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Optimizing of Enterprise Communication Processes Management

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1. Introduction

Companies, especially Small and Medium Sized Companies (hereinafter only SME) must look for the ways and opportunities how to survive in time of economic and financial crisis and try hard to execute all companies' activities in an optimum way. The solution can be found in optimization of managing, decisions-making and production processes. To ensure it is critical to have required actual and valuable information. Company information system utilizing available information technologies, as a key of high quality information base and communication system - ensures obtaining, processing, provision and distribution of information. Due to the fact that management and decision making does not depend only on early and actual information but knowledge of managers and employees who prepare necessary documents are the most important - also importance of information and tasks required to prepare systems change. It can be stated that information revolution did not bring only a change in information understanding - its consequence is a change in a way of manipulation with information. It is critical to manage technologies used to cover information needs of environment in which they are spread and manage the way in which they are provided due to information needs of competent people through activities of which they change to knowledge. Both areas claim that this task is not simple due to the fact that it is not possible to define exactly all the factors which influence company knowledge management. An important part of this form of management is a human factor and ability of a company to utilize possibilities of information technologies the most effectively as well. The problem in such a way of management is a big dependence on employees' knowledge which must be willing to share it with the others and on their skills and abilities to apply available IT and tools supported by them. Management of a system of such networks is very complicated especially when it is a must to consider the balance between costs ratio to solutions effectiveness since this is a very sensitive topic in the current crisis. The method of process management introduction to the area of company information and communication processes management that we suggest brings a chance to acquire mathematic apparatus to analyse complicated nets - complicated due to the great dependence on human factor share.

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2. Necessity of enterprise communication processes management

Nowadays companies have to adapt quick changes in their surroundings and this is really a demanding process, where the way and speed of response condition the total success of doing business, it means whether a company strengthens its competitiveness or it may happen that a company loses its market place or fades. These influences and impacts make pressure on companies not only in a requirement to change the way of doing business but they often have to change the location, form or even line of business. Entering to new markets both local and foreign or necessity to provide new services as product added value or to change orientation towards a completely different type of production in dependence on customers and market requirements bring a necessity to be able to orientate in business conditions. If it is critical to reorganize company activities and processes or in a case that the place or line of business is being changed and some organization units fade or new ones are formed - it is necessary to carry out the changes within a short period of time and as effectively as possible.

New forms of team co-operation are created where a necessity of co-operation of more experts exists: team members do not come only from the organization itself, but they often co-operate, partners are particular clients themselves, for whom the organization produces its products or provides services, or they are other experts from the surrounding. In such forms of co-operation number of decisive and managing roles at lower level of company management goes up, importance of personal responsibility and employees' competency grows and at the same time number of administrative and repetitive tasks decreases and this brings higher demands towards support of teams management and their mutual co-operation. Need for team co-operation of more experts often requires different point of view to see the reality in a company - not from the personal point of view but in a context with the opinions of other team members that should be accepted and adapted to. It means that it is necessary to know:

- To distinguish and change long-lived ideas and effects which influence total understanding of reality and following decision - making of company management,
- to overcome barriers in acceptance of opinions of colleagues in labour relations while the ultimate criteria should not be acceptance or non-acceptance of a particular opinion, e.g. due to the status, but based on knowledge and experience of team members what leads to increase of growth of learning organization.

Also entries to new markets bring the need to adapt company activities to other new form of co-operation. Enterprises must monitor the organization's environment and promptly react to its changes; they must use the manpower as an information source, as well as upgrade and minimize the set of business rules (i.e. legislation, standard specifications and instructions). This knowledge is also essential for doing business on any foreign market, where companies are supposed to cooperate with foreign partners. They also must flexibly adapt to different economic, legislative, social, demographic and cultural environment.

These requirements make pressure on company management since they have to modify or change common cycle of company activities very quickly due to the actual need, and it brings the requirement to determine new work activities precisely, to define competencies of team members, their responsibilities and competences for the work done, even without creation of new forms of organization structure. These claims result from the need:

- to ensure unique approach to required information from the point of view of more experts, what requires a need to unite technological platform of information systems,

- to change the way of management of setting for work with information and it requires:
 - to know exactly how to determine necessary activities connected with coverage of information needs,
 - to determine exactly who and for what type of activities is responsible,
 - to know the way how inspection of their execution will be carried out,
- to co-ordinate of more activities so that they present integrated sequence of processes and activities based on precise specification of their claims.

It is not enough just to make necessary information accessible, i.e. meet the requirement of quick information accessibility, but it is needful to change information understanding – its new dimension and value is not created through the fact that they are available more quickly, but through the fact that it is the base for knowledge development, while the most important share on knowledge quality has a human factor and its personal abilities. It can be stated that work with knowledge is equal to a necessity of change of utilized models of thinking, which presents a necessity of change of information interpretation in context with the actual state in a company and based on own knowledge and experience.

It requires precise identification of executed tasks, where process management has got its place. It does not concern only individual production processes but also process management of information processes and activities connected with creation of needful information and communication support. Through their utilization in combination with available information about changes in company surrounding the company obtains a tool to increase its competitiveness.

2.1 Role of information technologies in the enterprise communication system

The risk of doing business is closely related to the need of good knowledge in business area and terms of business in real condition by their partners as well as by their competitors – it's the key to whichever successful business deal and effective collaboration between partners or clients. As it was stated - changes happen even without planning and so it is necessary to change a way of information support provision in dependence on what type of changes occurs. Currently accessible information systems only in a small scale or not at all provide information about slough in a company and that is why also an ability to suppose in advance if suggested solution will present benefit or lost investment of a company is quite low. This situation brings the requirement to look for a simple solution aimed at risk elimination. This means to find the right solution concerning optimizing and investments to development of network, communication and information systems as well as people knowledge databases which help managers to concentrate on their core competencies.

Effective exploring of enterprise information sources brings the possibility how to increase the competitive advantages. Acquired data must provide information not only about common aspects of analysed processes but may be decomposed in time and by a location which will use them in a decision-making process. Next, an enterprise must provide information about itself - not only legal information, goodwill of management but also by acceptance of global policy and corporate culture. It is the role of external communication system.

All the terms and rules must be set strictly; they are supposed to reflect a real situation, support assignment and transfer of several changes in and out of the enterprise in accordance with changes in enterprises goals. For an effectively hyper-connected enterprise this means to achieve reduction of time to make a decision, increase of productivity and the

ability to provide simple and consistent user experience by means of all types of communications. Generally, it means to have right information to succeed in communication with their partners. Managers can make claimed decision in expected reaction time.

Nowadays we know that people suffer from information overload; there's much more information concerning any given subject than a person is able to access. The result is that people are forced to depend on each other due to their knowledge. Know-who information rather than know-what, know-how or know-why information has become the most crucial. It involves getting to know who has the required information and being able to reach that person and being able to know how and from whom the information can be achieved – to know information source (Singh, 2007).

Therefore it is necessary to:

- contact the right person immediately (to achieve information about partners),
- provide information they need quickly, accurately and helpfully (information about the enterprise for partners),
- be able to interact with partners in a way that suits them best, whether personally, over the phone, SMS, via email or a website.

The reason is to find such solution that assures an effective utilization of enterprise communication network supported by common information and communication technologies (ICT) where the right information is always available to managers and front line staff to make right decision in their knowledge management processes. They help to eliminate barriers between voice, email, conference, video and instant messaging.

It means to bring solutions that support:

- clear and consistent processes for handling partners interactions,
- back office systems accessible through a common interface - so partners and product or service information are instantly retrievable,
- highly motivated staffs who come across as helpful and well informed.

It is required to achieve unified communication that provides an integrated access to people, information and other knowledge sources. Opened information technologies help to remove the barriers between existing used communication tools to do claimed decisions. Consequently, to make communication and collaboration process more effective, it is needed to create an opened and optimized communication structure that supports on-line exchange of information necessary for more flexible and operative decision-making and managing processes.

Unified communication solutions have to aggregate people, as well as systems and ICT to unified communication systems which create a unified decision support (Lohnert, 2008).

Gartner, Inc. analysts specify in the information technology research (Petty, 2009) - the unified communication conditions that are focused to answer the following questions:

What? – Unifying of communication ways, systems, devices and applications:

- telephone data label, mobile voice, fixed voice, pager, chat, e-mail – allow connections with managers everywhere and anytime. These communication tools have technological restrictions due to various solutions and their accessing. There it is needed to know what solution to use to be successful by communication at the given time in its enterprise.

Why? – To achieve more effective, faster and simple communication. Various tools are used in different situations.

How? – Through using common and new ICT more effectively.

For all that if we want to bring an effective utilization of information to a top position in the business market competition process it is needed essential to know the weaknesses of enterprise communication network and consequently decide where it is necessary to invest finance to develop or innovate the functionalities as well as its management tools of such network in accordance with achieving above mentioned needs. To do it correctly we paid attention to analysis of a real condition in the SME enterprise aimed at using of communication system as a support of business activities, as well as to the above mentioned factors.

2.2 Current trends in communication technologies

Today more SME have ICT support of information and communication systems but they always don't exploit all abilities of their advantages. Just the problem is: it is more risky to decide about changes in the enterprise communication system due to limited finances. Incorrect leverage has to invoke weaken even bring to end all business activities of SME. There is necessary to analyse not only information sources but also factors like enterprise strategy, management concept, organizational structure, corporate culture, employee's knowledge, their abilities and finally their demands concerning information. It is critical to search such solutions which help effectively to manage information and communication processes.

The requirement of technologies management results from a basic problem of current period i.e. impact of information revolution – its consequences in companies is seen in a form of information strategy aimed at permanent innovation and purchase of the latest technologies to achieve the highest quality and the most modern technologies focused on getting a very quick and fast access to necessary information. This trend in companies caused that they often purchased technologies that enabled different functions and functionalities of information systems but only rarely were used by companies to support running processes and activities. Next there were the trends which allowed support of managing and decisive activities through information systems applied by them, but their innovation was very costly and the supports were applied quite seldom by companies. A permanent requirement towards users to adapt to new technologies, functionalities and surroundings seemed to a problem. Consequently next problematic point is heterogeneity of information systems platforms due to various IT platforms and data formats which formed a base of purchased solutions of information systems. This is the reason why the investment was perceived as ineffectively spent.

At first while companies used accessing of technologies to speed up access to required information the impacts of the above mentioned shortcomings were not monitored in a wide scale. But when it was necessary to ensure a common access of all interested employees to required information in both internal and external company surroundings through a net access the problem of data non-integrity and tools heterogeneity arose. Especially the way how companies were able to manage this fact i.e. how they solved the task of information platform unification and assurance of the form of co-operation determined their competitive advantage.

Apart from problem of non-integrity it is necessary to solve the problem of determination of opinions priority what is connected with identification of co-ordinates importance and their opinions and their position within a decision making process. In a network surrounding where team forms of co-operation are utilized it is very demanding to set priority position

within the relationships hierarchy especially if this position is not identical with positions in applied company hierarchy. Both tasks concern management of information assurance network while detailed knowledge of individual information processes and their claims is an assumption to its proper activity. In this process skills and abilities of employees in the area of work with information technologies play an important role.

A new way how to make investment more effective is consolidation of existing information technologies used to building of information system infrastructure. Such solution enables utilization of unused capacity in a company, while network access and virtualization of working premises allow its management from a server. It presents a possibility of more effective work and a user does not have to be informed about the particular infrastructure he actually uses. Such solutions increase management effects, decrease company costs and present a tool for unification of information area. To apply such solution it is needed to know real enterprise information requirements.

3. Management of communication processes and social network theory

Determination of the concept of information demands, their tactics, methods, tools, rules as well as decisions how to use ICT more effectively are the basic points of information process analysis. We focussed our attention to monitor actually applied rules and tactics and according to them we should provide the answer to processes and activities used in the analysed enterprise.

Consequently it is necessary to prepare not only data evaluation but evaluation of all used communication and social sites elements of the enterprise. As we have appointed before for all that it is necessary to manage social networks effectively to gain access to the proper pieces of information. The result of such analysis gives more possibilities to collect information demands to be answered due to all processes inside and in outside the enterprise. It provides more possibilities as well as determination of the rules and activity sequences that are unique, minimal, and consistent and follow the areas and aims they were aimed at. In this context understanding of determination, development and utilization of social network becomes more important. Therefore we have to focus our attention to social network theory.

A social network is a set of people (or organizations or other social entities) connected by a set of social relationships, such as friendship, co-working or information exchange. At their work they often utilize an information network. Researchers working at the intersection of information systems, sociology and mathematics are interested in information networks as well. They study the uses of social networks and the ways in which they are mediated in a society and at workplaces through ICT such as Intranet or some other networks (LAN, MAN, WAN) or the Internet.

The power of social network theory results from its difference from traditional sociological studies, which assume that it is the attributes of individual actors - whether they are friendly or unfriendly, smart or dumb, etc. - that's matter. Social network theory produces an alternative view, where the attributes of individuals are less important than their relationships and ties with other actors/participants within the network. This approach has turned out to be useful for explaining many real - world phenomena, but provides less space for individual agency, the ability of individuals to influence their success which depends on a particular structure of their network (Singh, 2007). Such process strongly depends on employees' relations, entrepreneurial objectives, as well as on employees' loyalty.

In SME there is a specific situation because most of employees at top positions are family members. They have high-ranking management competences due to their specific position, but they do not always have a topic and actual information. They often gather it from own employees who sometimes don't dispose with required tools needed required to obtain such information (often obtained as a result of specific data analyses or from ulterior information sources). But it is important to invest finances to such tools as well as people skills. The real challenge is to develop a member of intelligence analysts who are encouraged to "think creatively" and to acquire intellectual capital in the form of substantive expertise on a broad range of topics. The need for creative thinking runs directly into the need to reform secrecy and compartmentalization of information. A better balance is needed between investments in the emerging collection systems and enhanced forms of analytical capability. The latter means a greatly expanded investment in high quality personnel and new technologies that help analysts, instead of overwhelming them. To say it in a simple way - huge amounts of collected but unprocessed and unanalyzed data are useless for any policymaker - accordingly for SME.

Network theory is similar to system theory and complexity theory. Social networks are also characterized by a distinctive methodology encompassing techniques for collecting data, statistic analysis, visual representation, etc. We can use many different methods and models to analyse such properties of information network and its data flows used as a support of enterprise communication system. Great mass data processing methods based on exploitation of common IT and visualisation provide modelling of precision final solutions by means of acceptance of real or expected conditions. But just in SME it is necessary to estimate whether it is more needful to invest to ICT or into analysis tools to make information and communication system more effective. The most important question to consider is which type of membership activity and where most affects the information and communication network? As we have appointed before enterprises must also monitor the organization environment and promptly react to its changes. It is possible if they better know both advantages and disadvantages of their communication system. To do it, we can apply the analyses which give more opportunities to set up if this network operates effectively or if financial resources or people potential are exploited efficiently.

4. Properties of social network analysis

The purpose of social network analysis is to identify important actors, crucial links, subgroups, roles, network characteristics, answer substantive questions about its structure, etc.

There are three main levels of interest: element, group and network level. As to element level, one is interested in properties (both absolute and relative) of individual actors, links or incidences. An example of this type of analysis is bottleneck identification and structural ranking of network items. On his group level, one is interested in classification of the elements of a network and properties of sub-networks. Examples are - actor equivalence classes and cluster identification. Finally, on the network level, one is interested in properties of the overall network such as connectivity or balance.

If we want to make a network analysis we must study social relations among a set of actors. Network researchers have developed a set of distinctive theoretical perspectives as well. Some of the points of these perspectives are:

- focus on relationships between actors rather than attributes of actors,

- sense of interdependence: global rather atomistic view,
- structure affects substantive outcomes,
- emergency effects.

Social relations can be thought of as dyadic attributes. Whereas mainstream social science is concerned with monadic attributes (e.g. income, age, sex, etc.), network analysis is concerned with attributes of pairs of individuals, of which binary relations are the main kind.

Some examples of dyadic attribute (Richards, 2006):

- Social roles: a boss of, a teacher of, a friend of, etc.
- Affective: likes, respects, hates,
- Cognitive: knows, views as similar,
- Actions: talks to, has lunch with, attacks,
- Distance: number of person between,
- Co-occurrence: is in the same position as, has the same relation as...,
- Mathematical: is two links removed from

If we study network properties we have to analyse parameters like:

Fig. 1. Network variables

1. Substantive effects of social network variables
 - Attributes of ego network → access to resources, mental/physical health
 - Network closeness → influence, diffusion
 - Similarity of position → similarity of risks, opportunities, outcomes
2. Substantive determinants of social network variables
 - Personality → centrality?
 - Similarity → friendship ties? (homophily)
 - Reduction of cognitive dissonance → transitivity?
 - Strategic "networking"
3. Network determinants of network variables
 - Relationship between density and centrality.

If we want to make an ego network analysis, it can be done in the context of traditional surveys. Each respondent is asked about the people he/she interacts with and about the relationships among these people.

Ego network analysis is extremely convenient because it can be used in conjunction with random sampling, which enables classical statistical techniques to be used to test hypotheses.

We speak about a complete network analysis in situations where we try to get all the relationships among a set of respondents, such as all the friendships among employees of a given company. Most of rhetoric surrounding network analysis is based on complete network. All the techniques such as subgroup analysis, equivalence analysis and measures like centrality require complete network.

Network analysis is conventionally criticized for being too much methodological and too little theoretical. Critics say that there are few truly network theories of substantive

phenomena. This is not a well-considered argument, however, because when examples of network theories are presented, critics say “that's not really a network theory”. This is natural because theories that account for, say, psychological phenomena, tend to have a lot of psychological content. Theories that account for sociological phenomena have sociological independent variables. Only theories that explain network phenomena tend to have a lot of network content (Chung et al., 2007).

5. Utilization of social network analysis and settings of its properties by small enterprise

In spite of all expectations communication system is often strongly dependent on its elements that bring up unexpected situations or processes. Such elements are people and their activities. Hence it is essential to know that the social network theory can be also used to examine how company's members interact with each other, characterize many informal connections that link executives together, as well as associations and connections between individual employees of different departments. Such analysis tools provide the proper ways for companies to gather, reject or achieve information about competition and also about any unexpected collusions occurred in business activities.

A social network theory is interpreted as a network with nodes (often referred to as actors), i.e. entities such as persons, organizations, or simply objects that are linked by binary relations such as social relations, dependencies or exchange.

To express the structure of such net a net model may be used in which any node (a group of nodes) may have optional links (relations) to another optional node (a group of nodes). The links between nodes present existing social links of a system of communication in a company - both formally and informally.

Its advantage is a chance to simulate difficult tasks such as decision makings in a short time interval, where it is necessary to recognize the importance of a particular node from the point of view of announced information and their impact on a way of decisive problems solution. This model was developed from the hierarchical model, so the hierarchical model is a special case of a net model – it is its subset. Net model consists of sets of arranged couples of nodes where one element is called an owner and the second one is a member (Fig. 2.).

Fig. 2. Enterprises ties

The superior node (e.g. supplier) may have an optional number of subordinate nodes – records (e.g. customers), which can be mutually chained. The rule in this model is that if we miss or add some records links within data base are not disrupted.

Both nodes and links may have additional attributes of any type, and numerical link attributes may strengthen or weaken the tie between two nodes. In its most simple form we can use a social network diagram as a map of all of the relevant ties between the nodes which are being studied.

Such network theory and its model can also be used to determine the social capital of individual actors. It is used to illustrate the data continuity analysis process. Each node in this network represents a person that works in a particular knowledge domain. Nodes often present the individual actors within the networks, and ties are the relationships between the actors. Such network has oriented ties due to character of enterprise relationships.

To understand properties of such analysis we analysed the small enterprise in its social network diagram, where nodes (Y_i) are the points and ties are the lines. People are displayed as nodes Y_i and their social relationships are ties X_{ij} .

The social network diagram has the following structure (Fig. 3.):

Fig. 3. Social network diagram

The Y_1 is a chief, Y_2 is his wife and Y_3 is a sale and marketing manager, Y_4 is an accountant and other two are regular enterprise members. People have cumulative work duties according to this small business where it is necessary to do it in this way. Neither of people have different knowledge than the others so there can be many kinds of ties between the nodes. So we can easily analyse the structure of network as well as closed points of such social network.

Next in that social network we must know the most significant nodes and their properties – centralities. One of the ways to understand social network needs includes accounts of centrality and of one node's relationship to other nodes in a network. That is why Linton C. Freeman's article concerning centrality in social networks is important (Freeman, 1978). He explored how "graph centralization" is based on differences in point centralities. He also outlined three competing theories regarding the definition of centrality based on degree of a point, control and independence. Because social networks are fundamentally social tools in which people are constantly monitoring and growing their social network, most social network media depict growth using the degree of point definition.

However, control and independence can be more useful definitions. As we have mentioned above, a person who controls information flows is more important than one who is on the topic position or may have more friends in the network. Such person may have better information to eliminate the risk of common business activities. But the importance of this

position is not as high as it should be. Holder of the position is often responsible for finding out such points and their relationships - it's the key to a successful business deal.

Therefore in the next we calculate - for analysed network's nodes - such properties as local measures of degrees and distance centralities. It helps us to decide better about centralities of such network.

Degree centrality is defined as the number of links incident upon a node (i.e. the number of ties that a node has). In an enterprise network this means counting the number of informed people it has in a social network. The more people are connected to a given node, the more important the node is.

Degree centrality can also indicate which members are the most useful or well connected and therefore the best information resources. It is often interpreted in terms of the immediate risk of node for catching whatever is flowing through the network. The greater a person's degree, the greater the chance that he will catch whatever is flowing through the network, whether it is good or bad. Nodes with degree centrality are not only more viewable and controllable but the network better obtains any information which may effectively exploit in the competition process. In a better way they gather new innovation and knowledge. In general, the greater a person's degree, the more potential influence the network has and vice-versa. For example, in the enterprise network, a person who has more connections can spread information more quickly, and is also be more likely to hear more information. It is so in our enterprise where the marketing manager (node Y_3) has always better information about sales promotion so he can better plane purchase orders than his chief who prepares plans for firm's stock-in-trade as well as enterprise strategy. Also a lot of research points say that organisations gather better more information incidentally or through fellowship dialogs than through official reports.

Due to fact that an enterprise communication network is usually directed network we also set measures of prestige measures. Such measures are computed for directed networks only, since for those measures the direction is important property of the relation (Wasserman & Faust, 1994). In a directed graph prestige is the term used to describe a node's centrality.

Next we will also analyse distance centralities to obtain better information about weaknesses as well as about opportunities of a communication network. We outline the betweenness centrality based on a counting rate of information ties as well as distance and density centralities computing. There we use a graph-analysis methodology combined with a correlation matrix analysis (Balog & Straka, 2005) to optimize such network properties.

5.1 Setting of local measures of centralities by using a graph-analysis methodology

If we constructed a social network diagram we could analyse point's properties, set hierarchy levels of communication network as well as its density. To do it correctly we configured a matrix model which corresponds with a communication network diagram by Fig. 3.

That correlation matrix corresponds with information flow's relations of the analysed network's subjects described above.

Let this matrix be a compact model of information graph. In the social network there is a time delay of information flows between input and output data according to their background processing in the analysed social network. Let these elements of social network mark as subjects of that system - Y_i . Some relations between these subjects described as oriented paths are variable $X_{i,j}$ those can be even 1, if there is a relation from node Y_i to Y_j node, and $X_{i,j}$ can be even zero, if this relation does not occur. We get an information matrix (matrix of relations between a manager and his employees - see Table 1.):

M 1=

	Y1	Y2	Y3	Y4	Y5	Y6
Y1	0	1	1	1	0	1
Y2	0	0	1	0	0	0
Y3	0	0	0	1	1	1
Y4	0	0	0	0	1	0
Y5	0	0	0	0	0	0
Y6	0	0	0	0	0	0
Σ	0	1	2	2	2	2

Table 1. Correlation matrix of information relation network

In the next step we summarized the values in the columns to set hierarchy levels of communication network. If the sum in the columns is zero, these points are integrated to the same hierarchy levels. As we can see from the Fig. 3., the node Y₁ has the highest degree position. Such position we identify as a “Status prestige”. It corresponded to the chief position of analysed enterprise network.

To obtain next levels we calculated series of matrix n-exponentiation and consequently we again summarized the values of the columns answered to particular nodes. We repeated that process until we obtained a zero-matrix.

The number of exponentiation corresponded with the number of hierarchy levels. We must exponent our matrix 5-times to obtain a zero-matrix – so our network has five hierarchy levels. Gradually we determined distribution of nodes to several levels and assigned to nodes relevant information flows to the nodes according to existing ties of communication system.

This model monitors the analysed network more transparently because of more visible hierarchy levels and ties and it simplifies the above mentioned graph diagram (Fig. 3.). Our network was simpler, but if we could analyse a bigger social network we could obtain a structure of hierarchy levels more transparently – even it seemed to be complicated at the first sight in the first graph diagram of such network.

Next, if the network is directed (meaning that ties have their direction), then we must usually define two separate measures of degree centrality, namely indegree and outdegree. An indegree is the number of ties directed to the node, and outdegree is the number of ties that the node directs to the others. For positive relations such as friendship or consultancy, we normally interpreted indegree as a form of popularity, and outdegree can be seen as indicating gregariousness (Chung et al., 2007).

So we obtained a new graph model of information network corresponding to existing information hierarchy levels (Fig. 4.).

Next we could decide who has a better control in the communication network. We can use graph-analysis method that also gives information about control centrality. The **control** refers to the extent to which nodes depend on one specific node to communicate with other ones. For example, if more employees are connected to each other only when that node serves as the bridge connecting them, then its centrality is high. It is the node that controls the communication flows. There it is a node Y₃. If such a worker absents information flows from Y₂ to Y₄, Y₅ and Y₆ absent. The worst situation is when Y₁ also doesn’t work. Such situation we called as “Social cohesion”. It is the minimum number of members who, if removed from a group, would disconnect the group. By our network is minimum equal to 2, it is node Y₁ or Y₃.

Fig. 4. Graph presentation of hierarchy model

Next we can calculate a measure of centralities in our network. First one is a degree centrality.

- **degree** centrality has the node Y_3 because the most outstar and instar paths connect other nodes to it (Fig. 4.).

We calculate degree centrality as:

$$C_E(v) = \sum \omega(e) \tag{1}$$

where e is a count of all instars and outstars paths. As we have counted a degree centrality of network by Fig. 4.:

$C_E(v)$ for node Y_3 is even 5.

We can name such centrality as a “Degree Prestige” because this node is prominent due to a lot of other adjacent nodes is linked to this node.

Next we want to set local measures of centralities. We compute

- **outdegree** centrality as:

$$C_E(v) = \sum_{e \in \text{outstar}(v)} \omega(e). \tag{2}$$

We can say the node Y_1 has the highest outdegree centrality because its $C_E(v)$ is equal to 4. Next it is Y_3 , but not Y_2 as we could gather from hierarchy model (wife of chief) of enterprise structure.

Next centrality is

- **independence** centrality:

means that a node is closely related to all the nodes considered – so that it is minimally dependent on any single node and it isn’t a subject to control. This means it can “reach” the maximum number of people through the shortest number of links, without being dependent on a few particular nodes (Y_1). It is normal because the boss of the firm has such position in the firm. He may and have to control all employees’ activities.

Vice-versa the point Y_3 is strongly dependent on other nodes so its activities are more visible. It can put stress to its work duty beneath criticism.

On the other side we can decide which of all nodes is well informed – it has relatively the highest level of control in such network.

We can compute it from a graph theory as a:

- **closeness** centrality is a centrality measure of a node within a graph.

Nodes that are “shallow” to other nodes (it means, the nodes that tend to have short distances to other nodes with in the graph) have higher closeness. In the network theory, closeness is a sophisticated measure of centrality. It is defined as the mean shortest path between a node and all other nodes reachable from it.

If we computed this centrality for all nodes as:

$$C_E(v) = \frac{1}{\sum_{t \in V(G)} \delta(v, t)} \quad (3)$$

we obtained that closeness centrality has the node Y_3 . We deduced that in such network node Y_3 is the most important one, it means such employee is more important person in the enterprise even if it does not seem like that at first sight. So a successful business deal of all enterprise will depend on his activities.

If chief of enterprise can achieve a better control of all activities he can link to two people who are not linked. He can control their communication. If he fills a structural hole the “static hole” can be strategically filled by connecting one or more links to link together other points (Fig. 4.). It is linked to ideas of social capital of network. Chief who prepares planning of stock-in-trade can obtain better information about real situation when he controls communication activities between Y_4 and Y_6 . Y_4 is an accountant manager who gathers information from regular enterprise members.

5.2 Analysis measures of distance centralities and redundancy

Furthermore we can decide about the position of Y_3 when we compute measure of distance centrality:

- **betweenness** centrality

It is a distant measure of nodes within a graph. The nodes that occur on many shortest paths between the other nodes have higher betweenness than those that do not.

The highest betweenness centrality has Y_3 and it serves as the bridge between the most nodes and controls the information flows.

The **betweenness** centrality for node v is:

$$C_E(v) = \sum_{s \neq v \neq t \in V(G)} \frac{\delta_{st}(v)}{\delta_{st}} \quad (4)$$

where:

$\delta_{st}(v)$ - is the number of the shortest paths from the node s to t that pass through v ,

δ_{st} - is the total number of the shortest paths from the node s to t .

Betweenness centrality has node Y_3 . Its measure is equal to $1/4$. The distance measure is the shortest for the node Y_3 , where a path to the node Y_5 is the shortest of all through the node Y_3 (but not through the node Y_4). As we can see the analysis through a network graph in the Fig. 3. is more frosted than one in the Fig. 4. because we can't set the shortest way so exactly

because were not aware of hierarchy levels distribution of all nodes. It confirmed our findings that Y_3 is the well important node in such communication network. It is necessary to pay attention to such point because we have to be aware of information security violation. On the other hand, when we analyse an existing network it is necessary **to decide** about **information redundancy**, if it is needful or needless. It is necessary to balance the positives and negatives of size and communication activity.

If we would analyze redundancy we can also use a correlation-matrix model. There we must configure matrix of ties counting rate. The number of ties indicates the number of information redundancies of network nodes (Table 2.):

	Y1	Y2	Y3	Y4	Y5	Y6
Y1	0	1	2	2	2	2
Y2	0	0	1	1	2	1
Y3	0	0	0	1	2	1
Y4	0	0	0	0	1	0
Y5	0	0	0	0	0	0
Y6	0	0	0	0	0	0

Table 2. Matrix of counting rate information ties

As we can see the information redundancy have the nodes Y_3, Y_4, Y_5 and Y_6 . If we summarize rather obtained findings (chapter 5.1) we can say the information redundancy for node Y_3 is needful but the other nodes redundancy is needles.

The main shortage of the model is its difficulty concerning a display of links between nodes and also from the point of view of a need of data manipulation – from the point of view difficulty of expression of input and output flow of data in mutual relations in a described company structure of activities or processes. Its advantage is its similarity to physical structures of stored data which enables making company management more transparent, specification of importance of individual nodes in a network, what is very complicated in this open structure, where sometimes workers at lower positions possess important information from the point of view of company priorities.

5.3 Network analysis by using Visone

Nowadays we can use an analysis tool that facilitates the visual exploration of social networks by using Visone programme. It may be used if we have a large network with many nodes and ties, where it is more simply to research its properties through models and build algorithms which integrate and advance the analysis and visualization of social networks (Brandes & Wagner, 2007).

It includes counting of many above described centralities.

Such tool enables a social network analysis by using graph-theoretic concepts - to describe, understand and explain social structure. The Visone software is an attempt to integrate analysis and visualization of social networks and is intended to be used in research of complicated social networks. It attempts to make complicated types of analysis and data handling transparent, intuitive and more readily accessible. Nevertheless we recommend using such tools for SME enterprises if they need to analyse their network. Software Visone is free for research purposes, but not for commercial use. It can be downloaded from <http://visone.info/download/>.

Fig. 5. Visone model analysis

6. Model of company communication network process management

In the previous part we have introduced the model which may be applied to manage a communication network in a company – from the point of view of determination of importance of individual members (nodes) in this network. If we wanted to develop a model the role of which would be to make management of activities concerning required materials processing and basic documents concerning information assurance of economic activities in a company more effective, it would be necessary to know in details all the activities connected with the process. It means that it is vital to carry out a process analysis of performed activities related with provision of corresponding information needs, define needed processes, their consequence and also people responsible for their execution.

Based on it is possible to determine a map of processes and corresponding information flows in a form of related documents. For designing a map of an adequate processes and individual nodes structure which present employees responsible for their execution may be used (Pomffyová, 2008). Based on the processes map – next it is possible to make analysis of repetitive activities at execution of economic operations of a particular company and find out if some activities do not repeat or if they are not executed uselessly. It allows making related processes more transparent and minimizing them so that all activities and processes which are carried out ineffectively or are redundant - are eliminated. Based on it is possible to make not only decisions of operative character but also strategic decisions which concern for example a change of organizational structure, its form, even cancellation or initiating creation of a new working position – based on actual company needs, what is often a narrow place and an obstacle the impact of which may negatively influence company operation and success of business as well.

The advantage of this model is that if processes and responsibilities for their execution are transparent – also partial elimination of human factors influence - resulting from impossibility to carry out particular changes due to superior position of a member of team, or due to underestimation of expert abilities and knowledge of lower range experts – is possible.

As it was already mentioned – if the map of processes and responsible people exists, we can start with optimization of their activities and the criteria which is measurable is monitoring of a length of a cycle of individual documents processing, i.e. we will try to optimize periods

of distribution flows execution – flows related to processing of required documents and length of intervals of idles related to their technological processing.

Based on the results of monitoring and period analysis we may create a matrix in which we record all required intervals. In this way we will get a matrix which clearly depicts a flow of documents between individual nodes. To analyse documents flow a method of matrix of transport model will be used (Balog & Straka, 2005).

As criteria of optimization a sum of multiplication of documents transmission in the direction of their flow is selected:

$$T_c = \sum_{j=1}^S \sum_{i=n}^n (t_{i,j} + tm_{i,j})$$

(5)

where:

T_c is a total length of a cycle of documents processing (e.g. project documentation),

n - number of positions,

S - number of searched documents,

$t_{i,j}$ - time of duration of technological operations required to process a document of its i -position, including document receiving, document processing and circulation of processed document through all j -positions,

$tm_{i,j}$ - time of stoppage of i -position document at j -position of work place (time during which we do not work with particular documents).

At optimization the time of total cycle of documents transmission must be minimal. Matrix can be created in a form of a Table 3.

transport matrix		work place seq. number					
		P ₁	P ₂	P ₃	...	P _n	SUM
document seq. number	D ₁	tm _{1,1} t _{1,1}	tm _{1,2} t _{1,2}	tm _{1,3} t _{1,3}		tm _{1,n} t _{1,n}	TD ₁ 0
	D ₂	tm _{2,1} t _{2,1}	tm _{2,2} t _{2,2}	tm _{2,3} t _{2,3}		tm _{2,n} t _{2,n}	TD ₂ 0
	D ₃	tm _{3,1} t _{3,1}	tm _{3,2} t _{3,2}	tm _{3,3} t _{3,3}		tm _{3,n} t _{3,n}	TD ₃ 0
	...	...	...	...		...	
	D _n	tm _{s,1} t _{s,1}	tm _{s,2} t _{s,2}	tm _{s,3} t _{s,3}		tm _{s,n} t _{s,n}	TD _s 0
	SUM	TP ₁	TP ₂	TP ₃		TP _n	ΣT _c D = ΣT _c P
		0	0	0	0	0	

Table 3. Matrix of transport model

The matrix of transport model allows researching times of individual documents processing $t_{s,n}$ times of stoppages of individual documents $tm_{s,n}$ time necessary to process individual documents at particular work places TD_s and time which work places need to process individual documents TP_n .

It is important to find such values of TD_s and TP_n , so that the sum of their times is minimum. Mathematic record of traced equality:

$$\Sigma T_{cD} = \Sigma T_{cP} \quad (6)$$

expresses that total sum of times of individual documents at individual work places must be equal to total sum of times work places need to process individual documents. Through minimization of times of total transmission of documents - times of technological processing and stoppages of documents are optimized and we get a tool to model documents movement and analysis of corresponding processes. Through analysis of times provided in individual lines and columns we get a tool for shortages elimination in corresponding processes and it enables to find out narrow places in a company structure. It improves not only management of existing documents movement but also makes managements of processes and activities connected with management of relations in the company more transparent – since this is often the main problem in most companies.

From the point of view of optimization of information flows in companies we have a high quality mathematic apparatus which may be utilized for management of processes connected with creation and processing of company internal documentation or management of distribution of expert, special and project documentation, the delivery of which by e.g. electronic post may bring problems due to a huge capacity of data (e-mails boxes are overload).

7. Assessment of possibilities of individual models of communication network management

Searching and setting of centralities in the social network gives more possibilities to manage the network, supports data management, etc. It is executed by implementation of social network analysis. Social network in enterprises has unique properties and due to them it is a socio-technical system that is created by people with their specific characters but not only by exploitation of technical components and other communication tools.

Separation of weaknesses and some limitations of managed network provide better utilization of communication network in business processes, in negotiations or in decision-making processes. It is possible to eliminate treatments of network nodes that may evoke some failures by more important dealings or statements. Setting of their centralities may eliminate constraints and threats which may occur by using such network to predict partner behaviour and identify new business opportunities mostly when doing business on foreign markets. Definitely, they need enough proper information about possible ways and available support when they carry out business activities with their partners.

8. Conclusion

Applications of such theory in different ways described in this paper provide variable tools to analyse various networks. We presented an extension of graph-analysis methodology combined with correlation matrix analysis which simplifies relationships management in the enterprise communication network. The correlation matrix modelling is described by a functional analysis which includes the graph-analysis of our network. The computing of centralities offers a precise tool to determine centralities of such network. In this way, the discontinuity or darkness points can be eliminated. In the tests of the method in a simple system we assigned the advantages of such analysis that helps us to determinate seclusions, menaces as well as opportunities of analysed enterprise system occurred in such business

segment. If we optimise a network by using such tools we can precisely analyse also the network which seemed to be complicated at the first side. It is due to necessity of the top subject matter experts – SME – they must search information, use both direct and indirect links – hierarchical as well as informal communication paths. Therefore SME can apply the above described network measure metrics of centralities as well as distance centralities. According to them they can better decide about the size of investment which company needs to improve its management through higher quality communication processes. It is especially necessary for SME due to incorrect leverage that could weaken or even end all their business activities.

Proposed models of net structure management, from the points of view of determination of importance of work positions through a method of social networks and analysis of communication processes and periods of their duration through a matrix of transport model bring benefits for the company because information strategy conforms to the requirements of company management and its activities. The advantage of the models we propose is that they are suitable for management of complicated social-economic system of any company at different levels of management, while at the same time they eliminate as much as possible the influence of human factor. They also allow analysis of its interactivity with other systems and when the map of processes is created negative impacts resulting from superior positions of some employees are not considered. The system also allows management of a system of rapid changes - especially thank to transparency and specification of processes, and brings the possibility to model various situations and possibility of what-if analysis and its impact on total operation in a company, etc. The above mentioned models make possible to analyse complicated internal relations in a company and it is possible to detect often hidden characteristics of network nodes and operations carried out with them – which may positively or negatively influence the way of doing business and total success of a company on the market. A company obtains a tool through which it can get a view concerning situation in the company and make strategically important decisions, i.e. strategically manage development in a particular company. Based on it - it is possible to eliminate narrow places in company work organization, while if all necessary measures are carried out we get a tool which changes strategy of company's management and it is based on a principle of IT utilization – as a part of information strategy of the company. What is not good? It is situation when managers as well as employees do not want to cooperate by preparing of such communication and information processes analysis. In the next we will pay attention to better specification of all processes occurred in enterprise communication and information network to do such analysis more exactly, then that needs to be defined as well.

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