Evaluating the Impact of the Influencer Marketing Industry on E-Commerce Using Fuzzy Cognitive Maps

FEYZA ÇOKAK, MEHTAP DURSUN Industrial Engineering Department, Decision Analysis Application and Research Center Galatasaray University Ciragan Street. No: 36 Besiktas, İstanbul TURKEY

Abstract:- This study is designed to measure the impact of the influencer marketing industry on ecommerce in Turkey. After the increasing use of mobile devices, developing technology, changing customer needs and social media usage, and especially with COVID-19, the influencer marketing industry was formed and this sub-branch has become one of the most important and most effective items of marketing. This large and increasing volume has brought along unnecessary expenditures and unsuccessful advertisements that repel consumers. In this study, the factors affecting sales, product views and product favorability in the e-commerce sector and the degree of influence of these factors are examined. For this purpose, commission rate, product price, product discount rate, influencer's compatibility with the brand, number of followers of the influencer, product narrative, product category and number of shares of the advertisement will be analyzed in depth.

In the research, data were collected from experts in the e-commerce sector and these data were analyzed with the Fuzzy Cognitive Map method.

Key-words: - E-commerce, influencer, influencer marketing, Fuzzy Cognitive Map (FCM), decision making.

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1 Introduction

With the innovations created by digital transformation and the increase in internet usage rates over the last decade, e-commerce has entered our lives with an increasing momentum, in addition to this, the change in consumer habits and expectations following COVID-19 has brought new opportunities and tools in the e-commerce sector all over the world. Global e-commerce sales have increased steadily, increasing approximately 4 times from 2014 to 2021. From 2022 to 2026, sales graphics are expected to increase without losing momentum [1]. Digital transformation and internet usage have brought new professions to our lives in addition to e-commerce and the use of social media. E-commerce has been the representation of effortless shopping since the first day, and the professional groups that make this shopping process safer and more effortless are influencers who research and find products that the customer can demand and share their product experiences.

Brands indirectly target their followers with influencers and offer their products to more specific target audiences with the help of influencers. At the same time, they aim to gain brand and platform trust through the trust of the followers in influencers and thus increase their sales. At this point, the harmony of the brand and influencer followers is of great importance. Influencers are people who specialize in a particular subject, have a large following on social media platforms such as Youtube, Instagram, and Tiktok, and can provide a certain impact or inspiration to these followers and gain the trust of their followers. Compared to other media users, influencers establish a direct connection with their followers and share only product experience but not also interruptions from their lives. This personal connection with followers makes influencer recommendations more effective and enables people to shop by taking into account an influencer recommendation they like or appreciate. The reason why influencers are content producers in Turkish is that brand and product advertisements are more personal, creative and remarkable. At this point, with the social media usage rate of 82% in our country and Instagram being one of the most used social media platforms, every post made on this platform reaches thousands of people. It influences them at the point of decision-making and saves people from the trouble of searching for products [2].

Social media influencers earn high sums of money through posts or stories by receiving commissions directly on product sales with the e-commerce platform links they share or by agreeing with the brand on advertising fees. Research shows that influencer marketing campaigns done in the right way increase conversions and sales. Especially today, with the decrease in the rate of television viewing and the increase in the use of social media, Instagram posts of social media influencers are shown as a low-budget but effective alternative to television advertisements [3].

In summary, influencers play an important role in the marketing world by filling the "trust" gap in the world of commerce and enable brands to reach their target audiences, promote their products, create a perception of trust and increase sales. Therefore, influencer marketing has become an important marketing strategy for both brands and e-commerce platforms and an easy way to reach users.

In the study, Fuzzy Cognitive Map-Linguistic Elements Assignment Method (FCM) was used for the analysis due to linguistic elements and complex structure. In the FCM process, 8 criteria and causality degrees were determined by literature review and expert opinions. Then we will complete our analysis with MATLAB-Fuzzy ToolBox and FCMapper- Excel Macro. In this way, we will create a map with linguistic elements.

Unlike the literature on the subject, the data were collected based on the opinions of ecommerce site company employees in the sector and differed in method.

This study aims to gain a new perspective on the future of the developing influencer marketing industry, to determine the points that e-commerce platforms in the sector can pay attention to while collaborating, to measure the trust of followers in influencers based on sales and views, and to contribute to the improvement of existing business processes according to the needs of the future.

Section 2 of the study reviews the existing literature. Section 3 describes the FCM methodology. The proposed decision algorithm is summarized in the next section. Section 5 describes the case study. Conclusions and discussions are summarized in Section 6. Conclusions and future research directions are given in the last section.

2 Literature Review

At this stage, the researches on influencer marketing and e-commerce and the methods used were included. Based on the literature review and expert opinions, the criteria to be used in the study were decided.

Özkan and Yerezhep [4] stated that a language containing sincerity and trust in influencer marketing campaigns enables consumers to trust the brand. Ulastiran [5] revealed in his study that trust is effective in consumer purchasing decisions. Kemec and Yüksel [6] observed that trust in influencers increases trust in the brand using structural equation modeling. Erdoğan and Özcan [7] stated that influencer attractiveness is not effective in consumers' decision-making process. Woodroof et al. [8] emphasised that consumers expect a more transparent and explanatory narrative from influencers. Casey [9] stated that influencers 'sharing the most affordable products on social media affects consumers' preferences. In the We Are Social [2] report, it was pointed out that internet users worldwide frequently use the internet for product and brand research. Özkahveci [10] stated that influencers' consumption activities make a significant contribution to marketing communication and encourage consumers to purchase by creating a sense of need. Ulastiran [5] explained in his study that surveys and methods such as AMOS and SPSS were used to understand the impact of influencer advertisements on consumer behavior. Wiedmann and Mettenheim [11] conducted analyses on SmartPLS and found that the credibility and attractiveness of influencers positively affected the purchase. Mert [12] stated that Instagram is an interactive platform and the reason why it is preferred in digital marketing is its fast use. Influencer Marketing Hub [3] showed in its research that influencer marketing grew during the pandemic period and became a strategy preferred by marketers. Kantsperger and Kunz [13] emphasized that one-to-one communication via social media is an effective communication tool with the increasing impact of relational marketing and trust factor.

The general subject of the studies is the effect of influencers on purchasing tendencies and factors. Data were collected from users through surveys, which raises a question mark about the reliability of the studies due to the problem of reaching the right sample. No study has specifically focused on the "influence on ecommerce", so it is thought that this study will be differentiated. At the same time, since the sector is developing, the literature generally belongs to the last 10 years.

3 Fuzzy Cognitive Map

Cognitive mapping is a method used to represent thoughts on a problem. It is a useful tool for decision-makers to model and simplify complex systems [14]. Cognitive maps deal with the causality between the concepts that define the system. Causality is indicated by arrows on the maps and positive/negative relationships are marked [15]. Since the Cognitive Map cannot reveal a numerical relationship between the criteria, this method was developed and the Fuzzy Cognitive Map (FCM) emerged.

FCM is a cause-and-effect-based methodology that emerged from the combination of fuzzy logic and neural networks, aiming to model complex decision systems, and maps that can express the system as a whole. Concept variables are represented by nodes and this set can be represented as $C = \{C_1, C_2, ..., C_n\}$. The indicate the causality between arrows conceptual nodes and W_{ij} the weight of the relationship between each key concept of the system. It is reflected in the degrees of causality between concepts and instead of the typical binary logic, a special logic is used where the weights of the links can be expressed in the range [-1,1] or in grammatical terms such as "negative very strong", "zero", "positive weak".

In terms of weight, there are three possibilities;

- C_i positively affects C_j . If any of the concepts increases at any level, the other concept will also increase $(W_{ij}>0)$.
- C_i affects C_j negatively. If one of the concepts increases/decreases at any level, the other concept will decrease/increase ($W_{ij} < 0$).
- C_i neither positively nor negatively interacts with C_j . This means that there

is no interaction between C_i and C_j ($W_{ij}=0$) [16].

The value of each concept is calculated by calculating the influence of other concepts on a specific concept, applying the following calculation rule [1]:

$$A_{i}^{(k+1)} = f \left(A_{i}^{(k)} + \sum_{j \neq i, j=1}^{N} (A_{j}^{(k)} * W_{ij}) \right)$$
(1)

Where $A_{i(k)}$ is the value of concept C_i at step k, $A_{i(k+I)}$ is the value of concept C_j at step k+1, w_{ji} is the weight of the link from C_j to C_i and f is a threshold function.

There are 2 different threshold (transformation) functions that can be commonly seen in the literature. These functions are used to stabilize FCM values within a certain range.

- The unipolar sigmoid function, which can operate in the value range [0,1] and with the parameter \Box (\Box >0), the sharpness with which the value at the input of the function can be given to the output can be adjusted:

$$f(x) = \frac{1}{1 + e^{-\lambda * X}}$$
(2)

- The hyperbolic tangent function tanh(x) is used if it is desired that the values to be taken by the concepts are in the range [-1,1], that is, if it is desired that the concept values take both positive and negative values:

$$f(x) = \frac{e^{2x} - 1}{e^{2x} + 1}$$
(3)

4 Proposed Decision Approach

Since this study contains linguistic elements and complex relationships, it will be analyzed using the Fuzzy Cognitive Maps (FCM) method and linguistic element assignment method.

Considering the criteria of the FCM method, it is seen that it does not contain any negative relationships, so an analysis was performed in the range [0,1] using the sigmoid polarity function in Equation 2. The following steps were followed for the study:

- 1. Decision makers are identified and evaluation criteria Ci(i=1,2,...,j,...,N) are defined.
- 2. The causal relationship between each pair of factors was identified. In this case, the casualties are either zero or positive.
- **3.** For the strength of causal links between factors, data was obtained from experts and FCM literature using a scale of nine linguistic variables. However, since no negative effects were observed in the study, five linguistic variables were used: zero (z), positive weak (pw), positive moderate (pm), positive strong (ps), and positive very strong (pvs).
- **4.** The defuzzification method was used to defuzzify the linguistic data.
- **5.** The fuzzy numbers for each relationship and decision matrix were combined and the center of gravity was calculated.
- **6.** The initial vector [1,...,1,10=A] is activated by an iterative process. This step is defuzzification and FCMapper Excel Macro was used for this.
- 7. The values of the first vector are constrained to the interval [0,1] using the sigmoid function (Equation 2).
- 8. The changes in the system and the updated vector are monitored until a certain threshold is reached and step 6 is repeated. In other words, these steps continue until the system reaches equilibrium.

Table	1:	Trian	gular	fuzzy	numbers	scale.
			0			

Linguistic Term	Fuzzy Number
nvs	(-1,-1,-0.75)
ns	(-1,-0.75,-0.5)
nm	(-0.75,-0.5,-0.25)
nw	(-0.5,-0.25,0)
Z	(-0.25,0,0.25)
pw	(0,0.25,0.5)
pm	(0.25,0.5,0.75)
ps	(0.5,0.75,1)
pvs	(0.75,1,1)

5 Case Study

Influencer spending has become one of the most important elements of marketing for both brands and e-commerce companies. However, in this case, ineffective spending and collaborations have emerged as well as effective spending, creating unnecessary costs, and poorly managed advertising campaigns not only create unnecessary costs, but also cause consumers to prejudge the brand. The purpose of this analysis is to measure the success and impact of the influencer marketing industry in e-commerce and to make the industry more efficient by identifying the main points of this impact.

For the analysis, 8 criteria were determined based on previous literature reviews and expert recommendations. To determine the causality relationship between the criteria, 3 experts working in Turkey's largest e-commerce site were interviewed and causality relationships were determined. While determining the relationships, care was taken to determine direct rather than indirect relationships.

Table 2: Influencer Marketing Industry's Impact Factors on E-commerce

Label	Concept
el.	Conformity between influencer and brand/target audience
c2	Influencer's product description
c3	Category of product
05	Price of product
c5	Discount status of peoduct
c6	Number of shares of advertised product
e7	Number of influencers' followers
08	Commission rate offered to influencer for advertising

The first version of the matrices collected from 3 decision-makers with linguistic items for causality measurement is as follows.

Table 3: Matrix of Linguistic Elements	for
Decision Maker 1	

Expert I	cl.	==2	15	c4.	rd.	68	£3	48
cJ.	2	pm.	2	E.	1	2	2	2
.62	z	2	2	1		pu:	z	1
68	2	z		pm		2	2	pu
44	2	1986	z	E.	pw	2	z.	2
c5		pa.		pvs		per-		7
c18		2						7
£7	pa	2	*					=
60	2	pa	2			pva.		2

Equent 2	c1	+ 12	10	45	123	- 10	42	-18
c1		pe	pe.	1				1
42	pre	2	z	z			x	÷.
C3	1	200	2	pa	2	4		1
c7		pe	Ŧ	x	2			
15		279	2	pres	2	1881	2	2
cd		2					2	
£7.	711	*		z		TH	x	*
68	1	jan .		1	2	pvs.	4	1

Table 4: Matrix of Linguistic Elements for Decision Maker 2

Table 5: Matrix of linguistic elements for Decision Maker 3

Ripert J	cl	62	¢∂	cé.	c5	.00	67	cð
13		pm	hw.					10
62	pm							
c5		pm	2	pa	ha	inn.	z	z
44	*			2	£		r	=
£3.				ps.	#		4	4
216	4		*	#				ŧ
67	pw	2	2	2		2	2	- 2
10	1	25%	2	2	2	24/8	2	2

Once the relationships defined by e-commerce with linguistic variables were identified, the SUM method and the center of gravity method, which is a stabilization method, were applied respectively with the help of MATLAB, and the relationships between the concepts were converted into numerical values and a new weight matrix was created. All weights obtained are shown in Table 6.

 Table 6: Influencer marketing industry weight matrix.

	et -	162	- 18	16	12	- 18	117	58
11		6.625	0,852.		. 8			.0.
12	8,25:	0			2.0	0;121	1.0	0
11	1.1	6,362		0.421	6325	0,25	× .	6,125
-14	- E	4,342			8.3.23			.0
25	E	4,374		0,788	0	0,22	10	.0
75		0			0			0
27	6.2	0			.0	0,121		.0
et		4.795		- 14 C	. 0	0.923		

To defuzzify the matrix and calculate the importance of the criteria, the above weight matrix is copied. Excel FCMapper starts with an initial vector. As mentioned before, the values of the vector are updated using Equation 1 and the sigmoid function Equation 2. This new vector is considered as the initial vector in the next iteration.

When Excel is run, many values such as the degree of entry, degree of exit, centrality, number of nodes, number of links, etc. are also calculated as in Table 8. Each criterion (risk factor) affects the other criteria according to the weighted connections between them, the fuzzy cognitive map showing this effect is shown in Figure 1. The value of each factor is multiplied by the value of the causal factor to obtain all causal event weights.

Table 7: Index

Concepts	Outdegree	Indegree	Centrality
cl	0.977	0.750	1.727
c2	0.375	2.591	2.966
c3	1.522	0.352	1.874
c4	0.522	1.423	1.945
c5	1.422	0.250	1.672
c6	0.000	1.673	1.673
c7	0.625	0.000	0.625
c8	1.721	0.125	1.846

After the 10th iteration on average, the system stabilized and the weights of the concepts are shown in Table 8.

Table 8: Weights of criteria for the impact of the influencer marketing industry on e-commerce.

Criteria	Weights
c1	0.79618
c2	0.94762
c3	0.73382
c4	0.86966
c.5	0.71388
c6	0.88937
c7	0.65905
c8	0.68497

There are a total of 18 relationships between 8 criteria in the system.



Figure 1: Illustration of the weight matrix for the impact of influencer marketing on ecommerce.

6 Results and Discussions

c1-Conformity between influencer and brand/target audience: It represents the alignment between the influencer and the brand. This alignment has a moderate effect on other factors and on itself. A high fit between the influencer and the brand increases

consumer trust and the likelihood of purchase. The weight of c1 criterion is the 4th highest out of eight criteria, highlighting the importance of brand-influencer alignment. The map shows that c1 and c2 have a reciprocal relationship, and there is an interaction from c7 to c1, indicating the impact of cohesion on the influencer's number of followers. The relationship between product category and c1 is also important, as incompatible product endorsements may not be effective.

c2- Product description: A detailed and welldescribed product attracts more attention from users. C2 is heavily influenced by other concepts and is one of the most central elements of the network. It has the highest weight, indicating the importance of detailed product description. The network map shows that product description is influenced by factors such as commission rate, and it also influences other factors such as c3, c4, c5, and c6. The impact of c2 on other factors is high, suggesting its critical role in e-commerce volume.

c3- Category of product: It has a low direct influence on other concepts but is influenced to some extent. Certain product categories may be more prone to influencer marketing, indirectly impacting e-commerce volume. The weight of c3 is medium, indicating its medium impact. It is linked to c4, influencing product pricing, and also influences c6. The frequency of sharing depends on the category, with high-demand categories being shared more often. The product category also affects c2 product narrative.

c4- Price of product: Although it has a low direct influence, it is influenced by other factors. Pricing strategy strongly influences the perceived value and sales volume of the product. More affordable and moderately expensive products may not directly impact views but do influence purchases.

c5- Discount status of a product: It is found that discounts can significantly influence consumers' purchase decisions. The concept of discounts is influenced by the product narrative (c2) and the product category (c3). Technological devices are discounted less frequently and at a lower rate compared to the clothing category. The weight of c5 indicates

that discounts can have a significant impact on customer demand and e-commerce volume.

c6- Number of shares of advertised product: This factor has a strong interaction with other variables in the model. The number of shares is an important metric for e-commerce volume, and the commission rate (c8) can influence the number of shares. Influencers may share a link multiple times to generate more revenue.

c7- Number of Influencer's followers: While this factor has little direct influence on other concepts, brand alignment can increase the number of followers. Collaborating with an influencer with a high number of followers doesn't always lead to high sales and engagement, but the number of followers can indirectly affect e-commerce volume.

c8- Commission rate: This factor has a medium influence and influences c2 and c6. Higher commission rates can motivate influencers to describe and share the product more, thus affecting e-commerce volume.

The impact of different factors on e-commerce volume was analyzed using scenario analysis in FCMapper. Criteria weights were adjusted to observe the changes in centrality measures after each manipulation.

- 1. Scenario: The first scenario involved reducing the weight of the c2-product narrative factor to 0, indicating no effect on consumers and e-commerce sales. This resulted in negative effects on other factors, except for c7, suggesting that trust in influencers would decrease without product narrative.
- 2. Scenario: The second scenario manipulated the c8-product commission, simulating a scenario without commission payment to influencers. This change negatively affected all factors except c6 and c7.
- **3.** Scenario: The third scenario involved reducing the weight of c7 to 0, simulating a scenario where the number of influencers' followers had no effect. All factors changed

negatively,	especially	c1-
brand/influence	er alignment.	

4. Scenario: Lastly, a scenario was created to observe the effect of product price and discount status. The c2-product description was affected, indicating that a successful influencer advertising campaign can increase sales regardless of the price.

Table 9: New criteria weightings for scenarios

Weights_4	Weights_3	Weights 2	Weights 1	Weights 0	Criteria
0.79404	0.72297	0.79434	0.74556	0.79618	c1
0.90359	0.94501	0.90967	0	0.94762	c2
0.73363	0.72750	0.73366	0.72946	0.73382	c3
0	0.86913	0.86965	0.86930	0.86966	c4
0	0.71366	0.71388	0.71373	0.71388	c.5
0.86743	0.87977	0.79454	0.87553	0.88937	сő
0.65905	0	0.65905	0.65905	0.65905	c7
0.68496	0.68475	0	0.68482	0.68497	c8

7 Conclusion

Influencer marketing has gained significant importance in the marketing industry, especially after the COVID-19 pandemic. However, there is a lack of research and diverse methods in this new sector. This study aims to fill the gap by determining the factors that affect e-commerce volume in influencer marketing and improving collaboration between brands and influencers. The Fuzzy Cognitive Map - Linguistic Item Assignment Method was chosen to analyze the complex relationships and verbal concepts involved. The identified eight criteria, such as studv influencer-brand alignment and product description, to analyze the factors. The results showed that product promotion, number of product link shares, and product price were the most critical factors. Understanding the interactions between these factors and their impacts on the e-commerce volume is crucial for effective marketing strategies. The study provides valuable insights for companies to make informed decisions regarding influencer collaborations and optimize marketing efforts. Future studies can explore different methods, analyze real numerical data, and evaluate the outcomes of influencer marketing campaigns using tools like SPSS. Overall, this study serves as a starting point and opens avenues for further research in the field.

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