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SOCIAL NETWORK ANALYSIS AS THE IDENTIFICATION TOOL OF HIDDEN PROPERTIES OF MARKET RELATIONSHIP STRUCTURES, ILLUSTRATED BY BRANCH FORUMS ON THE MOBILE MARKET

Introduction

The widespread application of new media in transferring communication messages by organizations results in the necessity to reorganize the hitherto investigations that should focus on the measurement and acquisition of interaction or network data. That kind of approach reflects best the current character of market relationships. The literature on the subject includes an investigation method that is referred to as the *Social Network Analysis, SNA,* which makes it possible to distinguish and identify the internal, hidden, multi-level and multi-dimensional structure of market relationships through the determination of the dependencies between nodes and ties. On the basis of SNA it is possible to identify network properties that result directly from the number of ties (the elementary network properties or measures that determine social distance) or the ones that become visible solely as the result of data analysis (local structures, centrality or the position of the nodes in the network) [1].

The aim of the article is to identify the properties of network structures and to analyze network properties of market relationships as illustrated by branch forums of mobile phone operators. The goal was achieved in two stages; firstly, by the determination of the network explicit properties that result from the character of ties in the network, which was possible by the network structure visualization itself and, secondly, by presenting the network hidden attributes, which is possible in the course of SNA. Thus, an element of tacit knowledge was revealed that is unique to a particular organization and concerns its relationships and ties with its stakeholders.

In their communication strategies, all operators take into consideration the new technologies of establishing and developing communication with their customers in order to construct deep relationships and bonds. The branch forums under investigation constitute a platform for the flow of information regarding the operator's service offer, technical data of

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[1] M. Kowalska-Musiał, *Strukturalna metodologia pomiaru sieci społecznych – rys historyczny i współczesne obszary zastosowań*, Zeszyt Naukowy (No. 28) –Socjologia, 2013, www.zeszytnaukowy.pl

mobile phones, current sales promotions, complaints, remarks concerning customer service, opinions on current advertising campaign, etc. The topics of on-line conversations are initiated both by the representatives of the operators or by the registered forum users.

Due to the limited space, the article presents the analysis results regarding only the identification of the explicit and hidden properties of the T-Mobile relationship structure.

1. Methodology of investigation

The research consisted in work sampling of the branch forum that was conducted by a T-Mobile mobile operator. The process lasted one week. One topic of discussion was selected and the criterion was the number of discussion participants and the number of posts. It should be pointed out that - considering the objective of the research - the discussion topic as such was insignificant. An interaction matrix was constructed. on the basis of the chats on the forum under investigation. The matrices were entered into Ucinet 6.0 program[2] and were the basis for the visualization of the service provider – customer network and the applied computations of the selected structural indicators of network relationships.

The analysis of the selected topics of discussion resulted in the acquisition of basic demographic data (gender) and attributes regarding the activity of forum users (the role played by the user in the forum and the number of the posts sent, which constitute the total activity on the Internet forum). The role of the network user is determined and assigned automatically by a service moderator at the registration of a new forum user; then it is updated and changed with regard to the level of his/her activity, the number of replies sent and the frequency of entries to the forum.

For analytical purposes the levels of the roles were uniformed and their number was reduced from six to three: level one referred to the beginners on the forum of opinion exchange, level two – included committed users, who were active members of the network community and frequently entered the forum concerning the operator's services, and level three – which was assigned to the participants that played particular roles of administrators, forum moderators or the operator's workers.

The number of posts was the total of all replies and activities on the operator's forum from the moment of the user's registration. The number was counted automatically thanks to

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[2] S.P. Borgatti, M.G. Everett, L.C. Freeman, *Ucinet 6.0 Version 1.00*, Analytic Technologies, Natick, MA 1999.

adequate statistics of entries that were conducted by the internet provider and the system administrator who was responsible for running the customer opinion platform and information flow forum for the operator. Thanks to the data obtained, it was possible to develop a visualization of the network relationship structures between particular providers and customers, and to determne collective network properties of the structure.

The structure of the service provider – customers relationship network for the users of the T-Mobile operator is given in table 1 with the consideration of gender and the roles played in the relationship network. The visualization of the T-Mobile – customers network relationship structure features 20 users: three women (node positions 7, 16 and 20) and 17 men (the remaining node positions). The structure was definitely male-dominated, while women played a marginal role.

In the network structure a subgroup can be clearly distinguished. It consists of three men who were the beginners in the forum of the T-Mobile network. Other participants of the network relationships can be described by their roles in the network: eleven beginning users (nodes 1, 6, 15, 16, 17, 18, 19, 20 and 11,12, 13), and seven active users (nodes 2, 3, 5, 7, 9, 10 and 14). There were two moderators (nodes 4 and 8). The role of the moderator positioned at node 4 should be emphasized as he constituted a bridge between the two groups of participants. If not for this user, the structure could split into two subgroups.

The structure given below can be referred to as an unbalanced one – the dominating role was played by the beginning users, while the committed ones were basically placed in the peripheries of the structure (except node 14, who was a committed user and a bridge in the network relationship structure)

Table 1. Interaction network of the T-Mobile operator user forum with the consideration of gender and role in the communication network.
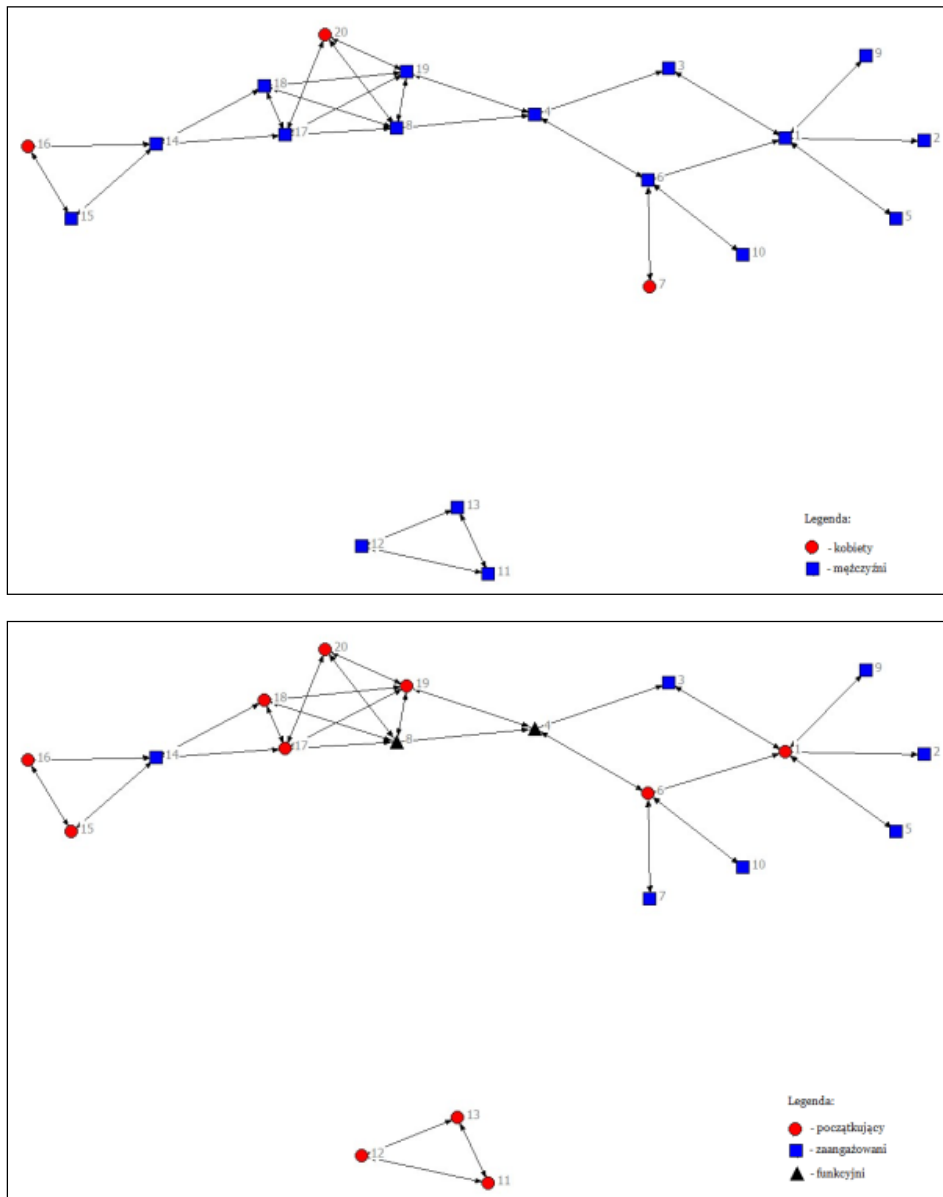
Source: Author's research. Visualization in Ucinet 6.0.

Key: men women

Key: beginners committed functional

In conclusion: the visualization of the service provider – customers relationship network structure made it possible to point at the network structural features that resulted from the character of ties among network participants, and consequently to identify collective

properties of the structure. Thus, the following network properties were identified: network density and size, local densities, subgroups, bridges and attraction nodes.

In order to distinguish the hidden properties of the relationship structure on the mobile phone market, SNA was conducted for data that were obtained by work sampling of communication processes in a branch forum.

2. The impact of actors' demographic attributes on the structure network properties

In order to analyze the structure of network interactions, four structural measures were selected that indicated the hidden attributes of the service provider-customers relationship network: 1) in-degree / out-degree, 2) structural holes, 3) Bonacich's power, 4) Freeman's betweenness.

With the aim to identify the dependencies between the demographic characteristics of the participants and the network structure properties, the analysis of variance (ANOVA) was conducted for such explanatory variables as gender, the role in the network and the number of posts sent[3]. The results of ANOVA were crucial at $p \langle 0{,}05$ for a 95% trust range and the level of significance $\alpha = 0{,}05$[4]. In the network analysis and the testing of variance and regression hypotheses (due to the parametric character of the number of posts variable) Ucinet 6.0 was applied[5].

The network out-degree and in-degree measures indicate the total number of ties between a particular actor and the others. The out-degree measure informs about the number of ties a particular actor has; thus, it informs about the degree of his/her influence on the actors that

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[3] ANOVA (*analysis of variance*) is a set of statistical methods applied to compare a number of populations. It is an assessment method in which results depend on one or several simultaneous factors. ANOVA makes it possible to test if the factors under investigation influence the results obtained. The aim of the variance analysis is to test the statistical significance of differences between the averages (for the groups of variables). The objective is achieved through the analysis of variances, i.e. through the division of the total variance into the component corresponding to the true random error (SS within the groups) and the components that refer to the differences between the averages. The latter components of variances are tested for the statistical significance, and if that is confirmed, one can reject a zero hypothesis which assumes that there are no differences between the averages; thus, an alternative hypothesis can be accepted that states that the averages in the population have different values.

[4] A. Stanisz, *Przystępny kurs statystyki z zastosowaniem Statistica pl – na przykładach z medycyny*, Vol. 2: *Modele liniowe i nieliniowe*, Statsoft, Kraków 2007, pp. 271–336.

[5] S.P Borgatti, M.G. Everet, L.C. Freeman, *Ucinet 6.0...*; R.A. Hanneman, M. Riddle, *Introduction to Social Network Methods, University of California, Riverside, CA 2005.*

he/she is tied to. That measure can be considered the element's expansion measure, while the in-degree measure indicates the volume of connections coming to a particular node. The latter measure can be referred to as the attractiveness measure of an element in the network.

The four measures for the T-Mobile service provider are given in table 1.

Table 1. Values of hidden measures for T-Mobile operator relationship structure

	In-degree position	Structural holes	Bonacich power	Freeman's betweenness
1	5,000	5,000	7,036	43,500
2	1,000	1,000	1,407	0,000
3	2,000	2,000	2,814	18,000
4	4,000	3,500	5,629	65,500
5	1,000	1,000	1,407	0,000
6	4,000	4,000	5,629	47,000
7	1,000	1,000	1,407	0,000
8	5,000	2,600	7,036	27,333
9	1,000	1,000	1,407	0,000
10	1,000	1,000	1,407	0,000
11	2,000	1,000	2,814	0,000
12	2,000	1,000	2,814	0,000
13	2,000	1,000	2,814	0,000
14	4,000	3,000	5,629	28,000
15	2,000	1,000	2,814	0,000
16	2,000	1,000	2,814	0,000
17	5,000	2,600	7,036	19,833
18	4,000	2,000	5,629	16,500
19	5,000	2,600	7,036	27,333
20	3,000	1,000	4,222	0,000

Source: Author's research. Visualization in Ucinet 6.0.

The presented above figures concerning the in-degree measure, which informs about position attractiveness in the service provider-customers relationship structure, indicate that there were as many as four attraction nodes : they were positions 1, 8, 17 and 19 which had 5 ties each. The structure could be referred to as a balanced one in terms of the attractiveness of the positions in the relationship network

Moreover, with the aim to identify the dependencies among demographic characteristics of the actors and the properties of the network structure, an analysis of variances was conducted. The results in the relationship network structure under investigation were statistically significant for two variables: 1) the number of posts for the regression measure (proportion as large = 0.004) at a 95% trust level, 2) the role played in the network structure whose statistics equaled F = 6.0552 and p = 0.0086, which can be interpreted that the increase in the number of posts results in the increased number of ties and, consequently, has an impact on the attractiveness of the position in the service provider – customers relationship network structure.

Another measure that was analyzed and which indicates the collective and hidden network properties was the **structural hole measure**, which is applied to describe the ties among positions. Structural holes occur between positions that provide information that is unrepeatable in nature. It can be concluded from table 1 that the highest value of the structural hole degree in the structure under investigation appeared in positions 1 and equaled 5. That position has the advantage over other network participants due to the access to network benefits: varied information unrepeatable in nature which comes from various sources. The ANOVA that was conducted for the T-Mobile – customers relationship network structure was not statistically significant and consequently the demographic and psychographic attributes did not account for the character of the structural holes.

The next measure which was analyzed and which indicates the collective and hidden network properties was the **Bonacich power**. It is a measure that determines network centrality. According to the results given in table 1, the measure in the structure under investigation had the highest value of 7.036 for four positions: 1, 8, 17 and 19, which can be interpreted that these positions gained strategic positions in the network relationship structure. Other measures had relatively low values.

The analysis of variance made it possible to obtain additional interpretations. Statistically significant results that presented the dependencies between the demographic attributes of actors and the network structure properties were confirmed for two variables: the number of posts sent and the role played in the structure. For the first variable, the regression measure, (*proportion as large* = 0.004) and that value was statistically significant for the significance level. For the latter variable, the value of statistics was F = 6.0552, p = 0.0078. The data resulted in the interpretation which indicated a collective attribute: the increase of the number of posts by one leads to the growth of the centrality measure expressed by the Bonacich index.

The fourth structural measure of collective and hidden network properties that was analyzed was Freeman's betweenness, which indicates the distance (closeness) of a particular position to the other ones in the structure. The whole network structure can be illustrated through a low or high authority level. According to table 1, the highest value of Freeman's betweenness was achieved at position 4 and equaled 65.500. The variance analysis enabled an additional interpretation of the impact of demographic variables on the value of Freeman's betweenness. Statistically significant results were confirmed again for two variables: the role played in the structure and the number of posts sent. The attribute indicating the role in the structure influenced significantly the value of Freeman's closeness centrality and was $F = 4.3123$ and $p = 0.0312$. Moreover, the regression measure was statistically significant: (*proportion as large* $= 0.004$). As a result the following interpretation description of collective and hidden structure properties were obtained: with the increase of their activity in the communication network structure, the users reach a higher status in the service provider – customers network structure; thus, they achieve a central position in the network and have power, which results in the capability to influence other network participants. In the case of relationship networks of the remaining service provider – customers structures that were investigated, the demographic attributes do not account for the character of the value of Freeman's closeness centrality measure in a statistically significant way.

To sum up, gender did not affect in any case the network measures under investigation. It might be caused by the fact that in the anonymous Internet it is difficult to identify the actual sex of forum participants and, consequently, to assign particular attributes of behavior to the gender. Obviously, the analysis would provide a fuller context of network attributes when conducted from the operator's level of information management, i.e. when the information about the registered users is complete. The user status or the label assigned by the administrator of the forum depended both on the activity of the users and the behavior in the internet network. Basically, that criterion differentiated substantially the collective, hidden properties of the relationship structure such as the degree position, Bonacich power and Freeman's betweenness in the T-Mobile – customers relationship.

Conclusion

The visualization of the relationship network structures and the analysis of the social networks made it possible to indicate structure properties that resulted from the character of

ties between the network participants and to identify the hidden measures of the network structure. With the consideration of the type of ties in the service provider – customers relationship network, the following structure properties were determined: 1) network density, 2) size, 3) local densities, subgroups, subnetworks, 4) isolates, 6) attraction centers, 7) structural holes, 8) centrality and 9) closeness. Moreover ANOVA was conducted, which enabled the indication of dependencies between the demographic attributes of the participants and the selected network measures. The network attributes that were obtained concerned the following dependencies: 1) gender, which by no means differentiated the analyzed network measures , 2) the status of the users, which depended both on their activity and behavior related to the network label. The above criteria differentiated significantly the hidden properties of the relationship structure: 1) position degree, 2) Bonacich power, 3) Freeman betweenness. The number of posts sent had a statistically significant impact on such collective structure characteristics as position degree, Bonacich power and Freeman betweenness.

The presented analysis of social networks is associateed with the necessity to emphasize strongly the identification of the hidden properties of the market relationship structure. The recognition of the levels of the relationship structure – particularly in terms of the interaction effects and the network – provides a more complete analytical context of the flow processes on the consumer market. Further research in that field is indispensible and the investigations of other authors that are described in the literature on the subject should be taken into consideration. Although the analysis of social networks is applied in various areas of marketing analysis, it is still an underestimated object of the current academic and commercial marketing research in Poland. Its basic advantage is that it covers the issues of dyads, both subjects of the relationships, and the identification of the emergent, collective and hidden dimensions of relationship structure, which are frequently impossible to define with the application of classic research methods.

The data and results obtained from the dyadic, interactive and network marketing research should be taken into consideration in the development of company marketing strategies. Collective (either interactive of network) relationship attributes influence the selection of adequate operations that aim at maintaining customers and strengthening their ties with the company; they also determine the specific strategies such as – for example – creating brand identity or communication strategy, and they have an impact on company's information management policy.

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Abstract

Modern marketing strategies of business focus on effective communication with all stakeholders: the customers, potential or current investors, journalists and potential employees in order to build permanent market relationships. Thus, the new (interactive or network) context imposes new and different methods of data collection and their analysis or interpretation. The aim of the article is to analyze the market relationship network with the application of the Social Network Analysis with the aim to reveal new, hidden attributes of market structures.