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Application of Network Visualization for Identifying the Impact of Partnership Networks on the Development of Telecommunication Companies

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Abstract: *The development of a company is a complex phenomenon of qualitative nature and may be consider in multiple aspects. Fundamentally, the growth of a business may be implied just by its survival on the market for a longer time. The demand for the offered products and the resulting sale of goods and services proves that the business has adapted to the consumers' expectations and the environment - these are both quantitative and qualitative changes. Therefore, it should be noted that shaping the company's development is directly related to the organization of sales. Three types of sales networks are present in businesses. These are the company's own sales network and a partnership sales network - also called an external network or a dealership network, along with mixed networks, within which the two former types operate simultaneously. The paper presents the possibilities of using a network system analysis to identify the impact of partnership sales network on the growth of businesses. The research covered the telecommunication industry and the key concept of the research process, analyses and considerations included in the paper is the identification of dependences between the operation of partnership sales networks and the growth of businesses using such networks. The paper aims to determine the level of stimulation of growth as the result of functioning of these structures as expressed with the intermediation ratio.*

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I. Own and partnership sales networks

A network is an organizationally connected structure present inside and/or outside a company, with its separate resources and tasks. The structure also serves as a link connecting the market with the company, through which goods are sold, for example. The creation of forms of network sales processes results from the search for new methods of realization of such tasks by businesses[1,2,3,4].

The development of network forms leads to the utilization of new methods of work organization. An employee may be used to create value in the company. More and more often employees enjoy a relatively wide range of rights and responsibilities. Self-management teams and time forms, e.g. task forms (partnership sales networks), are gaining popularity [4,5,6,7,8,9,10,11,12,13,14].

Three types of sales networks are present in telecommunication businesses. These are the company's own sales network and a partnership sales network - also called an external network or a dealership network, along with mixed networks, within which the two former types operate simultaneously. The functioning of the company's own sales network fully depends on its resources: the employees have employment contracts. Conversely, partnership sales networks are usually based on trade contracts and the majority of operating costs are, in a way, transferred to businesses operating within this type of network.

The entities making up a partnership sales network are businesses. The leading entity - the parent company (the creator of the network) commences cooperation on the basis of trade contracts (cooperation agreements) with partners who will be executing goods and services sales processes for the benefit of the parent company. In turn, the partners shape their own sales structures. Costs resulting from labour intensity. Consequently, the remuneration for conducting sale processes for the parent company by the partner is commission based, as per the rate determined in the agreement. The reason behind this is the allocation of tasks among various entities. Similar relations exist between the partner and sales representative employed within a partnership sales network. All "operating" costs are transferred to sales representatives.

Despite a certain similarity in the goal behind their operation, which may be synthetically specified as the highest possible efficiency in the realization of sale processes, the operation itself and merging within the company's structure, own and partnership sale networks differ greatly. Hence, their comparison seems justified.

The common features and differences between own sales networks and partnership networks will be

put into the following categories: employees, sales plans, organization, costs, remuneration, rights and responsibilities, property and control with supervision. The comparison is presented in Table no. 1

Table no 1: Features of own sales networks and partnership sales networks - comparison

Details	Own sales networks	Partnership sales networks
Employees	Employees with employment contracts.	The cooperation between the parent company and the partner is based on a cooperation agreement. The partner also employs their employees on the bases of the cooperation agreement (contracting).
Sale plans	The employees are given monthly, quarterly, semi-annual and annual sale plans.	For partners, a general sale target (for the entire company) is set, along with individual targets for specific employees, such as sales representatives and sales managers.
Organization	The sales network is incorporated within the company's structure, as one of the elements of the Sales Department and is managed by the Sales Director, pursuant to the targets specified by the Board.	Partnership networks operate outside the company's structure. Additionally, the partner implements their own organizational solutions. The partner is still contractually subordinate in relation to the parent company and usually a Partnership Network Director is responsible for supervising the network.
Costs	The parent company covers all costs of operating their own sales network. Among else, these costs include remunerations (with margins, bonuses, etc.), training, equipment and tools (e.g. fleet cars, fuel, mobile phones, laptops, tablets, software, customer data bases, etc.) and promotional activities (advertising materials, promotional campaigns, bonuses for clients).	All costs of the operation of a partnership sales network are covered by the partner and their employees. These costs include training, equipment and tools (e.g. mobile phones, laptops, tablets, software, customer data bases, etc.) and promotional activities (advertising materials, promotional campaigns, bonuses for clients).
Revenues (income - in the case of partnership networks)	Covered by the parent company, on the basis of employment contracts and regulations covering bonuses and incentives.	As an entity, the partner receives remuneration for their services and then pays the remuneration of their employees on the basis of sales volumes and commission rates.
Rights and responsibilities	The employees of the company's own sales network are fully authorized to sell goods and services.	The independent company is fully authorized and responsible to fulfil their function.
Property	Fixed assets such as real estate, e.g. land, buildings, structures and separate premises, their parts and shares in them; machinery, equipment and means of transportation belong to the parent company.	Fixed assets such as real estate, e.g. land, buildings, structures and separate premises, their parts and shares in them; machinery, equipment and means of transportation belong to the parent company or sales representatives and constitute privately owned assets. Partial utilization of the parent company's infrastructure.
Control and supervision	The parent company's board and officers can freely control the operation of their own sales network, have full access to the market, can introduce any changes or modifications to the operation as and when they see fit.	From the perspective of the parent company the possibilities of controlling the partnership network are limited, introducing any modifications is more difficult and more time is needed for them to begin functioning; the partner is fully in charge and has unrestricted supervision in introducing changes, etc.

Source: own work.

The fundamental difference between the two types of sales networks discussed here are the agreements with sales representatives, forming the basis for employment. In the case of own sales networks these are (in principle) employment contracts, while in partnership sales networks cooperation agreements are used (as connected with contracting). There are also differences in the organization, as own sales networks are incorporated within the structure of the parent company. There is no such connection within partnership networks and the only connection is the partnership network director, who is employed in the ordering company. Own networks have much higher operating costs. In partnership networks, the remuneration is commission-based - if the employees fail to complete sales, there is no grounds to pay for the work. In the case of the company's own sales network, the board and officers have unrestricted control over its operation.

Speaking of certain similarities in the operation of own and partnership networks, we should mention the rights - in both cases the employees are fully authorized to conclude contracts and sell goods and services. The property (the company's resources) is another element and it is jointly used to a certain extent.

The sales network, its operation to be specific, is in fact a decomposition of sales functions, which means that it is necessary to create networks whose elements fulfil the following partial functions:

- guaranteeing financial revenues to the company,
- initiating new possibilities of selling goods and services,
- entering into and maintaining relations with clients (their specific groups),
- developing efficient models for presentations and negotiations,

- monitoring and supervising the completion of sales targets,
- ensuring the efficiency of operation of the sales network's specific elements,
- ensuring that employees are trained adequately,
- increasing the sales volume,
- gathering market information.

This set of functions for the sales network allows the company to be active in the market. The company becomes insolvent if no revenues from core business are guaranteed. Increasing the sales volume allows the company to grow - revenues increase, new employees are employed, new departments are created. The company begins to perform increasingly complex processes. Its organizational structure will often grow, too. Increased sales may also generate a new quality of operation of the business, thereby promoting its growth.

II. The company's development and methods of measuring it

The company's development is a concept that has been widely discussed and examined, both in Poland and abroad [15, 16,17,18,19,20,21,22,23,24,25]. However, this is not an unambiguous, simple, accurate and precise definition. The multiple definitions also point to certain aspects through which a company's development should be considered.

First of all, the development is a qualitative phenomenon that consists in the introduction of innovations in products, processes and structures, as well as in the area of organization and management[26]. From another perspective, the essence of development may be interpreted dually: as the liquidation of a developmental gap (the difference between the potential and the actually achieved results) or as the process of improving the organization's position in the environment[19]. The development is an objective phenomenon that occurs both in society and economy, based on continued change - but not every change should be understood as development[27,28,29]. The development of a company means coordinated changes of systems within the company that adapt it to the dynamic environment. Such adaptations are efficient if they allow the company to achieve and maintain competitive edge, which is a necessary condition to survive in the market[30,31,32], as far as the concept of development clearly constitutes a quantitative category. It means the growth of the company's resources, which in general leads to its increased presence in the market or the maintenance of such presence, or alternatively the expansion of its activity. The development is measured with the dynamics of sales, the dynamics of market presence, the dynamics of the growth of the value of assets or the employment. Primarily, the development is a phenomenon of qualitative nature[23,33]. The development means the occurrence of qualitative changes that are positively evaluated from the perspective of the objective to which they pertain[34]. The change and the development should be both viewed in the following aspects:

- economic aspect (the efficiency of managing the resources),
- organizational aspect (tasks, processes, organizational structure, personnel changes),
- personnel aspect (creation of desired behaviours, improvement of team organization, employee development),
- informational aspect (improvement of identification processes, diagnostics and preparation of decision-making information, improvement of communication),
- technical and production aspect (diffusion of innovations, redefining the scope of activity in the product range aspect, specialization, improvement of planning and control processes).

The development is a long-term process of directional changes within which consecutive stages of changes (development stages) of a given object can be distinguished, which differentiate this object in a specific views[35]. Four types of company development may be distinguished[36]:

- internal development - the extension of the company's economic potential through investment projects completed with own resources,
- external development - the extension of the company's activity scale through developing capital or contractual connections with the participants of the environment,
- fusion - a method of capital development where companies (at least two) are initially joined in an autonomous way to create a new business, with each of them losing their independence in the process,
- acquisition - gaining control by one company (most often a company that is stronger economically) over another company, by acquiring their shares.

To survive in the dynamically changing market, a company strives to develop, which often consists in the introduction of internal changes to the system, caused by the active shaping of external conditions by the system itself, through which the system can achieve a higher level of complexity, translating into a wider range of diversity when compared to the previous status[37,38,39,40]. The development of a company means coordinated

changes to the company's systems, which adapt it to the continually changing environment or preventing the anticipated dangers. These changes are efficient if they allow the company to achieve and maintain competitive edge, which is a necessary condition to survive in the market[41,42].

Generally, the development is treated as the occurrence of qualitative changes that are positively evaluated from the perspective of the objective to which they apply, namely taking into account the valuation of changes. In this view, company development management is defined as a system, whose goal is to shape the economic, organizational, personnel, information, technical and production progress. The changes are broadly treated as projects of innovative and restructurization nature.

The essence of managing the organization and shaping its development potential, thus determining the right strategic directions, consists in tackling tensions of this kind. The ability to identify contradictions and to subsequently integrate them in a rational manner, which leads to the complexity and uniformity of development, poses a challenge for company managers today[43].

The development of a company means coordinated, qualitative changes of systems within the company that adapt it to the dynamic environment. Such adaptations are efficient if they allow the company to achieve and maintain competitive edge, which is a necessary condition to survive in the market. Moreover, the development is generally treated as the occurrence of qualitative changes that are positively evaluated from the perspective of the objective to which they apply, namely taking into account the valuation of changes[44].

There have also been attempts to parametrize the concept of company development, which may be perceived as the function of various factors and variables that may potentially stimulate or inhibit the development. The authors have attempted to determine the impact of partnership networks on the company's development on the basis of categorization of this concept and, following J. Myszewski[45], identify the development as the function (1):

$$RP = f(LK \uparrow, LK - p \uparrow, S \uparrow, S - p \uparrow, W \uparrow, W - p \uparrow, R \uparrow, R - p \uparrow, P \downarrow, P - p \downarrow, Q \downarrow, Q - p \downarrow) \qquad (1)$$

where:

- LK - the number of clients is calculated as the number of active SIM cards (phone numbers) registered in the data base,
- LK-p - the number of clients (active SIM cards) obtained by the partnership network employees,
- S - completion of strategic goals, calculated as the level of completion of goals within a period of time,
- S-p - the level of completion of strategic goals in the partnership network,
- W - the number of employees - namely, the number of employed personnel,
- W-p - the number of employees employed in the partnership network,
- R - revenues, calculated as the company's revenues,
- R-p - revenues generated by the partnership network,
- P - organization's problems – the number of complaints filed by the clients,
- P-p - organization's problems – the number of complaints filed by the clients obtained by the employees of the partnership network,
- Q - unsolved problems - problems recurring in the consecutive, examined period,
- Q - unsolved problems - problems recurring in the consecutive, examined period in the partnership network.

The arrows designate the tendency of particular variables, with LK, LK-p, S, S-p, W, W-p, R, R-p seeking to maximize the value, whereas for P, P-p and Q-p (which manifest the organization's problems) the value should be as low as possible. The individual elements of the formula for validating the company's development are not summed up.

III. Methodological assumptions of the authors' study

The purpose of the study was to evaluate the possibility of use of network analysis to identify the impact of partnership sales networks on the development of businesses (in telecommunications as the example). The level of stimulation of the growth as the result of functioning of these structures will be expressed with the intermediation ratio.

Additionally, the authors formulated the following research problems:

- Q1: What is the scope of usability of the "Pajek" program for the evaluation of the growth of a company that creates their own networks and that initiates or incorporates partnership networks?
- Q2: What factors related to the functioning of partnership sales networks in particular imply the growth of telecommunication businesses in Poland?

A telecommunication company is a business entity authorized to conduct business activity consisting in providing telecommunication networks, associated facilities or rendering telecommunication services, with the

telecommunication company being authorized to render telecommunication services and provide public telecommunication networks or associated facilities.

The planned study process will include drawing conclusions with regard to the entire statistical population on the basis of information collected during the examination of the statistical (representative) sample for businesses operating in the telecommunication service.

The examined telecommunication companies operate in Poland. They use partnership networks which operated as mandated by telecommunication companies active in Poland, performing sales both in the business market and for individual clients (sales to natural persons); the examination will cover companies offering "post-paid" (subscription) services. There are 4 companies satisfying these criteria, which at the same time is the general population of organisations making up the telecommunication sector in Poland.

The applied network analysis is a method used for detecting, describing and identifying relations among people or organizations[46]. This is an interdisciplinary method that uses elements of the graph theory, statistics, matrix algebra, as well as sociology, social psychology or anthropology that mostly focuses on the structure of relations existing between social entities (people, teams, organisations, regions, etc.). When using this method, one should bear in mind the limitations resulting from the social nature of the analysed structures (not all of the considered values can be measured, aggregated or subjected to statistical analysis). The network analysis is used in practice (mainly in analytical processes) in management sciences, both at the pan-organizational level, which also includes inter-regional level, and in relation to the broadly understood business activity[47,48]. The network analysis is a combination of the graph theory, statistics, information technology and matrix algebra and is applied in economics[49]. This approach may be classified as the combination of quantitative and qualitative approach, where the quantity data are subjected to qualitative analysis and interpretation[50].

The network analysis allows to evaluate the network's structures by analysing connections at various levels, identifying structural gaps and the emerging sub-groups connected with a particularly strong structure of relations, and by evaluating the importance of individual groups in the examined social processes. Network parameters such as density and cohesion can also be determined. The analysis' main structure is the network of relations depicted as summits and their connections (graphs). The presented relations may be directed (arcs with starting and end points) or not directed (straight, proving the existence of a given relation, but without determining e.g. its initiator).

"Pajek", software developed by V. Batagejl and A. Mrvar[51], was used for the network analysis and visualisation. The program allows to reflect relations and impact between the variables and to calculate the value of intermediation and the value of the vector. The intermediation value shows the probability at which a given variability is crucial in the process of shaping the company's growth (calculated on the basis of all connections within the network; the maximal value for a given variable is 1). The higher the intermediation value, the higher the importance of the factor's variable. The impact of individual, analysed variables on shaping the growth of the company can be determined on the basis of the intermediation factor that parametrises the significance of the network's nodes, for the purpose of this study, in the creation of the development function vector. Moreover, this ratio determines the relation of the number of the shortest paths between any two nodes that pass through the node v to the total number of all shortest paths. Usually, the intermediation is normalised so that the intermediation within a network is maximally 1. The vector's value determines the strength of impact of the factor on the ration.

IV. The analysis of the impact of partnership sales networks on the development of telecommunication companies in Poland

The study covered the impact of growth factors included in the parametric function (1):

$$RP = f(LK \uparrow, LK - p \uparrow, S \uparrow, S - p \uparrow, W \uparrow, W - p \uparrow, R \uparrow, R - p \uparrow, P \downarrow, P - p \downarrow, Q \downarrow, Q - p \downarrow) \quad (1)$$

The following variables were used:

- the number of clients (LK),
- the completion of strategic goals (S),
- the number of employees (W),
- revenues (R),
- filed complaints (P),
- unresolved complaints (P),

The arrows designate the tendency of particular variables, with LK, LK-p, S, S-p, W, W-p, R, R-p seeking to maximize the value, whereas for P, P-p and Q-p (which manifest the organization's problems) the value should be as low as possible.

The analyses were conducted in four companies marked as A, B, C and D. The results of the study related to individual telecommunication businesses will be presented below. The summary of the values of vectors for the variables of the function of growth of company A is presented in Table No. 2.

Table No. 2: The value of vectors and the intermediation ratio of the variables of the function of growth of Company A

Variable	Vector's value	Intermediation ratio
RP	29842943974.00	-
W	7282.00	0.000630
W-p	11406.00	0.000630
S	735.00	0.000630
S-p	745.00	0.000630
R	25737412000.00	0.000630
R-p	4032588000.00	0.000630
P	-1466610.00	0.000560
P-p	-170890.000	0.000630
Q	-185459.00	0.000630
Q-p	-13235.00	0.000630
LK	72052900.00	0.000630
LK-p	2707100.00	0.000630

Source: own work.

The summed values of all variables - the value of the vector of the growth function was 29842943974.00000. The variables R and R-p had the largest share (respectively, 25737412000.00000 and 4032588000.00000), then LK and LK-p (respectively 72052900.00000 and 2707100.00000) and then W and W-p (respectively 7282.00000 and 11406.00000). It should be noted that practically all variables (apart from P - the organization's problems) had the same value of intermediation - 0.000630. This means that the presented variables equally strongly imply the company's growth. Hence, they may be crucial in shaping the growth of the examined company with the same probability. The summary of the values of vectors for the variables of the function of growth of company B is presented in Table No. 3.

Table No. 3: The value of vectors and the intermediation ratio of the variables of the function of growth of company B

Variable	Vector's value	Intermediation ratio
RP	116792135879.00	-
W	55996.00	0.000345
W-p	26785.00	0.000345
S	1466.00	0.000345
S-p	1378.00	0.000345
R	97151100000.00	0.000654
R-p	19303255000.00	0.000448
P	-8302581.00	0.000345
P-p	-825473.00	0.000345
Q	-904372.00	0.000345
Q-p	-47753.000	0.000345
LK	342104888.00	0.000368
LK-p	5670545.00	0.000345

Source: own work.

The summed values of all variables - the value of the vector of the growth function was 1116792135879.0000. The variables R and R-p had the largest share (respectively, 97151100000.000000 and 19303255000.000000), then LK and LK-p (respectively 342104888.000000 and 5670545.000000) and then W and W-p (respectively 55996.000000 and 26785.000000). The key variable for shaping the growth of company B is R - revenues (intermediation ratio 0.000654). Additionally, the variable R-p (revenues generated by the partnership sales network) also belongs to important developmental determinants (intermediation ratio 0.000448). A higher value with regard to the intermediation ratio was also noted for the variable LK - the number of clients (intermediation ratio 0.000368). All remaining variables carried the same intermediation ratio value (0.000345), consequently meaning that they affect the growth of the company to the same extent. The summary of the values of vectors for the variables of the function of growth of company C is presented in Table No. 4.

Table No. 4: The value of vectors and the intermediation ratio of the variables of the function of growth of company C

Variable	Vector's value	Intermediation ratio
RP	123156203778.00	-
W	51965.00	0.000435
W-p	35640.00	0.000435

S	1318.00	0.000435
S-p	1287.00	0.000435
R	110541742000.00	0.000435
R-p	12444550772.00	0.000435
P	- 5169088,00	0.000435
P-p	- 620929,00	0.000435
Q	- 759133,00	0.000435
Q-p	- 58482,00	0.000435
LK	173385068.00	0.000435
LK-p	3043360.00	0.000435

Source: own work.

The summed values of all variables - the value of the vector of the growth function was 123156203778.0000. The variables R and R-p had the largest share (respectively, 110541742000.000000 and 12444550772.000000), then LK and LK-p (respectively 173385068.000000 and 3043360.000000) and then W and W-p (respectively 51965.000000 and 35640.000000). All analysed variables may be crucial in shaping the growth of the company with the same probability. The summary of the values of vectors for the variables of the function of growth of company D is presented in Table No. 5.

Table No. 4: The value of vectors and the intermediation ratio of the variables of the function of growth of company D

Variable	**Vector's value**	**Intermediation ratio**
RP	109889074827.000000	-
W	64804.000000	0.000352
W-p	17775.000000	0.000463
S	1232.000000	0.000463
S-p	1222.00	0.000463
R	98685334896.00	0.000768
R-p	11033621748.00	0.000542
P	- 5432087,00	0.000463
P-p	- 663219,00	0.000463
Q	-1143500.00	0.000463
Q-p	- 70172,00	0.000463
LK	173777000.00	0.000452
LK-p	3565128.00	0.000487

Source: own work.

The summed values of all variables - the value of the vector of the growth function was 109889074827.000000. The variables R and R-p had the largest share (respectively, 98685334896.000000 and 11033621748.000000), then LK and LK-p (respectively 173777000.000000 and 3565128.000000) and then W and W-p (respectively 64804.000000 and 17775.000000). It was concluded that the variables R - revenues and R-p - revenues generated by the partnership sales network had the highest probability of the impact on the development of the company. The variable LK-p, which is the number of clients acquired through the partnership network, should be also mentioned. These are the factors that have a significant impact on the growth of the examined company.

In company A all variables (except for P - organization's problems (complaints) - intermediation ratio 0.000560) had the same value of intermediation ratio - 0.000630. For company B, the variable R - revenues (intermediation ratio 0.000654), was the key variable stimulating the shaping of growth. The variable R-p (revenues generated by the partnership sales network) and LK - number of clients also played a big role. In company C, all examined variables had the same probability of affecting its growth. In company D, however, the following variables were of key importance for its development: R - revenues and R-p - revenues generated by the partnership sales network. The variable LK-p (the number of clients acquired through the partnership sales network) is also worth mentioning.

V. Summary and conclusions

The assumed model of categorisation of company growth and the analysis of variables showed a positive impact of the discussed form of sales structures on company development. The revenues, the number of clients and the number of employees were the factors with the highest vector value.

Intermediation ratio (used for parametrising the importance of network nodes in creating the growth function vector) was used in network analysis in relation to the impact of the analysed variables on company growth. In company A all variables (except for P - organization's problems - intermediation ratio 0.000560) had the same value of intermediation ratio - 0.000630. This is why we can conclude that the growth of a company is shaped by variables showing similar probability. For company B, the variable R - revenues (intermediation ratio

0.000654), was the key variable stimulating the shaping of growth. The variable R-p (revenues generated by the partnership sales network) and LK - number of clients also played a big role. In company C, all examined variables had the same probability of affecting its growth. In company D, however, the variables R - revenues and R-p - revenues generated by the partnership sales network, were of key importance for its development. The variable LK-p (the number of clients of the partnership network) is also worth mentioning.

It can be firmly stated, on the basis of studies with the application of network visualization and in relation to factors affecting the growth of a company, that partnership sales networks stimulate the growth of businesses participating in the study. The authors believe that the "Pajek" software can be used as a tool for evaluating the development of a company that creates their own sales networks and partnership sales networks. In particular, this applies to telecommunication businesses that were examined here.

The "Pajek" software can be used for evaluating the functioning of partnership sales networks. Additionally, thanks to network analysis tools, not only the current patterns can be examined, but also possible growth scenarios that indicate future developments.

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