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THE MEDIATING ROLE OF LOGISTICS 4.0 CAPABILITY ON THE RELATIONSHIP BETWEEN E-COMMERCE MARKETING AND FIRM PERFORMANCE

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Abstract: This study aims to determine whether e-commerce marketing capability impacts firm performance and what role logistics 4.0 plays in this relationship. Based on the literature and grounded on dynamic capability theory we develop a theoretical framework in which logistics 4.0 capability plays a mediating role in the relationship between e-commerce marketing and firm performance. Our hypotheses are tested using survey data from 553 respondents working in the logistics, textiles, white goods, and electronics sectors. The data is analyzed using structural equation modeling. Empirical results show that e-commerce marketing positively impacts firm performance and logistics 4.0 capability is mediating in this relationship. Logistics 4.0 capability enhances firm performance by improving on-time deliveries and increasing the efficiency of supply chain processes. Our results highlight the importance of investing in Logistics 4.0 capability including talent, managerial, and technical resources to improve the benefits the firm is getting from e-commerce marketing. Logistics 4.0's capability enhances e-commerce marketing's impact on firm performance by increasing on-time deliveries, efficiency, flexibility, quality, and responsiveness to customers, and improving the ability to build enterprise agility. This study contributes to firm performance literature by identifying the mediating role Logistics 4.0 plays in the relationship between e-commerce marketing and performance.

Keywords: Logistics 4.0 Capability, E-Commerce Marketing Capability, Firm Performance, Dynamic Capability

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Introduction

E-commerce has become a critical supply chain mechanism in increasing productivity for businesses by changing product flows, increasing the effectiveness of supply chain processes, and creating opportunities for businesses to reach new markets (Kurniawati et al., 2020). Globalization of markets, the shortening of product life cycles, changing customer demands, and technological developments have enabled the digitalization of e-commerce and logistics systems (Dallasega et al., 2022). E-commerce is an approach that allows companies to alleviate information asymmetry in the supply chain, reduce costs, and improve the link between supply and market demand (Lin et al., 2020).

Nowadays, it is vital for businesses that desire to be one step ahead of their competitors to enhance their innovation capability in e-commerce and review their e-commerce strategies (Fruhling and Siau, 2007). The Turkish e-commerce market is the 18th largest e-commerce market in the world, with a revenue of US$ 22,983.4 million. The electronics sector ranks first with a rate of 42.2%, the textile sector at 22.6%, the toys and hobby sector at 16.6%, the white goods and furniture sector at 9.8%, and the cosmetics and food sector at 8.5%. The e-commerce market is gaining momentum in Turkey. With the expected 40.9% growth in 2023, the Turkish e-commerce market is expected to contribute to the 17% growth rate worldwide in 2023. Turkey's e-commerce market volume is estimated to be 39,441.6 million USD in 2027 (e-commerce, 2023). Although the electronics and textile sectors are the most growing e-commerce markets in Turkey, it is noteworthy that enterprises focus on e-commerce, especially in the electronics and logistics sectors in our research.

Logistics 4.0 capability acts as leverage in strengthening their e-commerce capability. With the effect of globalization, businesses tend to invest in e-commerce resources. Investing in logistics 4.0 implementation to increase capability in e-commerce processes does not guarantee success, but it allows for increased firm performance (Ravichandran et al., 2009). These technologies are categorized as blockchain, big data, internet of things, artificial intelligence, augmented reality, 3D-4D printers, cloud computing, autonomous vehicles, and robots (Lambert et al., 2011). Artificial intelligence and robotics are used in logistics operations such as transportation, storage, inventory management, distribution planning, demand forecasting, and order processing in supply chain processes with Logistics 4.0 capability (Wilson, 2020). The Internet of Things offers managers real-time monitoring and data visualization (Wielki, 2017). Unexpected conditions can be determined in advance and demand forecasts can be made accordingly with big data and artificial intelligence technologies, augmented reality technologies reduce the labor cost in packaging and product-picking processes in e-commerce enterprises (Wachnik, 2022). Thus, the Internet of Things, big data, artificial intelligence, and augmented reality technologies increase business performance (Nour, 2022).

Knapp firm's advanced augmented reality technologies in warehouse operations have reduced the likelihood of complexity and human errors by approximately 40% (Baur and Wee, 2015). Tesla firm was used machine learning software to collect data

from specific GPS locations and make predictions about how drivers will behave (Kumari and Bhat, 2021). 3D printers will have positive effects on last-mile logistics. In addition, since the need for spare parts production will be met immediately, capital bonding will be prevented in the electronics, textile, automotive, and white goods supply chain industries. Rolls Royce, BMW, and AUDI, General Motors companies use 3D printing technology to produce spare parts for automotive testing and assembly. This technology allows new designs to be tested very quickly, thus saving time and costs (Elakkad, 2019). Amazon and Alibaba companies manage drones to deliver small packages to speed up delivery (Tang and Veelenturf, 2019).

This study proposes to fill the gap in the literature by investigating the linkages among e-commerce capability, logistics 4.0 capability, and firm performance. This investigation determined the dynamic capability used in logistics 4.0 and revealed the relations between the firm performance and logistics 4.0 capability, e-commerce marketing capability through the comprehensive model.

Key research questions that motivated our study are:

1) In an e-commerce setting, how does E-commerce marketing capability influence firm performance?

2) How does logistics 4.0 capability mediator the relationship between E-commerce marketing capability and firm performance?

We first developed a theoretical framework grounded on the enterprises' e-commerce marketing capability and logistics 4.0 capability view to answer these questions.

Literature Review

E-commerce marketing capability and firm performance

The emergence of logistic E-commerce is defined as a universally usable resource that provides a competitive advantage in national and international markets. E-commerce capacity reflects an unprecedented cognitive technology capability and the ability to use the Internet (Lin et al., 2020). In addition, e-commerce capacity is significant in managing consumer services, strategic collaborations in the supply chain, and intra-organizational relationships (Braojos et al., 2019). E-commerce capability is adapted to the enterprise's business processes and describes the ability to conduct business over the Internet among the enterprises in the supply chain (Corejova et al. 2022). The extent to which e-commerce is equipped to a firm varies. Therefore, companies benefit from the Internet by integrating e-commerce capability into their organizational structures to produce resource complementarity (Zhu, 2004).

E-commerce capacity is categorized under 3 headings e-commerce management capability, e-commerce technical capability, and e-commerce talent capability. E-commerce management capability integrates business intelligence, e-commerce knowledge, and foresight and is an effective tool for achieving organizational goals (Chen et al., 2015). It is a leverage for enterprises to manage business processes, streamline transactions, and enhance customer service (Zhang et al., 2016; Zhu and

Kraemer, 2002). Enterprises with high e-commerce management capability can coordinate supply chain activities effectively, optimize the e-commerce process successfully, and increase efficiency with new information technologies in e-commerce. E-commerce technical capacity has an effective function in integrating e-commerce initiatives into IT infrastructures. Because it solves the technical problems that arise in the e-commerce activities of the enterprises. Otherwise, e-commerce technical competence can also offer simultaneous information sharing for actors in the supply chain in international markets (Chen et al., 2014).

E-commerce technical capability plays a key role in eliminating the technical deficiencies of enterprises in e-commerce within the scope of know-how, problem-solving processes, and business unit cooperation strategies (Benitez et al., 2018). E-commerce talent capability focuses on the development of professional knowledge and skills of employees for the successful execution of e-commerce applications (Kim et al., 2017). Enterprises will design key performance indicators of their e-commerce initiatives with employees with high e-commerce skills. In addition, these skills will enable the change in e-commerce demand to be predicted more easily and in a short time, and it will be possible to work the e-commerce strategy in harmony with the business strategy (Wamba et al., 2017). Businesses with high e-commerce capability can enable customers to create value for themselves through information sharing and online communities. Although e-commerce has helped businesses grow tremendously in both national and international markets, it also contains many challenges. E-commerce capability provides an increase in business performance with the criteria of "information technology capability, strategic flexibility and ability to build trust" (Saini and Johnson, 2005).

Table 1. The Relationship Between E-Commerce Marketing Capability and Firm Performance

References	Advantages of E-Commerce Marketing Capability
Lin et al. (2020)	E-commerce market capability increases enterprise agility and contributes to financial and non-financial performance.
Benitez et al. (2018)	E-commerce technical capacity enables businesses to manage operations with a more flexible infrastructure and facilitates the integration of e-commerce initiatives with information Technologies.
Chen et al. (2017)	E-commerce market capability helps businesses evaluate opportunities and challenges in the macro and microenvironment.
Wamba et al. (2017)	E-commerce talent capability is a good instrument for good analysis of consumer expectations and requests. It encourages the consumer to purchase the products.
Akter et al. (2016)	E-commerce market management capability effectively coordinates sharing information and offers solutions.
Yang et al. (2015)	High-level e-commerce capability accelerates the integration of information technologies to facilitate e-commerce processes and increase customer satisfaction.

Garrison et al. (2015)	E-commerce technical capability offers an opportunity to deal with threats in national and international markets and reduces bureaucratic processes
Chakravarty et al. (2013)	E-commerce market capability increases the accuracy of demand forecasts by closely tracing the market changes and paying attention to the opinions of the customers.
Kim et al. (2012)	Enterprises that intend to improve their e-commerce talent capability tend to increase their employees' digital skills to increase firm performance and respond to changes in international markets.
Zhijun (2011)	E-commerce market capability not only strengthens supply chain integration but also enhances the organization's turn into a more agile structure and improves effective communication in the e-commerce process.
Stoel and Muhanna (2009)	E-commerce market capability is an effective tool for quickly and reliably analyzing market data and dealing with market fluctuations.
Zhu (2004)	E-commerce market capability develops faster and more informed decision-making in the e-commerce process and increases efficiency by reducing the possibility of error.
Kauffman and Walden (2001)	E-commerce market capability enables information flow to take place more effectively, motivates employees, and reduces transaction costs.

Logistics 4.0 capability and firm performance

Logistics capability is one of the most important keys to achieving competitive advantage and improving firm performance (Zhao et al., 2001). Mentzer et al., (2004) logistics capability is categorized under three parts (demand management capability, supply management capability, and information management capability). However, Gligor and Holcomb (2012) added coordination capability and defined the logistics capability in four factors. Logistics capability offers new innovative solutions in the supply chain process and strengthens the ability of companies to achieve a more agile structure (Ralston et al., 2013).

Logistics 4.0, expressed as smart logistics, is a concept developed to provide sustainable logistics solutions and meet customer requests and requirements without increasing costs (Winkelhaus and Grosse, 2020). Moreover, it is a blend of technologies that increases the speed of processing real and recent information and eliminates imprecision from sourcing raw materials to the destination (Barreto et al., 2017). Logistics 4.0 capability is a significant instrument in providing cost and quality control, as well as adding value to forward and reverse logistics processes. Reinforcement of the technological infrastructure and integration of digital technologies into all supply chain processes are fundamental for developing logistics 4.0 capability (Oleskow-Szłapka and Lubinski, 2016). Hazen et al. (2014) emphasized that the effective and efficient management of supply chain processes depends on logistics 4.0 capability. Khan et al. (2022) proved with the Dematel method that the cooperation among the supply chain members of the logistics 4.0 adaptation and the support of the technological transformation by the top management are critical success factors in the logistics 4.0. Bhagawati et al. (2019) discussed the concept of the logistics 4.0 applications Which increase logistics

integration and strengthen supplier relationships in automotive supply chain management.

Table 2. The Relationship Between Logistics 4.0 Implementations and Firm Performance

References	Advantages of Logistics 4.0
Prajapati et al. (2022)	IoT-based supply chain applications develop visibility and connectivity.
Tukamuhabwa et al., (2021)	Adoption of logistics 4.0 technologies enables sustainable competitive advantage and decreases carbon footprint.
Atzeni et al. (2021)	Robots eliminate non-value-adding processes and reduce the time for the collection of returnable goods.
Choudhury et al. (2021)	Logistics 4.0 technologies increase real-time access, quality, and speed.
Ali et al. (2021)	Drone technology realizes product supply and delivery on time so it helps to reduce waste.
Gottge et al. (2020)	Big data, Augmented Reality, and Internet of Things technologies create innovations in operational and strategic processes and diminish uncertainty in the supply chain.
Ghadge et al. (2020)	Smart Logistics technologies boost flexibility, efficiency, and responsiveness in the supply chain.
Winkelhaus and Grosse, (2020)	Logistics 4.0 technologies contribute to the development of industry and international trade Which ensure customer satisfaction without increasing costs.
Schulz and Freund, (2019)	Blockchain technology improves reliable and effective communication in the supply chain without a central authority or intermediaries.
Saberi et al. (2019)	Blockchain technology provides security and privacy and assists in operational enhancements.
Mayr et al. (2018)	Cloud technology advances effective demand forecasting methods and reduces energy costs.
Hofmann and Rüsch, (2017)	Augmented Reality, Blockchain, Big Data, Internet of Things increase transparency in the supply chain.
Ramadan et al. (2017)	Smart Logistics technologies enhance real-time tracking of material flows in the supply chain.
Barreto et al. (2017)	Cloud Computing Systems and RFID technology offer quick solutions to transportation problems.
Wamba et al. (2017)	Big data technology increases growth in sales, high return on investment, higher levels of profitability, and minimizing inventory costs.

Development of Hypotheses

This conceptual framework suggests that appropriate measures of e-commerce capability, logistics 4.0 capability, and firm performance have to be developed.
E-commerce marketing capability increases access to new geographic market segments and attracts new customers to the portfolio. Thus, it enables the creation of new distribution channels (Chircu and Kauffman, 2000). During the pandemic period, E-commerce marketing capability is an effective tool to attract consumers

and increase sales. Enterprises optimize digital price promotions to create new opportunities (Agus et al., 2021). E-commerce marketing capacity increases retailers' online sales and strengthens coordination in distribution channels (Pentina and Hasty, 2009). Bakker et al. (2008) argue that there is a positive correlation between E-commerce marketing capability and logistics capability in the e-commerce process.

H1: E-Commerce marketing capability influences logistics 4.0 capability.

Logistics 4.0 capability is the ability of container shipping service enterprises to beget and distribute resources to answer the logistics needs and develop better customer service performance (Yang et al., 2009). Bag et al. (2020) stated that the technological and environmental capabilities of the enterprises are stronger than their organizational capability in the logistics 4.0 dynamic capability. Also, logistics 4.0 capability increases firm performance. Gupta et al. (2020) presented the logistics 4.0 technologies approach to systematic digitalization and outlined the importance of big data technology in increasing supply chain performance. Mathauer and Hoffmann (2019) argued that the adoption of logistics 4.0 technologies improves service quality and saves time in the logistics industry.

H2: Logistics 4.0 capability influences firm performance.

E-commerce marketing capacity improves firm performance in the retail industry (Fuller et al., 2022). Zhu and Kraemer (2002) emphasized that to gain a competitive advantage in e-commerce, it should focus on information technologies and ensure tight integration in the supply chain. Zhu (2004) found that there was a positive relationship between e-commerce marketing capability and technological infrastructure in the retail sector and drew attention to the fact that this relationship reduces inventory turnover and cost, thereby improving business performance.

H3: E-Commerce marketing capability influences firm performance.

E-commerce marketing capability positively affects export venture market performance and enhances distribution efficiency (Gregory et al., 2019). This capability accelerates the development of sectors and increases the circulation of products in wider geographies. Zhu et al. (2015) draw attention that E-commerce marketing capability can help businesses integrate the supply, logistics, and marketing processes of products, shorten the roaming connection, and gain a competitive advantage in international markets. Therefore, E-commerce marketing capacity reduces logistics costs and improves business performance (Kurnia et al. 2015).

H4: Logistics 4.0 capability plays a mediator role in the effect of e-commerce marketing capability on firm performance.

Based on our review of the literature, a conceptual framework has been developed as shown in Figure 1.

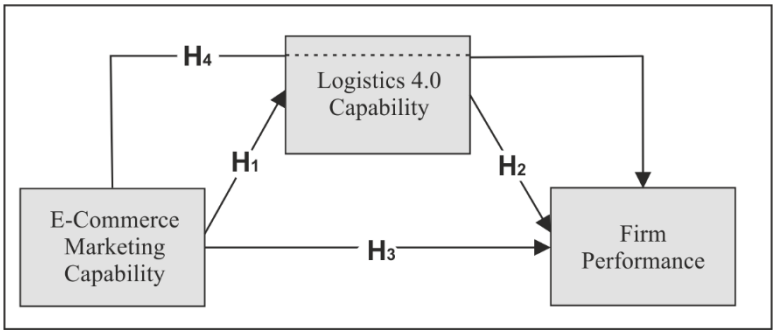

Figure 1: Conceptual Research Model

Research Methodology

The mediator function of Logistics 4.0 capability in the link between e-commerce marketing capability and Financial Performance was examined using the Baron and Kenny technique. Three alternative models are created using the Baron and Kenny technique to identify the mediator variable in the relationship between independent and dependent variables. Decomposing the expected effects between dependent, independent, and mediator factors is the rationale behind this (Baron and Kenny, 1986). The first step is the complementary factor analysis (CFA). CFA validates the theoretically predicted factor validity. Structural Equation Modelling has been preferred to test the hypotheses. This multivariate analysis technique enables the conceptual model's hypothesis to be tested concurrently and measures direct and indirect relationships within a single model. Also, compared to conventional approaches, it is the method that reduces measurement mistakes (Byrne, 2010). (Fornell and Larcker, 1981). The studies were conducted using the statistical applications AMOS and SPSS.

Measures and sampling

The scales taken from prior studies were utilized to measure the constructs. To measure Logistics 4.0 Capability, the scale adopted by Bag et al., (2020) was used for the E-Commerce Marketing Capability. Gregory et al. (2019), Wamba et al. (2017), and Bag et al. (2020) developed a scale measurement model for Firm Performance. 553 valid questionnaires were collected from different leading logistics, textile, electronics, and white goods companies in Turkey. The universe of the research consists of businesses that are e-commerce sites in Turkey and focus on Logistics 4.0 applications. Data were collected online with a Google survey form between January and December 2023. The sample of the research consists of 553 employees selected from the population by convenience sampling method. In total, 600 employees received feedback and the data obtained from 47 participants were not included in the analysis due to the missing answers of the participant.

To ensure scope validity, the measurement items were taken from the existing literature and adapted for e-commerce companies. For the English scale to accurately reflect the meaning of the items, all items were first translated into Turkish by two

researchers and then independently translated back into English by another researcher and checked. The two English versions of the scale were compared and adjusted to minimize language inconsistencies. 30 managers in logistics, textile, electronics, and white goods companies filled out the pre-test questionnaire. According to the feedback information, the scale was further changed to make the content accurate, neat, and easy to understand.

Construct validity and reliability

To determine the convergent validity, CFA was used (Anderson and Gerbing, 1988). Following the principal component analysis procedure, the confirmatory factor analysis (CFA) was performed for the 25 provided items. The following CFA model fit metrics are sufficient: $\chi 2/DF$ =3.090, CFI=0.927, IFI=0.927, RMSEA= 0.062. The Likelihood Ratio Chi-Square analysis, or CMIN, shows how well the obtained model matches the starting model. The results of the CFA analysis are shown in Table 3, where each item's standardized loads have been determined to be bigger than 0.5 and significant. The appropriate levels of $\chi 2/DF$ and other fit indices have been discovered (Civelek, 2018).

Table 3. Confirmatory Factor Analysis Results

Variables	Items	Standardized Factor Loads	Unstandardized Factor Loads
Logistics 4.0 Capability (L4C)	L4C0109	0.627	1
	L4C0219	0.746	1.015
	L4C0210	0.685	0.960
	L4C0311	0.647	0.931
	L4C0415	0.686	1.012
	L4C0118	0.789	1.045
	L4C0314	0.695	1.060
	L4C0617	0.808	1.189
	L4C0516	0.795	1.114
Firm Performance (FPR)	FPR0120	0.680	1
	FPR0221	0.717	0.971
	FPR0322	0.777	1.221
	FPR0625	0.744	1.160
	FPR0928	0.683	1.058
	FPR0423	0.785	1.201
	FPR0827	0.674	0.964
	FPR0524	0.762	1.120
	FPR0726	0.728	1.041
E-commerce Marketing Capability (EMC)	ECM0808	0.583	1
	ECM0707	0.644	1.100
	ECM0505	0.666	1.161
	ECM0101	0.624	1.152

	ECM0303	0.700	1.282
	ECM0202	0.707	1.364
	ECM0404	0.754	1.307

Note: p<0.05 for all items

The findings have established the scales used in this study's convergent validity. The AVE (Average Variance Extracted Value) has been calculated and compared to the correlation values of the constructs in the same column to confirm the discriminant validity (Civelek, 2018). The values in Table 4's brackets, which are higher than the correlation values in each column, represent the square root of the AVE value for each construct. Each construct's dependability was also examined. The Cronbach values and overall reliability are above the cutoff point (i.e. 0.7) (Fornell and Larcker, 1981). Composite reliabilities, Pearson correlation coefficients, average extracted variance values, Cronbach's alpha values, and descriptive statistics are shown in Table 4.

Table 4. Descriptive Statistics, Correlations, and Reliability

Variables	1	2	3
1. Logistics 4.0 Capability	(0.722)		
2. E-Commerce Marketing Capability	0.604*	(0.670)	
3. Firm Performance	0.652*	0.464*	(0.729)
Composite reliability	0.907	0.850	0.910
Average variance ext.	0.522	0.449	0.531
Cronbach α	0.910	0.851	0.911
Mean	4.28	4.31	4.35
Standard Deviation	0.53	0.52	0.51

Note: *p < 0.01 Values in the bracket indicate the square root of AVEs.

Research Results

The Baron and Kenny approach has been used to test research hypotheses (Baron and Kenny, 1986). Three models had to be tested to implement this strategy. Figures 2, Figure 3, and Figure 4 present, respectively, these three models. Using CB-SEM, tests have been run on each model (Covariance Structural Equation Modelling). The default strategy has been maximum likelihood estimation. Each model's absolute and relative goodness-of-fit indices have been assessed to see how well it fits the data. As seen in Figure 2, the following values have been found for Model 1: $\chi 2$/DF value is 3.026. CFI and IFI are 0.953. RMSEA is 0.061. As seen in Figure 3 for Model 2: $\chi 2$/DF value is 2.884. CFI and IFI are 0.959. RMSEA is 0.058. As seen in Figure 4, for Model 3: $\chi 2$/DF value is 2.920. CFI and IFI are 0.933. RMSEA is 0.059. The outcomes fall within the permissible threshold ranges (Civelek, 2018).

To use the Baron and Kenny approach, the correlation coefficients between the variables must initially be significant (Baron and Kenny, 1986). This is necessary

before conducting a mediator variable analysis. Significant correlation coefficients were discovered during the analysis, as indicated in Table 2. The first model measures the direct relationship between the dependent and independent variables. The second model measures the connection between the mediator and independent variables. The third model measures all of the conceptual model's variables' interactions simultaneously. Each model's fit indices are considered independently. Afterward, the standardized coefficients of three distinct models were contrasted. When the mediator variable is included in the model, it is assessed how the comparison affects the significant association between the dependent and independent variables (Civelek, 2018).

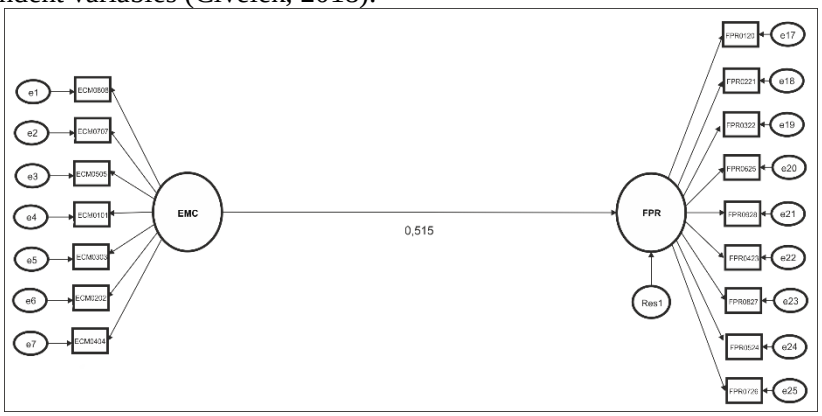

Figure 2: Results of SEM Analysis of Model 1
Note: $\chi 2/DF = 3.026$, CFI = 0.953, IFI = 0.953, RMSEA= 0.061
Source: Own elaboration

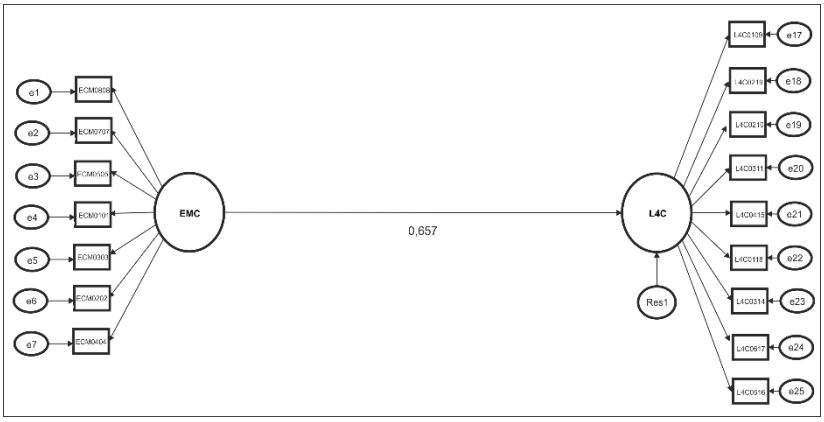

Figure 3: Results of SEM Analysis of Model 2
Note: $\chi 2/DF = 2.884$, CFI = 0.959, IFI = 0.959, RMSEA= 0.058
Source: Own elaboration

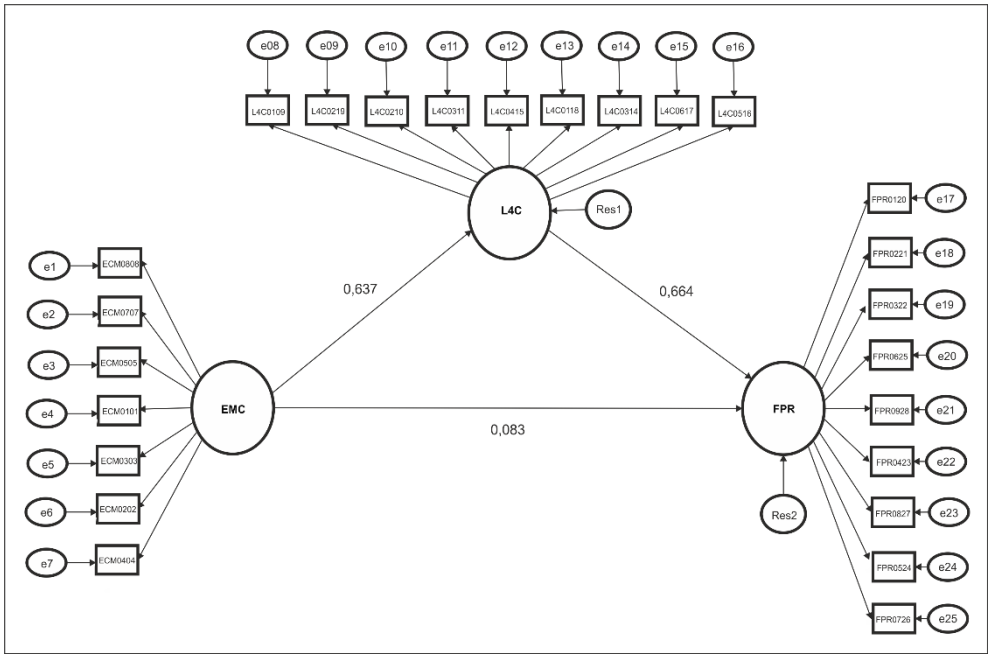

Figure 4. Results of SEM Analysis of Model 3
Note: $\chi 2/DF = 2.920$, CFI = 0.933, IFI = 0.933, RMSEA= 0.059
Source: Own elaboration

Table 5. Test Results of the Models

Relationships	Model 1	Model2	Model 3
EMC → FPR	0.515*		0.083
EMC → L4C		0.657*	0.637*
L4C → FPR			0.664*

Note: *p < 0.01 Path coefficients are standardized

The test results for each model are shown in Table 5. The hypotheses are all supported. The link between EMC and FPR dissolved and became insignificant once L4C was incorporated into the model. The findings lead to the conclusion that L4C mediates the effect of EMC on FPR. Our research model was tested using survey data on 553 survey responses in Turkey. We found that e-commerce marketing capability has positive effects on business performance. In addition, we concluded that the logistics 4.0 capability has an intermediary role in the effect of e-commerce marketing capability on firm performance.

Discussion

Digital transformation is called logistics 4.0 or "smart logistics"; the use of high-tech sensors and equipment in logistics operations includes the use of advanced robotics

and the connection of the entire supply chain with information technologies. Moreover, logistics 4.0 is a digital transformation process that makes a big difference for businesses. Nowadays, digital transformation is not a choice, it is a necessity. Logistics 4.0 is the most effective tool for maintaining the perfect balance between automation and mechanization. Cooperation, coordination, and communication between suppliers, manufacturers, retailers, and customers are provided by digitalization and process automation (Tjahjono et al., 2017).

Logistics 4.0 capability, E-commerce marketing capability, and dynamic capability are interrelated concepts. Dynamic capability aims to achieve a sustainable competitive advantage. The importance of dynamic capability has enhanced even more when digital transformation has gained momentum, and risks and uncertainties in international trade have increased in recent years (Sandberg, 2021).

Today, creating a competitive advantage in international markets is closely related to the ability to use e-commerce marketing capability and logistics 4.0 capability. Considering the growth potential of e-commerce technologies, businesses need to focus on logistics 4.0 applications to add value to the consumer and save costs. Entrepreneurs' willingness to invest in developing technological infrastructure and increasing incentives for logistics 4.0 applications will accelerate the logistics 4.0 adaptation. It indicates that e-commerce marketing capability will accelerate the adaptation of businesses to new technologies and help them find new business opportunities in international markets.

Logistics 4.0 technologies applications in e-commerce will increase business performance by reducing delivery times, improving agility in the supply chain, and decreasing logistics costs, error rates, and cycle time of various processes. Managers consider that Logistics 4.0 technologies diminish the need for personnel in operational processes, on the other hand, it is estimated that the need for qualified personnel will increase. Moreover, these technologies can raise inventory accuracy and advance skills to apply predictive analytics.

Conclusion

This Digital transformation is called logistics 4.0 or “smart logistics”; the use of high-tech sensors and equipment in logistics operations includes advanced robotics and the connection of the entire supply chain with information technologies. Moreover, logistics 4.0 is a digital transformation process that makes a big difference for businesses. Nowadays, digital transformation is not a choice, it is a necessity (Alshourah et al., 2023). Logistics 4.0 is the most effective tool for maintaining the perfect balance between automation and mechanization. Digitalization and process automation provide cooperation, coordination, and communication between suppliers, manufacturers, retailers, and customers (Tjahjono et al., 2017).

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more when digital transformation has gained momentum, and risks and uncertainties in international trade have increased in recent years (Sandberg, 2021).

This study explores the effect of e-commerce capability on firm performance under logistics 4.0 capability. It provides a significant theoretical explanation and empirical evidence on how e-commerce marketing capability and logistics 4.0 capability enhance firm performance. Dynamic capacity is used in the study within the framework Which helps academicians and industry managers understand the current situation of the subject and provides a basis for determining strategies. The finding further implies that e-commerce marketing capability is more relevant to Logistics 4.0 capability. E-commerce marketing capability increases firm performance (especially, salespeople's ability to access product/price/performance information online and tracking online for orders and deliveries). Results show that logistics 4.0 applications ensure on-time delivery and supply and offer controllable costs in the supply chain process. Additionally, findings present that Logistics 4.0 technologies design an effective and efficient workflow, focus on zero errors, and increase reliability in quality control. The advantages provided by logistics 4.0 capability prove to increase firm performance.

According to Scheffe and Tukey Tests, statistically significant differences were detected between the duration of the activities (especially between 1-5 years and 6-10 years, 1-5 years and 11-20 years) of the enterprises and the Logistics 4.0 capability. Findings show that enterprises that have less than 10 employees differ from others in terms of Logistics 4.0 capability. It explains that these companies don’t focus on Logistics 4.0 technologies. Also, It does not seem possible for newly established businesses to invest in blockchain, the Internet of Things, big data, and artificial intelligence. On the other hand, results will encourage the textile, logistics, electronic, and white goods industries to engage in more investigation to refine the theory and measurement of e-commerce capability and logistics 4.0 capability. It provides a comprehension of e-commerce marketing capability and logistics 4.0 capability and how to enhance firm performance is evident in different enterprises' survival and sustainability.

Today, creating a competitive advantage in international markets is closely related to the ability to use e-commerce marketing capability and logistics 4.0 capability. Considering the growth potential of e-commerce technologies, businesses need to focus on logistics 4.0 applications to add value to the consumer and save costs. Entrepreneurs' willingness to invest in developing technological infrastructure and increasing incentives for logistics 4.0 applications will accelerate the logistics 4.0 adaptation. It indicates that e-commerce marketing capability will accelerate the adaptation of businesses to new technologies and help them find new business opportunities in international markets. Logistics 4.0 technologies applications in e-commerce will increase business performance by reducing delivery times, improving agility in the supply chain, and decreasing logistics costs, error rates, and cycle time of various processes. Managers consider that Logistics 4.0 technologies diminish the need for personnel in operational processes, on the other hand, it is estimated that

the need for qualified personnel will increase. Moreover, these technologies can raise inventory accuracy and advance skills to apply predictive analytics.

The first of the limitations of the study is country that Turkey where the research is conducted is a developing country and Logistics 4.0 applications are generally carried out in large and international enterprises. Secondly, this study is conducted in the logistics, textile, electronic, and white goods industries. The effect of moderating variables such as top management commitment, and organization culture in the effect of logistics 4.0 capability on sustainable supply chain performance can be analyzed in future studies. Therefore, it can enrich our understanding by collecting data from multiple countries such as Greece, France, and Germany conducting cross-analysis to make the results universal.

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POŚREDNICZĄCA ROLA LOGISTYKI 4.0 W ZWIĄZKU MIĘDZY MARKETINGIEM E-COMMERCE A WYNIKAMI FIRMY

Streszczenie: Niniejsze badanie ma na celu określenie, czy zdolność marketingu e-commerce ma wpływ na wyniki przedsiębiorstwa oraz jaką rolę odgrywa logistyka 4.0 w tej relacji. Opierając się na literaturze i bazując na teorii dynamicznych zdolności, opracowujemy teoretyczny model, w którym zdolność logistyki 4.0 pełni rolę pośredniczącą w relacji między marketingiem e-commerce a wynikami przedsiębiorstwa. Nasze hipotezy testowane są przy użyciu danych z ankiety, uzyskanych od 553 respondentów pracujących w sektorach logistyki, tekstyliów, sprzętu AGD i elektroniki. Dane analizowane są za pomocą modelowania równań strukturalnych. Wyniki empiryczne pokazują, że marketing e-commerce pozytywnie wpływa na wyniki przedsiębiorstwa, a logistyka 4.0 pełni rolę pośredniczącą w tej relacji. Potencjał logistyki 4.0 poprawia wyniki przedsiębiorstwa poprzez poprawę terminowości dostaw i zwiększenie efektywności procesów łańcucha dostaw. Nasze wyniki podkreślają znaczenie inwestowania w zpotencjał logistyki 4.0, w tym zasoby talentów, praktyki zarządzania i uwarunkowania techniczne, aby zwiększyć korzyści, jakie przedsiębiorstwo czerpie z marketingu e-commerce. Potencjał logistyki 4.0 wzmacnia wpływ marketingu e-commerce na wyniki przedsiębiorstwa poprzez zwiększenie terminowości dostaw, efektywności, elastyczności, jakości i reaktywności wobec klientów oraz poprawę zdolności budowania elastyczności przedsiębiorstwa. Niniejsze badanie wnosi wkład do literatury w obszarze wyników przedsiębiorstwa, identyfikując rolę pośredniczącą, jaką odgrywa logistyka 4.0 w relacji między marketingiem e-commerce a wynikami.

Słowa kluczowe: Potencjał logistyki 4.0, Potencjał marketingu e-commerce, Wyniki przedsiębiorstwa, Dynamiczne zdolności