementing these solutions, courier companies reduce emissions and improve operational efficiency and competitiveness in a market increasingly oriented toward sustainable development. These technologies also play a crucial role in meeting increasingly stringent national and EU regulations, such as the Fit for 55 package, CO_2 fleet regulations, and ESG reporting obligations.

Research results

The development of electric vehicle fleets in Europe in the years 2020–2025 reflects the response to the escalating climate crisis. The European Union implemented the European Green Deal strategy, which includes achieving climate neutrality by 2050 and reducing greenhouse gas emissions in high-emission sectors such as transport [The European Green Deal 2020]. A particular focus has been placed on urban deliveries, which contribute significantly to air pollution in cities [Świniarska 2016]. The electrification of courier fleets, supported by public policies and logistics operators' private investments, has emerged as a key response to these challenges.

Initially, in 2020, the share of electric delivery vehicles (EVs) in courier company fleets was marginal – in countries such as the United Kingdom, it was below 1% [ICCT 2021, pp. 6–8]. However, the following years saw rapid growth: by 2023, the number of electric vans in Europe exceeded 200,000 and their share in new registrations reached 8% [Transport & Environment 2024, pp. 4–5]. Simultaneously, charging infrastructure expanded significantly, with public charging points increasing from 130,000 in 2020 to over 700,000 in 2023 [European Environment Agency 2024, pp. 15–17].

Emission reductions were particularly notable among newly registered delivery vehicles – the average CO_2 emissions in the EU decreased by over 10% within three years [ICCT 2023, pp. 11–12]. Leading courier companies support this transformation: Amazon has invested one billion euros in expanding its EV fleet in Europe; DHL has deployed its proprietary electric StreetScooter vehicles and plans to operate 80,000 zero-emission vehicles by 2030; and InPost conducts zero-emission deliveries in major cities in Poland and France [Amazon 2024; DHL 2024; InPost 2024].

Table 1. Electrification of courier fleets in Europe (2020–2025)
Tabela 1. Elektryfikacja flot kurierskich w Europie (2020–2025)

Year	Number of electric vehicles in courier fleets	Share of EVs in courier fleets	Emissions reduction (new vehicles)	Investments in charging infrastructure	Examples of initiatives by courier companies (Amazon, DHL, InPost)
2020	< 50,000	< 1%	No significant reduction	~130,000 public charging points	Amazon: 1,800 e-vans; DHL: StreetScooter program; InPost: EV pilot project in Warsaw
2021	~70,000	~1%	Marginal	~350,000 charging points	Amazon: continued development; DHL: 15,000 EVs; InPost: 500 EVs in Poland
2022	~100–120,000	~1.2%	–5% (for new vehicles)	~520,000 charging points	Amazon: €1 billion investment in the EU; DHL: GoGreen strategy; InPost: expansion to France
2023	>200,000	~1.5–2%	–11% (for new vehicles)	~700,000 charging points	Amazon: deployment of Rivian vehicles in Germany, 45 million parcels delivered emission-free; DHL: 500 EVs in Poland; InPost: over 1,000 EVs and hybrids
2024*	~300–400,000 (forecast)	~2%	Continued reduction expected	~1 million charging points (forecast)	Amazon: >10,000 EVs; DHL: >20,000 EVs; InPost: expansion to new cities, APM Green City program
2025*	>500,000 (forecast)	3–5%	Target: –15% compared to 2021	>1.2 million charging points (forecast)	Amazon: implementation of 10,000 EV target; DHL: global scaling; InPost: last-mile carbon neutrality

Source: own elaboration based on data from [European Environment Agency 2024; ICCT 2021, 2023; Transport & Environment 2024; Amazon 2024; DHL 2024; InPost 2024] and internal analysis

Źródło: oprac. własne na podst. [European Environment Agency 2024; ICCT 2021, 2023; Transport & Environment 2024; Amazon 2024; DHL 2024; InPost 2024] i analiz wewnętrznych

Case studies: Amazon, DHL, InPost

As one of the most prominent e-commerce players in the world, Amazon operates an extensive logistics infrastructure, handling millions of orders daily. In 2019, the company announced "The Climate Pledge" – a commitment to achieve climate neutrality by 2040, ten years ahead of the target set in the Paris Agreement.

The company invested in over 100,000 electric vans to reduce transport-related emissions, mainly through a partnership with Rivian. In 2023, Amazon delivered millions of parcels using electric vehicles, gradually introducing autonomous robots and drones in test locations [Alverhed et al. 2024].

In 2023, Amazon achieved an annual 13% reduction in CO_2 emissions despite increased order volume. The electric fleet primarily serves countries with a well-developed charging infrastructure: the United States, Germany, the United Kingdom, and Ireland.

DHL, operating in over 220 countries [Majerska 2022], is a pioneer in sustainable logistics. The company was the first in Europe to begin the mass production of electric vehicles (StreetScooter) used in local deliveries. DHL operates a fleet of more than 20,000 electric vehicles and is testing cargo bikes and hydrogen vans. In 2023, the company reduced its emissions to 33.27 million tonnes of CO_2, representing a decline of over 11% compared to previous years. Despite its smaller operational scale, InPost, a leading Polish courier company, has achieved significant success in emission reduction. The "out-of-home delivery" model based on Automated Parcel Machines (APMs) is the key to its success.

Thanks to its flagship approach of "one courier – many parcels – one location", the company achieves up to 75% lower CO_2 emissions per parcel than traditional door-to-door delivery. InPost operates the largest electric vehicle fleet among courier companies in Poland (over 30% of the urban fleet consists of EVs) and runs the "Green City" program in 54 cities.

Table 2. Environmental innovations and emission indicators in selected courier companies (2023)
Tabela 2. Innowacje środowiskowe i wskaźniki emisji w wybranych firmach kurierskich (2023)

Company	**Estimated number of parcels (2023)**	**Share of EVs in fleet**	**Types of eco-friendly vehicles**	**CO_2 emissions (per parcel/ /total)**	**Key environmental innovations**
Amazon	> 5 billion globally	Deployment of 100,000 EVs (approx. 20–25% of the US fleet)	EV vans (Rivian, Mercedes, Ford), drones, delivery robots	–13% CO_2 per parcel YoY	AI-based route and packaging optimization, regionalization of logistics network
DHL	> 1.8 billion parcels globally	20,000+ EVs (approx. 25% of the EU fleet)	StreetScooter, cargo bikes, hydrogen vehicle pilots	33.27 million tons CO_2e (2023)	In-house EV production, use of renewable energy in warehouses, automation
InPost	891.9 million	30% of urban fleet (Poland)	EVs, cargo bikes, solar-powered parcel lockers	–75% CO_2 emissions per parcel (APM model)	APM network model, AI-based location forecasting, Green City programme

Source: own elaboration based on data from [Amazon 2024, DHL 2024, InPost 2024] and internal analysis
Źródło: oprac. własne na podst. [Amazon 2024, DHL 2024, InPost 2024] i analiz wewnętrznych

Comparison of the environmental policies of the analyzed companies

As part of the assessment of Amazon, DHL, and InPost's involvement in the green transformation of logistics, a comparison of their environmental strategies was conducted across four key areas: climate goals, scope of ESG reporting, transparency of activities, and the integration of strategy with the management system.

Amazon has declared its intention to achieve climate neutrality by 2040, making it one of the first signatories of the Climate Pledge initiative. The company invests in electric delivery vehicles and the regionalization of logistics. However, despite its extensive operational initiatives, Amazon does not have climate targets approved by the Science Based Targets initiative (SBTi). It does not thoroughly report per recognized international standards such as the Global Reporting Initiative (GRI).

DHL is a leader in integrated environmental policy. As early as 2008, it adopted the "GoGreen" strategy and aims to achieve net-zero emissions by 2050. The company has SBTi-approved targets, conducts comprehensive ESG reporting (Global Reporting Initiative), and consistently implements actions such as in-house production of electric vehicles (StreetScooter) and low-emission logistics on a global scale.

Despite operating on a smaller scale, InPost has implemented a comprehensive "Green Vision 2040" strategy, aiming to achieve climate neutrality by 2040. The company demonstrates high transparency in ESG reporting (GRI, TCFD – Task Force on Climate-related Financial Disclosures, SBTi) and links environmental goals to its management's remuneration system. InPost's activities include solar-powered parcel lockers, eco-depots, and the "Green City" program.

Table 3. ESG commitments and climate strategies of selected courier companies
Tabela 3. Zobowiązania ESG i strategie klimatyczne wybranych firm kurierskich

Criterion	Amazon	DHL	InPost
Climate neutrality target	2040	2050	2040
ESG strategy	Yes – proprietary strategy	Yes – "GoGreen"	Yes – "Green Vision 2040"
SBTi-approved targets	No	Yes	Yes
ESG reporting	Partial, internal	Comprehensive (GRI, KPI, audits)	Comprehensive (GRI, TCFD, ESG)
Linkage of goals to incentive schemes	None	Partial	Yes

Source: own elaboration based on data from [Amazon 2024, DHL 2024, InPost 2024]
Źródło: oprac. własne na podst. [Amazon 2024, DHL 2024, InPost 2024]

The climate and environmental strategies of Amazon, DHL, and InPost differ notably, as illustrated in Table 2. Key aspects were taken into account, such as the declared year for achieving climate neutrality, the existence and nature of ESG strategies, approval of decarbonization targets by the SBTi initiative, the scope of ESG reporting, and the linkage of environmental objectives to incentive systems.

It was indicated that both Amazon and InPost plan to achieve climate neutrality by 2040, while DHL has adopted a timeline extending to 2050. Regarding formalized actions, only DHL and InPost have climate targets approved by SBTi. Despite its proprietary strategy, Amazon has not obtained such certification. The scope of ESG reporting varies significantly among the companies – Amazon limits itself to internal documentation, whereas DHL and InPost conduct complete reporting per international standards (GRI, TCFD, ESG). Among the companies studied, only InPost has linked the achievement of environmental objectives with its remuneration system, which may indicate a higher level of integration of ESG strategy with corporate governance.

Table 4. ESG reporting standards, verification and transparency of environmental goals
Tabela 4. Standardy sprawozdawczości ESG, weryfikacja i przejrzystość celów środowiskowych

Company	Reporting standards	External verification	Goal transparency
Amazon	No unified standard; own ESG report	No verification by SBTi	General declarations; limited measurability
DHL	GRI, SBTi, CDP, proprietary KPIs	Yes (SBTi, ISO standards, external audits)	Clearly defined and measurable goals
InPost	GRI, TCFD, SBTi	Yes (SBTi, ESG Ratings)	Clear climate KPIs, parcel-level LCA assessments

Source: own elaboration based on data from [Amazon 2024, DHL 2024, InPost 2024]
Źródło: oprac. własne na podst. [Amazon 2024, DHL 2024, InPost 2024]

Significant differences between the companies were identified. Amazon does not apply a unified reporting standard and is not subject to external verification, which results in the generality of its declarations and the limited measurability of its targets. In contrast, DHL and InPost implement internationally recognized reporting standards such as GRI, SBTi, and TCFD, and subject their reports to independent verification (including by SBTi, ISO, and ESG Ratings). Both companies are characterized by high transparency regarding their goals – DHL sets measurable and clearly defined targets. At the same time, InPost additionally employs specific climate performance indicators (KPIs) and product life cycle assessments for individual shipments.

Table 5. Carbon footprint per delivery and scale of fleet electrification in Amazon, DHL, and InPost
Tabela 5. Ślad węglowy na dostawę i skala elektryfikacji floty w Amazon, DHL i InPost

Company	CO_2 emissions per parcel	Number of electric vehicles
Amazon	80.8 g CO_2	19,000+
DHL	~120 g CO_2e (estimated)	20,000+
InPost	<50 g CO_2e (APM delivery)	1,300+

Source: own elaboration based on data from [Amazon 2024, DHL 2024, InPost 2024]
Źródło: oprac. własne na podst. [Amazon 2024, DHL 2024, InPost 2024]

Table 4 compares CO_2 emissions per parcel and the number of EVs operated by Amazon, DHL, and InPost. The data allow for assessing the decarbonization of logistics operations at the unit level and the scale of low-emission fleet deployment.

The lowest carbon footprint per delivery was recorded by InPost – below 50 g CO_2 per parcel in a model based on parcel lockers, representing up to 38% lower emissions than Amazon and over 58% less than the estimated values for DHL. These figures suggest that despite comparable investments in fleet electrification, DHL's operational model may be less efficient in reducing per-parcel emissions than InPost's consolidated locker-based delivery system. This indicates that environmental efficiency per delivery unit depends on the number of low-emission vehicles, the adopted operational model, and the degree of last-mile optimization.

In the face of increasingly stringent climate regulations, the logistics sector faces the challenge of reducing greenhouse gas emissions. Analyzing pro-environmental initiatives by three major players – Amazon, DHL, and InPost – allows for identifying diverse strategies for implementing low-emission solutions and the prospects for their further development.

As a global leader in parcel volume, Amazon focuses on electrifying its delivery fleet. In the coming years, an expansion of electric vehicles into markets beyond the United States is expected, along with the continued deployment of advanced drone and robot technologies to reduce CO_2 emissions in last-mile deliveries. Furthermore, developing artificial intelligence algorithms will enable more precise route optimization, regionalization of the logistics network, and packaging management that minimizes volume and material usage. Another important development area may be the construction of zero-emission logistics centers powered by renewable energy. In the context of its environmental policy and the goal of achieving climate neutrality by 2040, the company will need to address deficiencies in formalizing its environmental efforts. Key future priorities include obtaining SBTi approval for climate targets and developing a transparent ESG reporting system.

As a globally established logistics operator, DHL is developing a decarbonization strategy based on diversifying transport technologies. The company's future development may focus on deploying hydrogen-powered heavy vehicles, which can significantly reduce emissions in long-haul transport. The further expansion of zero-emission zones through the development of cargo bike fleets and electric vehicles is another anticipated direction. The company is expected to invest in its own renewable energy sources (RES) to power distribution centers and the operational fleet in the infrastructure domain. In addition, digital tools that enable tracking and analysis of the carbon footprint at the level of individual shipments will play a significant role. The next stage will involve the creation of circular logistics models, where resources such as packaging are reused within a closed-loop system. DHL's environmental policy sets the goal of achieving climate neutrality by 2050. The company has a well-established reporting structure and approved climate targets, which provide a solid foundation for further development. It is expected that low-emission solutions will be scaled globally, ESG management will become increasingly automated, and new initiatives will be implemented in line with EU taxonomy requirements.

InPost demonstrates considerable potential for further CO_2 emission reductions per parcel by scaling its APM model to additional European markets. Key areas of development include further electrification of the urban fleet and increased use of cargo bikes for deliveries, particularly in densely populated urban areas. The company may also integrate with municipal sustainable development strategies (e.g., the Green City Program), using data and artificial intelligence to optimally deploy vehicle fleets, charging points, and other infrastructure elements, reducing its carbon footprint and lowering operational costs. InPost has the broadest scope of ESG activities among the companies analyzed and a target of achieving climate neutrality by 2040, positioning it advantageously for continued growth.

Discussion

The research presented in this study on the green transformation of logistics in courier companies – Amazon, DHL, and InPost – fits into the broader trend of contemporary analyses on sustainable development and transport decarbonization, providing a significant contribution to the empirical understanding of the effectiveness of technological innovations in reducing CO_2 emissions. Unlike many previous declarative studies [Dzwigol, Trushkina, Kwilinski 2021; Silva et al. 2023; Warsewicz 2025], this research focuses on a comparative analysis of actual reporting data from 2023–2024, enabling the identification of relationships between operational scale and the effectiveness of low-emission technology implementation. The use of benchmarking based on per-parcel emission indicators (CO_2e/parcel) and the share of electric vehicles in fleets made it possible not only to determine differences between the analyzed operators but also to verify the practical outcomes of transformation at the unit level.

The results confirm that company size alone does not determine the effectiveness of decarbonization—what matters most is the consistency of the technological-organizational strategy and the degree of integration between ESG reporting systems and operational management. In this context, the findings align with those of Haftor and Costa Climent [2021], who demonstrated that innovations in transport yield measurable environmental effects only when fully integrated with service-oriented models and digital management processes. Similarly, the research by Kolasińska-Morawska et al. [2022] confirms that sustainable last-mile logistics development requires synergy between technology, organization, and ecological awareness among both enterprises and consumers—an approach reflected in InPost's model based on automated parcel lockers.

The results concerning varying levels of corporate engagement in formalizing ESG policies and validating climate goals under the SBTi initiative indicate that environmental maturity is not always proportional to global scale. Amazon, despite its vast delivery volume and major investments in electric vehicles, demonstrates a relatively low level of reporting transparency, whereas InPost, as a regional operator, maintains a high level of compliance with international standards (GRI, TCFD, ESG). Similar observations were made by Nagy and Szentesi [2024], who emphasized that the effectiveness of ecological transformation depends more on internal management culture and pro-environmental leadership than on an organization's financial potential.

An important element of the discussion is also the confirmation of the findings of Larina et al. [2021], indicating that transport accounts for approximately one-quarter of global CO_2 emissions and constitutes a key area of climate action. The analyzed study confirms that the courier sector, as one of the most energy-intensive segments of urban logistics, requires the implementation of multidimensional strategies that combine fleet electrification, process automation, and the use of renewable energy sources. The examples analyzed demonstrate that only the parallel realization of these three components leads to real emission reductions, which aligns with the conclusions of Bányai [2024] regarding vertical and horizontal integration of logistics processes in the spirit of Industry 4.0.

The comparative approach adopted in this study, combining both quantitative data (emission indicators, EV share) and qualitative information (ESG reporting standards, the linking of environmental goals with incentive systems), made it possible to comprehensively characterize different decarbonization models within the courier sector. In particular, it was shown that InPost's consolidation-based model ("one location – multiple parcels") generates up to 75% lower unit emissions than the traditional door-to-door model (DHL), confirming the effectiveness of infrastructure solutions based on parcel locker networks. These results correspond with the findings of Guzowski et al. [2024] and Mohammad et al. [2023], who argue that automation and local delivery aggregation are among the most effective ways to reduce emissions in the final stage of the supply chain.

The discussion also leads to the conclusion that the effectiveness of the green transformation of logistics cannot be considered solely in terms of technology implementation, but rather as a systemic reorganization of the entire logistics chain. This conclusion is supported by the findings of Haftor and Costa Climent [2021] and Liu et al. [2024], who assert that real carbon footprint reduction results from the synergy between digitization, organizational innovation, and infrastructural adaptation. The research presented in this paper perfectly aligns with this perspective – showing that operators such as DHL and InPost combine technological transformation with management process reorganization, reporting transparency, and the integration of ESG strategies with corporate decision-making.

In summary, this study not only confirms the findings of earlier international research but also expands them with an empirical and comparative dimension that is particularly relevant for the European courier sector. It constitutes a significant contribution to the discussion on the effectiveness of decarbonization tools and provides concrete evidence that the green transformation of logistics requires the simultaneous integration of technology, environmental policy, and organizational culture – factors that determine its durability and real impact on reducing emissions in both urban and global transport systems.

Conclusions

The conducted study confirms that the green transformation of logistics depends not solely on the scale of operations, but on the degree of integration between technology, organization, and environmental strategy. The comparative analysis of Amazon, DHL, and InPost clearly demonstrates that courier companies combining the electrification

of fleets with digitalized and automated logistics networks achieve the highest levels of emission reduction per parcel.

The research objective – to determine how technological and organizational innovations support the reduction of greenhouse gas emissions in last-mile logistics – has been fully achieved. The analysis indicates that emission efficiency is a function of three interdependent components:

1. Technological innovation – the adoption of electric and hybrid vehicles, hydrogen prototypes, and intelligent fleet management systems based on AI and IoT.
2. Digital transformation – the use of predictive data analytics, real-time optimization, and automation of logistics processes (e.g., parcel lockers, robotic sorting centers).
3. Organizational alignment – embedding sustainability objectives into corporate governance, incentive systems, and ESG reporting structures verified by international standards (GRI, SBTi, TCFD).

From a technological standpoint, the study highlights that automation, artificial intelligence, and renewable energy integration are the key enablers of decarbonized logistics. The synergy between these tools allows for real-time monitoring of the carbon footprint, intelligent allocation of vehicles, and predictive route optimization that collectively reduce total CO_2e emissions. The analysis confirms that InPost's network-based delivery model exemplifies the most energy-efficient and scalable pathway for sustainable logistics, while DHL's global system illustrates how advanced ESG governance supports technological expansion across diverse markets.

In conclusion, green transformation in logistics should be understood as a systemic process that integrates technological advancement, infrastructure adaptation, and digital innovation. The study provides a practical framework for logistics operators and policymakers, supporting the design of decarbonization strategies aligned with EU climate targets. Future research should focus on measuring life-cycle emissions across logistics networks and evaluating the potential of next-generation technologies – including hydrogen mobility, autonomous last-mile systems, and blockchain-based ESG monitoring – to achieve full climate neutrality in the courier sector by mid-century.

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The application of information systems in passenger-car operation management: an analysis of the performance of start-stop and cruise control

Zastosowanie systemów informatycznych w kontekście zarządzania eksploatacją pojazdów osobowych na przykładzie analizy działania systemu start-stop i tempomatu

Abstract. The article addresses the issue of applying modern information systems in the automotive industry. The aim of the research was to determine the effectiveness of two driver-assistance systems – start-stop and cruise control – in the context of average fuel consumption. The study was conducted under real conditions on three passenger cars of different brands and production years. The analysis covered driving in urban and extra-urban traffic, with measurements of fuel consumption taken both with and without the use of the examined systems. The results indicate that the application of the start-stop system in urban traffic contributes to fuel consumption reduction, while the use of cruise control in extra-urban traffic supports fuel savings in selected vehicles. The obtained results confirm the validity of implementing modern information solutions in the automotive sector, both from an economic and environmental perspective. The article fits into the research trend concerning the use of information technologies in managing the quality of logistics processes related to vehicle operation and in improving driver-assistance systems.

Keywords: information systems, automotive industry, start-stop, cruise control, fuel consumption, management, logistics, vehicle operation

Synopsis. Artykuł podejmuje problematykę zastosowania nowoczesnych systemów informatycznych w branży motoryzacyjnej. Celem badań było określenie efektywności działania dwóch systemów wspomagających kierowcę – start-stop oraz tempomatu – w kontekście średniego zużycia paliwa. Badania przeprowadzono w warunkach rzeczywistych w odniesieniu do trzech samochodów osobowych różnych marek i roczników. Analizie poddano przejazdy w ruchu miejskim oraz poza-

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miejskim, dokonując pomiarów zużycia paliwa przy wykorzystaniu i bez wykorzystania badanych systemów. Wyniki wskazują, że zastosowanie systemu start-stop w ruchu miejskim przyczynia się do obniżenia spalania, natomiast użycie tempomatu w ruchu pozamiejskim sprzyja redukcji zużycia paliwa w wybranych pojazdach. Uzyskane rezultaty potwierdzają zasadność implementacji nowoczesnych rozwiązań informatycznych w motoryzacji, zarówno z perspektywy ekonomicznej, jak i środowiskowej. Artykuł wpisuje się w nurt badań nad wykorzystaniem technologii informatycznych w zarządzaniu jakością procesów logistycznych związanych z eksploatacją pojazdów oraz doskonaleniem systemów wspomagających kierowcę.

Słowa kluczowe: systemy informatyczne, branża motoryzacyjna, start-stop, tempomat, zużycie paliwa, zarządzanie, logistyka, eksploatacja pojazdów

JEL codes: L91, R49

Introduction

The dynamic development of information technologies in recent decades has substantially reshaped the operations of contemporary enterprises and fostered new management models. The automotive industry – one of the most innovative sectors of the economy – has been a particularly intensive field of implementation for modern ICT solutions. Digitalization spans both the organizational layer – manifested in ERP, CRM, and decision-support systems – and the technical layer, linked to the advancement of onboard mechatronic and electronic systems that support the driver [Seppänen 2025].

The literature emphasizes the dual nature of this digitalization. First, it concerns the optimization of intra-organizational logistics processes, such as production planning, logistics, and quality management. Second, it pertains to the integration of advanced in-vehicle systems whose role is to enhance safety, comfort, and fuel economy. The growing prominence of onboard systems is aligned with the Industry 4.0 paradigm and the transition of automotive transport toward sustainable mobility, in which data and process management play a pivotal role [Albrecht et al. 2024].

In this context, advanced driver-assistance systems (ADAS) are of particular importance. They not only raise the level of active safety but also affect vehicle operation and user experience. Among these solutions are the automatic engine start-stop system, which shuts down and restarts the engine during brief halts, and cruise control, which maintains a target vehicle speed under extra-urban driving conditions. Both systems are widely implemented in passenger cars and exemplify the practical application of information technologies in the automotive domain, with direct implications for the management of in-service vehicle operations [Tortorelli 2025].

From the standpoint of management and logistics sciences, investigating the effectiveness of such solutions is highly consequential. Verifying the actual impact of start-stop systems and cruise control on fuel consumption enables an assessment not only of their economic effects but also of their environmental consequences and their influence on the quality of operational processes – thereby informing decision-making in fleet management and the advancement of vehicle technologies.

The aim of this article is to examine the influence of the start-stop system and cruise control on average fuel consumption in selected passenger cars of various makes and model years. The empirical study was preliminary in nature and focused on differences between urban and extra-urban driving conditions. The contribution situates itself within the stream of research on the use of information systems in managing logistics processes associated with vehicle operation and on the refinement of driver-support technologies in automotive practice [Gao 2024].

The development of information systems in enterprise management, including in the automotive industry, constitutes one of the key areas of the contemporary economy and is a cornerstone of the Industry 4.0 concept [Dabic-Miletic 2023]. These systems have been framed in the literature in various ways, including as "management support systems" and "information systems for management". Their overarching goal is to acquire, store, and process information in such a way that it can serve as a basis for effective managerial decision-making. As emphasized by Bielecki, Chmielarz, as well as Kapczyński and Smugowski, information systems should be treated as an integral part of the organization, determining the quality of its functioning [Bielecki 2001; Chmielarz 2000; Kapczyński i Smugowski 2010, p. 28]. Klonowski indicates that the role of information systems in management stems from their ability to combine data from different areas of activity and transform them into knowledge necessary for decision-making [Klonowski 2004].

Today, the most advanced form of enterprise digitalization remains integrated systems, which encompass many functional modules and provide comprehensive support for management processes.

ERP and ERP II systems occupy an important place in the literature. Parys [2006] emphasizes that their purpose is the full integration of financial data, human resources, and production processes, which allows not only for the optimization of a company's internal processes but also for better integration with its economic environment. Majerski [2012] indicates that ERP systems constitute a key tool for managing logistics and production, enabling the planning, monitoring, and control of process flows.

The implementation of ERP systems brings measurable benefits in cost reduction, improvement of data quality, and increased organizational flexibility. Auksztol and co-authors emphasize that ERP systems, exemplified by SAP, enable better management of relationships with customers and suppliers and increase the transparency of processes [Auksztol, Balwierz, Chomuszko 2012]. The literature indicates that these systems contribute to improving customer service quality by better aligning operational activities with market expectations.

In the context of Industry 4.0, Gunia notes that contemporary information systems should ensure interoperability and rapid response within supply networks, which is particularly important in the automotive industry [Gunia 2019]. Also relevant in this area are industry certifications such as VDA and ITA, as well as early-warning systems implemented in ERP-class solutions, which support proactive risk and quality management [Prudhomme et al. 2022].

Examples of systems dedicated to the automotive sector, such as Rekord.ERP and MONITOR ERP, show that integrated solutions enable effective production planning, synchronization of purchasing, warehouse management, time reporting, and full

integration of financial and sales processes [Zalewski 2011; Calamaras 2022]. This directly translates into shorter production cycles, minimized downtime, and improved quality stability.

The most important advantages of the Rekord.ERP system are presented graphically in Figure 1.

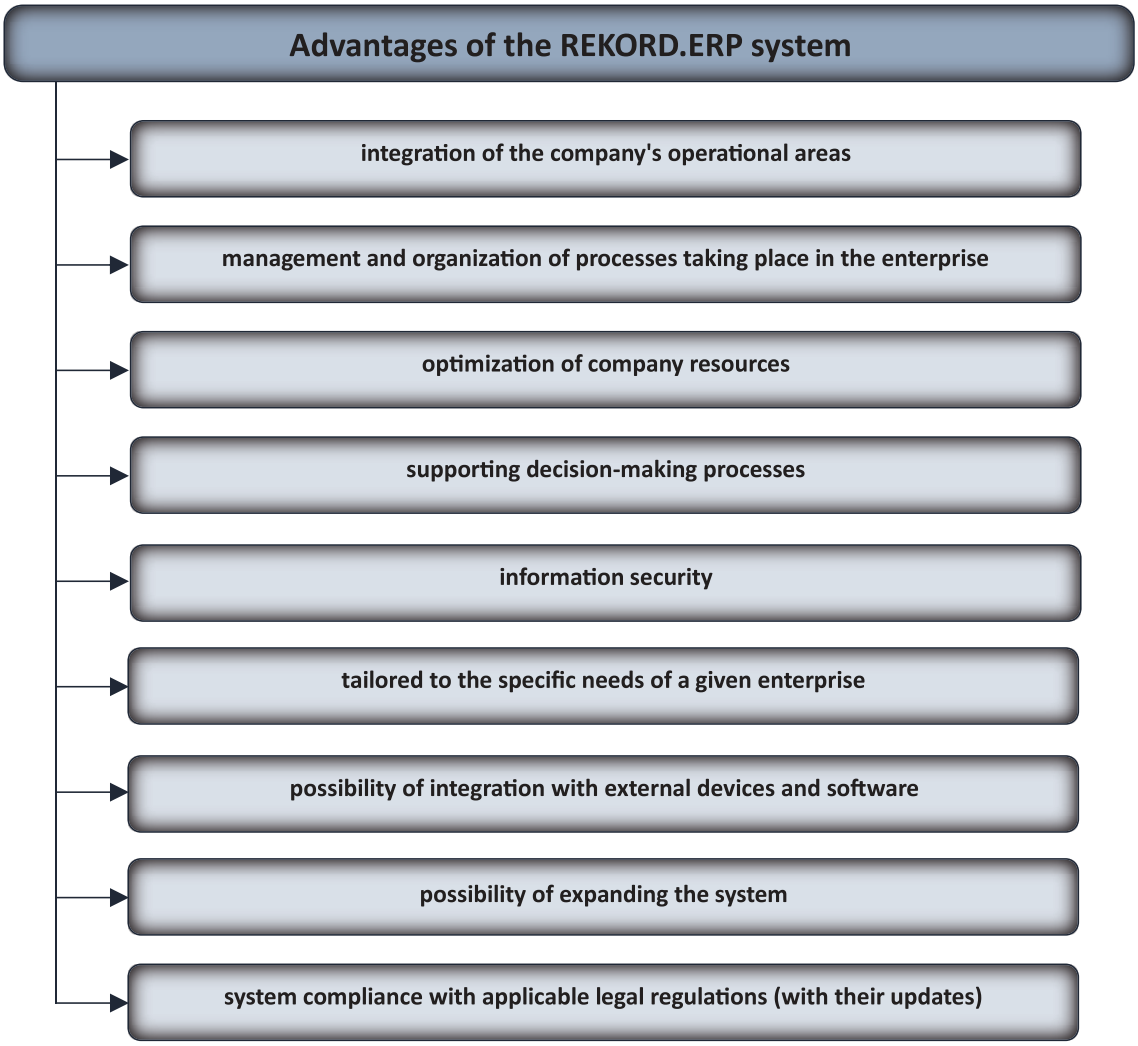

Figure 1. Advantages of the REKORD.ERP system
Rysunek 1. Zalety systemu REKORD.ERP
Source: compilation based on [Wornalkiewicz 2015]
Źródło: oprac. na podst. [Wornalkiewicz 2015]

A parallel strand of research focuses on driver assistance systems (ADAS), which directly affect both active and passive vehicle safety. Herner and Riehl discuss automotive electrical and electronic systems as the foundation for the operation of modern mechatronic solutions [Herner, Riehl 2014]. In turn, Michalski, Gonera, and Janulin indicate methods for assessing the impact of safety systems on vehicle operation and user experience [Michalski, Gonera, Janulin 2012].

Within this domain, systems such as start-stop and cruise control are of particular importance. The start-stop system automatically shuts down and restarts the engine depending on driving conditions, which helps reduce fuel consumption and carbon dioxide emissions, while simultaneously raising questions about the durability of serviceable components and maintenance costs [Wójcik 2019].

The literature also emphasizes the usefulness of microscopic traffic simulations as a tool for supporting transport management and reducing pollutant emissions in medium-sized cities. Brzozowska et al. present a methodology for emission analysis on main arteries using the SUMO platform and a progressive elaboration approach, which allows iterative refinement of the study scope and model parameters under resource constraints. The authors show that testing variants of traffic organization (including signal phase lengths, turning lanes, and "green wave" coordination) prior to implementation makes it possible to achieve smoother flow, shorter travel times, and measurable reductions in emissions (CO, CO_2, NO_x, PM), while simultaneously providing evidence for decision-makers regarding infrastructure modernization and the deployment of ITS as an element of sustainable mobility management [Brzozowska et al. 2021].

In this area, research on telematics and information systems that support continuous improvement processes is also important. Telematics systems implemented in transport enterprises enable not only improved service quality but also more effective fleet management and operational decision-making [Mazurkiewicz 2021; Miler et al. 2020; El Emary 2019; Brzozowska 2019].

Studies on vehicle operation increasingly employ an indicator-based approach that enables the assessment of fleet performance and the safety of transport task execution. As Owczarek emphasizes, an analysis of the operation of 24 delivery vehicles in seven transport companies revealed significant variation in fleet management strategies, and the proposed set of indicators (including working-time utilization, intensity of use, technical readiness, and economic efficiency) can serve as an effective tool to support decision-making in vehicle operation [Owczarek 2024]. The application of such indicators allows transport processes to be monitored, areas requiring improvement to be identified, and strategies to be developed that are oriented toward rational fleet management and enhanced service quality.

The literature increasingly underscores the role of computer simulations as tools that support decision-making in logistics and vehicle operation management. Simulations make it possible to model real transport operations, evaluate alternative scenarios, and forecast long-term impacts on costs and the environment. They are used, among other things, for route planning, fleet management, warehouse optimization, and assessing the impact of vehicle operation on emissions. Thanks to such solutions, enterprises can test new technologies and processes without incurring the costs of real-world implementation, which supports both economic efficiency and the achievement of sustainable development goals [Ługiewicz, Wierzbicki 2025].

The body of literature demonstrates that the development of information systems, ranging from ERP-class solutions to onboard ADAS, creates a coherent data ecosystem that strengthens enterprises' capacity for quality management, process optimization, and building competitive advantage. Nevertheless, questions remain open regarding the actual impact of selected driver-assistance systems on the economics of vehicle operation and the qualitative aspects of their use.

Research questions

1. To what extent does the application of the start-stop system affect average fuel consumption under urban traffic conditions?
2. Does the use of cruise control under extra-urban driving conditions allow for a significant reduction in fuel consumption?
3. What differences in the effectiveness of start-stop and cruise control systems can be observed in vehicles of different makes and model years?

Materials and methods

The purpose of the conducted research was to determine the impact of selected modern information systems used in passenger cars – the start-stop system and cruise control – on average fuel consumption under diverse traffic conditions. The study was empirical in nature and focused on analyzing the effectiveness of these systems in real operating conditions, taking into account both urban and extra-urban traffic.

In formulating the research assumptions, a main hypothesis was adopted according to which the use of driver-support information systems contributes to reducing fuel consumption, and thus to improving the economics and ecology of vehicle operation. Within the study, specific hypotheses were also advanced.

The first assumed that the use of cruise control under extra-urban driving conditions leads to a decrease in average fuel consumption. The second hypothesis concerned the impact of the start-stop system and assumed that its operation in urban traffic, characterized by frequent stops, results in a reduction of average fuel consumption. The third hypothesis related to differences between particular vehicle brands, indicating that the effectiveness of the systems under investigation may vary depending on the design solutions employed.

The objects of the study were three passenger cars of different makes and model years, purposively selected due to their varied levels of technical advancement and equipment. The sample included: an Audi A4 from 2014, a BMW X4 from 2017, and a Skoda Octavia II from 2012. Each vehicle was equipped with a set of safety and driver-assistance systems, yet differed in terms of the implementation of the solutions under study. This made it possible to carry out a comparison under controlled conditions while simultaneously reflecting real road situations (Figure 2).

The research experiment was conducted in two traffic environments. Extra-urban conditions were reproduced on the Częstochowa–Ładzice route with a length of 41.6 km, whereas urban conditions were modeled on the section of Jana Pawła II Street and Aleja Wyzwolenia in Częstochowa, characterized by the presence of numerous traffic lights. In each variant, average fuel consumption was measured both with the examined system switched on and with it switched off. Measurements were taken using onboard computers that enabled real-time monitoring of fuel consumption values. Each run was repeated twice in order to limit the influence of random factors and increase the reliability of the data obtained.

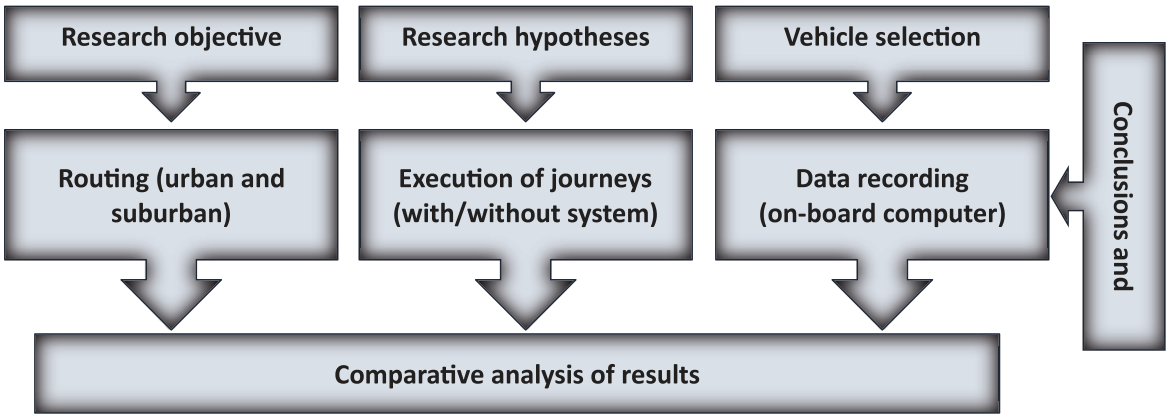

Figure 2. Schematic diagram of the research methodology for the start-stop and cruise control systems

Rysunek 2. Schemat metodyki badań nad systemami start-stop i tempomat

Source: own study

Źródło: badania własne

In the research process, an experimental method was applied, the essence of which was to compare results obtained under controlled conditions differing only in the use of the given system. To maintain result consistency, the driver participating in the study also recorded additional circumstances that could affect the measurements, such as traffic intensity and weather conditions. The collected data were subjected to comparative analysis, relating mean values to catalog data provided by manufacturers.

The results were compiled in tabular form, which made it possible to juxtapose differences between fuel consumption with the systems engaged and the values achieved in their absence. The analysis also made it possible to determine the extent to which the examined solutions contribute to improving the efficiency of vehicle use. It should be emphasized that the research was preliminary in nature and was limited to a small number of vehicles, which constitutes a certain limitation on the generalizability of the findings. Nevertheless, the results provide important empirical material that allows conclusions to be drawn regarding the potential benefits arising from the implementation of start-stop and cruise control systems in passenger cars. Given the preliminary nature of the study, a simplified measurement model was adopted, focused on analyzing differences in fuel consumption when using the start-stop and cruise control systems.

Research results

The conducted research aimed to verify the adopted hypotheses regarding the impact of the start-stop system and cruise control on fuel consumption in selected passenger cars. Three vehicles of different makes and model years were analyzed: an Audi A4 (2014), a BMW X4 (2017), and a Skoda Octavia II (2012), and their equipment, including modern systems, together with the year of manufacture, is presented in Table 2. These vehicles differed in their level of technological advancement, which made it possible to capture potential divergences in the effectiveness of the systems under study.

The research was carried out in two operational environments. The first was the extra-urban route Częstochowa–Ładzice (Table 1) with a length of 41.6 km (Figure 3), while the second was the section of Jana Pawła II Street and Aleja Wyzwolenia in Częstochowa (Figure 4), characterized by numerous traffic lights and frequent vehicle stops. Each run was performed twice: with the examined system engaged

Table 1. Average fuel consumption on the Częstochowa–Ładzice route
Tabela 1. Średnia zużycia paliwa na trasie Częstochowa–Ładzice

Brand and model	Manufacturer-rated average fuel consumption [l/100 km]	Average fuel consumption without cruise control [l/100 km]	Average fuel consumption with cruise control [l/100 km]
Audi A4	6.2	7.0	6.5
BMW X4	7.4	8.5	7.6
Skoda Octavia II	6.5	6.7	6.8

Source: compilation based on the author's own research
Źródło: oprac. własne autora

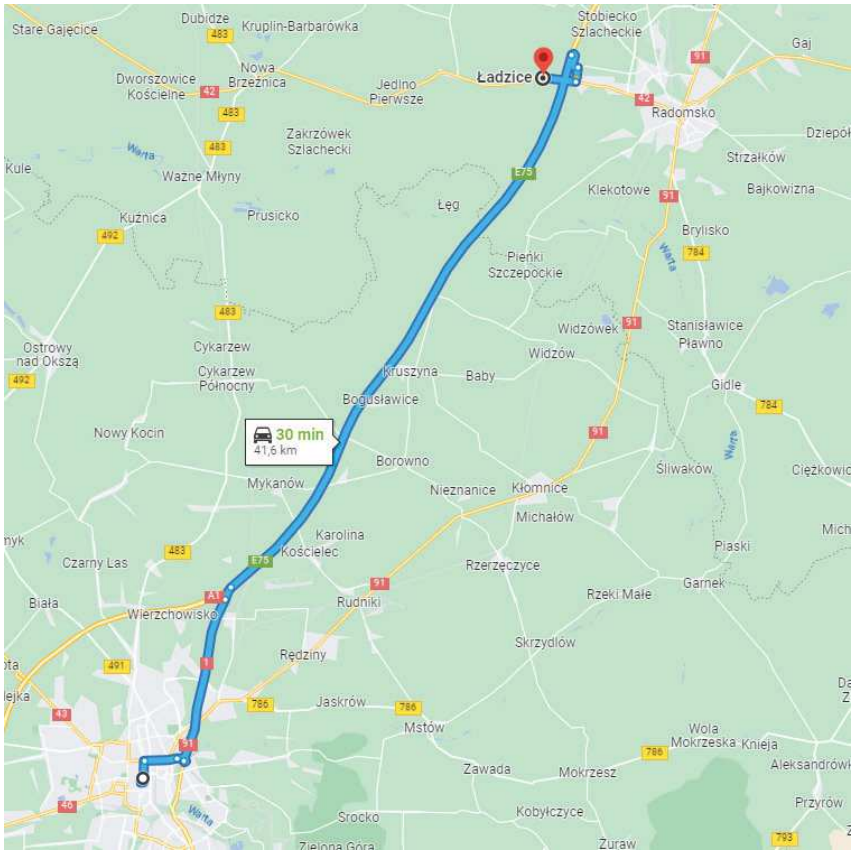

Figure 3. Map showing the Częstochowa–Ładzice route
Rysunek 3. Mapa z wyznaczoną trasą Częstochowa–Ładzice
Source: Google Maps [accessed: 24.08.2025]
Źródło: Mapy Google [dostęp: 24.08.2025]

(start-stop or cruise control) and without its use, which made it possible to compare reference values. Measurements were taken using onboard computers that recorded average fuel consumption. Under urban driving conditions, the start-stop system proved most effective in the BMW X4 (2017), where a decrease in average fuel consumption of about 0.4 l/100 km was recorded compared to the run without the system. In the Audi A4 (2014), the difference was slightly smaller and amounted to 0.2 l/100 km, whereas in the Skoda Octavia II (2012), the effect of the system was least noticeable, which may result from a lower level of advancement of the applied solutions. The average fuel consumption for this section with the start-stop system applied is presented in Table 2. These results confirm the hypothesis that the start-stop system, particularly under urban conditions, contributes to reducing fuel consumption, although the magnitude of this effect depends on the vehicle's design.

Under extra-urban driving conditions, the impact of cruise control operation was analyzed. In the case of the BMW X4, the use of the system made it possible to maintain a constant speed and resulted in a reduction in fuel consumption by 0.3 l/100 km.

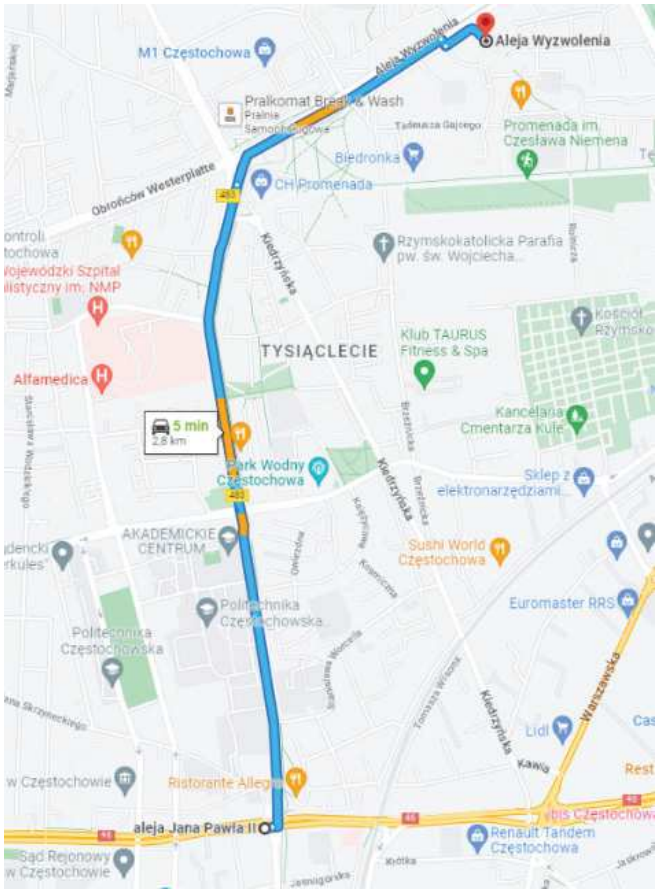

Figure 4. Map with the designated route in the city of Częstochowa within the area of Jana Pawła II Street and Aleja Wyzwolenia

Rysunek 4. Mapa z wyznaczoną trasą na terenie Częstochowy w obrębie ulic Jana Pawła II i Alei Wyzwolenia

Source: Google Maps [accessed: 24.08.2025]

Źródło: Mapy Google [dostęp: 24.08.2025]

Table 2. Average fuel consumption on the Częstochowa–Ładzice route
Tabela 2. Średnie zużycie paliwa na trasie Częstochowa–Ładzice

Brand and model	Manufacturer--rated average fuel consumption [l/100 km]	Average fuel consumption in urban conditions without the start-stop system [l/100 km]	Average fuel consumption in urban conditions with the start--stop system [l/100 km]
Audi A4	6.2	8.5	8.2
BMW X4	7.4	8.8	8.6
Skoda Octavia II	6.5	7.0	6.8

Source: compilation based on the author's own research

Źródło: oprac. własne autora

The Audi A4 recorded a reduction of 0.2 l/100 km, whereas the Skoda Octavia did not exhibit significant differences, which may result from design constraints and the absence of advanced algorithms governing system operation. The results indicate that cruise control supports driving economy, particularly in newer-generation vehicles; however, its effectiveness is not uniform across all makes and models.

Discussion

The comparative analysis confirmed that both the start-stop system and cruise control can have a real impact on reducing fuel consumption, and thus on the economics of vehicle operation. The effects of both systems, however, are differentiated and on both traffic conditions and the design specifics of the vehicle under study. The research also showed that actual savings are lower than the values declared by manufacturers, which indicates the need for further empirical work under real-world operating conditions.

From the perspective of management and logistics, the results confirm the importance of implementing information systems not only for driving safety and comfort, but also for optimizing operating costs. These findings may form the basis for decision-making in fleet management and for enhancing solutions aimed at improving energy efficiency and reducing emissions.

The research results obtained confirm the thesis that modern information systems used in passenger cars can perceptibly affect the economics of operation. The start-stop proved particularly effective under urban driving conditions, which is consistent with literature data indicating the potential to reduce fuel consumption and CO_2 emissions by shutting off the engine during stops. At the same time, it should be noted that the scale of savings in real conditions was smaller than that declared by manufacturers, which is confirmed by earlier observations of researchers analyzing mechatronic systems in the automotive domain [Caban et al. 2017].

Cruise control, whose task is to maintain a constant speed, showed the highest effectiveness under extra-urban driving conditions. The results of the present study indicate a reduction in fuel consumption on the order of 0.2–0.3 l/100 km, which corroborates

the views of authors analyzing the impact of cruise control on driving economy [Sobczak et al. 2017]. It is worth emphasizing, however, that in older-generation vehicles this system did not yield significant savings, which demonstrates that its effectiveness depends on the vehicle's design and on the algorithms that govern its operation.

An important conclusion arising from the research is that the impact of the systems under study on fuel consumption varies depending on the vehicle's make and model year. These results are consistent with the literature, according to which modern information systems must be analyzed in the context of interoperability and the degree of integration with other electronic subsystems of the vehicle [Gunia 2019]. In practice, this means that potential savings depend not only on the mere application of the system but also on the quality of managing its implementation across vehicles of different classes.

Verification of the actual impact of start-stop and cruise control systems on fuel consumption provides information not only on potential economic benefits for individual users, but also on opportunities to optimize costs in fleet management. Reduced fuel burn directly translates into lower operating costs, improved energy efficiency, and progress toward sustainable development strategies.

The results obtained fit within the broader context of the energy-climate transition, in which the transport sector plays a key role. As Gołąbeska and Harasimowicz [2023] emphasize, implementing sustainable development policies and the assumptions of the European Green Deal requires not only moving away from conventional energy sources, but also consistently reducing emissions in the mobility domain. Technical and organizational solutions that enable the rational use of energy and the reduction of CO_2 emissions are of particular importance here, aligning with broader low-emission economic strategies. The findings of this study show that even seemingly minor innovations, such as the start-stop system or cruise control, can contribute to achieving the objectives of the European Green Deal while simultaneously supporting fleet management in the spirit of sustainable development [Jeżowski 2017, pp. 69–83].

Information systems in the automotive sector can constitute an important component of quality management for operational processes. They confirm the potential of technology to improve the economics of driving, while at the same time drawing attention to the need for further empirical studies that include a larger number of vehicles and a broader spectrum of road conditions.

It is worth emphasizing that the significance of information systems in the automotive industry should also be analyzed in the context of Industry 4.0. This concept is based on technologies such as the Internet of Things, big data, digital twins, cyber-physical systems, and artificial intelligence, which enable full integration of production and operational processes. In practice, this entails a shift from simple driver-support solutions to comprehensive systems for managing logistics and operational processes at the scale of the entire enterprise. In line with the Business Process Management (BPM) approach, digital technologies become tools for identifying, modeling, and improving processes, which makes it possible not only to enhance the efficiency of an individual vehicle's driving, but also to optimize costs, emissions, and service quality at the fleet scale [Dostatni, Rojek 2024].

Summary and conclusions

The conducted study made it possible to verify the adopted hypotheses concerning the impact of the start-stop system and cruise control on average fuel consumption in passenger cars. The analysis of the results showed that the start-stop system, particularly under urban driving conditions, contributes to a reduction in fuel consumption, whereas cruise control proved most effective during extra-urban driving. However, the magnitude of the savings obtained varied depending on the vehicle's make and model year, which indicates the important role of technical design and the quality of system implementation.

From the perspective of fleet management in enterprises, these observations translate into three practical implications: (1) where urban driving predominates, vehicles with efficient start-stop systems (or hybrids) should be a purchasing priority, (2) on extra-urban and motorway routes, benefits are provided by a constant-speed strategy supported by eco-driving training and policies limiting unnecessary acceleration/braking, (3) fleet decisions should be made on the basis of real operating data (OBD loggers/telemetry), as these best reflect the effects of technology for a given vehicle-use profile. Incorporating these principles into a quality management system for transport processes makes it possible to sustainably reduce costs and emissions while simultaneously increasing operational predictability [Merkisz 2010, pp. 115–127].

The research results confirm the importance of modern information systems as tools supporting the process of optimizing operations. The data obtained can be used in the process of fleet management, where reduced fuel consumption directly translates into lower operating costs and increased energy efficiency. They also have an environmental dimension, supporting the implementation of sustainable development strategies and corporate social responsibility.

The conclusions drawn from the study allow several practical implications to be formulated. First, the implementation of start-stop and cruise control should be treated as an element of a broader process of managing the quality of vehicle operation, in which not only costs are analyzed, but also user comfort and environmental impact. Second, fleet managers should take into account the differentiated effectiveness of the systems studied depending on the vehicle's make and model year, adjusting investment policy and purchasing strategy to actual utility effects. Third, vehicle manufacturers should undertake actions aimed at improving the algorithms governing system operation so that their effectiveness is as high as possible under different road conditions.

In summary, the study confirms that the application of modern information systems in the automotive sector has not only a technological dimension but also a managerial one. These systems fit into processes of quality management, cost reduction, and building competitive advantage in the automotive industry. The conducted research is preliminary in nature and covers a limited sample of vehicles. Therefore, the results should be regarded as a starting point for further analyses involving a larger number of cars representing different brands, classes, and operating conditions. Future studies should also extend the scope of analysis to include environmental aspects in order to obtain a comprehensive picture of the effectiveness of driver assistance systems.

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Wykorzystywanie modelu Customer Relationship Management (CRM) w zarządzaniu przedsiębiorstwami

Using the Customer Relationship Management (CRM) model in business management

Synopsis. Artykuł poświęcony jest analizie roli systemu Customer Relationship Management (CRM) w zarządzaniu przedsiębiorstwami, ze szczególnym uwzględnieniem małych i średnich podmiotów gospodarczych. Celem badań było rozpoznanie korzyści oraz ograniczeń wynikających z zastosowania systemu CRM, a także określenie etapów jego efektywnego wdrażania. W opracowaniu zastosowano analizę literatury przedmiotu, wyniki badań firmy Act! przeprowadzonych w maju 2022 roku na grupie 1146 właścicieli MŚP oraz metodę case study, obejmującą przykłady wdrożeń systemu CRM w takich firmach jak Amazon, Porsche i L'Oréal. Wyniki badań wskazują, że CRM znacząco wpływa na poprawę relacji z klientami, wzrost ich satysfakcji i lojalności, a także na zwiększenie efektywności działań sprzedażowych i marketingowych oraz lepszą komunikację wewnętrzną. W małych i średnich przedsiębiorstwach wdrożenie systemu CRM przyczyniło się m.in. do wzrostu produktywności sprzedaży (42% wskazań) i poprawy obsługi klienta (35%). Podstawowe bariery wdrażania tego systemu związane są z kosztami, integracją i koniecznością dostosowania procesów. Wnioski z przeprowadzonych analiz potwierdzają, że CRM stanowi nie tylko narzędzie informatyczne, lecz przede wszystkim filozofię biznesową, która, jeśli zostanie odpowiednio wdrożona, pozwala zwiększyć przewagę konkurencyjną przedsiębiorstwa i osiągnąć długoterminowy sukces.

Słowa kluczowe: CRM, zarządzanie relacjami z klientami, lojalność klientów, małe i średnie przedsiębiorstwa, wdrażanie systemów informatycznych

Abstract. This article analyzes the role of Customer Relationship Management (CRM) in enterprise management, with particular emphasis on small and medium-sized businesses. The research aimed to identify the benefits and limitations of using a CRM system and the stages of its effective implementation. The study utilizes literature studies and the results of a survey by Act! conducted in May 2022 on a group of 1,146 SME owners, and a case study approach, including exam-

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ples of CRM system implementations in companies such as Amazon, Porsche, and L'Oréal. The research results indicate that CRM significantly improves customer relationships, increases satisfaction and loyalty, enhances the effectiveness of sales and marketing activities, and improves internal communication. In small and medium-sized enterprises, implementing a CRM system has contributed to, among other things, increased sales productivity (42%) and improved customer service (35%). The primary barriers to implementing this system are costs, integration, and the need for process adaptation. The analysis confirms that CRM is not only an IT tool but a business philosophy that, when properly implemented, can increase competitive advantage and long-term company success.

Keywords: Customer Relationship Management, customer loyalty, small and medium-sized enterprises, IT systems implementation

Kody JEL: M31, M15, L86

Wstęp

W gospodarce rynkowej pozycja danego przedsiębiorstwa zależy przede wszystkim od klientów. Ich liczba oraz wielkość realizowanych przez nich zakupów determinują wyniki finansowe podmiotów gospodarczych. W konkurencyjnym środowisku kluczem do sukcesu przedsiębiorstwa jest zatem zrozumienie i skuteczne zaspokojenie potrzeb klientów. Ich badanie oraz dbałość o jakość obsługi to kluczowe elementy strategii marketingowej, pomagające przedsiębiorstwom dostosować się do zmiennych oczekiwań rynku.

Zrozumienie potrzeb klientów oraz ich ocena stanowią podstawę do osiągnięcia celów programów lojalnościowych. Tego rodzaju narzędzia biznesowe mają na celu kontrolowanie relacji z klientami, aby było ich więcej i żeby częściej dokonywali zakupów [Śmiatacz 2012]. Programy lojalnościowe opierają się na długotrwałych działaniach marketingowych, które służą markom do budowania oraz utrzymywania relacji ze swoimi klientami. Powinny one obejmować zarówno aspekt strategiczny jako długoterminowy plan zarządzania lojalnością, jak i taktyczny będący określonym zestawem taktyk działania [Moczydłowska, Bitkowska 2020].

Odbiorcy, którzy pozostają wierni danemu podmiotowi gospodarczemu, nie tylko doceniają jego produkty i usługi, ale przede wszystkim okazują zaufanie do oferowanych przez niego rozwiązań. Zaufanie to istotny czynnik kształtujący wybory dokonywane przez konsumentów [Rudzewicz 2016]. Według Mayera i in. [1995] „zaufanie to gotowość jednej ze stron do akceptowania działań drugiej strony, wynikająca z oczekiwania, że ta druga strona zachowa się w szczególny i określony sposób, bez konieczności jej monitorowania i kontrolowania". Na podstawie zaufania kształtuje się lojalność, która jest głównym czynnikiem rozwoju przedsiębiorstwa i zdobywania przewagi konkurencyjnej.

Podmioty gospodarcze wykorzystują wiele różnych narzędzi w relacjach z klientami, jednym z nich jest system CRM, czyli Customer Relationship Management. Jest to pewnego rodzaju strategia biznesowa, która polega na wykorzystywaniu informacji, procesów, technologii i ludzi do zarządzania relacjami z klientem w danej firmie (marketing, sprzedaż, usługi i wsparcie). To filozofia myślenia, zgodnie z którą najważniejszy jest klient. Zadowolenie odbiorcy z produktów i usług przedsiębiorstwa jest priorytetem w podejmowanych przez niego działaniach.

Aby lepiej zrozumieć i komunikować się z potencjalnymi i obecnymi klientami, przedsiębiorstwa używają rozbudowanych systemów CRM, gromadząc określone dane nt. spotkań, zamówień, kontaktów. To narzędzie poprawia relacje biznesowe w kontaktach z dostawcami i klientami oraz wewnętrzną łączność między różnymi działami i zespołami przedsiębiorstwa. Dzięki temu dokładnie wiadomo, jak efektywni są pracownicy, czy dotrzymali terminów oraz którymi klientami obecnie się zajmują.

Początki systemu CRM datuje się na lata 80. i 90. XX wieku [Pałgan 2011]. W tym okresie głównym celem było obniżanie kosztów i związana z tym restrukturyzacja przedsiębiorstw, co często odbijało się na jakości obsługi klienta [CRM 2025]. Przedsiębiorcy zaczęli jednak dostrzegać potrzebę lepszego zarządzania relacjami z klientami. Na początku systemy CRM były prostymi bazami danych, które umożliwiały gromadzenie informacji o kontrahentach. Jednym z liderów w tym zakresie była amerykańska firma Siebel Systems, która w 1993 roku wprowadziła na rynek pierwsze oprogramowanie CRM. Wraz z ewaluacją technologii rozwijano kolejne narzędzia CRM, wyposażając je w coraz bardziej zaawansowane funkcje. Możliwe już było analizowanie danych, automatyzowanie procesów sprzedaży i obsługi klienta, personalizowanie komunikacji oraz śledzenie interakcji klientów na różnych platformach.

Obecnie systemy CRM integrują się z wieloma różnymi narzędziami i platformami, dzięki czemu przedsiębiorstwo może lepiej zrozumieć potrzeby i preferencje klientów, a także skuteczniej reagować na ich oczekiwania. Podmioty gospodarcze mogą efektywniej zarządzać procesami sprzedaży, budować trwałe relacje z klientami i zwiększać ich lojalność oraz poprawiać wyniki finansowe.

Cel i metodyka badań

Celem analiz było rozpoznanie korzyści i ograniczeń wynikających z zastosowania systemu CRM w przedsiębiorstwach oraz etapów jego efektywnego wdrażania. W tym celu wykorzystano studia literatury przedmiotu oraz wyniki badań zrealizowanych w maju 2022 roku przez firmę Act! na reprezentatywnej grupie 1146 właścicieli firm i osób decyzyjnych w małych i średnich przedsiębiorstwach. Dodatkowo zastosowano metodę case study w celu zaprezentowania przykładów pozytywnego wdrożenia systemu CRM w przedsiębiorstwach. W opracowaniu przedstawiono charakterystykę modelu zarządzania relacjami z klientami, wyzwania i korzyści wynikające z zaimplementowania systemu CRM w przedsiębiorstwach oraz przykłady skutecznego zastosowania tego rozwiązania w podmiotach gospodarczych. W analizach uwzględniono także ranking systemów CRM oraz kryteria jego tworzenia w celu ułatwienia podjęcia decyzji przedsiębiorcom, którzy chcieliby takie rozwiązanie wykorzystywać w działalności gospodarczej.

Charakterystyka modelu zarządzania relacjami z klientami

Customer Relationship Management (CRM) to system informatyczny, który służy do realizacji strategii zarządzania relacjami z klientami [Deszczyński 2011]. Zazwyczaj składa się z różnych modułów i funkcji, które umożliwiają śledzenie kontaktów z klientami, ich grupowanie, zarządzanie projektami itp. [Buttle, Maklan 2019]. Umożliwia

to indywidualne podejście do klientów oraz utrzymanie z nimi dobrych relacji nawet po odejściu z przedsiębiorstwa pracownika odpowiedzialnego dotychczas za dany obszar współpracy. Istotne jest także współdziałanie takiego oprogramowania z innymi systemami w przedsiębiorstwie. Zasadniczo CRM służy do usprawnienia zarządzania relacjami z klientami poprzez wykorzystanie narzędzi informatycznych.

System CRM jest również definiowany jako strategia, która umożliwia przedsiębiorstwom zidentyfikowanie potrzeb i możliwości oraz optymalizację ryzyka i kosztów związanych z obecnymi i potencjalnymi klientami [Buchnowska 2006]. Zakłada ona, że rynek nie jest jednolity, lecz składa się z różnorodnych, indywidualnych potrzeb klientów. W XXI wieku odchodzi się w gospodarce od produkcji na masową skalę na rzecz zaspokajania indywidualnych potrzeb klientów. Strategia CRM zakłada, że klienci preferują dokonywanie zakupów u dostawców, którzy rozumieją ich specyficzne potrzeby, szybko i precyzyjnie przekazują informacje o swojej ofercie oraz zapewniają wysokiej jakości wsparcie techniczne i serwis.

Strategia CRM zawiera kilka kluczowych elementów, takich jak:

– zrozumienie klienta – dla skutecznego zarządzania relacjami kluczowe jest poznanie, kim są klienci oraz jakie mają oczekiwania wobec produktów lub usług danego przedsiębiorstwa;
– personalizacja – dostosowywanie oferty produktów lub usług do indywidualnych potrzeb i preferencji klienta;
– automatyzacja działań takich jak marketing, sprzedaż czy obsługa klienta – odgrywa ona istotną rolę w strategii CRM, ponieważ pomaga zapewnić spójne i skuteczne interakcje z klientami;
– integracja z innymi systemami w przedsiębiorstwie, takimi jak zarządzanie łańcuchem dostaw, finanse czy zasoby ludzkie, w celu płynnego udostępniania danych i informacji między różnymi działami danego podmiotu gospodarczego;
– analityka i raportowanie – system CRM powinien być wyposażony w odpowiednie narzędzia do gromadzenia i przetwarzania danych o klientach, aby można było podejmować w przyszłości lepsze decyzje biznesowe;
– multikanałowość – klienci komunikują się współcześnie za pomocą różnorodnych kanałów, takich jak telefony komórkowe, e-maile, media społecznościowe czy czaty online. System CRM powinien zatem działać tak, aby móc obsługiwać wszystkie te kanały oraz zapewnić klientom spójne działania;
– zarządzanie relacjami – rozwijanie i utrzymywanie trwałych relacji z klientami poprzez aktywne zaspokajanie ich potrzeb, wzmacnianie lojalności oraz zwiększanie poziomu ich zadowolenia;
– rozwój i adaptacja – strategia CRM powinna być dynamiczna i dostosowywana do zmieniających się potrzeb zarówno przedsiębiorstwa, jak i klienta. W związku z tym istotna jest elastyczność i adaptacyjność CRM.

System CRM znajduje zastosowanie w trzech kluczowych obszarach: operacyjnym, komunikacyjnym (interakcyjnym) i analitycznym [Beliczyński 2011]. CRM operacyjny, pełniący funkcję front office, koncentruje się na pozyskaniu, przechowywaniu i wykorzystywaniu informacji dotyczących klientów, produktów i pracowników oraz przeprowadzonych transakcji. Przedsiębiorstwo może w dowolnym momencie przeglądać te zasoby i wykorzystywać je podczas bieżących i przyszłych interakcji z klientami [Pukas 2019].

Z systemem operacyjnym wiąże się interakcyjny system CRM, nazywany często komunikacyjnym. Obejmuje on rozwiązania umożliwiające bezpośredni kontakt z klientem. Jego głównym celem jest budowanie trwałych relacji poprzez zapewnienie stałej i wygodnej komunikacji między dostawcą a nabywcą. Zazwyczaj jest on uważany za najważniejszy obszar strategii CRM [Buchnowska 2006]. Z kolei analityczny CRM, zaliczany do back office, pozwala na analizowanie danych klientów i odkrywanie nieznanych informacji na ich temat. Wyniki tych analiz mogą stanowić podstawę do planowania przyszłych strategii sprzedaży i kampanii marketingowych, identyfikacji potrzeb klientów, a także oszacowania kosztów utrzymania i zdobycia nowych klientów [Olszak i in. 2015].

Wyzwania i korzyści wynikające z wdrożenia CRM w przedsiębiorstwach

Współczesny rynek charakteryzuje się dużą konkurencją, zmiennymi potrzebami i oczekiwaniami klientów, a także szybkim rozwojem technologii. W takich warunkach przedsiębiorstwa muszą cały czas poszukiwać sposobów na poprawę swojej efektywności i przewagi konkurencyjnej. Jednym z narzędzi, które mogą im w tym pomóc, jest system CRM, który ułatwia gromadzenie, uporządkowanie i zarządzanie danymi o kliencie. Do głównych korzyści wynikających z wdrożenia CRM należą:

– wzmocnienie relacji z klientami [Krzywdziński 2024],
– zwiększenie satysfakcji i lojalności klientów [Mazur i Mazur 2004],
– zwiększanie efektywności działań sprzedażowych i posprzedażowych,
– lepsza zewnętrzna i wewnętrzna komunikacja oraz współpraca,
– szczegółowe i wydajne bazy danych [Gliński 2025],
– efektywne działania marketingowe [Pałgan 2011].

Jedną z głównych korzyści z wprowadzenia modelu CRM w przedsiębiorstwie jest wzmocnienie relacji z klientem. Wiele przedsiębiorstw nie podtrzymuje kontaktów z klientami po zakończonej sprzedaży lub próbuje komunikować się z nimi na poziomie ogólnym, a nie indywidualnym. Jednak im więcej podmiot gospodarczy zbierze danych i informacji o kliencie, tym lepiej zadba o jego potrzeby. Zatrzymanie klienta jest prostsze i kosztuje mniej niż pozyskanie nowego. Wdrożenie systemu CRM umożliwia śledzenie całego procesu interakcji z klientem, od momentu, gdy przedsiębiorstwo po raz pierwszy zainteresuje klienta swoimi produktami lub usługami, aż do chwili, gdy stanie się on lojalnym odbiorcą produktów czy usług. CRM umożliwia przedsiębiorstwom lepsze zrozumienie klientów, komunikując się z nimi w sposób, który im najbardziej odpowiada, oraz reagując na bieżąco na ich potrzeby.

W ocenie relacji ważne jest zrozumienie, jak przekładają się one na satysfakcję i lojalność klientów. Przedsiębiorstwo, budując silne relacje z klientami, nie tylko zwiększa ich zaangażowanie, ale i sprawa, że kontrahenci czują się lepiej zrozumiani i mają do niego większe zaufanie. Prowadzi to do zwiększenia ich satysfakcji z produktów i usług, a to zwiększa lojalność wobec przedsiębiorstwa. Inwestując w relacje z klientami, przedsiębiorstwo osiąga długoterminowy sukces.

Wzmocnienie relacji z klientami jest korzystne nie tylko dla przedsiębiorstwa, ale także dla klientów i prowadzi do efektywniejszych działań sprzedażowych i posprzedażowych. System CRM działa jak baza danych, w której można przechowywać wszystkie

informacje na temat klientów i interakcji z nimi związanymi. Umożliwia to pracownikom łatwiejszy dostęp do tych informacji, a to pomaga lepiej obsługiwać klienta. Za pomocą CRM przedsiębiorstwa mogą automatyzować niektóre zadania, takie jak np. wysyłanie e-maili do klientów lub przypominanie pracownikom o ważnych terminach. Praca jest dzięki temu efektywniejsza, a zaoszczędzony czas można przeznaczyć na inne zadania. System pomaga zwiększyć sprzedaż oraz lepiej obsługiwać klientów po dokonaniu przez nich transakcji.

Rozpatrując korzyści wynikające z wdrożenia CRM, nie można pominąć faktu, że system ten ułatwia zarządzanie komunikacją. Dotyczy to zarówno interakcji z klientami, jak i komunikacji wewnątrz przedsiębiorstwa. Centralizacja danych i procesów komunikacyjnych umożliwia pracownikom dostęp do aktualnych informacji o klientach i ich potrzebach. To z kolei prowadzi do lepszej koordynacji działań i współpracy w przedsiębiorstwie.

Kolejną korzyścią z wdrożenia systemu CRM jest dysponowanie szczegółową bazą danych. Gromadzone w niej informacje dotyczą klientów, interakcji, transakcji itp. Możliwość raportowania oraz prognozowania wyników ułatwia podejmowanie i realizowanie strategicznych decyzji. Zakres i aktualność informacji umożliwiają monitorowanie bieżących działań i dokonywanie korekty procesów. Na podstawie analizy danych można np. zauważyć, że pewne kanały komunikacji są bardziej efektywne, i dostosować swoją strategię komunikacji, aby lepiej zaspokoić potrzeby klientów. Analiza danych umożliwia także określenie, które produkty i usługi są popularniejsze w danej grupie klientów. Można więc dokonać wyboru oferty, która lepiej spełni ich oczekiwania. Baza danych dostarcza istotnej wiedzy na temat klientów, co pozwala podejmować trafniejsze decyzje biznesowe.

Do korzyści wynikających z wykorzystania tego systemu należy także możliwość realizacji bardziej efektywnych działań marketingowych. Dział marketingu może lepiej dopasować swoje strategie i kampanie do potrzeb i oczekiwań grupy docelowej. CRM umożliwia segmentację klientów, personalizację komunikacji i śledzenie efektywności kampanii. Dzięki temu zasoby marketingowe są lepiej wykorzystywane, a skuteczność działań marketingowych jest większa.

Wdrożenie systemu CRM wiąże się jednak nie tylko z korzyściami, ma również pewne ograniczenia. Do jego słabych stron należą [Encyklopedia Zarządzania 2018a]:

– koszty,
– niewłaściwa implementacja systemu,
– wymagane zmiany systemu,
– niezgodność z systemami już istniejącymi w danym przedsiębiorstwie,
– niska wydajność.

Implementacja i utrzymanie systemu CRM mogą być kosztowne dla przedsiębiorstw, zwłaszcza mniejszych lub tych, które są dopiero na początkowym etapie działalności. Koszty obejmują nie tylko licencje na oprogramowanie, ale także szkolenia pracowników, dostosowywanie systemu do specyficznych potrzeb przedsiębiorstwa oraz opłaty za wsparcie techniczne i utrzymanie.

System CRM jest kompleksowy i do optymalnego funkcjonowania wymaga odpowiedniego wdrożenia. Niewłaściwa implementacja może prowadzić do błędów w bazie danych, duplikacji informacji, braku integracji z innymi systemami przedsiębiorstwa, a przede wszystkim może pogorszyć skuteczność zarządzania relacjami z klientami.

Istniejące systemy informatyczne w przedsiębiorstwie mogą być niezgodne z systemem CRM, co może skomplikować proces integracji i wdrożenia nowego oprogramowania. Konieczność dostosowania systemów może spowodować opóźnienia we wdrożeniu CRM oraz zwiększyć koszty.

Źle skonfigurowany lub nieprawidłowo zainstalowany system CRM może prowadzić do problemów z wydajnością. Podejmowane działania będą wówczas powolne i nieefektywne. Może dojść do problemów z integracją z istniejącymi systemami, a to utrudni dostęp do danych klientów oraz przeprowadzanie działań marketingowych czy sprzedażowych. Dlatego ważne jest, aby CRM był dopasowany do potrzeb i specyfiki działalności danego podmiotu gospodarczego.

Przed podjęciem decyzji o wdrożeniu CRM przedsiębiorstwo powinno dokładnie przeanalizować, czego tak naprawdę potrzebuje i oczekuje. Zarówno sam proces wdrożenia systemu CRM, jak i jego efekty nie są tak proste i natychmiast widoczne, jak tego oczekują przedsiębiorcy [Deszczyński 2011]. Podczas implementacji systemu można spodziewać się trzech barier: organizacyjnej, technicznej oraz finansowej [Porębska-Miąc 2013]. Pierwsza z nich wynika często z braku świadomości konieczności planowania zmian lub niechęci do zmieniania czegokolwiek. Kolejna bariera wiąże się zazwyczaj z koniecznością integracji CRM z systemami już istniejącymi oraz z wymaganiami dotyczącymi sprzętu, który może być niewystarczający lub niekompletny. Wdrożenie CRM jest też zwykle bardzo kosztowne.

Skuteczne wdrażanie modelu CRM w przedsiębiorstwie

System CRM może przynieść wiele korzyści, ale jego implementacja wiąże się z wieloma wyzwaniami. Samo posiadanie systemu nie wystarczy, aby osiągnąć sukces. Należy go skutecznie wdrożyć i wykorzystywać jego możliwości. Można wyróżnić kilka etapów implementacji tego systemu. Przede wszystkim należy ustalić, co przedsiębiorstwo chce usprawnić i jak planuje to zrobić. Może to obejmować różne aspekty, od poprawy efektywności operacyjnej po zwiększenie satysfakcji klientów. Następnie dany podmiot gospodarczy musi zdefiniować cel wdrożenia systemu, np. zwiększenie produktywności czy może poprawę jakości usług.

Gdy zostanie już wyznaczony cel, przedsiębiorstwo powinno określić wskaźnik rentowności inwestycji (Return On Investment – ROI), czyli relację zysku do kosztów inwestycji [Harbingers 2024]. W przedsiębiorstwach z reguły występują dwa skrajnie odmienne kierunki działań: małe inwestują w zbyt drogie systemy CRM, a duże – w rozwiązania tanie. Znając istotę działania systemu i określając cel wdrożenia oraz wyliczając ROI, zwiększa się szansę na osiągnięcie zysku z dokonanej inwestycji.

Następnym etapem jest ustalenie wymagań biznesowych wobec systemu CRM. Definiują one cel projektu, jego beneficjentów, czas i miejsce realizacji oraz kryteria, które zostaną użyte do jego oceny. W ramach tych wymagań przedsiębiorstwu może zależeć np., żeby system CRM umożliwiał generowanie faktur albo pokazywał historię kontaktów z kontrahentami. Zakres wymagań zależy od specyfiki danego podmiotu gospodarczego i decyzji osób nim zarządzających.

Kolejnym etapem jest podzielenie wymogów według metody MoSCoW (Must have, Should have, Could have i Won't have). Jest to technika priorytetyzacji, która pomaga

zdecydować, co trzeba zrobić na pewno, a co można przełożyć na później lub z czego zrezygnować. Jest to uniwersalna metoda, często stosowana w zarządzaniu projektami, która umożliwia zrozumienie i ustalenie priorytetów. Jej głównym celem jest zapewnienie jasnych wytycznych dla zespołu projektowego odnośnie do ważności poszczególnych wymagań. Technika ta odgrywa kluczową rolę w procesie podejmowania decyzji [Encyklopedia Zarządzania 2018b].

Dzięki realizacji wymienionych etapów osoby decyzyjne w przedsiębiorstwie stają się bardziej świadome swoich potrzeb i mogą zacząć poszukiwania odpowiedniego systemu CRM. Po wybraniu konkretnego systemu następuje proces jego stopniowego wdrażania, który jest dynamiczny, ponieważ potrzeby i cele przedsiębiorstwa mogą się zmieniać w czasie.

Implementacja systemu CRM jest bardzo mocno związana z pracą ludzi. Polega nie tylko na udostępnianiu narzędzi usprawniających codzienne funkcjonowanie przedsiębiorstw, ważne jest także właściwe zarządzanie procesami, tak aby pracownicy mieli poczucie, że dysponują narzędziem dostosowanym do ich potrzeb, pomocnym w wykonywaniu obowiązków i rozwiązywaniu różnych problemów. Wdrożenie systemu CRM należy prowadzić równolegle z dostosowaniem działań pracowników i ich nawyków do nowych uwarunkowań.

W praktyce trudno jest wyodrębnić poszczególne etapy wdrażania systemu CRM, ponieważ każde przedsiębiorstwo podchodzi do tego procesu indywidualnie. Potwierdzają to konkretne przykłady. Jednym z przedsiębiorstw, które skutecznie wdrożyło system CRM, jest Amazon – założona w 1994 w Seattle w Stanach Zjednoczonych firma specjalizująca się w handlu elektronicznym, będąca obecnie największym sklepem internetowym na świecie [Bożyczko 2022]. Na rynku zakupów online występuje bardzo duża konkurencja oraz zachodzą dynamiczne zmiany. Dzięki wdrożeniu systemu CRM Amazon oferuje przyjazną dla użytkownika stronę internetową, stosuje płynne operacje komunikacyjne i zapewnia bezpieczeństwo przechowywanych danych. Dane gromadzi w celu zapewnienia użytkownikom precyzyjnych i sprawnych zakupów [YourShortlist 2024]. Cały proces zakupowy w przedsiębiorstwie nie wymaga bezpośrednich interakcji międzyludzkich. Wystarczy kilka kliknięć, aby przejrzeć poprzednie zamówienia, śledzić przesyłki czy zaktualizować swoje dane. To wszystko sprawia, że system jest szybki, opłacalny i wydajny. Przynosi korzyści zarówno firmie Amazon, jak i jej klientom [Sunneklep 2019].

Innym przykładem skutecznie wdrożonego systemu CRM jest firma Porsche. To niemieckie przedsiębiorstwo, założone w 1931 roku przez Ferdinanda Porsche, produkuje sportowe oraz luksusowe samochody osobowe [Słup-Ostrawski 2024]. Za pomocą systemu CRM firma zapewniła sobie efektywną komunikację z klientami, co zwiększa ich lojalność. Uporządkowanie i ujednolicenie gromadzonych danych we wszystkich systemach obsługi klienta pozwala jej lepiej zaspokajać potrzeby kontrahentów i służyć pomocą swoim dealerom na całym świecie [Porsche 2024]. Przedsiębiorstwo stworzyło dla klientów i fanów marki cyfrową platformę usług My Porsche. Jej użytkownicy mają możliwość sprawdzenia aktualnego stanu samochodu, umówienia się na serwis czy też wyboru preferowanego Porsche Centrum [Precisely

2024]. Wszystko to przyczyniło się do zwiększenia satysfakcji klientów i ich lojalności wobec marki.

System CRM z powodzeniem wdrożyła również firma L'Oréal – francuskie przedsiębiorstwo kosmetyczne założone w 1909 roku i działające w ponad 130 krajach na całym świecie [Pure Beauty 2024]. System CRM pozwolił firmie poprawić prognozowanie sprzedaży, zredukować opóźnienia w płatnościach i szybciej podejmować decyzje [Wilson 2020]. Bezpośredni dostęp do kluczowych danych pomógł zmotywować zespoły projektowe oraz zwiększył atrakcyjność stanowisk operacyjnych w przedsiębiorstwie. L'Oréal wykorzystuje CRM jako podstawę dla ponad 200 stron e-commerce, czyli handlu produktami lub usługami przez Internet. Na podstawie wcześniejszych zakupów klientów, ich preferencji czy też zachowań na stronie internetowej przedsiębiorstwo może tworzyć dla nich bardziej spersonalizowane oferty [Yeomans 2017]. System CRM w L'Oréal pozwala firmie na dostosowanie działań do potrzeb i oczekiwań jej klientów.

System CRM w małych i średnich przedsiębiorstwach

W maju 2022 roku firma Act! przeprowadziła badania na reprezentatywnej grupie 1146 właścicieli firm i osób decyzyjnych w małych i średnich przedsiębiorstwach [Act! 2024]. Ich celem było zrozumienie nowych i dynamicznie zmieniających się wyzwań, z jakimi zmagają się tego typu przedsiębiorstwa. Badania dotyczyły także roli systemu CRM w zarządzaniu relacjami z klientami.

Małe i średnie przedsiębiorstwa, które zdecydowały się na wdrożenie systemu CRM do zarządzania relacjami z klientami, szybko zauważyły korzyści wynikające z tego tytułu. Z badań wynika, że używają one tego narzędzia w różnych formach, w chmurze, lokalnie na swoich komputerach lub hybrydowo, do wielu zadań. Najczęściej wykorzystują je do marketingu e-mailowego (50% wskazań), obsługi klienta (40%), zarządzania kontaktami (37%), śledzenia interakcji z klientami (30%) oraz tworzenia raportów i analiz (27%). Przy czym 40% właścicieli małych i średnich przedsiębiorstw korzysta z tego systemu codziennie do realizacji ważnych zadań. Wykorzystywanie poszczególnych funkcji systemu CRM przedstawiono na rys. 1.

Wdrożenie systemu CRM w małych i średnich przedsiębiorstwach przyczyniło się do poprawy funkcjonowania tych podmiotów w wielu obszarach. Badani wskazywali najczęściej na wzrost produktywności sprzedaży (42%), poprawę obsługi klienta (35%) oraz wzrost efektywności przedsiębiorstw (33%). CRM miał także istotne znaczenie w rozwoju marketingu bezpośredniego (32% wskazań) i satysfakcji klientów (30%). Zdaniem przedsiębiorców system ten umożliwia zwiększenie wiedzy o klientach, ich zrozumienie i zatrzymanie. Skalę poprawy różnych wskaźników dzięki zastosowaniu systemu CRM przedstawiono w tabeli 1.

Sektor MŚP potrzebuje takich systemów, aby utrzymać rentowność oraz sprostać wyzwaniom i rosnącym wymaganiom klientów. Poprzez usprawnianie procesów, zmniejszanie obciążenia pracowników obowiązkami i poprawę relacji z klientami staje się bardzo cenny dla przedsiębiorstw na dynamicznie zmieniającym się rynku.

Rysunek 1. Wykorzystywanie różnych funkcji CRM w małych i średnich przedsiębiorstwach
Figure 1. Using various CRM functions in small and medium-sized enterprises

Źródło: opracowanie własne na podstawie [Act! 2024]

Source: own elaboration based on [Act! 2024]

Tabela 1. Oddziaływanie systemu CRM na różne aspekty działalności małych i średnich przedsiębiorstw
Table 1. The impact of the CRM system on various aspects of the operations of small and medium-sized enterprises

Zakres	**Wynik procentowy**
Produktywność sprzedaży	42%
Obsługa klienta	35%
Efektywność przedsiębiorstwa	33%
Marketing bezpośredni	32%
Satysfakcja klienta	30%
Zatrzymanie klienta	28%
Wiedza i zrozumienie klientów	27%
Przychód/wzrost firmy	27%
Efektywność pracowników	21%
Udostępnianie i dostęp do informacji	19%
Wgląd operacyjny i strategiczny	18%

Źródło: opracowanie własne na podstawie [Act! 2024]

Source: own elaboration based on [Act! 2024]

Ranking systemów CRM

Biorąc pod uwagę potrzeby małych i średnich przedsiębiorstw w Polsce, firma Sellwise dokonała oceny różnych systemów CRM [Sellwise 2025]. Ich dopasowanie do specyfiki krajowego rynku jest istotne, gdyż oczekiwania i wymogi stawiane przez polskie przedsiębiorstwa mogą odbiegać od typowych dla innych krajów, takich jak USA czy państwa Europy Zachodniej. Każdy z systemów CRM został oceniony na podstawie następujących kryteriów:

– zdolność do tworzenia i zarządzania profilami klientów,
– śledzenie historii interakcji z klientem,
– aplikacja mobilna umożliwiająca dostęp do systemu podczas pracy w terenie,
– możliwości modułu raportowego,
– poziom automatyzacji.

Pierwszym z kryteriów była zdolność do tworzenia i zarządzania profilami klientów. Systemy CRM powinny umożliwiać łatwe tworzenie i edytowanie szczegółowych profili klientów. W profilach tych powinny się znaleźć takie informacje, jak dane kontaktowe, preferencje zakupowe, historia zakupów oraz notatki dotyczące wszelkich interakcji z klientem. Efektywne zarządzanie profilami pozwala przedsiębiorstwom lepiej zrozumieć potrzeby swoich klientów i dostosować ofertę do ich oczekiwań.

Ważnym aspektem każdego CRM jest również możliwość śledzenia wszystkich interakcji z klientem, takich jak rozmowy telefoniczne, e-maile, spotkania. Ta funkcjonalność pozwala na budowanie pełnego obrazu relacji z kontrahentem, co jest kluczowe dla jego skutecznej obsługi i utrzymania.

Tabela 2. Ranking systemów CRM w 2025 roku
Table 2. Ranking of CRM systems in 2025

Nazwa firmy	Liczba pkt
HubSpot	89
Pipedrive	85
Salesforce	83
Creatio	82
Dynamics 365	82
Firmao	81
Zendesk sell	73
Livespace	70
Raynet	70
Monday.com	67

Źródło: opracowanie własne na podstawie [Sellwise 2025]
Source: own elaboration based on [Sellwise 2025]

Dla wielu przedsiębiorstw, zwłaszcza tych, które mają mobilne zespoły sprzedażowe, niezbędna jest aplikacja mobilna. Pozwala ona handlowcom na dostęp do wszystkich funkcji systemu z dowolnego miejsca, co znacząco zwiększa ich efektywność i elastyczność pracy.

Kolejnym aspektem są zaawansowane moduły raportowe w systemach CRM, które pozwalają na generowanie szczegółowych raportów dotyczących wielkości sprzedaży i jej prognoz, wydajności zespołów oraz analizy zachowań klientów. Te raporty są niezwykle istotne dla menedżerów, którzy potrzebują możliwie dokładnych danych do podejmowania strategicznych decyzji.

Ostatnim kryterium branym pod uwagę przy ocenie systemów CRM był poziom automatyzacji. Wysoka automatyzacja umożliwia wykonanie wielu rutynowych zadań, takich jak wysyłanie e-maili albo przypomnienia o spotkaniach. Pomaga zaoszczędzić czas, redukować błędy i zwiększać produktywność zespołów sprzedażowych.

Na podstawie wskazanych kryteriów powstał ranking systemów CRM w 2025 roku przedstawiony w tabeli 2.

Z danych wynika, że dla podmiotów gospodarczych, które chcą zautomatyzować wiele działań sprzedażowych, najlepszym narzędziem będzie HubSpot [HubSpot 2025]. Na drugiej pozycji znalazło się Pipedrive, a na trzeciej Salesforce.

Podsumowanie i wnioski

Z analiz wynika, że zarządzanie relacjami z klientami (CRM) to nie tylko system, ale przede wszystkim filozofia biznesowa, która kładzie nacisk na trwałe i wartościowe interakcje. Współczesne definicje CRM podkreślają, że jest to podejście strategiczne, które integruje procesy biznesowe i technologie w celu identyfikacji, pozyskania oraz budowania lojalności klientów.

Kluczowe znaczenie dobrych relacji z klientem wynika z faktu, że są one fundamentem trwałego sukcesu przedsiębiorstwa. Podmioty gospodarcze, które skupiają się na zrozumieniu potrzeb i preferencji swoich klientów, są w stanie lepiej dostosować swoje produkty i usługi do popytu, co w efekcie prowadzi do zwiększenia satysfakcji i lojalności ich odbiorców, a tym samym do wzrostu przychodów.

Korzyści płynące z wdrożenia CRM obejmują między innymi poprawę efektywności działań marketingowych, ułatwienie zarządzania kontaktami i interakcjami z klientami, a także zapewnienie lepszego wsparcia posprzedażowego. Systemy CRM umożliwiają również lepszą segmentację klientów, co pozwala na bardziej spersonalizowane podejście i skuteczniejsze docieranie do nich z ofertą.

Wyzwania związane z wdrożeniem CRM mogą obejmować konieczność dostosowania procesów biznesowych, szkolenia personelu, a także zapewnienia integracji z innymi systemami informatycznymi w przedsiębiorstwie. Kluczowe jest również stałe aktualizowanie danych i informacji o klientach, aby system CRM mógł być efektywniejszy.

Badania firmy Act! [Act! 2024] wykazały, że przedsiębiorstwa, które prawidłowo wykorzystują systemy CRM, często odnotowują znaczący wzrost efektywności oraz poprawę relacji z klientami. Z kolei z analizy rankingu systemów CRM wynika, że nie ma jednego uniwersalnego rozwiązania – każde ma swoje mocne i słabe strony, które należy przeanalizować w kontekście specyficznych potrzeb i możliwości przedsiębiorstwa.

Reasumując, system CRM to element niezbędny we współczesnych przedsiębiorstwach, który, jeśli zostanie właściwie wdrożony i wykorzystany, może przynieść znaczące korzyści dla podmiotu gospodarczego i zwiększyć jego przewagę konkurencyjną. Warto jednak pamiętać, że sukces zależy od wielu czynników, w tym od zaangażowania pracowników, ciągłego doskonalenia procesów i adaptacji do zmieniającego się rynku.

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