Use of Social Network Analysis in Early Phases of ICT Projects

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Abstract: According to results of our surveys in 2011 the ICT project managers operating in the Czech Republic would like to have wider possibility of influencing the selection of team members in their projects.

The article focuses on the psychological and the sociological aspects of the ICT project teams’ structure, analyzing the existing social networks within a company as well as the concept of the team roles when setting up the project team by mapping the existing relationships among the team members and the possible personality divergence of each employee.

The first part of the article summarizes the important milestones for mapping the social networks, the possibility of mapping the network of social relationships, communication channels and relationships in the company, it is focusing on the differences between a team and a work group and the consequences on their functioning.

The article represents two surveys results. First one took place among 36 ICT project managers and the second one among visitors of international conference Systems in integration 2011. Based on these results, we are presenting a brief description of process design that supports and is important for the ICT team leader’s nominations, as well as for the ICT team members, respecting their relationship structure, results of past cooperation and psychological team roles.

The process includes a mapping of a subset of social networks, recommendations of competent managers for the approved project charters based on the output of the analysis, progress and outcomes of finished projects and other relevant business information. The following stage carries the selection and recommendation for individual leaders in regards of the appropriate team members. To ensure the continuous process improvement and preservation of knowledge for the next cycle, the last part is completed by the feedback and evaluation. The proposed process cycle should stress the importance of psychological and sociological factors when setting up the ICT teams in order to speed up the team development and achieve maximum team performance as soon as possible.

Keywords: social network analysis, ICT project, network, team, success.

1. Introduction

1.1 Social network analysis

Social network analysis discloses and describes the relations among nodes (representing individuals, teams, organizations, and resources) using varies tools (e.g. sociograms and metrics). Further definition of the social networks analysis in (Otte 2002) "Social network analysis is sometimes also referred to as 'structural analysis', rather than a formal theory, it is a broad investigating strategy for social structures."

Sociogram represents relationships and their structure. Edges are used to illustrate the relevant links among nodes (mostly in the form of lines or curves). Figure 1 represents communication within small subset of employees captured by e-mail exchange. We can see that the employee in the middle received e-mails from every other member of the group and communicated only with one group member.
The idea how to use the theory of social networks in practice has arisen as relationship sociology in the 1980s.

Survey (Yang 2004) has shown that:
- "Group cohesion was positively related to overall performance.
- Group characteristics, e.g., cohesion and conflict, fluctuated in different phases, but in later stages, much less cohesion occurred and the advice network seemed to be very important.
- Group structures seemed to be a critical factor for good performance."

In (Leenders 2007) are presented results which support the idea of the importance of social network analysis for mapping and explaining efficiency of some teams compared to other, less effective teams. It seems that the key factor for effective work and innovation is a presence of some alternative communication paths and good links to well-connected knowledgeable others.

In each relationship a number of parameters can be observed, from which one of the elementary are:
- Reciprocity describing the relationship in terms of balance, whether there are similar or the same relationships between two persons or if it is a one-sided relationship that is not reciprocated by the other person.
- Durability expressing resistance of relations of the each individual.
- Intensity reflecting the strength of the relationship and the resulting consequences.

According to these metrics it is possible to describe individual relationships and to draw conclusions. Based on these findings, we are proposing a revision of the usual but insufficient selective processes and compilation of the project teams.

1.2 The team and work group

To understand the potential of the team and teamwork it is necessary to define difference between team and work group.

The term “team” means formal internally unstructured small group of people whom perform together within the specified timeline” (Novy 2002)

As the team is quite often called a group of people that are working together, but not participating in collective tasks and not sharing the same objectives. In fact these characteristics describe a work group not a team.

The main differences between terms team and work group are summarized in table 1.
Table 1: Differences between terms and workgroup. Source: Authors based on (Novy 2002)

<table>
<thead>
<tr>
<th>Team</th>
<th>Workgroup</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Shared target and the willingness of reaching it</td>
<td>Shared workspace</td>
</tr>
<tr>
<td>Various internal structures (e.g. profession, qualification, demographical structure)</td>
<td>Social relationships are usually permanent</td>
</tr>
<tr>
<td>Balanced orientation between relationships and tasks</td>
<td></td>
</tr>
<tr>
<td>The life duration of a team is usually limited by time or task</td>
<td></td>
</tr>
<tr>
<td><strong>Distinct characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>No formal internal organization structure</td>
<td>Internal organization structure of working roles is Defined formally</td>
</tr>
<tr>
<td>All team members are performing together with Common results responsibility</td>
<td>The each work role responsibility is clearly set</td>
</tr>
<tr>
<td>Optimal size of the team is 5-9 members</td>
<td>The usual size of the group is 3-30 members</td>
</tr>
<tr>
<td><strong>Characteristics in common</strong></td>
<td></td>
</tr>
<tr>
<td>Shared targets separate the group and the team from the company environment</td>
<td></td>
</tr>
<tr>
<td>Frequent personal interaction among co-workers</td>
<td></td>
</tr>
<tr>
<td>Sense of group affiliation</td>
<td></td>
</tr>
</tbody>
</table>

The important difference between team and group has been pointed out by John Adair: "Individual members of the team complement each other’s work, whereas the members of the workgroup are mostly replaceable." (Adair 2008).

The team work in general offers wide range of advantages and benefits that could be achieved, oppose to a working group. Therefore it should be the goal of each project manager to develop a real project team from the assigned group of people as soon as possible. For achieving this goal is important to know the theory of group dynamics described in next chapter.

### 1.3 Tuckman's model of group dynamics

The development of working groups and teams passes through several stages and has been described by many models. The most famous and often quoted includes the Dr. Bruce Tuckman's concept. Dr. Bruce Tuckman has published the first version of its four step model in 1965. He’s added fifth stage in 1977.

The Model contains the following phases (Tuckman 2010):

1. **Forming** - the team members meet for the first time looking for relationships and accountability,
2. **Storming** – relationship among team members is created, tasks are assigned and the team members are starting to build mutual status,
3. **Norming** - all team members take the responsibility, team creates the rules of internal behavior, which allows to achieve the objectives, the mutual trust is developed,
4. **Performing** – roles and rules are established, the team works as a well-organized high-performing unit,
5. **Adjourning** - completion of the tasks and strengthening of mutual relationships and performance as a team that should last even when the project is finished. These relationships can accelerate the development of the team (the initial few phases) in case of future cooperation.

The team has a low level of performance during the first three stages, because firstly the team members have to pass through the initial stages, and only then the performing rules are established and the team performance arises. The most productive stage is described in the fourth phase, when
the team performance is the highest. The common work of the team finishes during the final phase where it should be evaluated and the gained know-how should be documented.

According to the fact that the fourth stage is the most productive, it is advisable to go through previous stages as fast as possible for every project. It is suitable to reuse the high performing project teams in the same or similar structure many times, because these teams can go through the initial stages very fast or even skip them.

1.4 Roles in team work

The roles and positions within the team represented by the individual workers are not predetermined. Spontaneous creation of the structure of the social and working roles begins with the forming of the team. Each member of the team has certain characteristics of behavior and their specific style, whether it is in their way of communicating with other team members, or their work approach. These behavioral characteristics can be divided into groups, based on which the team roles can be assigned. A lot of scientists have been focusing on the research in this area since the first half of last century. One of the most famous models was introduced by an English psychologist Raymond Meredith Belbin, who observed successful and unsuccessful teams in a long time period and found out that the homogeneous teams are not being successful. For successful and efficient performance of the team, the team should not be only composed by similarly-based personalities, because the team strength lies in the diversity and in the sufficient team role assignments. Belbin developed a concept that covers the nine team roles, which can be divided into three groups based on their orientation: goal achieving, thinking and analysis and team. Determination of the individual workers’ team roles is done in two steps. First the worker fills in a special questionnaire, which is followed up by the second step where the evaluation form is ideally completed by four co-workers. On the basis of the evaluation both mentioned tools identify the dominant team roles of the co-worker’s behavior. There is special software that evaluates these forms and assigns Belbin’s team roles automatically. This can represent significant reduction of the company’s work and costs. There are number of authors that engage in the Belbin’s concept (e.g. Blenkinsop 2010).

In practice, most of the employees usually don’t represent only one role, but 2 to 3 team roles with various intensity. In a properly composed team the strengths of each role are complementary and the weaknesses are being reduced.

2. How to acquire a project team

To acquire a project team, so that it has prerequisites of effective and high performance team work, is not just a question of qualifications and expertise of each team member, but there are also many other important factors.

In order to acquire effective team, we recommend considering the following factors:

- qualification,
- reliability,
- communication skills,
- previous good experience,
- existing social relationships,
- team roles,
- communication skills,
- previous experience,

The nomination of the project team should not only be done by the line managers of the potential team member on the basis of the qualifications, but they should cooperate with the Human Resources Department that should be working with psychological and social characteristics of each employee and with the project managers, whom will manage the team and will be responsible for its proper performance. This idea, however, in everyday reality conflicts with a number of problems like the unavailability of the selected personnel, missing information about them and their relationships, lack of knowledge about the theory of teamwork on the managers’ side as well as the company processes setup.

Although the project management processes are applied by many companies, only a small part of them deals with the efficiency of their project teams, although the progress and results of the project are critically dependent on their work. On the basis of our experience, only some basic problems are
addressed with individuals, and it is only the project manager for the relevant project that monitors and influences the team. The stage of evaluating the internal functioning of the team and its performance is usually missing. That is why not only the evaluation of the project team performance is badly affected, but also the effort to find out the root causes and what to do to improve the performance for the future projects is missing.

2.1 Results of related surveys

There was a survey among project managers in ICT companies in the autumn of 2011, which was focused on the teamwork and way of setting up project teams. 45 respondents were addressed to fill a questionnaire. 36 of them sent their responses. Results can be summarized as follows.

Most of the PM (54%) has a low or no opportunity to influence the structure of the project team. The most important factor for selecting a member for a team is his or her expertise (30%) and reliability (26%), followed by communication skills 23%. We found that only a very few respondents (6%) choose people according to the team roles. That indicates a lack of awareness of the importance of seeing the team from a psychological point of view.

Another survey took place during international conference Systems integration 2011. 19 valid questioners were gathered from mostly companies’ or ICT projects managers. Results showed growing concerns linked with the optimal combination of employees in project team and psychological and sociological problems during team work and also often related to delivering project output in time. Almost every filled questionnaire showed demand for having the chance to alter team members, but just less than 50% of responders had rights to make those changes. Research also showed that employees often search for previous solution of current problems by their co-workers, friends and knowledge databases to save time and project resources.

The results of the surveys clearly show that the current process of team’s composition is mainly a question of qualifications and reliability whilst the psychological and social factors are neglected. These findings reveal a huge potential for improving the functioning of the project teams and consequently increases project success. It can be said that the modern theory of teams is not yet considered in the Czech ICT environment.

3. Advanced process of setting up the ICT teams

Based on the results of our surveys we recommend improving the process of the personnel selection during the team allocation with the help of the social network analysis and while taking into consideration other psychological and social factors. Additional information about relationships inside company should help with satisfying growing demand for opportunity to change personnel assigned to planned project before its actual start. This change of point of view should also help to accelerate the initial stages of the team development and to achieve better interpersonal relationships as well as a greater overall performance.

Figure 1 depicts the global connection of individual processes.

![Figure 1: Connection of individual processes for support team selection (Source: Authors)](image-url)
3.1 Process of mapping social network

The process of mapping social network is initiated by the time stamp. Three months is recommended as the most appropriate interval after which the process should be repeated and the social network map updated. It is sufficient time period for significant changes in the structure of social networks as well as the interval is not that frequent to significantly affect the utilization of the company resources. The initial inputs are the company strategy plan, related management decisions (related to solving problems of ICT projects and other factors), and approved project plans and running projects’ characteristics.

Next task is to decide on the scope of the analysis and its objectives. From the available sources (employees e-mail communication, instant messaging, final reports of completed projects and running projects and feedback from employees) a well-established method has been transformed and structured by the data describing the structure of communication and relationships.

Figure 2 shows example of social connections of an employee in last 12 months based only on send and received e-mails. Every colored dot represents one e-mail account. In the center is employees’ account. All direct connections with other accounts are highlighted (red lines). We can see that from this cheap, automated and fast visualization can be reasoned information about his connections to important people (one mustn’t forget that ways of social interaction are much richer than e-mails. Quality of decisions made is strongly related with organizational culture). Addition of another information sources should provide more accurate map of employees’ position within the social network.

Fig. 2: Visualization of connections of an employee based on analysis of send and received e-mails (Source: Authors)

Based on these records a map of relationships and their attributes can be created. On the basis of the quality, quantity and the expected importance assigned by the organization to the process of mapping
the social network, it can be extended to include information obtained from structured interviews and questionnaires completed by employees. This approach, however, compared to the existing materials’ analysis takes more time and company resources. It also requires a higher level of expertise and experience for proper evaluation. It needs to be decided whether the scope, detail and accuracy of the maps are sufficient after final map evaluation. The process is finished by the approval of the map or its revision and modification of the concept and scope of social network mapping.

3.2 Recommendation of project managers

Process that recommends the most suitable project managers for relevant projects begins by defining the requirements for project manager based on the characteristics of relevant project (e.g. area of project implementation, the dependency on the outcomes and interdependences on other projects). The list of qualified staff for the project manager role, their planned allocation and connections, is the most important input for the identification of the right individual. According to this at least one suitable candidate for each project should be identified. The output of this process is a list of preselected project managers and if all needed positions were not assigned, the process is repeated (the criteria can be modified).

3.3 Recommendation of team members

The process of team members’ selection starts in similar way as the process of project managers’ identification, therefore with defining the requested roles and knowledge. On these basis of these requirements the group of candidates with requested know how is identified. The next cycle takes into account team roles of the potential team members. We can compare gathered employees’ maps of relationships and decide who has the best connections to reach critical people to complete his task or project. Figure 3 shows different map of relationships of another employee. Compared with the previous one (see Figure 2) the map has less connections and most of nodes represents people not related with planned project and with no interest in its success. The difference can be measured by several metrics. Their value can reveal position within analyzed network and typical behavior of selected employee and its dynamics over time. Consideration of these information can give the project manager additional information and help him with choice of right people for his project.

Fig. 3: Visualization of connections of an employee based on analysis of send and received e-mails (Source: Authors)
The final selection of the team members then follows according the social network map analysis and evaluation of the employees’ capabilities. In case that not all the roles are assigned it is possible to initiate the process once more and to adjust the requirements.

### 3.4 Evaluation and feedback process

The evaluation and feedback process starts with evaluation of the estimates and actual project execution and feedback from the team members. The changes in the criteria and the cycle could be approved and implemented on the basis of the collected information.

The presented draft of the processes should help to reduce problems with team performance identified in the real ICT project environment. It allows setting up project teams not only on the basis of qualification and availability of potential team members, but it could also improve relationships among the team members, their line managers and the rest of the organization. Furthermore this draft includes the factor of learning, knowledge preservation and continuous process improvement.

### 4. Conclusion

Importance of social network analysis and psychological factors grows in ICT project management. This can be demonstrated by the increasing usage of agile methodologies and by adding human resources management aspects into the rigorous methodologies. Presented researches confirmed this trend and a needed shift in paradigm of project team composition. The main goal of the presented process is to increase the weight of psychological and social factors in the process of setting up IT project teams. This change should help to increase number of the successful projects, decrease duration of initial phases when establishing the team and team roles and also help to create better working environment inside the team. The described process provides optimization of project team structure based on maps of social relationship inside the company, requirements on qualification of employees and their team roles. According to previously published research and articles (e.g. Mesicek & Molnar 2011) we believe that team assembled by this process will perform better and produce more valuable results in shorter time period. Use of this process is not only limited to the area of ICT project solution, but could be as well used in the other sectors dependent on team work.

Verification of this design will be part of our future work.

### References


### JEL Classification: C88, L86