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Digital Logistics Market Performance of Developing Countries

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Abstract

Executing logistics activities based on digital platforms enables logistics and transportation activities to be carried out more effectively and efficiently, reducing logistics costs. For countries to increase their logistics performance and competitiveness at the macro level, the orientation towards digitalization in logistics should be encouraged and successfully managed. This research aims to determine developing countries' digital logistics market performance (DLMP) in 2022. In determining the DLMP, the countries' logistics market performances and digital competitiveness performances were used. In the study, the MEREC method was used to weigh the criteria. The RAFSI method was used to determine the DLMP rankings of developing countries. The DLMP was calculated for nineteen developing countries based on seven criteria. According to the research findings, the technology criterion is the most important criterion among the digital logistics market performance criteria. For the DLMP ranking, China, Malaysia, and Qatar are in the top three developing countries. The last three developing countries are Peru, Colombia, and Argentina. In addition, suggestions were developed for developing countries by comparing DLMP rankings with logistics market performance and digital competitiveness rankings.

Keywords:

Logistics Market Performance, Digital Competitiveness, MCDM, MEREC,

Gelişmekte Olan Ülkelerin Dijital Lojistik Pazar Performansı

Özet

Lojistik faaliyetlerin dijital platformlara dayalı olarak yürütülmesi, lojistik ve nakliye faaliyetlerinin daha etkin ve verimli bir şekilde yürütülmesini sağlayarak lojistik maliyetlerini düşürmektedir. Ülkelerin makro düzeyde lojistik performanslarını ve rekabet güçlerini artırmaları için lojistikte dijitalleşmeye yönelim teşvik edilmeli ve başarılı bir şekilde yönetilmelidir. Bu araştırma, gelişmekte olan ülkelerin 2022 yılı dijital lojistik pazar performansının (DLMP) belirlenmesini amaçlamaktadır. DLMP'nin belirlenmesinde, ülkelerin lojistik pazar performansları ve dijital rekabet gücü performansları kullanılmıştır. Kriterlerin ağırlıklandırılmasında MEREC yöntemi kullanılmıştır. Gelişmekte olan ülkelerin DLMP sıralamalarını belirlemek için RAFSI yöntemi kullanılmıştır. DLMP, yedi kritere dayalı olarak on dokuz gelişmekte olan ülke için hesaplanmıştır. Araştırma bulgularına göre dijital lojistik pazar performans kriterleri arasında en önemli kriter teknoloji kriteridir. DLMP sıralamasında Çin, Malezya ve Katar gelişmekte olan ilk üç ülke arasında yer almaktadır. DLMP sıralamasında son üç ülke ise Peru, Kolombiya ve Arjantin'dir. Ayrıca DLMP sıralamaları ile lojistik pazar performansı ve dijital rekabet edebilirlik sıralamaları karşılaştırılarak gelişmekte olan ülkeler için öneriler geliştirilmiştir

Anahtar Kelimeler:

Lojistik Pazar Performansı, Dijital Rekabet Edebilirlik, ÇKKV, MEREC, RAFSI

INTRODUCTION

In today's competitive world, where progress in the digital ecosystem is inevitable, the digitalization of logistics services is also inevitable (Cichosz, 2018). Technological developments affect not only industrial activities and create radical changes in logistics transformation. The use of digitalization and autonomous systems in logistics and transportation activities is increasing to both benefit from advanced technologies and reduce logistics costs (Kuhlmann and Klumpp, 2017). Commercial activities based on digital platforms reveal the concept of logistics digitalization. It offers future-oriented solutions for increasing logistics network efficiency and designing logistics processes in international trade (Korchagina et al., 2020). At the same time, it provides systematic development in the logistics industry, increasing logistics performance and gaining long-term competitive advantage (Woschank et al., 2021).

Digitalization in logistics based on the use of advanced technology and autonomous systems in the logistics industry provides benefits in planning resources, warehouse management systems, transportation systems, and information security (Bardakcı, 2020). In addition, it contributes to developing flexible supply chain structures by enabling faster and more accurate logistics operations (Shadibekova, 2021). Although these benefits are at the level of companies, they indirectly affect the determination of the country's logistics performance level. At this point, country policies should be developed for logistics digitalization and countries should support logistics digitalization (Borisova et al., 2019).

In the literature, there are studies to determine countries' logistics performance and digital competitiveness levels. The logistics performance index by Worldbank explains the logistics performance of countries. the agility emerging markets logistics index (AEMLI) explains the logistics market performances of developing countries. The IMD World Competitiveness Center determines the digital competitiveness performances of countries. However, there is no research to determine developing countries' digital logistics market performance (DLMP). This study aims to determine the DLMP levels of developing countries for 2022 using MEREC and RAFSI methods, which are multi-criteria decision-making methods (MCDM). The research questions determined for this purpose are as follows:

- *Research Question 1:* Can developing countries' digital logistics market performance be determined?
- *Research Question 2:* Can digital logistics market performances be determined based on the logistics market performance and digital competitiveness performances of developing countries?
- *Research Question 3:* Can developing countries' digital logistics market performance be determined with MCDM hybrid methods?

Literature review and criteria selection is made in the second part of the research to answer the research questions. In the third part, MEREC and RAFSI methods are explained. In the fourth part, an application for the digital logistics market performances of developing countries is presented. In the fifth part, the results are presented, and suggestions are made to the countries.

LITERATURE REVIEW AND SELECTION OF CRITERIA

Recently, the importance of digitalization in logistics and transportation activities has been emphasized in the literature. Especially, Industry 4.0 and digitalization have come to the fore, and digital logistics platforms have increased. Digital logistics platforms help both in the creation of digital-based ecosystems and in the easier management of logistics activities with software and hardware systems (Dmitriev and Plastunyak, 2019). Cichosz et al. (2020) identified critical success factors and barriers that affect the digital transformation processes of logistics service providers. The critical success factors are leadership, organizational cultural support, employee and partner involvement, information technology strategies, data integration, employee training, agile transformation management, and technological knowledge. Barriers are complex logistics networks, insufficient resources, technology adoption, resistance to change, and security leaks. Saparbaevna et

al. (2021) point out that digital logistics applications in railway transportation provide technological efficiency, competitive advantage, commercial and socio-economic benefits. Barykin et al. (2021a) have developed a model proposal that adopts a digital logistics approach to achieve successful outputs in energy service management.

Although there is no research in the literature to determine the digital logistics performance of countries, there are efforts to compare digital logistics platforms and reveal their importance. Barykin et al. (2021b) comparatively examined the digital logistics platforms of BRICS (Brazil, Russia, India, China, and the Republic of South Africa) countries. In this research, they benefited from the logistics performance index and trade data of BRICS countries. Explaining that digital logistics applications integrate both production and supply chain processes, Sharakhin et al. (2021) suggested that companies should outsource their digital logistics applications by focusing on their core competencies. Pekarčíková et al. (2020), on the other hand, state that the transition from traditional logistics approaches to digital logistics applications is inevitable.

With logistics digitalization, it is necessary to develop strategies to improve their digital logistics performance in their countries. However, countries need to determine their digital logistics performance. This study discusses two main indicators to detect DLMP in developing countries. These are the countries' current logistics market performances and digital competitiveness performances. In the calculation of DLMP, domestics logistics opportunities (DLO), international logistics opportunities (ILO), business fundamentals (BF), and digital readiness (DR) criteria were taken from the AEMLI report. Knowledge (KN), technology (TE), and future readiness (FR) criteria were taken from the digital competitiveness index (DCI). The primary purpose of using these criteria is to determine the DLMP in this way by considering both the logistics market performances and digital competitiveness performances of developing countries.

DLO refers to the intralogistics opportunities that countries have. By using the DLO, it is ensured that the logistics opportunities for the domestic market of the country are considered. The ILO refers to the international logistics opportunities that countries have. The logistics opportunities of the country in international trade were considered by using the ILO in determining the DLMP. BF refers to the logistical core assets of the countries. DR shows how ready countries are for digital logistics platform applications. KN is the technological knowledge capacity of countries in digital competition between countries. TE is the technology power in digital competitiveness. FR is the level of readiness for changing and developing technologies. The criteria used in this study are presented in Table 1.

Table 1: Selected Criteria

Criteria	Reports	Year	Countries
Domestics logistics opportunities (C1) International logistics opportunities (C2) Business fundamentals (C3) Digital readiness (C4) Knowledge (C5) Technology (C6) Future readiness (C7)	AEMLI DCI	2022	China, India, Malaysia, Indonesia, Saudi Arabia, Qatar, Thailand, Mexico, Turkey, Chile, Bahrain, Brazil, Philippines, Jordan, Kazakhstan, South Africa, Colombia, Peru, Argentina

METHODOLOGY

Method Based on The Removal Effects of Criteria (MEREC)

In the MEREC method, which is a new criterion weighting method in the literature, criterion weights are calculated by calculating the changes in performance values between alternatives. The MEREC method has been discussed in the literature on different criteria weighting issues. This method is used for pallet truck selection (Ulutaş et al., 2022), sustainable material selection (Haq et al., 2022), aircraft selection (Özdağoğlu et al., 2022), green renewable energy source selection (Goswami et al., 2022), truck mixer concrete pump selection (Ivanović et al., 2022), innovation performance (Ecer and Aycin, 2022; Ersoy, 2022) and social development

index determination (Aycin and Arsu, 2021). The steps of this method are described below, respectively (Keshavarz-Ghorabaee et al., 2021; Ulutaş, 2022):

Step 1-1: The decision matrix shown in Eq. (1), consisting of n alternatives *(j)* and m criteria *(i)*, is created.

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{i1} & \cdots & x_{ij} & \dots & x_{in} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{m1} & \cdots & x_{mj} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

Step 1-2: The decision matrix is normalized with Eq. (2).

$$n_{ij}^{x} = \begin{cases} \frac{\min_k x_{kj}}{x_{ij}}, & for\ benefical\ criteria \\ \frac{x_{ij}}{\max_k x_{kj}}, & for\ cost\ criteria \end{cases} \quad (2)$$

Step 1-3: The overall performance values of the alternatives (S_i) are calculated by Eq. (3).

$$S_i = \ln\left(1 + \left(\frac{1}{m}\sum_j \left|\ln\left(n_{ij}^{x}\right)\right|\right)\right) \quad (3)$$

Step 1-4: The changes in the performance value of the alternatives $\left(S'_{ij}\right)$ are calculated by Eq. (4). This is done by subtracting each criterion.

$$S'_{ij} = \ln\left(1 + \left(\frac{1}{m}\sum_{k,k\neq j} \left|\ln\left(n_{ij}^{x}\right)\right|\right)\right) \quad (4)$$

Step 1-5: The sum of the absolute deviations $\left(E_j\right)$ is obtained by Eq. (5).

$$E_j = \sum_i \left|S'_{ij} - S_i\right| \quad (5)$$

Step 1-6: The criteria weights are calculated by Eq. (6).

$$w_j = \frac{E_j}{\sum_k E_k} \quad (6)$$

Ranking of Alternatives through Functional Mapping of Criterion Sub-Intervals into A Single Interval Method (RAFSI)

A new normalization technique is used in the RAFSI method developed by Žižović (2020). In this method, criteria ranges are calculated using arithmetic and harmonic averages. The RAFSI method has been discussed in the literature on alternative ranking issues. This method is used for location selection (Alosta et al., 2021), bank performance analysis (Demir, 2021), floating photovoltaic site selection (Deveci et al., 2022), flight base selection (Akyurt et al., 2021) and COVID-19 vaccine performance (Demir, 2022). The steps of this method are described below, respectively (Pamučar et al., 2020; Žižović et al., 2020; Alosta et al., 2021; Božanić et al., 2021):

Step 2-1: First, the decision matrix in Eq. (1) is created.

Step 2-2: Ideal and anti-ideal values for each criterion are determined by Eq. (7).

$$C_j \in \begin{cases} \left[\xi_{N_j}, \xi_{I_j}\right], for\ benefit\ criteria \\ \left[\xi_{I_j}, \xi_{N_j}\right], for\ cost\ criteria \end{cases} \quad (7)$$

Step 2-3: The $f_{A_i}(C_j)$ values are calculated with Eq. (8). These values form the standardized decision-making matrix $\left(T = [\varphi_{ij}]_{mxn}\right)$ elements in Eq. (9). Since the ideal value is six times more important than the anti-ideal value, it is assumed that $n_1 = 1$ and $n_b = 6$.

$$f_{A_i}(C_j) = \varphi_{ij} = \frac{n_b - n_1}{\xi_{I_j} - \xi_{N_j}} \xi_{ij} + \frac{\xi_{I_j}.n_1 - \xi_{N_j}.n_b}{\xi_{I_j} - \xi_{N_j}} \quad (8)$$

$$T = \begin{bmatrix} \varphi_{11} & \cdots & \varphi_{1j} & \cdots & \varphi_{1n} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \varphi_{i1} & \cdots & \varphi_{ij} & \cdots & \varphi_{in} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \varphi_{m1} & \cdots & \varphi_{mj} & \cdots & \varphi_{mn} \end{bmatrix}, \varphi_{ij} \in [n_1, n_b] \quad (9)$$

Step 2-4: Eq. (10), Eq. (11) and Eq. (12) normalize the decision matrix $\left(N = [\varphi_{ij}]_{mxn}\right)$. It is represented by Eq. (13).

$$\gamma_{ij} \in \begin{cases} \frac{\varphi_{ij}}{2A}, for\ benefit\ criteria \\ \frac{H}{2\varphi_{ij}}, for\ cost\ criteria \end{cases} \quad (10)$$

$$A = \frac{n_b + n_1}{2}\ (Aritmetic\ mean) \quad (11)$$

$$H = \frac{2}{\frac{1}{n_1} + \frac{1}{n_b}}\ (Harmonic\ mean) \quad (12)$$

$$N = \begin{bmatrix} \gamma_{11} & \cdots & \gamma_{1j} & \cdots & \gamma_{1n} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \gamma_{i1} & \cdots & \gamma_{ij} & \cdots & \gamma_{in} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ \gamma_{m1} & \cdots & \gamma_{mj} & \cdots & \gamma_{mn} \end{bmatrix} \quad (13)$$

Step 2-5: The criterion functions of the alternatives $\left(Q(A_i)\right)$ are calculated by Eq. (14). Thus, the alternatives are listed.

$$Q(A_i) = \sum_{j=1}^{n} w_j \gamma_{ij} \quad (14)$$

APPLICATION

This application was made to determine developing countries' digital logistics market performance. In practice, MEREC was used to weigh the criteria and RAFSI was used to detect DLMP in developing countries. Seven criteria were used within the scope of the application (C1: DLO, C2: ILO, C3: BF, C4: DR, C5: KN, C6: TE, C7: FR). Nineteen developing countries were identified as alternatives. The application was carried out in two stages. In the first stage, criteria weights were determined. In the second stage, DLMP scores and rankings of developing countries were obtained. The application was made sequentially for the steps presented in the methodology section.

Step 1-1: The decision matrix consisting of 19 alternatives and 7 criteria is created in Table 2. Data for the first four criteria were obtained from the AEMLI (2022) report. Data for the last three criteria were obtained from the DCI (2022) report.

Step 1-2: The decision matrix in Table 2 is normalized by Eq. (2). Normalized decision matrix is presented in Table 3.

Step 1-3: S_i values are calculated by Eq. (3). It is shown in Table 4.

Step 1-4: S'_{ij} values are calculated by Eq. (4). It is shown in Table 5.

Table 2: The Decision Matrix

Countries	C1	C2	C3	C4	C5	C6	C7
China	8,54	9,75	7,06	7,25	79,27	76,69	80,93
India	8,01	7,23	5,96	6,74	53,95	60,25	55,2
Malaysia	5,32	5,92	8,19	7,35	70,08	71,45	65,33
Indonesia	6,34	5,95	5,93	6,47	42,2	55,33	50,31
Saudi Arabia	5,35	5,51	8,16	7,07	61,96	72,92	64,34
Qatar	5,79	4,89	7,96	6,52	59,11	78,65	74,98
Thailand	5,13	6,01	5,82	6,54	55,52	74,97	51,7
Mexico	5,54	6,4	5,13	5,4	49,17	42,79	49,83
Turkey	5,28	5,87	5,87	5,96	42,34	46,83	53,49
Chile	4,87	5,17	7,17	6,14	49,78	61,42	65,11
Bahrain	4,99	4,68	7,3	5,16	66,47	74,17	64,53
Brazil	5,5	5,43	3,95	5,58	49,52	44,38	52,13
Philippines	5	5,25	4,38	5,99	40,51	51,58	43,95
Jordan	4,86	4,73	6,7	4,97	48,63	51,19	45,91
Kazakhstan	4,67	4,7	6,2	4,93	67,64	61,56	67,51
South Africa	4,69	4,95	5	5,17	47,76	40,06	43,5
Colombia	4,69	5,02	4,52	4,9	45,9	34,53	44,84
Peru	4,7	5,1	4,57	4,52	46,34	41,33	46,12
Argentina	4,86	4,61	3,92	5,03	45,46	30,36	52,46

Table 3: The Normalized Decision Matrix

Countries	C1	C2	C3	C4	C5	C6	C7
China	0,547	0,473	0,555	0,623	0,511	0,396	0,538
India	0,583	0,638	0,658	0,671	0,751	0,504	0,788
Malaysia	0,878	0,779	0,479	0,615	0,578	0,425	0,666
Indonesia	0,737	0,775	0,661	0,699	0,960	0,549	0,865
Saudi Arabia	0,873	0,837	0,480	0,639	0,654	0,416	0,676
Qatar	0,807	0,943	0,492	0,693	0,685	0,386	0,580
Thailand	0,910	0,767	0,674	0,691	0,730	0,405	0,841
Mexico	0,843	0,720	0,764	0,837	0,824	0,710	0,873
Turkey	0,884	0,785	0,668	0,758	0,957	0,648	0,813
Chile	0,959	0,892	0,547	0,736	0,814	0,494	0,668
Bahrain	0,936	0,985	0,537	0,876	0,609	0,409	0,674
Brazil	0,849	0,849	0,992	0,810	0,818	0,684	0,834
Philippines	0,934	0,878	0,895	0,755	1,000	0,589	0,990
Jordan	0,961	0,975	0,585	0,909	0,833	0,593	0,948
Kazakhstan	1,000	0,981	0,632	0,917	0,599	0,493	0,644
South Africa	0,996	0,931	0,784	0,874	0,848	0,758	1,000
Colombia	0,996	0,918	0,867	0,922	0,883	0,879	0,970

Peru	0,994	0,904	0,858	1,000	0,874	0,735	0,943
Argentina	0,961	1,000	1,000	0,899	0,891	1,000	0,829

Table 4: The S_i Values

Countries	S_i	**Countries**	S_i	**Countries**	S_i	**Countries**	S_i
China	0,51	**Qatar**	0,38	**Bahrain**	0,32	**South Africa**	0,12
India	0,36	**Thailand**	0,31	**Brazil**	0,17	**Colombia**	0,08
Malaysia	0,40	**Mexico**	0,21	**Philippines**	0,15	**Peru**	0,10
Indonesia	0,26	**Turkey**	0,22	**Jordan**	0,19	**Argentina**	0,06
Saudi Arabia	0,38	**Chile**	0,29	**Kazakhstan**	0,28		

Table 5: The S'_{ij} Values

Countries	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
China	0,45	0,44	0,46	0,47	0,45	0,42	0,45
India	0,30	0,31	0,32	0,32	0,33	0,29	0,33
Malaysia	0,38	0,37	0,32	0,35	0,34	0,31	0,36
Indonesia	0,23	0,24	0,22	0,22	0,26	0,20	0,25
Saudi Arabia	0,36	0,36	0,30	0,33	0,33	0,29	0,34
Qatar	0,36	0,37	0,31	0,34	0,34	0,28	0,32
Thailand	0,30	0,28	0,26	0,27	0,27	0,21	0,29
Mexico	0,19	0,17	0,18	0,19	0,19	0,17	0,19
Turkey	0,21	0,19	0,17	0,19	0,22	0,17	0,20
Chile	0,29	0,28	0,23	0,26	0,27	0,21	0,25
Bahrain	0,31	0,32	0,25	0,30	0,26	0,22	0,28
Brazil	0,15	0,15	0,17	0,15	0,15	0,12	0,15
Philippines	0,14	0,13	0,14	0,11	0,15	0,08	0,15
Jordan	0,18	0,19	0,12	0,18	0,17	0,13	0,18
Kazakhstan	0,28	0,27	0,22	0,27	0,22	0,20	0,23
South Africa	0,12	0,11	0,09	0,10	0,10	0,08	0,12
Colombia	0,08	0,07	0,06	0,07	0,07	0,06	0,08
Peru	0,10	0,09	0,08	0,10	0,09	0,06	0,10
Argentina	0,06	0,06	0,06	0,05	0,05	0,06	0,04

Step 1-5: E_j values are calculated by Eq. (5). It is shown in Table 6.

Table 6: The E_j Values

E_j	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
	0,286	0,372	0,817	0,515	0,538	1,213	0,488

Step 1-6: w_j values are calculated by Eq. (6). Criteria weights are shown in Table 7.

Table 7: The w_j Values

w_j	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
	0,0676	0,0880	0,1932	0,1218	0,1272	0,2868	0,1154

Step 2-1: For the RAFSI method, the decision matrix in Eq. (1) is used.

Step 2-2: Since all criteria are benefit criteria, the ideal values calculated by Eq. (7) are shown in Table 8.

Table 8: The Ideal Values of The Criteria

Benefit Criteria	C1	C2	C3	C4	C5	C6	C7
	[4,67; 8,54]	[4,61; 9,75]	[3,92; 8,19]	[4,52; 7,35]	[40,51; 79,27]	[30,36; 78,65]	[43,5; 80,93]

Step 2-3: The standardized decision-making matrix $\left(T = [\varphi_{ij}]_{mxn}\right)$ obtained with $f_{A_i}(C_j)$ values was calculated by Eq. (8). It is shown in Table 9.

Step 2-4: Eq. (10), Eq. (11) and Eq. (12) normalize the decision matrix $\left(N = [\varphi_{ij}]_{mxn}\right)$. It is represented by Eq. (13). It is shown in Table 10.

Step 2-5: The criterion functions $(Q(A_i))$, and alternative ranking of the alternatives obtained by Eq. (14) are in Table 11. The criteria weights calculated by the MEREC method were used.

Table 9: The Standardized Decision-Making Matrix

Countries	C1	C2	C3	C4	C5	C6	C7
China	6,0000	6,0000	4,6768	5,8233	6,0000	5,7971	6,0000
India	5,3152	3,5486	3,3888	4,9223	2,7337	4,0948	2,5629
Malaysia	1,8398	2,2743	6,0000	6,0000	4,8145	5,2545	3,9161
Indonesia	3,1576	2,3035	3,3536	4,4452	1,2180	3,5854	1,9097
Saudi Arabia	1,8786	1,8755	5,9649	5,5053	3,7670	5,4067	3,7839
Qatar	2,4470	1,2724	5,7307	4,5336	3,3994	6,0000	5,2052
Thailand	1,5943	2,3619	3,2248	4,5689	2,9363	5,6190	2,0954
Mexico	2,1240	2,7412	2,4169	2,5548	2,1171	2,2870	1,8456
Turkey	1,7881	2,2257	3,2834	3,5442	1,2361	2,7053	2,3345
Chile	1,2584	1,5447	4,8056	3,8622	2,1958	4,2160	3,8867
Bahrain	1,4134	1,0681	4,9578	2,1307	4,3488	5,5361	3,8092
Brazil	2,0724	1,7977	1,0351	2,8728	2,1623	2,4516	2,1528
Philippines	1,4264	1,6226	1,5386	3,5972	1,0000	3,1971	1,0601
Jordan	1,2455	1,1167	4,2553	1,7951	2,0475	3,1568	1,3219
Kazakhstan	1,0000	1,0875	3,6698	1,7244	4,4997	4,2305	4,2073
South Africa	1,0258	1,3307	2,2646	2,1484	1,9352	2,0043	1,0000
Colombia	1,0258	1,3988	1,7026	1,6714	1,6953	1,4318	1,1790
Peru	1,0388	1,4767	1,7611	1,0000	1,7521	2,1358	1,3500
Argentina	1,2455	1,0000	1,0000	1,9011	1,6385	1,0000	2,1969

Table 10: The Normalized Decision-Making Matrix

Countries	C1	C2	C3	C4	C5	C6	C7
China	0,8571	0,8571	0,6681	0,8319	0,8571	0,8282	0,8571
India	0,7593	0,5069	0,4841	0,7032	0,3905	0,5850	0,3661
Malaysia	0,2628	0,3249	0,8571	0,8571	0,6878	0,7506	0,5594
Indonesia	0,4511	0,3291	0,4791	0,6350	0,1740	0,5122	0,2728
Saudi Arabia	0,2684	0,2679	0,8521	0,7865	0,5381	0,7724	0,5406
Qatar	0,3496	0,1818	0,8187	0,6477	0,4856	0,8571	0,7436
Thailand	0,2278	0,3374	0,4607	0,6527	0,4195	0,8027	0,2993
Mexico	0,3034	0,3916	0,3453	0,3650	0,3024	0,3267	0,2637
Turkey	0,2554	0,3180	0,4691	0,5063	0,1766	0,3865	0,3335
Chile	0,1798	0,2207	0,6865	0,5517	0,3137	0,6023	0,5552
Bahrain	0,2019	0,1526	0,7083	0,3044	0,6213	0,7909	0,5442
Brazil	0,2961	0,2568	0,1479	0,4104	0,3089	0,3502	0,3075
Philippines	0,2038	0,2318	0,2198	0,5139	0,1429	0,4567	0,1514

Jordan	0,1779	0,1595	0,6079	0,2564	0,2925	0,4510	0,1888
Kazakhstan	0,1429	0,1554	0,5243	0,2463	0,6428	0,6044	0,6010
South Africa	0,1465	0,1901	0,3235	0,3069	0,2765	0,2863	0,1429
Colombia	0,1465	0,1998	0,2432	0,2388	0,2422	0,2045	0,1684
Peru	0,1484	0,2110	0,2516	0,1429	0,2503	0,3051	0,1929
Argentina	0,1779	0,1429	0,1429	0,2716	0,2341	0,1429	0,3138

Table 11: The $(Q(A_i))$ Values and Ranking

Countries	$Q(A_i)$	Rank	Countries	$Q(A_i)$	Rank
China	0,8092	1	**Bahrain**	0,5696	5
India	0,5348	6	**Brazil**	0,2964	15
Malaysia	0,6837	2	**Philippines**	0,3059	14
Indonesia	0,4299	10	**Jordan**	0,3631	12
Saudi Arabia	0,6545	4	**Kazakhstan**	0,4791	9
Qatar	0,6701	3	**South Africa**	0,2603	16
Thailand	0,5317	7	**Colombia**	0,2125	18
Mexico	0,3287	13	**Peru**	0,2362	17
Turkey	0,3693	11	**Argentina**	0,1922	19
Chile	0,5081	8			

RESULTS AND CONCLUSION

Depending on technological developments, digitalization and digital platforms are among the basic requirements of the digital age. Digitalization in logistics activities, on the other hand, provides a competitive advantage by contributing to the operational success of logistics service providers. The fact that logistics digitalization becomes applicable at the macro level is directly proportional to the digital logistics performance levels of the countries. Especially the strengthening of the developing markets in terms of logistics ensures they can compete with the developed countries. Therefore, this research aims to determine the digital logistics market performances of developing countries. For this purpose, the criteria involved in determining DLMP are determined. Then, criterion weights are determined by the MEREC method. Considering the findings of the MEREC method applications, the most essential criterion in the determination of DLMP is determined as the technology criterion ($w_6 = 0{,}2868$). The importance levels of other criteria are as follows: business fundamentals ($w_3 = 0{,}1932$), knowledge ($w_5 = 0{,}1272$), digital readiness ($w_4 = 0{,}1218$), future readiness ($w_7 = 0{,}1154$), international logistics opportunities ($w_2 = 0{,}0880$) ve domestics logistics opportunities ($w_1 = 0{,}0676$). According to these findings, the technological development level of the countries is the most critical criterion in determining the DLMPs of developing countries compared to other criteria. The least important criterion is the domestic logistics opportunities that the countries have.

The RAFSI method is used to determine the DLMP rankings of developing countries. China, Malaysia, and Qatar are the top three countries in the DLMP ranking. The countries with the lowest performance are Peru, Colombia, and Argentina. AEMLI, DCI and DLMP rankings of developing countries are presented in Table 12. When AEMLI and DLMP performance rankings are compared, the countries whose DLMP rankings fall according to the AEMLI ranking are India, Indonesia, Mexico, Turkey, Brazil, Philippines, and Colombia. In this case, it can be said that although these countries have high logistics market development, they do not have good competitive performance in terms of digital logistics. The countries that are rising in the DLMP ranking are Malaysia, Saudi Arabia, Qatar, Bahrain, Jordan, Kazakhstan, and Peru. In this case, it can be said that although these countries have high digital competitiveness, they are not sufficient in terms of logistics market performance. There is no change in the rankings of China and Thailand. When the DCI and DLMP performance rankings are compared, the countries whose DLMP rankings fall according to the DCI rankings are Qatar, Bahrain, Brazil, Kazakhstan, Peru, and Argentina. In this case, it can be said that although these countries have high digital competitiveness performance, they do not have sufficient competitive performance in terms of digital logistics. The DLMP ranking rising countries are India, Malaysia, Saudi Arabia, Mexico, Turkey,

Philippines, South Africa, and Colombia. In this case, it can be said that although these countries have high digital competitiveness, they are not sufficient in terms of digital competitiveness performance. The rankings of China, Indonesia, Thailand, Chile, and Jordan remained unchanged.

Table 12: Comparing AEMLI, DCI and DLMP

Countries	Ranks			Countries	Ranks		
	AELMI	**DCI**	**DLMP**		**AELMI**	**DCI**	**DLMP**
China	1	1	1	**Turkey**	9	13	11
Malaysia	3	3	2	**Jordan**	14	12	12
Qatar	6	2	3	**Mexico**	8	14	13
Saudi Arabia	5	5	4	**Philippines**	13	15	14
Bahrain	11	4	5	**Brazil**	12	11	15
India	2	9	6	**South Africa**	16	17	16
Thailand	7	7	7	**Peru**	18	16	17
Chile	10	8	8	**Colombia**	17	19	18
Kazakhstan	15	6	9	**Argentina**	19	18	19
Indonesia	4	10	10				

The suggestions for developing countries are as follows:

- All developing countries should improve both their digital competitiveness and their logistics market performance.
- Although their digital competitiveness levels are high, Qatar, Bahrain, Qatar, Bahrain, Brazil, Kazakhstan, Peru, and Argentina are not an acceptable digital logistics performance. Therefore, they should improve their logistics market performance level. At the same time, they should reflect their digital competitiveness in logistics practices.
- Although India, Indonesia, Mexico, Turkey, Brazil, Philippines, and Colombia have high logistics market performances, their digital logistics performance is low. Therefore, they should take steps to increase their digital competitiveness performance.
- China is first in all rankings. It should continue the current logistics market and digital competitiveness policies.
- Compared to the logistics market performance and digital competitiveness performance of Malaysia, Saudi Arabia, Thailand, Chile, Jordan, and South Africa, their digital logistics market performance is high. Efforts should be developed to improve all criteria to increase the DLMP rankings of these countries.

With this research, the digital logistics market performances of developing countries in 2022 were determined. The logistics market performances and digital competitiveness levels of the countries have been accepted as reference points in the performance determination processes. At this point, the main limitation of our research is that it is based only on the data obtained from the reports in the digital market performance determination process. Different approaches can be adopted in the digital logistics performance determination process of countries, and solutions based on different data sets can be presented. In addition, differences can be determined by comparing the findings obtained with these research findings. In addition, the DLMP of previous years of developing countries can be determined by taking the same methodological approach. Even the DLMP index can be improved. Finally, in this research, the digital logistics performances of developing countries are revealed, and awareness is raised at the macro level.

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