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Evaluating the Role of Couriers in E-commerce Delivery: A Performance-Based Ranking Model for Optimising Logistics Efficiency

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Abstract: The efficient delivery of e-commerce parcels is heavily reliant on the performance of couriers, who represent a critical interface between businesses and end-users, thus influencing the competitive positioning of companies within the logistics sector. This study seeks to analyse the pivotal role of couriers in e-commerce delivery by evaluating various operational activities associated with the delivery process. Through an extensive literature review and analysis of company-provided data, nine key performance criteria were identified: daily delivery volume, average delivery time, delivery accuracy, monthly complaint rate, customer satisfaction ratings, route efficiency, professionalism, incidence of damaged shipments, and overtime rate. Subsequently, 20 courier alternatives were assessed based on these criteria, with the objective of ranking their relative performance in the delivery process. A novel methodological approach, integrating the CRiteria Importance Through Intercriteria Correlation (CRITIC) and Multi-Attributive Border Approximation Area Comparison (MABAC) techniques, was adopted to determine the criteria weights and rank the couriers, respectively. The CRITIC method was employed to compute the relative importance of each criterion, while the MABAC method was utilised to rank the couriers according to their performance. The results indicated that courier alternative A16 achieved the highest performance ranking, whereas alternative A15 was ranked lowest. The findings underscore the robustness of the proposed model and its potential applicability to similar decision-making challenges in related domains, such as supply chain management and logistics. This study highlights the importance of performance-based assessments in improving operational efficiency and enhancing the overall effectiveness of logistics networks.

Keywords: Courier; E-commerce; Delivery; Efficiency; Performance; Logistics

1. Introduction

The term "courier service" has its origins in postal services. The reason for the differentiation of the courier service sector lies in the inefficiencies of national postal companies and the low quality of services provided (Marcysiak, 2021; Liao et al., 2006). Couriers serve numerous industries; with varying roles and the types of packages they deliver. Some of the key responsibilities of couriers include (Detrack, 2025):

- Last-mile delivery – the final step in the delivery process, where goods are transported from the distribution center (DC) to the end customer. Couriers ensure this stage runs smoothly, as it directly impacts customer satisfaction.
- Document delivery – often requiring secure transportation, even in the digital age. Couriers ensure that sensitive paperwork, such as legal contracts or medical records, reaches its destination intact and on time.
- Specialized deliveries – some couriers focus on providing specialized services, such as transporting laboratory samples or pharmaceutical products under strictly controlled temperature conditions.
- E-commerce support – as online shopping becomes the norm, couriers play a crucial role in meeting customer expectations for fast, reliable, and often free delivery.

The courier, express, and parcel (CEP) services market has experienced impressive growth rates worldwide over

the past decade. E-commerce is one of the main drivers of CEP market expansion, generating significant revenue. Social distancing, business closures, and other lockdown measures during the COVID-19 pandemic accelerated the growing trends in e-commerce. As a result, internet users increasingly turned to online shopping, even for necessities (Gao et al., 2020; Gulc, 2021). This shift led to a surge in business-to-consumer (B2C) sales and influenced business-to-business (B2B) e-commerce. By the end of May 2020, online orders had doubled compared to the previous year in North America and increased by 50% in Europe. Before the pandemic, the global courier market was valued at €330.3 billion in 2019, reaching €400 billion in 2024, reflecting an annual growth rate of 8-10%, which is projected to continue in the coming years (Gulc, 2021).

Poland's CEP market dynamics are among the strongest in Europe. The value of the Polish courier market was €2.3 billion in 2020, marking a 20% increase compared to 2019. During the same period, the total number of parcels grew by 34.9%, reaching 814 million shipments. Poland is among eight European countries (Germany, the United Kingdom, France, Spain, Italy, the Netherlands, and Belgium) that account for 76% of Europe's GDP and 80% of total courier service revenues in Europe. The Polish CEP market is highly diversified and "saturated" with both global providers offering complex logistics services and small to medium-sized companies specializing in urban deliveries. The market is dominated by the ten largest operators, which accounted for 97.6% of the total volume (shipments) and 94.6% of total revenue in 2019. Leading CEP market players in Poland include DPD, DHL, UPS, FedEx, and Geis (Gulc, 2021).

Due to significant liberalization, privatization, globalization, and the development of e-commerce, the entire courier service sector has evolved into a dynamic and growing service industry, facing increasing competition. Fierce competition forces existing courier providers to reassess their strategies to strengthen their competitive advantages. Courier service providers are under pressure to implement various strategic and tactical measures to attract new customers while retaining existing ones (Otsetova, 2017). Market conditions have driven courier services to become more flexible in meeting customer expectations. Today, many services operate globally, adhering to high-quality service standards. Courier market operators increasingly rely on extensive distribution networks, modern sorting centers, and terminals (Marcysiak, 2021; Vakulenko et al., 2018). To continually enhance service quality, courier companies strive to tailor their operations to individual customer needs (Lou et al., 2020; Marcysiak, 2021). With ongoing transformations, courier operators have become more agile in adapting their services to customer demands, particularly in shipment management. Recipients can redirect packages to a different address, reschedule deliveries, and even modify delivery time slots (Marcysiak, 2021; Schwerdfeger & Boysen, 2020). Additionally, some courier service operators have introduced late afternoon and evening delivery options (Alsaad & Taamneh, 2019; Marcysiak, 2021).

Modern technology has profoundly transformed the traditional courier services market, reshaping the delivery process. The integration of innovative tools and systems has streamlined logistics operations, resulting in faster and more efficient deliveries. One of the key advancements in the courier industry is the use of real-time tracking systems, enabling customers to easily monitor the status and location of their shipments. This level of transparency not only enhances the overall customer experience but also optimizes delivery routes (IFA., 2025). Furthermore, recognizing the widespread adoption of smartphones, courier services have launched mobile applications. These apps allow users to track shipment status, check pick-up locations and delivery times, or modify their orders (Lemke et al., 2016; Marcysiak, 2021). At the same time, due to rising customer expectations regarding delivery time management and increasing costs (including labor expenses), courier market operators have initiated the dynamic development of pick-up points. Currently, in addition to collecting parcels at company branches, post offices, or via automated machines, deliveries can also be made to partner networks, such as stores, newsstands, or gas stations (Iwan et al., 2016; Marcysiak, 2021).

A few years ago, most courier shipments followed a door-to-door (D2D) delivery model. However, as courier services aimed to improve service quality, they faced challenges related to online orders placed by individual customers who were often not at home during courier working hours or were located in hard-to-reach areas. This led to the development of alternative delivery models, including door-to-point (D2P) and point-to-point (P2P) systems. These approaches rely on automated parcel lockers and pick-up/drop-off (PUDO) locations. In 2018, over 13% of parcels were delivered through PUDO networks, and the popularity of these delivery models continues to grow each year (Janjević & Winkenbach, 2020; Marcysiak, 2021). Additionally, during the COVID-19 pandemic, a decline in service quality management for customers was observed, highlighting the need for adaptation among both courier service providers and their business partners (Marcysiak, 2021). The implementation of automated sorting and routing algorithms has significantly reduced errors and delivery delays. With the help of artificial intelligence and machine learning, courier companies can optimize operations, minimize costs, and efficiently manage resources. The shift toward sustainable practices, such as electric vehicles and environmentally friendly packaging materials, also plays a crucial role in reducing the carbon footprint of courier services. In today's fast-paced world, the impact of modern technology on courier services cannot be overstated, as it continues to drive innovation and improve delivery efficiency (IFA., 2025). Based on all previously said, the aim of this paper is to examine the role of couriers in e-commerce delivery by proposing a new model used for evaluating their performance.

The paper is structured as follows: After the introduction, Section 2 outlines the problem description and provides a review of the literature. Section 3 discusses the organization of courier operations in e-commerce parcel delivery. The following section presents the methodology of the proposed model and the results of its implementation. Finally, Section 5 offers concluding remarks and suggests directions for future research.

2. Problem Description and Literature Review

2.1 The Role and Development of Courier Delivery Industry

Competing against one another, courier companies strive to minimize costs. Consequently, they attempt to offer increasingly lower delivery prices. However, cost optimization opportunities are limited, as costs are determined by the profit threshold of the courier company and its subcontractors (Grabara et al., 2013; Karcz & Ślusarczyk, 2016). At the same time, customers seek to satisfy their needs while expecting a high quality of service. Quality in this context pertains to timely stock availability and other customer requirements. For the courier industry, the most crucial quality parameters are (Karcz & Ślusarczyk, 2016):

- Timeliness of delivery (delivery delays);
- Delivery efficiency (number of returns from senders and refusals to accept goods);
- Loss coefficient (number of damaged shipments and complaints).

One of the major challenges in delivering parcels to private recipients is their frequent absence at home. Couriers typically deliver parcels between 10 AM and 6 PM. Traditionally, standard courier routes catered to institutional clients who required guaranteed morning deliveries. The study and improvement of the delivery process primarily concern undelivered shipments during the workday (to be redelivered the following day). This issue is one of the key quality indicators in courier companies. Customers, especially large e-commerce businesses, demand a supply efficiency rate of 98-99%. It is important to note that several factors contribute to unsuccessful deliveries (Karcz & Ślusarczyk, 2016):

- Recipient absence;
- Refusal to accept the delivery;
- Change of delivery address;
- Incorrect address.

In recent years, the courier services market has been marked by a decline in profit margins, largely driven by the global economic crisis. Nevertheless, steady growth is expected in the courier transportation sector. Managers cannot base their business strategies solely on market forecasts. A critical mistake in the overall management of these companies lies in flawed pricing policies and associated decision-making. Courier companies commonly face the same challenges (Karcz & Ślusarczyk, 2016):

- Rising fuel prices;
- Higher costs of non-courier personnel maintenance;
- Underdeveloped road infrastructure;
- Congested streets;
- Increasing demand for B2C services.

Currently, many courier companies are experiencing the consequences of pricing policy errors made in recent years. These companies have continually (and mistakenly) lowered their service prices instead of maintaining them while considering market inflation levels. Instead, they should focus on a continuous improvement of service quality. Over the past two decades, price levels have decreased by approximately 15-20%, prompting sales managers to aggressively attract new clients. Increasing revenue from service sales has become the primary focus of sales departments, even though this growth has not translated into higher costs. The economic environment has provided pricing policymakers with opportunities to slightly increase service prices (due to qualitative improvements). However, these opportunities have not been fully utilized (Karcz & Ślusarczyk, 2016).

One of the most common mistakes made by courier companies is setting excessively low prices for the lightest parcel category. As a result, there is a narrow margin for heavier shipments since pricing structures are designed "linearly." Prices are typically determined by averaging across the entire pricing structure. Consequently, light parcels, which often represent over 80% of a company's total shipments, are transported at unsustainably low rates. Additionally, the implementation of customer discounts is often misaligned with the intended pricing strategy. Seasonal shipping patterns must also be considered. For instance, when comparing two clients with similar annual shipment volumes, one may ship regularly throughout the year while the other operates seasonally, with increased activity during specific periods. A client with steady shipments places less strain on the courier network, whereas a seasonally active client significantly burdens the system during peak times. They should not be granted identical discounts (Karcz & Ślusarczyk, 2016).

A specific approach to discount implementation involves ex-ante and ex-post discounting schemes. Ex ante discounts allow customers to secure lower rates without a binding obligation to send a predetermined number of shipments. However, it is important to acknowledge that customers are skilled negotiators, just like courier service

providers. Customers often attempt to declare an inflated monthly or annual shipment volume to secure maximum discounts. In practice, they may only ship a fraction of the declared volume, strategically distributing shipments among multiple service providers to maintain leverage in future negotiations. By doing so, they can argue that they aim to meet the agreed shipment volume but fail to achieve the expected outcome, thereby maintaining the ability to negotiate better rates by threatening to switch providers (Karcz & Ślusarczyk, 2016). In contrast, under an ex-post discounting scheme, the customer receives a discount only after reaching a specific shipment volume within the courier network. The fundamental conclusion regarding pricing policy formulation is that it must be established rationally, considering all relevant aspects, particularly the volume of shipments. This approach requires precise analyses and the ability to quickly optimize operational strategies. Failure to adjust pricing policies accordingly in the courier transport sector may lead to the bankruptcy of companies operating in the market (Karcz & Ślusarczyk, 2016).

2.2 The Impact of Fleet Management Practices on the Efficient Provision of Courier Services

Efficient service delivery is at the core of logistics, as it reflects the physical movement of goods between points within the supply chain. High customer expectations and low tolerance for inadequate performance contribute to an intensely competitive environment. This pressures service providers to ensure both an exceptional customer experience and cost-effectiveness (Giaglis et al., 2007; Mehmood, 2021). To achieve this, courier services must effectively manage their vehicle fleets throughout the entire process, from the moment an order is placed to its final delivery, often referred to as the "last mile" (Joerss et al., 2016; Mehmood, 2021).

Fleet Management: Effective fleet management practices aim to minimize overall costs by optimizing resource utilization. Traditional fleet management approaches have, for decades, struggled with cost-efficiency challenges, particularly in designing optimal routing strategies for a broad range of real-world distribution problems (Giaglis et al., 2007; Mehmood, 2021).

Efficient Service Delivery: Properly managed distribution operations are the backbone of success for e-commerce companies, ensuring sustained business growth for those that implement effective solutions. Customer retention, a critical aspect of long-term success, is closely linked to efficient service delivery (Mehmood, 2021; Payne & Frow, 2013). Key benefits include:

- Enhanced business reputation – Courier service providers that maintain reliable and timely delivery processes are more likely to receive positive customer feedback on digital platforms and be recommended to others, such as family and friends.
- Improved operational efficiency – Establishing a well-organized distribution strategy helps courier service providers enhance productivity and reduce handling time for shipments.
- Increased customer satisfaction – Many consumers prefer e-commerce purchases due to the convenience of online shopping, which allows them to order from home without visiting physical stores. Fast and reliable delivery, sometimes even within the same day, significantly contributes to customer retention and satisfaction.

2.3 Quality of Courier Services

Improving service quality should remain a constant focus for courier service providers. They should never refrain from becoming increasingly proactive in achieving customer satisfaction by continuously enhancing courier services. Today, courier services are classified as a type of logistics service. Therefore, in analyzing and assessing courier service quality, logistics service quality (LSQ) models are applicable. However, researchers and logistics practitioners have yet to reach a consensus on a universal approach to defining the concept of quality in logistics services and its associated dimensions. Although several authors have addressed this topic, their conclusions and proposals differ significantly in terms of LSQ dimensions and attributes (Otsetova, 2017; Thai, 2013). Nevertheless, most definitions of service quality emphasize that a (logistics) service must meet customer needs and expectations, often interpreted as the gap between service delivery conditions and customer expectations (perceived service) (Otsetova, 2017).

There are two main approaches to conceptualizing LSQ. The first approach suggests that service quality refers to the alignment of service specifications defined by service providers (Otsetova, 2017; Rafiq & Jaafar, 2007; Thai, 2013). According to this approach, LSQ consists of the physical aspects of service distribution, implying that the focus is solely on logistics service providers, without considering the customers (Otsetova, 2017). The second approach suggests that service quality is based on customer evaluation and perception. It attempts to identify objective variables assessed through customer perceptions relative to their expectations (Bienstock et al., 1997; Mentzer et al., 1989; Mentzer et al., 1993; Mentzer et al., 1999; Mentzer et al., 2001; Otsetova, 2017). As a result, a new LSQ concept emerged, proposing a model that incorporates additional elements of customer service, referred to as "marketing customer service." Through revision and validation, a new multidimensional model was developed, placing greater emphasis on the customer's perspective rather than on the operational dimensions of

the service (Otsetova, 2017). To measure service quality, an extended LSQ model was developed, identifying eight key dimensions of service quality in the courier services sector: information quality, ordering procedures, order release quantities, timeliness, order accuracy, order conditions, order discrepancy handling, and quality of personnel contact (Otsetova, 2017; Rafiq & Jaafar, 2007). Over time, the model was further refined by conceptualizing the process into four key phases: order placement, order processing, order dispatching, and order fulfillment. Customers are actively involved in this logistics process when placing and receiving orders. If the order reception does not meet expectations, customers remain engaged in the logistics process through the "order discrepancy handling" procedure (Mentzer et al., 2001; Otsetova, 2017).

2.4 Determinants of Courier Service Quality in E-Commerce from the Clients' Perspective

Most of the research is based on the SERVQUAL method to evaluate the dimensions of service quality (tangibility, reliability, security, responsiveness, and empathy) (Frąś, 2014; Gulc, 2020; Tabassum & Badiuddin, 2014; Yee & Daud, 2011; Yu et al., 2012). Yee & Daud (2011) examined the impact of service quality dimensions on customer satisfaction with parcel/package deliveries. The study found that tangibility, reliability, and security significantly affect customer satisfaction, while empathy and responsiveness do not have a significant impact. Similarly, Tabassum & Badiuddin (2014) based their research on SERVQUAL but adjusted certain items to fit the specific characteristics of courier services. The primary goal of this study was to identify the gap between customer expectations and perceptions of service quality. The largest gap was observed in the areas of reliability and responsiveness, which courier operators should focus on. In addition, Yu et al. (2012) explored a method for improving courier service quality called "Two-Stage Quality Functional Deployment" to transform demand for express services into resources for those services. This study aimed to eliminate internal factors negatively affecting service quality within the company but did not assess the impact of those factors on the quality of services perceived by customers. Although this method has been validated in the express industry, the authors suggest that it could be applied to other service sectors (Gulc, 2020).

While SERVQUAL is the most widely used method for measuring service quality, it has also been widely criticized for its general nature and the need for modification based on the specifics of each type of service. Furthermore, the method does not differentiate between satisfaction and the actual service quality. Another criticism concerns the fundamental assumption of this method regarding overall service quality, which is calculated as the difference between expected and perceived quality (Gulc, 2017b; Gulc, 2020). Therefore, some authors have applied a less complex method for measuring courier service quality as perceived by customers. One such study addressing the specific features of courier services is the study (Gulc, 2017b; Gulc, 2020). Some authors used the LSQ scale (Liu & Liu, 2014; Ho et al., 2012), while others attempted to develop a set of dimensions for courier services that could be evaluated (Gulc, 2017a; Gulc, 2020; Valaei et al., 2016). Liu & Liu (2014) focused on evaluating the quality of express logistics services based on the SERVQUAL method, while applying the LSQ scale, which includes dimensions such as reliability, protection, safety, empathy, and perception. Meanwhile, Ho et al. (2012) used the LSQ scale to identify the most important factor of courier service quality that impacts customer satisfaction. The scale included dimensions such as timeliness, order condition/accuracy, information quality, and staff availability/quality. The objective of the study by Valaei et al. (2016) was to determine the dimensions of courier service quality and the impact of perceived service quality on overall service quality. This study was based on the SERVQUAL method; however, the authors formulated the scale in the context of courier services, naming it "CouQual" and including dimensions such as punctuality, convenience, accuracy, safety, and tangibility (Gulc, 2020).

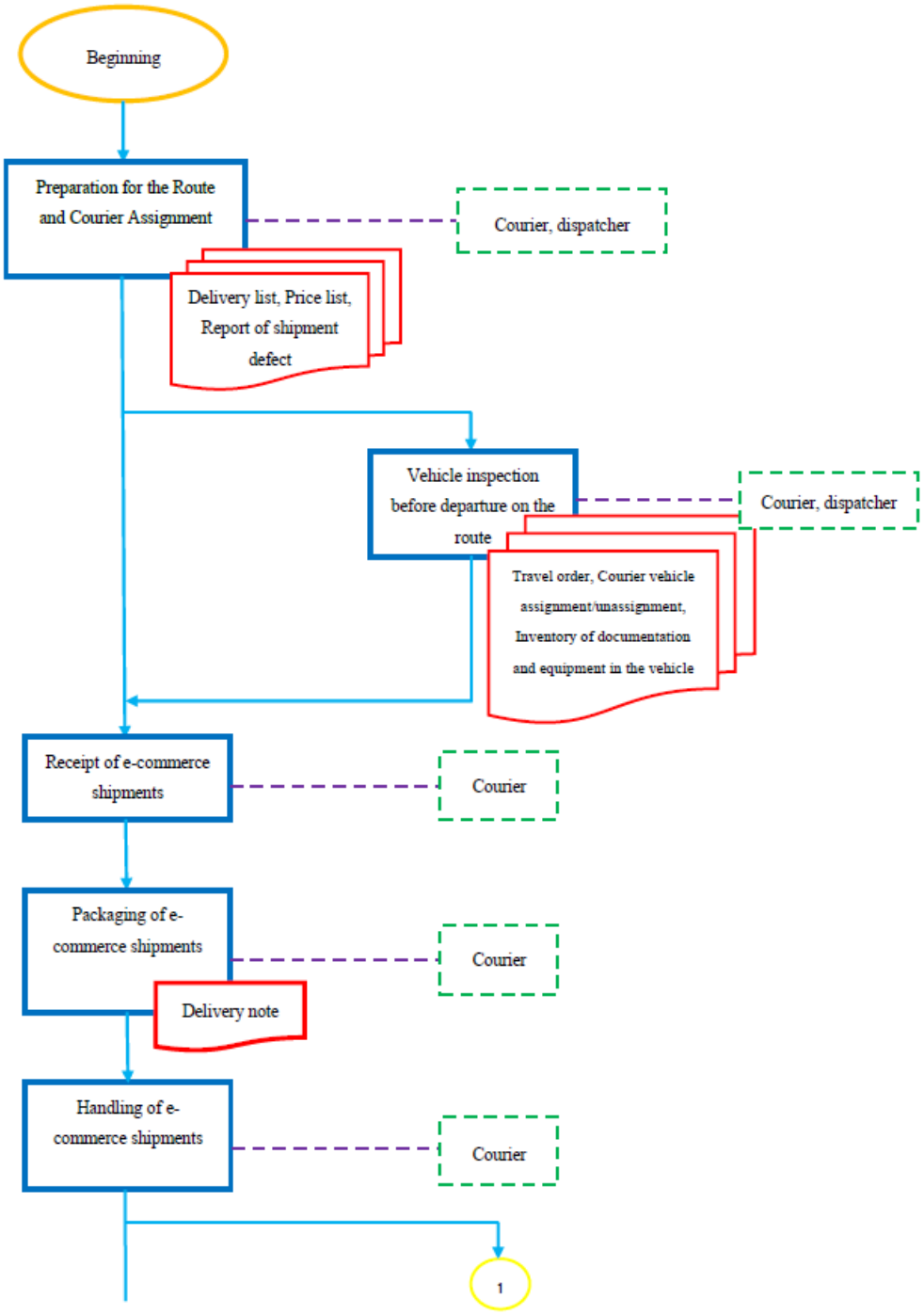
2.5 Trust as a Determinant of Service Quality

Thus far, the process of defining and measuring trust in (logistic, courier) services has primarily focused on interpersonal relationships between service providers (courier services) and customers. To define and measure services, a different approach to trust needs to be developed, taking into account the two distinct types of services: user-oriented and technology-oriented, with a particular emphasis on the latter. The development of services through information and communication technologies (i.e., technology-oriented services), which replace interpersonal relationships, requires the adoption of a new approach to trust research, one that also considers trust in material, physical factors. Many authors confirm that trust relates not only to interpersonal but also to human-technology relationships (Ejdys & Gulc, 2020; Park et al., 2019). In various sectors, relationships between users and service providers are increasingly being replaced by different self-service technologies (e.g., in the banking industry) (Ejdys & Gulc, 2020; Meuter et al., 2000).

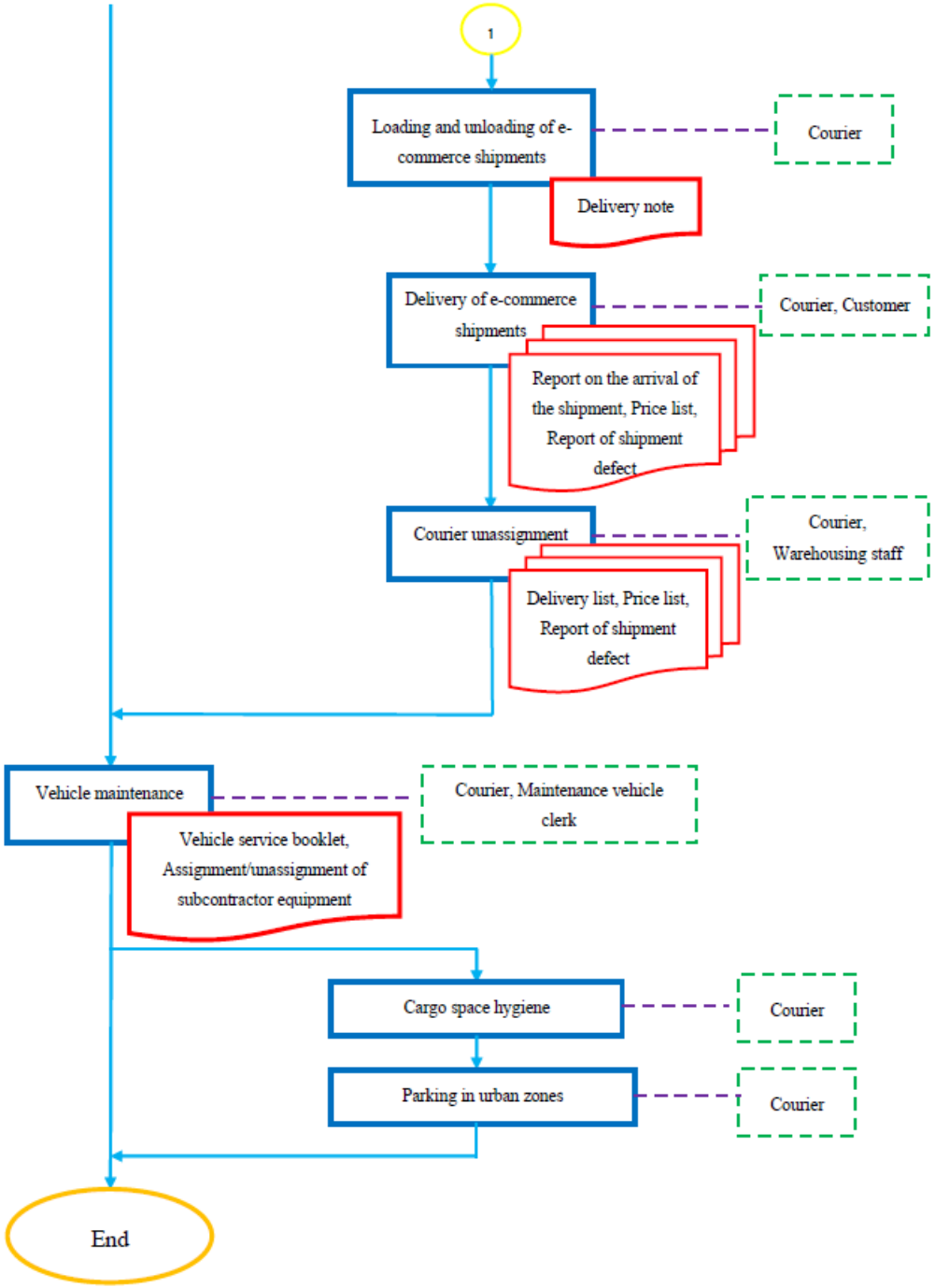
3. Organization of Courier Work in E-Commerce

The distribution process of e-commerce shipments begins with the receipt of an order from the customer and

ends with the transportation and delivery of the shipments to the customers or the end consumers. From the fact that the distribution process involves a large number of activities and participants, one can conclude its significance for any company. Through the distribution process, the company establishes direct contact with consumers, making logistics a key factor in competitiveness (Pajić, 2024). The distribution process is further complicated by the demands that arise in e-commerce. Specifically, products ordered online must physically pass through highly complex logistics systems, where logistics processes require time, generate costs, engage various resources, and encounter numerous risks and disruptions. It is rightly argued that logistics and product delivery are crucial and critical factors for the success of e-commerce. Online sellers seek various solutions to efficiently deliver products and meet increasing consumer expectations. In this process, companies have two options: to handle distribution with their resources or to outsource it to logistics companies (providers) (Pajić, 2024). For the sellers themselves, the second option is more favorable as they engage a logistics service provider who has the necessary knowledge, experience, resources, and qualifications to offer and provide comprehensive logistics services in the areas of logistics system design, planning, management, and shipment delivery.



(a)



(b)

Figure 1. Flowchart diagram of e-commerce shipment distribution

In this context, the topic of this chapter is the organization of courier work in e-commerce. The process flow diagram (Figure 1) presents all the steps, or activities, that need to be carried out in the distribution of e-commerce shipments from the perspective of the courier service/courier. Naturally, all activities (and the accompanying documentation) will be described in more detail. It is also important to highlight that the participants in the observed process (distribution of e-commerce shipments) include:

- Courier;
- Warehousing staff;
- Maintenance vehicle clerk;
- Dispatcher; and
- Customer (legal or natural person).

3.1 Preparation for the Route and Courier Assignment

Before departure on the route, the courier is obliged to check and collect the necessary documentation, packaging, and equipment, as well as perform a vehicle inspection at the DC. Additionally, upon signing the Employment Contract, the courier is assigned responsibility for the uniform, ID card, vehicle, and fuel card. Couriers are personally responsible for any money collected from customers for postage and insurance until the time of their unassignment. Furthermore, they are responsible for the PDA device, printer, vehicle, and the e-commerce shipments they load before leaving for the field, as well as the shipments they have received from clients that day (Company X, 2024).

3.1.1 Documentation and equipment

When collecting or delivering shipments, the courier must have the following documentation and equipment (Company X, 2024):

- PDA device;
- GPS device;
- Printer for printing labels;
- Delivery list / e-commerce shipment checklist for pickup;
- Price list;
- Shipment defect report;
- Transport envelopes and bags;
- Return packaging.

3.1.2 Vehicle inspection before departure on the route

After collecting the documentation and PDA device, the courier proceeds to the parking lot where they collect the vehicle assigned for the given route. The courier is informed by the DC dispatcher whether it is necessary to perform a vehicle handover with another courier (in case the vehicle was used by another courier on the previous route) or if only the regular vehicle inspection is required (if the courier was the only one using the vehicle on the previous route). If the courier is taking over a vehicle previously used by another courier, a vehicle handover process is carried out. This involves inspecting the vehicle, equipment, and accompanying documentation. The factual status is recorded on the Courier Assignment/Unassignment Vehicle Documents (vehicle details are entered), and the Inventory of Documentation and Equipment in the Vehicle (details of the documentation and equipment in the vehicle are entered). Couriers confirm by signature that the vehicle handover, equipment, and documentation have been completed in accordance with the information on the documents. Each report is printed in two copies - one copy is handed to the dispatcher by the courier who handed over the vehicle, and the other copy remains with the courier receiving the report (Company X, 2024).

If the fuel or AD Blue tank is not filled to the top, if the oil or any other fluid levels are not at the prescribed levels, or if any defects or malfunctions are found in the vehicle, documentation, or equipment, the courier receiving the vehicle must immediately notify the dispatcher and await further instructions. After vehicle assignment, the courier must check the following before departure (Company X, 2024):

- Amount of fuel, engine oil, and coolant;
- Amount of windshield washer fluid;
- Functionality of steering and braking systems (play in the steering wheel and brake pedals, wheel attachment);
- Functionality of lighting and signaling systems;
- Condition of tires;
- Completeness and validity of vehicle documentation (traffic permit, fire extinguisher certificate, six-month inspection certificate, insurance policy);
- Possession of mandatory equipment (first aid kit, safety triangle, reflective vest, spare tire, tow rope, jack, etc.);
- Hygiene, i.e., cleanliness and tidiness of the vehicle.

While completing the route, the courier is prohibited from:

- Transporting persons not listed in the travel order;
- Driving over the speed limit;
- Driving on curbs or lawns;
- Parking or stopping vehicles outside the approved route or designated areas.

Of course, couriers are obliged to adhere to traffic regulations during their tasks and ensure that the vehicle is returned clean and ready for the next route or courier.

3.2 Receipt of E-Commerce Shipments

When receiving an e-commerce shipment, the courier is obligated to check the accuracy of the data provided. Specifically, they must verify the dimensions, weight, and packaging of the shipment. The receipt of shipments is carried out using the PDA device (Company X, 2024).

3.3 Packaging of E-Commerce Shipments

When collecting an e-commerce shipment from a customer, whether a new or existing client, the courier must pay attention to the contents of the shipment and ensure that it is appropriately packaged so it can be delivered to the desired address without damage. Packaging of e-commerce shipments involves placing the contents in appropriate packaging to prevent damage to the goods and other shipments during transport. The sender is responsible for both internal and external packaging, i.e., the primary and secondary packaging. Proper packaging means that the e-commerce shipment must be packed in such a way as to protect it from damage (for example, packaging heavy or bulky goods in thin plastic will likely cause the packaging to tear during the first handling, leading to damage). Furthermore, proper packaging means that the box containing the goods must be 100% filled, meaning that friction between items or between the items and the walls of the box must be prevented. Therefore, the courier is obligated to refuse the receipt of an e-commerce shipment if they determine that the packaging is inadequate and cannot protect the contents.

For fragile items, they must be wrapped in protective material (e.g., bubble wrap, rigid foam, Styrofoam, etc., depending on the contents) and packed in a hard box, or in sturdy cardboard if the shape of the item does not allow packing in a box. Liquids, greasy substances, and powders must be packaged in leak-proof containers. Each container is further placed in a special sturdy box with appropriate absorbent material to soak up any liquid in case the container is damaged. The box lid is securely closed so that it cannot open during transport. If the shape of the item does not allow packaging in a box, the item must be wrapped in stiff cardboard and filled with appropriate protective material. If the courier is responsible for packaging the shipment, they must choose the appropriate packaging based on the dimensions, weight, and type of e-commerce shipment, such as a cardboard envelope (for documents) or a PVC bag (Company X, 2024).

3.4 Handling of E-Commerce Shipments

Couriers are obligated to handle e-commerce shipments with care. Improper handling significantly increases the likelihood of damage to the shipment, leading to customer dissatisfaction and financial loss for the company. Special attention should be given to valuable shipments and return documentation. During this process, the courier is required to suggest that the customer insure their shipment. Furthermore, when collecting valuable or cash-on-delivery shipments, the courier must request to see the customer's ID with a photo to verify the identity of the sender. The number of the personal ID with a photo is entered into the receipt list. Return documentation is to be kept by the courier, especially when leaving the vehicle, as courier vehicles are often targeted for break-ins. The courier must always keep the cash from collected cash-on-delivery and valuable shipments in a pouch around their waist, where they also carry the PDA device. Shipments that are marked with special labels (Figure 2) require extra care when handling (Company X, 2024).

3.4.1 Prohibited for transport

The contents of an e-commerce shipment must be appropriate for transportation by the courier service, as transporting perishable or fragile goods is often not feasible. The following items are prohibited from being transported (Company X, 2024):

- Dangerous or harmful materials, as well as items that can endanger human health and life or damage other shipments, except for materials regulated by specific laws.
- Narcotics and psychotropic substances, except when the sender and recipient are authorized for their trade or use.
- Products or substances that may damage other shipments or equipment due to their nature or packaging.
- Money, coins, banknotes, other valuables, precious metals, and valuable jewelry pieces, except in valuable shipments.
- Live animals.
- Other materials or items whose shipment is prohibited by other regulations.

If there is reason to suspect that a shipment contains prohibited items, the courier may request the sender to open the package for inspection upon acceptance. If necessary, the courier may also ask for proof of the sender’s identity. Once the inspection is complete, the sender must reseal the package in the courier’s presence.

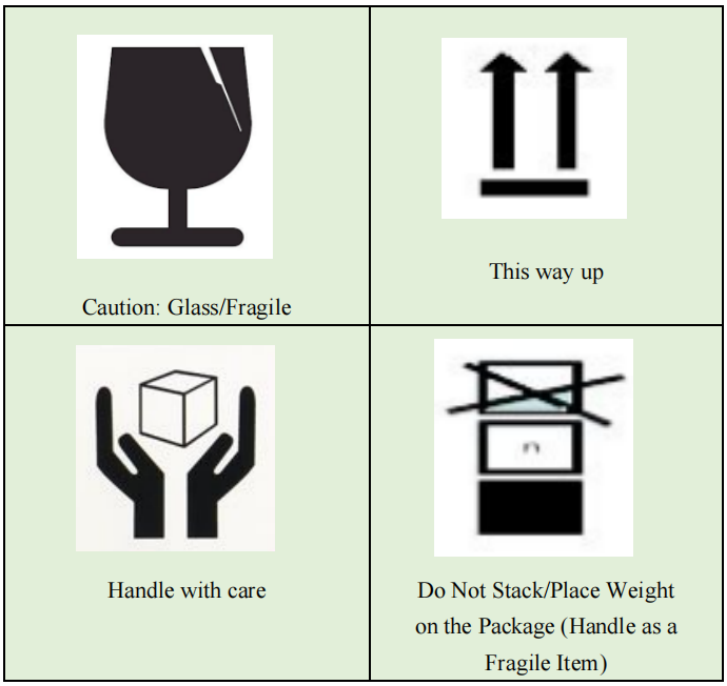


Figure 2. Labels for shipment packages requiring special handling

3.4.2 Loading and unloading of e-commerce shipments

When loading e-commerce shipments into the vehicle's cargo space, couriers must pay special attention to the size, weight, and contents of the packages. Lighter and fragile packages are always placed on top (packages must not "move around" inside the vehicle). Shipments that will be delivered later are loaded first, followed by those that will be unloaded first, following the LIFO (Last In, First Out) principle. A proper arrangement of goods inside the vehicle prevents package overturning and minimizes the risk of damage, as well as reduces time spent searching for packages. This method enhances courier efficiency in the field (Company X, 2024).

3.4.3 Delivery procedure and handling of e-commerce shipments

As a rule, the courier personally delivers the e-commerce shipment to the recipient, an authorized representative, or an authorized person. Delivery includes direct delivery to the recipient's address, as well as pickup at postal operator branches, other contractually defined locations, or locations agreed upon verbally between the service user and the operator or courier, including parcel lockers. If the e-commerce shipment cannot be delivered to the specified persons, the courier may deliver the shipment to an adult household member, a household employee, or an employee found in the recipient's business premises. In cases of unsuccessful registered shipment deliveries, the courier must leave a notice of arrival, specifying the deadline and location where the recipient can collect the postal shipment. This notice can be sent electronically (via email or SMS notification) or physically left at the recipient's address. If a notice of arrival has been issued before the delivery deadline expires, the courier is considered to have fulfilled their obligation, and the shipment is deemed delivered within the prescribed period. E-commerce shipments delivered to a postal operator's branch must be collected by recipients within five working days. The deadline starts from the next working day of the postal operator following the issuance of the arrival notice. The sender has the right to manage the shipment until it is delivered to the recipient. Conversely, the recipient has the right to refuse the shipment. Unless otherwise specified by the sender, an e-commerce shipment is immediately returned to the sender if (Company X, 2024):

- The recipient refuses acceptance;
- The recipient is unknown;
- The address is incomplete;
- The address is incorrect;
- The storage period has expired; and
- The recipient has relocated.

3.4.4 Courier clearance at the DC after e-commerce shipment delivery

After picking up and delivering e-commerce shipments, the courier, upon returning to the DC, must complete clearance for the collected shipments and their accompanying documentation, returnable packaging, equipment, and collected payments/receipts (submitted to the dispatcher). Additionally, the courier is required to hand over

adequately packed shipments to the warehouse worker. In the event of a package shortage (e.g., lost package), the courier is held accountable. Furthermore, the physical pickup and delivery of e-commerce shipments are tracked via system-based courier check-in/check-out using a PDA device (Company X, 2024).

3.5 Vehicle Maintenance

The courier is responsible for:

- Proper vehicle maintenance;
- Maintaining both external and internal cleanliness – external cleanliness ensures the proper functioning of lighting and signaling devices, visibility while driving, and an aesthetically acceptable appearance in public traffic, while internal cleanliness and the proper functioning of heating and ventilation (or air conditioning) systems enhance driving comfort and reduce driver fatigue;
- Rational vehicle usage with speed adjusted to road conditions (reckless driving can lead to package damage).

Additionally, based on vehicle monitoring through onboard instruments, the courier must notify the vehicle maintenance officer about the need for scheduled servicing at least six days in advance. The maintenance officer schedules the service and informs the courier (time and place) at least one day in advance. The courier is then required to deliver the vehicle to the service center at the designated time and submit all necessary documents obtained from the service to the maintenance officer. The courier is responsible for any vehicle damage resulting from improper use or negligent behavior (Company X, 2024).

3.5.1 Hygiene of the cargo space

Before loading e-commerce goods/shipments, the courier must ensure that the vehicle meets the following hygiene requirements:

- The external appearance of the vehicle must be clean and in visibly good condition;
- The cargo space (floor, walls, and roof) must be free of odors, grease stains, moisture, floor damage and patches, wooden debris, metal shavings, and the presence of rodents or insects.

Vehicle washing is scheduled for Fridays, after route completion. If necessary (e.g., due to adverse weather conditions), additional washes can be performed once or twice during the week with prior supervisor approval (Company X, 2024).

3.5.2 Parking in urban zones

Couriers must adhere to time-restricted parking regulations in designated zones. Parking zones and time restrictions depend on the city where e-commerce shipments are being distributed. Couriers are required to stay informed about the zones and payment methods for parking spaces (e.g., via the Parking Service website) (Company X, 2024).

4. Performance Measurement and Ranking of Couriers in E-Commerce

4.1 Methodology

A model was developed to rank the couriers, utilizing the CRITIC and MABAC methods. Following a literature review and an analysis of data provided by the company, nine criteria and 20 alternatives (couriers) were identified. The CRITIC method was then applied in the first phase to determine the criteria weights, after which the MABAC method was used to rank the alternatives (Figure 3).

4.1.1 CRITIC method

The CRITIC method considers the intensity of contrast and conflict within the decision-making problem structure and uses correlation analysis to identify differences among criteria. The following steps should be conducted when implementing this method (Pajić et al., 2024; Adali & Isik, 2017).

Step 1. Forming an initial decision-making matrix $X = [x_{ij}]_{mxn}$ that has m alternatives and n criteria, and where x_{ij} is the value of an alternative according to a specific criterion.

Step 2. Normalizing the decision-making matrix by applying Eq. (1).

$$x_{ij}^{*} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \tag{1}$$

Step 3. Calculating criteria weights by taking into account the standard deviation of the criterion as well as its correlation with other criteria (Eq. (2)).

$$w_j = \frac{C_j}{\sum_{i=1}^{m} C_i} \tag{2}$$

where, C_j is the quantity of information contained in the j^{th} criterion and is calculated by applying Eq. (3).

$$C_j = \sigma_j \sum_{i=1}^{m} (1 - r_{ij}) \tag{3}$$

where, σ_j represents the standard deviation of the j^{th} criterion, while r_{ij} is the correlation coefficient between the j^{th} and i^{th} criteria. The relative importance of a criterion is determined by the value of C_j, as a higher value indicates a greater amount of information obtained from that criterion.

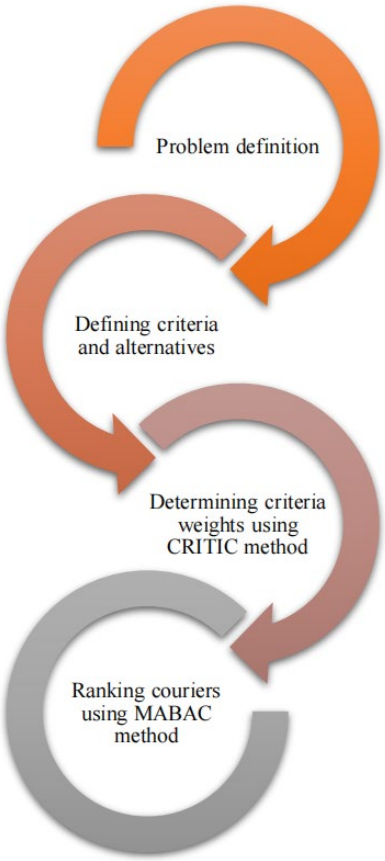


Figure 3. Methodology of the paper

4.1.2 MABAC method

On the other hand, the following steps must be conducted when implementing the MABAC method (Pamučar & Ćirović, 2015; Wang et al., 2024).

Step 1. Defining the initial decision-making matrix (X) that has m alternatives and n criteria.

Step 2. Normalization of the initial decision-making matrix (X) using Eq. (4), for benefit criteria, and (5) for cost criteria.

$$n_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \tag{4}$$

$$n_{ij} = \frac{x_{ij} - x_i^+}{x_i^- - x_i^+} \tag{5}$$

where, x_{ij}, x_i^+ and x_i^- represent the elements obtained from the initial decision-making matrix using Eq. (6) and (7):

$$x_i^+ = \max(x_1, x_2, \ldots, x_m) \tag{6}$$

$$x_i^- = \min(x_1, x_2, \ldots, x_m) \tag{7}$$

Step 3. Determining the weighted decision-making matrix (V) using Eq. (8).

$$v_{ij} = w_i * (n_{ij} + 1) \tag{8}$$

Step 4. Determining border approximation area (BAA) matrix (G) using Eq. (9).

$$g_i = (\prod_{j=1}^{m} v_{ij})^{1/m} \tag{9}$$

Step 5. In order to form matrix Q, the calculation of the distance of the alternative from the BAA must be conducted. The determination of the alternative's proximity to the border approximation area (q_{ij}) is calculated by computing the discrepancy between elements in the weighted matrix (V) and the value assigned to the border approximation area (G). Hence, g_i denotes the border approximation area associated with criterion C_i, while v_{ij} represents the weighted matrix of the elements (V).

Alternative A_i is classified into the border approximation area (G), upper approximation area (G^+), or lower approximation area (G^-), expressed as, $Ai \in \{G \vee G^+ \vee G^-\}$. The upper approximation area (G^+) includes the ideal alternative (A^+), while the lower approximation area (G^-) contains the anti-ideal alternative (A^-). The assignment of alternative A_i to one of these approximation areas (G, G^+, or G^-) is determined using Eq. (10).

$$Ai \in \begin{cases} G^+ \; if \; q_{ij} > 0 \\ G \; if \; q_{ij} = 0 \\ G^- \; if \; q_{ij} < 0 \end{cases} \tag{10}$$

Step 6. In the last step, alternatives ranking is conducted based on the values of the criterion functions for the alternatives, Eq. (11).

$$S_i = \sum_{j=1}^{n} q_{ij}, j = 1, 2, \ldots, n \;\; i = 1, 2, \ldots, m \tag{11}$$

4.2 Results

To implement the developed model, the process began with defining the criteria for evaluating couriers (alternatives). The selection of criteria was based on a thorough review of the literature and company data, specifically the parameters tracked during the delivery process. As a result, nine key criteria were established (Kosareva et al., 2016; Kwak & Kim, 2018; Andrejić & Pajić, 2023; Stević et al., 2024). Additionally, 20 alternatives (couriers) were identified and assessed according to these criteria. This evaluation led to the construction of the initial decision matrix (Table 1).

- Number of Deliveries per Day (C1): Represents the average number of shipments a courier delivers to end customers in a single day.
- Average Delivery Time (C2): Indicates the average duration of a delivery.
- Delivery Accuracy (C3): Measures the percentage of shipments delivered within the promised time frame.
- Number of Complaints per Month (C4): Represents the number of complaints related to the courier's performance.
- Customer Rating (C5): Reflects customer feedback on the courier's service, rated on a scale from 1 to 10 (qualitative criterion).
- Route Efficiency (C6): Assesses the courier's ability to adapt to traffic conditions and optimize delivery routes independently, rated on a scale from 1 to 10 (qualitative criterion).
- Professionalism (C7): Evaluates the courier's politeness and behavior towards customers during delivery, rated on a scale from 1 to 10 (qualitative criterion).
- Damaged Shipments (C8): Represents the percentage of shipments that sustain damage during delivery.
- Overtime Rate (C9): Indicates how frequently a courier must work beyond scheduled hours to complete all deliveries.

Table 1. Initial decision-making matrix

Courier	C1	C2 (min)	C3 (%)	C4	C5 (1-10)	C6 (1-10)	C7 (1-10)	C8 (%)	C9 (%)
Courier 1 (A1)	25	20	96	1	9	8	9	0.4	5
Courier 2 (A2)	20	25	92	2	8	7	8	0.6	10
Courier 3 (A3)	28	18	98	1	9	9	10	0.3	4
Courier 4 (A4)	22	22	90	3	7	7	8	0.7	12
Courier 5 (A5)	30	16	99	0	10	10	10	0.2	3
Courier 6 (A6)	24	20	94	2	8	8	8	0.5	8
Courier 7 (A7)	26	18	97	1	9	9	9	0.3	6
Courier 8 (A8)	23	22	93	2	8	7	8	0.6	9
Courier 9 (A9)	27	19	95	1	9	8	9	0.4	7
Courier 10 (A10)	25	20	96	1	9	9	9	0.4	5
Courier 11 (A11)	21	24	89	3	7	7	8	0.8	11
Courier 12 (A12)	29	17	98	0	10	10	10	0.2	4
Courier 13 (A13)	22	22	91	2	8	7	8	0.7	10
Courier 14 (A14)	28	18	96	1	9	9	9	0.3	6
Courier 15 (A15)	19	26	88	3	7	6	7	0.9	15
Courier 16 (A16)	30	15	99	0	10	10	10	0.2	2
Courier 17 (A17)	24	21	94	2	8	8	8	0.5	9
Courier 18 (A18)	27	19	95	1	9	9	9	0.4	5
Courier 19 (A19)	20	25	90	3	7	7	8	0.7	12
Courier 20 (A20)	29	17	97	0	10	10	10	0.3	4

After defining the initial decision matrix, the CRITIC method was applied to determine the criteria weights. After applying Eqs. (1)-(3), the following criteria weights were obtained (Table 2).

Table 2. Criteria weights obtained using the CRITIC method

	C1	C2	C3	C4	C5	C6	C7	C8	C9
Weights	0.101	0.113	0.099	0.157	0.111	0.098	0.095	0.119	0.107

In the next phase, the MABAC method was applied along with the criteria weights obtained in the previous phase. The initial step when implementing the MABAC method represents the normalization of the initial decision-making matrix (Table 3) by applying Eq. (4) and Eq. (5), based on the criteria type.

Table 3. Normalized decision-making matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9
A1	0.545	0.545	0.727	1.000	0.667	0.500	0.667	0.714	0.769
A2	0.091	0.091	0.364	0.500	0.333	0.250	0.333	0.429	0.385
A3	0.818	0.727	0.909	1.000	0.667	0.750	1.000	0.857	0.846
A4	0.273	0.364	0.182	0.000	0.000	0.250	0.333	0.286	0.231
A5	1.000	0.909	1.000	1.000	1.000	1.000	1.000	1.000	0.923
A6	0.455	0.545	0.545	0.500	0.333	0.500	0.333	0.571	0.538
A7	0.636	0.727	0.818	1.000	0.667	0.750	0.667	0.857	0.692
A8	0.364	0.364	0.455	0.500	0.333	0.250	0.333	0.429	0.462
A9	0.727	0.636	0.636	1.000	0.667	0.500	0.667	0.714	0.615
A10	0.545	0.545	0.727	1.000	0.667	0.750	0.667	0.714	0.769
A11	0.182	0.182	0.091	0.000	0.000	0.250	0.333	0.143	0.308
A12	0.909	0.818	0.909	1.000	1.000	1.000	1.000	1.000	0.846
A13	0.273	0.364	0.273	0.500	0.333	0.250	0.333	0.286	0.385
A14	0.818	0.727	0.727	1.000	0.667	0.750	0.667	0.857	0.692
A15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A16	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
A17	0.455	0.455	0.545	0.500	0.333	0.500	0.333	0.571	0.462
A18	0.727	0.636	0.636	1.000	0.667	0.750	0.667	0.714	0.769
A19	0.091	0.091	0.182	0.000	0.000	0.250	0.333	0.286	0.231
A20	0.909	0.818	0.818	1.000	1.000	1.000	1.000	0.857	0.846

In the next step, a weighted normalized decision-making matrix was obtained using Eq. (8). The obtained values are given below (Table 4).

Table 4. Weighted normalized decision-making matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9
A1	0.156	0.175	0.171	0.314	0.185	0.147	0.158	0.204	0.189
A2	0.110	0.123	0.135	0.236	0.148	0.123	0.127	0.170	0.148
A3	0.184	0.195	0.189	0.314	0.185	0.172	0.190	0.221	0.198
A4	0.129	0.154	0.117	0.157	0.111	0.123	0.127	0.153	0.132
A5	0.202	0.216	0.198	0.314	0.222	0.196	0.190	0.238	0.206
A6	0.147	0.175	0.153	0.236	0.148	0.147	0.127	0.187	0.165
A7	0.165	0.195	0.180	0.314	0.185	0.172	0.158	0.221	0.181
A8	0.138	0.154	0.144	0.236	0.148	0.123	0.127	0.170	0.156
A9	0.174	0.185	0.162	0.314	0.185	0.147	0.158	0.204	0.173
A10	0.156	0.175	0.171	0.314	0.185	0.172	0.158	0.204	0.189
A11	0.119	0.134	0.108	0.157	0.111	0.123	0.127	0.136	0.140
A12	0.193	0.205	0.189	0.314	0.222	0.196	0.190	0.238	0.198
A13	0.129	0.154	0.126	0.236	0.148	0.123	0.127	0.153	0.148
A14	0.184	0.195	0.171	0.314	0.185	0.172	0.158	0.221	0.181
A15	0.101	0.113	0.099	0.157	0.111	0.098	0.095	0.119	0.107
A16	0.202	0.226	0.198	0.314	0.222	0.196	0.190	0.238	0.214
A17	0.147	0.164	0.153	0.236	0.148	0.147	0.127	0.187	0.156
A18	0.174	0.185	0.162	0.314	0.185	0.172	0.158	0.204	0.189
A19	0.110	0.123	0.117	0.157	0.111	0.123	0.127	0.153	0.132
A20	0.193	0.205	0.180	0.314	0.222	0.196	0.190	0.221	0.198

In the next two steps, the calculation of the border approximation area matrix (Table 5) is conducted by applying Eq. (9) and Eq. (10).

Table 5. Border approximation area matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9
G_i	0.152	0.170	0.153	0.254	0.164	0.150	0.148	0.189	0.167

Finally, in the last step, alternatives are ranked using the values of S_i (Table 6). The best-ranked alternative is the one with the greatest value after using Eq. (11).

Based on the results presented in Table 6, it can be concluded that the best-ranked alternative is A16, followed by A5, A12, and so on, while the worst-ranked alternative is A15.

Table 6. Ranking of the alternatives

	C1	C2	C3	C4	C5	C6	C7	C8	C9	S_i	Ranking
A1	0.004	0.005	0.018	0.060	0.021	-0.003	0.011	0.015	0.022	0.152	11
A2	-0.042	-0.046	-0.018	-0.019	-0.016	-0.028	-0.021	-0.019	-0.019	-0.228	16
A3	0.031	0.026	0.036	0.060	0.021	0.021	0.042	0.032	0.030	0.300	5
A4	-0.024	-0.015	-0.036	-0.097	-0.053	-0.028	-0.021	-0.036	-0.036	-0.346	17
A5	0.050	0.046	0.045	0.060	0.058	0.046	0.042	0.049	0.038	0.434	2
A6	-0.005	0.005	0.000	-0.019	-0.016	-0.003	-0.021	-0.002	-0.003	-0.064	12
A7	0.013	0.026	0.027	0.060	0.021	0.021	0.011	0.032	0.014	0.224	7
A8	-0.015	-0.015	-0.009	-0.019	-0.016	-0.028	-0.021	-0.019	-0.011	-0.152	14
A9	0.022	0.015	0.009	0.060	0.021	-0.003	0.011	0.015	0.005	0.155	10
A10	0.004	0.005	0.018	0.060	0.021	0.021	0.011	0.015	0.022	0.177	9
A11	-0.033	-0.036	-0.045	-0.097	-0.053	-0.028	-0.021	-0.053	-0.028	-0.393	18
A12	0.041	0.036	0.036	0.060	0.058	0.046	0.042	0.049	0.030	0.398	3
A13	-0.024	-0.015	-0.027	-0.019	-0.016	-0.028	-0.021	-0.036	-0.019	-0.205	15
A14	0.031	0.026	0.018	0.060	0.021	0.021	0.011	0.032	0.014	0.234	6
A15	-0.051	-0.057	-0.054	-0.097	-0.053	-0.052	-0.053	-0.070	-0.060	-0.547	20
A16	0.050	0.056	0.045	0.060	0.058	0.046	0.042	0.049	0.047	0.453	1
A17	-0.005	-0.005	0.000	-0.019	-0.016	-0.003	-0.021	-0.002	-0.011	-0.082	13
A18	0.022	0.015	0.009	0.060	0.021	0.021	0.011	0.015	0.022	0.196	8
A19	-0.042	-0.046	-0.036	-0.097	-0.053	-0.028	-0.021	-0.036	-0.036	-0.395	19
A20	0.041	0.036	0.027	0.060	0.058	0.046	0.042	0.032	0.030	0.372	4

5. Conclusions

The findings of this study underscore the critical role of couriers in e-commerce deliveries. Their significance is further amplified by the fact that, beyond delivery speed and cost, two of the most important criteria for customers today, trust and delivery flexibility, have also emerged as key factors influencing customer satisfaction. Given this, it is imperative to continuously implement performance monitoring measures to enhance courier efficiency and service quality. This study aimed to analyze the role of couriers in last-mile delivery and propose a performance evaluation model to improve their effectiveness. Along with a detailed breakdown of the various task's couriers undertake, the study introduces a model based on CRITIC-MABAC methods for assessing and ranking courier performance. To validate the proposed model, it was applied to a real-world case study, evaluating 20 couriers based on nine criteria: number of deliveries per day, average delivery time, delivery accuracy, number of complaints per month, customer rating, route efficiency, professionalism, damaged shipments, and overtime rate. The CRITIC method identified C4 as the most influential criterion, while C7 had the least impact on rankings. The results revealed that Courier 16 ranked the highest, whereas Courier 15 ranked the lowest.

A key limitation of this study is the relatively small sample size (20 couriers), highlighting the need for future research to expand the dataset. Further research directions include applying the proposed methodology to larger datasets and extending its use to other logistics operations, such as ranking order pickers, forklift operators, and other key personnel. Additionally, combining the proposed model with other analytical approaches (e.g., DEA, MCDM, linear programming, metaheuristics) presents a valuable avenue for further study. Finally, developing and implementing the model in Python is another promising direction for future research.

Author Contributions

Conceptualization, Aleksa Maravić, Vukašin Pajić, and Milan Andrejić; Methodology, Aleksa Maravić, Vukašin Pajić, and Milan Andrejić; Software, Vukašin Pajić and Milan Andrejić; Validation, Aleksa Maravić, Vukašin Pajić, and Milan Andrejić; Writing—original draft preparation, Aleksa Maravić, Vukašin Pajić, and Milan Andrejić; Writing—review and editing, Aleksa Maravić, Vukašin Pajić, and Milan Andrejić. All authors have read and agreed to the published version of the manuscript.

Data Availability

The data supporting our research results are included within the article.

Conflicts of Interest

The authors declare no conflict of interest.

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