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The Topology And Evaluation Of The International Complex Network Of Communication Devices Within The Context Of Integrated Marketing Before And After The Covid-19

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ABSTRACT
Communication is now an indispensable part of both human and commercial relations. Accordingly, communication needs are to be satisfied using a number of essential electronic communication products, the most prominent of which are smartphones, modems, base stations, antennas, and other relevant accessories/apparatuses. In the integrated marketing communication approach, it has then become mandatory to manage complex networks interconnected by communication tools (people, businesses, countries, etc.) and the changes in such networks (structural changes in the distribution channels) in the context of the supply chain. Besides, it is highly needed to constantly monitor the changes and adopt change-oriented attitudes to prevent disruptions in the supply chain during the COVID-19 pandemic and in the future. The present study selected the G-20 countries, bearing the majority of world exports, and attempted to draw an export network of communication devices and related parts, classified in foreign trade with the code HS-8517, before and after the pandemic in these countries. The findings revealed that China and the USA were the strongest countries in the network in the pre-pandemic period and maintained their dominance in the network in the post-pandemic period. Although it seems there was an increased change in the complex structure of the network considering the export figures in the post-pandemic period, the change was found to be almost overlapping when considering pre- and post-pandemic periods together.

Keywords: Complex Network Analysis, Pandemic, Communication Devices, Integrated Marketing, COVID-19, post-COVID19.

1.INTRODUCTION

Interpersonal and social relations are indeed characterized by communication. It assumes a principal role in shaping social relations in every place and condition that people exist (Odabaşı, 2002: 15). The relevant literature offers different definitions of communication. It can be defined as the process of mutual exchange of thoughts, information, and news between individuals, communities, and organizations (Cemalcılar, 1988:305). In another definition, it is a process of thought consensus between the sender and the receiver (DeLozier, 1976: 1). It is also defined as a process of conveying, understanding, and processing information to the other party (Clow et al., 2016: 3). Most of the interactions in daily life occur in verbal form since one, by nature, desires to attribute a meaning to what they utter and do (Lazar, 2001: 54). While hunter and gatherer communities used to adopt signs and symbols to continue their lives, verbal communication started to develop rapidly when this primitive form of communication was not sufficient to introduce a common language (Erdoğan, 2011: 287).
Communication is also a prominent mediator in the marketing world(mainly Facebook, Twitter, Instagram et al.). Integrated marketing communication, on the other hand, is a set of activities oriented to customers' perceptions (Duncan et al., 1993). Accordingly, it is reasonable to adopt a simple and single communication strategy for each target audience. Besides, integrated marketing communication has been necessarily improved over time thanks to some influencing factors, such as structural changes in advertising agencies, advertisers, and distribution channels, increasing costs of traditional advertising media, globalization, changing expectations of advertisers, reducing effects of traditional advertising media and zapping phenomenon, technological improvements, the introduction of data-based systems, and changes in consumer trends (Bozkurt, 2003). The above-mentioned factors and cutting-edge innovations in information technologies (IT) introduce electronic marketing as a direct marketing method.
Businesses engage in competition in two separate worlds. While the first is called the physical world of resources that managers can see and touch, the second is referred to as the information-led virtual world. The internet is, on the other hand, the most apparent reality of the virtual world (Kiani, 1998: 185). As well as shopping, internet marketing allows interpersonal and community communication and exchange over a network

without the boundary of time and space. Therefore, the products and accessories (smartphones, modems, base stations, antennas, and accessories) are highly important for online trade.
The present study attempted to explore the export of products and apparatuses as the leading providers of communication between people and in the global marketing network (smartphones, modems, base stations, antennas, and their accessories, etc.) in the G-20 countries considering the pre-pandemic (2018) and post-pandemic (2021) periods and using the UCINET program in the network analysis. Since Germany, France, Italy, and England were considered in the analysis, the European Union (EU) was not recruited for the analysis. Accordingly, the overall structure (topology) of and the changes in the network were investigated on a 19*19 matrix.

2.LITERATURE

In the literature; (Setiawan et al.,2021), (Bharti&Purohit, 2016), (Ponciano Intal Jr.& Joel Hernandez, 2006), (Brett Berger, Robert F. Martin, 2013). (Michalski B., 2018) and while many studies are encountered with the HS 8517 classification system, it is seen that it is generally analyzed together with other classification(SITC) and mainly clustering and concentration analyzes are made, but no specific network analysis is made on the HS-8517 classification system.

3.METHEDOLOGY AND DATA

In this study, we aim to examine the increasing importance of G-20 communication devices(As a part of SITC harmonized system) electronics and parts) in world trade. The examination of electronics and components that provide integration for this purpose, and the performance of the G-20 school, which provides a significant size of this market, maintains the HS-8517 classification scope. There are many studies in the literature that analyze using the HS-8517 international classification code. It is important to clearly establish global relations, especially with regard to communication electronics and parts. Understanding and managing this complex structure can only be corrected by revealing this complexity by simplification. For this reason, complex network analysis is increasingly used to analyze the economy.
It is necessary to separate a complex system into its parts in order to analyze it (Reichardt, 2009). In this reason, we examine a complex structure by using nodes and edges to each other in one direction (export or import or two-way (both export and import). Network analysis using the Ucinet program has its own statistical concepts. These are the concepts of Betweenness, Centrality, etc.. The data were taken from the UN Comtrade Database in order to compare the period before(2018) and after the pandemic(2021). Then, the network analysis was performed by creating a 19*19 matrix table(EU is exclude).

4.FINDINGS

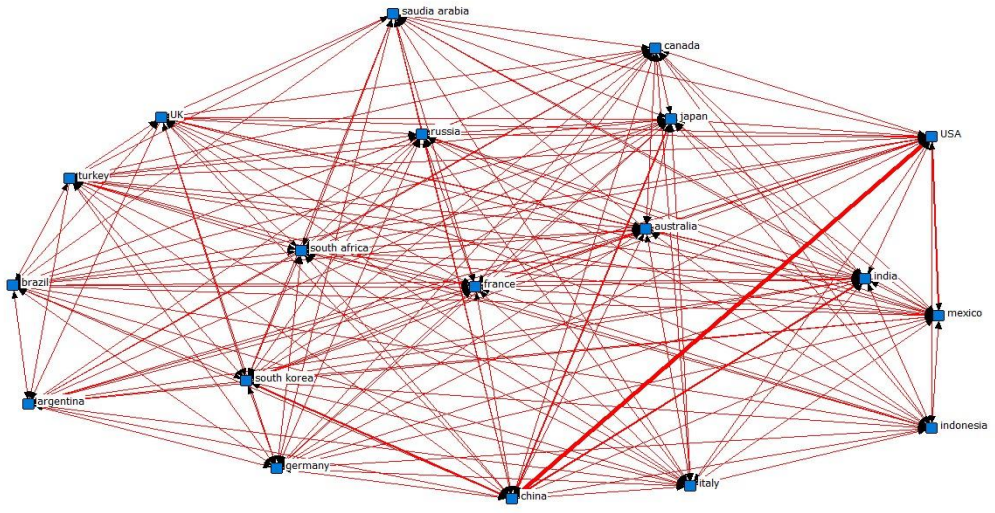

Fig.1:Export network of the G20 countries (2018)

Considering the network in 2018, Figure 1 shows that all countries established ties. The network was overall complex and consisted of directed ties. While the USA and China had very strong ties, the ties between China-India and Mexico-South Korea appeared as strong. It is evident that the countries had similar incoming and outgoing ties in the network.

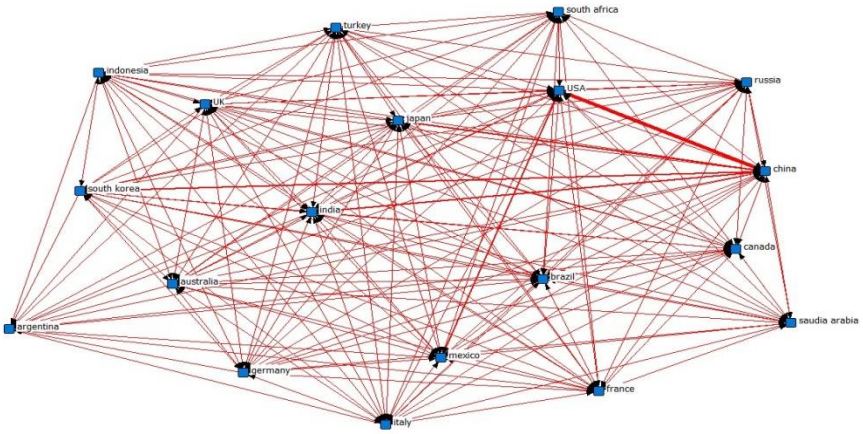

Fig.2:Export network of the G20 countries (2021)

When it comes to the network in 2021, it seems that all countries established ties. The network is overall complex and consists of directed ties. While the USA and China had very strong ties, the ties between Japan-China, China-South Korea, and China-India can be classified as strong. It is evident that the countries had similar incoming and outgoing ties in the network. Compared to the previous period, the network preserved its complex structure.

Table 1. Number of incoming and outcoming ties in exports of G-20 countries in 2018 and 2021

		3	4	3	4
		nOutdeg	nIndeg	nOutdeg	nIndeg
1	argentina	0.000	0.001	0.000	0.001
2	australia	0.000	0.004	0.000	0.004
3	brazil	0.000	0.003	0.000	0.004
4	canada	0.002	0.009	0.002	0.008
5	china	0.128	0.006	0.126	0.007
6	france	0.003	0.005	0.001	0.005
7	germany	0.005	0.007	0.005	0.008
8	indonesia	0.000	0.004	0.001	0.004
9	italy	0.001	0.005	0.001	0.006
10	japan	0.003	0.014	0.002	0.013
11	south korea	0.010	0.014	0.009	0.008
12	mexico	0.017	0.009	0.011	0.008
13	russia	0.000	0.005	0.000	0.006
14	saudia arabia	0.000	0.002	0.000	0.002
15	india	0.001	0.011	0.003	0.008
16	south africa	0.000	0.002	0.000	0.002
17	turkey	0.000	0.002	0.000	0.002
18	UK	0.002	0.008	0.002	0.009
19	USA	0.016	0.080	0.014	0.072

The number of countries with outgoing ties increased to seven in 2018 compared to the previous period. Accordingly, while China (128) had the highest number of outgoing ties, the USA (80) stood out as the country with the highest incoming ties. Considering the picture in 2021, there was a slight decrease in the number of outgoing ties of China (126) and the USA (72) compared to the previous period.

Table 2. Hub-authority analysis of the G-20 countries' exports in 2018 and 2021

		1 Hub	2 Autho
1	argentina	0.000	0.009
2	australia	0.002	0.041
3	brazil	0.001	0.028
4	canada	0.022	0.049
5	china	0.972	0.005
6	france	0.006	0.032
7	germany	0.017	0.066
8	indonesia	0.000	0.054
9	italy	0.004	0.050
10	japan	0.012	0.192
11	south korea	0.090	0.208
12	mexico	0.213	0.063
13	russia	0.000	0.066
14	saudia arabia	0.000	0.024
15	india	0.004	0.148
16	south africa	0.000	0.019
17	turkey	0.000	0.022
18	UK	0.007	0.084
19	USA	0.016	0.930

		1 Hub	2 Autho
1	argentina	0.000	0.013
2	australia	0.002	0.053
3	brazil	0.001	0.043
4	canada	0.020	0.055
5	china	0.988	0.004
6	france	0.004	0.035
7	germany	0.014	0.080
8	indonesia	0.011	0.064
9	italy	0.006	0.058
10	japan	0.013	0.184
11	south korea	0.049	0.118
12	mexico	0.145	0.077
13	russia	0.000	0.093
14	saudia arabia	0.000	0.034
15	india	0.013	0.118
16	south africa	0.000	0.018
17	turkey	0.000	0.031
18	UK	0.008	0.105
19	USA	0.016	0.942

While China (972) assumed the role of a hub, the USA (930) was the authority country in 2018. The case was also the same in 2021 (China = 988 vs. the USA = 942; Table 2).

Table 3. Eigenvector analysis of the G-20 countries' exports in 2018 and 2021

		1 Eigenvector
1	argentina	0.010
2	australia	0.035
3	brazil	0.027
4	canada	0.078
5	china	0.674
6	france	0.029
7	germany	0.055
8	indonesia	0.037
9	italy	0.036
10	japan	0.138
11	south korea	0.199
12	mexico	0.184
13	russia	0.045
14	saudia arabia	0.018
15	india	0.103
16	south africa	0.014
17	turkey	0.016
18	UK	0.066
19	USA	0.649

		1 Eigenvector
1	argentina	0.011
2	australia	0.044
3	brazil	0.037
4	canada	0.079
5	china	0.688
6	france	0.031
7	germany	0.066
8	indonesia	0.051
9	italy	0.045
10	japan	0.134
11	south korea	0.113
12	mexico	0.150
13	russia	0.064
14	saudia arabia	0.024
15	india	0.089
16	south africa	0.014
17	turkey	0.022
18	UK	0.083
19	USA	0.659

The eigenvector centrality ranged between 10 and 674 in 2018. While China became the leading country with the highest centrality value, the country with the second highest centrality value (649) was the USA. The mentioned value ranged between 11 and 688. Accordingly, China had the highest centrality value, followed by the USA with 659, suggesting that these two countries preserved their ranks compared to the previous period.

Table 4. Ego network analysis of the G20 countries' 2018 and 2021 exports

		1 Size	2 Ties	3 Pairs	4 Densit
1	argentina	16.00	238.00	240.00	99.17
2	australia	18.00	287.00	306.00	93.79
3	brazil	18.00	286.00	306.00	93.46
4	canada	18.00	285.00	306.00	93.14
5	china	18.00	285.00	306.00	93.14
6	france	18.00	285.00	306.00	93.14
7	germany	18.00	285.00	306.00	93.14
8	indonesia	16.00	238.00	240.00	99.17
9	italy	18.00	286.00	306.00	93.46
10	japan	18.00	286.00	306.00	93.46
11	south korea	18.00	286.00	306.00	93.46
12	mexico	18.00	287.00	306.00	93.79
13	russia	18.00	288.00	306.00	94.12
14	saudia arabia	16.00	238.00	240.00	99.17
15	india	18.00	286.00	306.00	93.46
16	south africa	18.00	288.00	306.00	94.12
17	turkey	18.00	286.00	306.00	93.46
18	UK	18.00	286.00	306.00	93.46
19	USA	18.00	285.00	306.00	93.14

		1 Size	2 Ties	3 Pairs	4 Densit
1	argentina	15.00	210.00	210.00	100.00
2	australia	18.00	282.00	306.00	92.16
3	brazil	18.00	282.00	306.00	92.16
4	canada	18.00	282.00	306.00	92.16
5	china	18.00	282.00	306.00	92.16
6	france	18.00	282.00	306.00	92.16
7	germany	18.00	282.00	306.00	92.16
8	indonesia	17.00	256.00	272.00	94.12
9	italy	18.00	282.00	306.00	92.16
10	japan	18.00	282.00	306.00	92.16
11	south korea	18.00	282.00	306.00	92.16
12	mexico	18.00	282.00	306.00	92.16
13	russia	17.00	267.00	272.00	98.16
14	saudia arabia	16.00	239.00	240.00	99.58
15	india	18.00	282.00	306.00	92.16
16	south africa	17.00	266.00	272.00	97.79
17	turkey	18.00	283.00	306.00	92.48
18	UK	18.00	282.00	306.00	92.16
19	USA	18.00	281.00	306.00	91.83

In 2018, the ego role was shared with values 16 and 18. Accordingly, while Argentina, Indonesia, and Saudi Arabia took a value of 16, the other countries took a value of 18. Besides, density refers to the ratio of actual ties divided by the foreign trade volume (total incoming and outgoing ties); in other words, it indicates that the country with a high density percentage engages in less commercial activity. Although the countries with the highest density percentage were Argentina and Saudi Arabia (99), the density percentage of the others was also above 90. While the countries with the lowest number of directed ties were Argentina (238), Saudi Arabia (238), and Indonesia (238), this number ranged between 285 and 288 for the others. The high number of ties indicates a dense trade of communication devices between the countries. Regarding foreign trade volumes (pairs) (i.e., the totals of a country's imports and exports of communication devices), while Argentina (240), Saudi Arabia (240), and Indonesia (240) became the countries with the lowest pair values, the others took a value of 306. In the 2021 period, the ego role was shared with values 15, 16, 17, and 18. Similarly, Argentina, Indonesia, Saudi Arabia, Russia, and South Africa took the first three values, while the others took a value of 18. Regarding density, although the countries with the highest density percentages were Argentina (100), Saudi Arabia (99), Russia (98), South Africa (97), and Indonesia (94), the other countries also had a density percentage of 92. Argentina (210), Saudi Arabia (239), Indonesia (256), and Russia (256) had the lowest number of directed ties. This number became 281 and 282 for the other countries, and Turkey was among the countries with the highest number of directed ties, implying that it had a superior international trade of communication devices. In terms of foreign trade volumes (pairs), while Argentina (210), Saudi Arabia (240), Indonesia (272), and South Africa (272) appeared as the countries with the lowest pair values, the others had a pair value of 306. Thus, despite a slight increase in the post-pandemic figures compared to the pre-pandemic period, the picture was almost overlapping regarding the international communication device trade.

Table 5. Core and periphery countries in the exports in 2018 and 2021

2018	**Core:** China, USA **Periphery:** Argentina, Australia, Brazil, Canada, France, Germany, Indonesia, Italy, Japan, South Korea, Mexico, Russia, Saudi Arabia, India, South Africa, Turkey, the UK
2021	**Core:** China, the USA **Periphery:** Argentina, Australia, Brazil, Canada, France, Germany, Indonesia, Italy, Japan, South Korea, Mexico, Russia, Saudi Arabia, India, South Africa, Turkey, the UK

According to Table 5, it was discovered that core and periphery countries did not change in both periods. Accordingly, while the core countries became China and the USA, the others became periphery countries in the mentioned periods.

5.CONCLUSION

Marketing communication is conceived of as a two-way communication: conveying and receiving messages. It is also in the nature of trade to establish, develop, and maintain this relationship. It is essential to manage complex trade networks well within integrated marketing communication. The pandemic has suggested that unexpected massive events may hinder trade, leading to significant economic problems and market loss for countries.

Based on the idea that communication devices form a complex network in global trade, one may need to master the topology of such networks to take action according to the changes in the supply chain. Disruptions in the supply chain adversely affected developing countries, particularly China, during and after the pandemic. In this study, the export of communication devices in the G-20 countries was addressed in the context of the sustainability of communication and the supply chain. The findings revealed no substantial changes in the network in the pre-pandemic and post-pandemic periods.

While the USA and China had very strong ties, the ties between China-India and Mexico-South Korea appeared as strong in the pre-pandemic period. When it comes to the network in 2021, While the USA and China had very strong ties, the ties between Japan-China, China-South Korea, and China-India can be classified as strong. In other words, the post-pandemic period has brought an increased trade of communication devices between Japan and China compared to other actors in the network.

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