Study the Efficiency of Interproject Communication with Social Network Analysis

4 authors:

Dmitry Plokhov
Moscow Technological Institute
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Ilya V Osipov
i2i Study INC, Californy, USA
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Sergei Titov
Moscow Technological Institute
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Evgeny V. Nikulchev
Moscow State Institute of Radio Engineering, Electronics and Automation
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Study the Efficiency of Interproject Communication with Social Network Analysis

Dmitry PLOKHOV*, Ilya V. OSIPOV**, Sergei TITOV***, Evgeny NIKULCHEV****

Abstract

Traditional performance monitoring techniques in project management are based on classical measures – costs, schedule and scope of work. But focusing our view on these indices and their derivatives we can overlook one of the most important elements of project management – project participants. Degrees of their coordination, cohesion and collaboration directly influence on the extent to which project goals could be achieved. Communications and relations between participants play a vital role of special glue holding project parts together. Besides, communication environment integrate within itself information about all aspects of a project – successes, failures and conflicts. Character of interpersonal relations and structure of communications between participants are proposed as indicators of successfulness or failures. In present report project participants are considered as a social network. Using social network analysis (SNA) techniques provides opportunities to examine links between structural characteristics of interproject communication networks and project performance.

Keywords: *social network, interproject communication, project performance.*

1. Introduction

A project can be viewed as a temporal organization formed within an enterprise for achieving unique goals [1]. In addition, to create a unique product, service or result, particular characters of projects are dynamic environment in which a project is managed and high level of uncertainty. Of course, traditional project management tools, processes improvement instruments, agile management techniques, and other management optimization frameworks are of high importance for the project success. However, as it was rightly pointed out in the article of T. Cooke-Davies [2], project results are delivered by people and through the interaction between people, not by and through processes, procedures and systems. Through the interaction with each other and the environment, project participants constantly adopt their work to new conditions and challenges in order to eventually achieve the major strategic goals, to meet customer needs and project constraints. Hence, communications and relations between people determine the quality of the processes, and thereby the quality of project management and projects' performance in general [3].

The most common approach for evaluating project management performance is based on comparison of actual project measures with approved constraints on costs, time and specification of work. This approach, that can be called classical, makes possible to get bird-eye view on the situation through a set of formal metrics. Though the analysis with classical metrics and their derivatives is clear and well-formalized, it seems extremely difficult to use such metrics to evaluate impact of major social factors – communications and social relations that can significantly impact on the project team productivity and creativity [4].

A communication environment acts not only as a data transfer system, but it also integrates all information in broad terms. Project initiation proceeds in parallel with forming of a social and information network, the members of which are the project participants. The communication structure is inevitably interwoven with informal relations that also have great impact on the work environment and complement relations based on formal administrative interactions [5].

The social nature of project management is also reflected in a link between emerging mismatches or contradictions and conflicts between participants. There are two opposing viewpoints on the role of conflict in project management. Traditional views supporters consider conflicts as a threat to a project and its environment. So conflicts should be avoided. Given the modern behavioral framework in management, conflicts are inevitable parts of the human organization, and with proper approach they can bring benefits and give right clues to resolve contradictions [6]. Thamhain and Wilemon [7] focused their research on identifying the main causes of conflict in projects and covered almost all aspects of project management. The general consensus of proponents of traditional and behavioral viewpoints is that conflicts can be symptoms of problems in project management and, not being solved, potentially lead to damages [8].

In the presented article, we investigate a communication structures and their impact on the flow of conflict and on the projects' performance with the help of social network analysis techniques. In theoretical part of the article we analyze the role of communications in project management. Then, we describe the application of social network analysis techniques for studying interproject communications. In the empirical analysis, we investigate three projects, their communication network structures and analyze the potential links between communications structures and the project success.

2. Role of communications in project management

Many researchers highlighted the critical role of communications for the success of projects. For instance, Gupta and Wilemon analyzed the interaction between marketing and research departments in a project-based company and found out that the quality and the structure of the communications between these two types of departments notably effected the effectiveness of

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* Moscow Institute of Physics and Technology, 141700 Dolgoprudny Moscow reg., Russia; E-mail: **mityay.forever@gmail.com**.
** i2istudy, Inc., 94123 San Francisco CA, USA; E-mail: **ilya@osipov.ru**.
*** Moscow Technological Institute, 119334 Moscow, Russia; E-mail: **s_titov@mti.edu.ru**.
**** Moscow State University of Technology and Management, 109004 Moscow, Russia & Moscow Technological Institute, 119334 Moscow, Russia; E-mail: **nikulchev@mail.ru**.

the innovation projects [9]. Pinto and Pinto ascertained that the high level of cooperation between the project teams accompanied by the higher probability of the project success [10]. Allen, Lee and Tushman showed that the performance of projects connected with the styles and quality of communications within the project teams [11]. Jagdev and Müller [12] and Henderson [13] determined the connection between communication competencies of project team members and success of projects. Ryynanen emphasized that effective communications are especially important for knowledge-intensive engineering projects [14]. Though many authors investigated the role of communications in projects of different types, these studies were largely of conceptual rather than of empirical nature. Yet another deficiency of the current body of research on communications in project management is the insufficient number of quantitative findings. The article presented is trying to compensate for the lack of empirical quantitative research in the field of communication management in project management context. The key research technique in the article is the social network analysis.

3. Social network analysis techniques for studying interproject communication

Techniques of social network analysis (SNA) are used extensively for studying of relations within organizations and between them. The main part of such research is based on analysis of corporate communications and information from the participants obtained through surveys and interviews. In relation to the project management, researches interests are targeted on features of interaction within virtual teams and the evaluation of their performance [15, 16], the issues of building effective communication between organization/project members [17], optimal conditions for spreading of practices and knowledge [18].

Communication issues were the central topics of the significant number of researches in the context of studying project management practices in construction and engineering industries. In [19–23] the authors considered the possibility of applying the social networks concept and analysis techniques to improve the efficiency of construction projects. The analysis of the links between the structure of teams' communications and innovative projects effectiveness was undertaken by S. Titov [24].

The growth of interest in SNA methods results from their flexibility that allows possibility to explore the communities and organizations of all sizes, to identify and visualize the formal and informal networks, to evaluate the quantitative parameters of communication structures and conduct a comparative analysis on their basis. In addition, several powerful software products, including free, were developed for supporting researchers to use SNA methods. These user-friendly products allow building and analyzing networks of various sizes. All this makes the use of social network analysis methods is very promising for the studies of organization and project communication networks.

3.1. Research methods

Earlier it was noted that communication structures and their character are the essential success factors on projects. From the full variety of project communication issues this study considered links between the structural balance of the project network and the project success rate by the end of the conflict. According to [25], there is structural balance in a social network when in do not contain relations – "positive attitudes (friendship, cooperation) between A and B and between B and C, but negative attitudes (hostility, rivalry) between B and C". It is supposed that balanced networks are more comfortable for participants and more stable than unbalanced. Thus, the conflict should split a network into balanced sub-groups (conflict parties) consisting of like-minded people who share similar points of view.

The studied project networks were built information by using data about communications between the participants by formal and informal ways, directly related to the certain project. Also in-

tensity (evaluated in the form of a numeric attribute) and character (attitude) of communications are taken into account.

The authors distinguished three levels of communication intensity: low, medium and high, which were associated with the values 0, 1 and 2 respectively. Consideration was given to mutual directed communication, i.e. the intensity of the evaluated communications between the certain participants pair was the same from the point of view of each of them.

Character (attitude) of communication communications associated with the "+" sign, if the communications were friendly, i.e. participants had mutual sympathy or common ground, or "–" sign in case of antipathy or difference in views. In each of the projects previously mentioned regarding the subject matter of the conflict. The positions conditionally designated as "Agree", "Disagree" or "Neutral".

The basis for the study was the information about the following three projects:

❑ **The project A.** 14 participants. The main object: development of the online educational games [26]. The conflict subject: disagreements about the final versions of the game concept and scenarios. Summary of the conflict: disagreements were finally overcome by harmonizing the wishes of all parties, but time was substantially out of schedule. Overall assessment of project results given by the participants is positive.
❑ **The project B.** 9 participants. The main object: development of an enterprise information system. The conflict subject: different views on technical solutions and disagreements about quality assessment of project results. Summary of the conflict: the parties were not able to reach a consensus which led fail to meet the project deadlines, and, subsequently, the project was cancelled.
❑ **The project C.** 7 participants. The main object: developing of educational online service [27]. The conflict subject: reforming of the project organization structure, attracting new members. Summary of the conflict: the deadlines were broken; some of the participants were out of the project. A key problem raised by participants was an impossibility of compromise on the conflict issue.

Summary data about communications (intensity and character) are presented in tables 1-3. These tables indicate the participants' position on the matter of the conflicts (A – "Agree"; D – "Disagree"; N – "Neutral").

It should be noted that the projects have been implemented in different organizations and by different teams, even though planned times of project duration had roughly the same.

Table 1. The matrix of communications in the project A

Parti-cipant	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14
A1		2	-1									1		1
A2			1	1								2	1	1
A3				2	1	2		-1				1		
A4						1		1		1		2		
A5							1	2	1					
A6							2	2	1	1	1	1	2	
A7								2	1	2	1			
A8									2	1	2			
A9											1			
A10											1			
A11														
A12													2	2
A13														2
A14														
Posi-tion	D	N	D	D	A	N	A	A	N	A	N	N	N	N

Table 2. The matrix of communications in the project B

Participant	B1	B2	B3	B4	B5	B6	B7	B8	B9
B1		1	1					1	
B2			1	2	2	1	1	2	-1
B3				1				1	
B4					2	2	2	-2	-2
B5						2		-1	-2
B6								-1	-1
B7								2	2
B8									2
B9									
Position	A	A	A	D	D	N	N	A	A

Figure 1. The communication network in the project A

Table 3. The matrix of communications in the project C

Participant	C1	C2	C3	C4	C5	C6	C7
C1		2	2	-2	1	-1	2
C2			1			1	
C3				-1	1	1	
C4					2	-1	
C5							
C6							
C7							
Position	A	A	A	D	D	N	N

Figure 2. The balanced clustering in the project A network

3.2. Analysis of result

The data about the structure of project communications were investigated using the freeware Pajek [28], presented by its authors to open access.

Visualization models of networks' structure are illustrated by graphs whose vertices correspond to the project participants and edges reflects meaningful communication between them. Since initially it was assumed that existed communications were mutual directed, undirected graphs was used for building the models. The models of communication networks for the investigated projects are shown in the *figures* 1, 3, 5. The communications with positive character are shown by solid line and with positive character – by dashed. The participants' positions in the conflicts are illustrated by color of its vertices: white color is corresponding "Agree", black – "Disagree", gray – "Neutral".

The rule of finding a balanced solution for a particular network can be formulated as follows: the balanced solution should contain that partition of the network into subgroups (clusters) in which all positive ties are within clusters and negative are located between them. It should be given that the formulated rule describes an ideal situation, in which positive and negative ties between network members are placed respectively strictly inside the clusters or outside. It do not occurs always in real life, so researchers using the error weight factor a can control the program threshold for penalizing of erroneous negative ties within subgroups (valid values range from 0 to 1). The error weight factor for erroneous positive ties between subgroups counts automatically as (1–a). For the present study it is used a=0.5. This factor can be explained from a socio-psychological point of view. Before selecting a value of a researcher should assess participants' tolerance to those with whom they have a negative attitude. If, in the opinion of the researcher, project members exist in an atmosphere of strong rejection of the opposite point of view, a should be defined close to 1. On the contrary, in the case where someone's disagreement does not prevent to consider him part of the team, a can be lowered closer to 0.
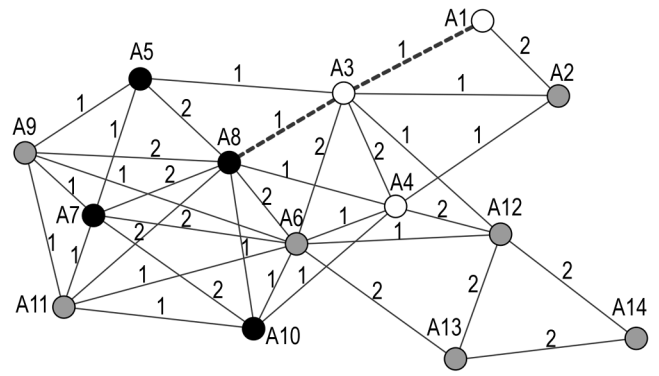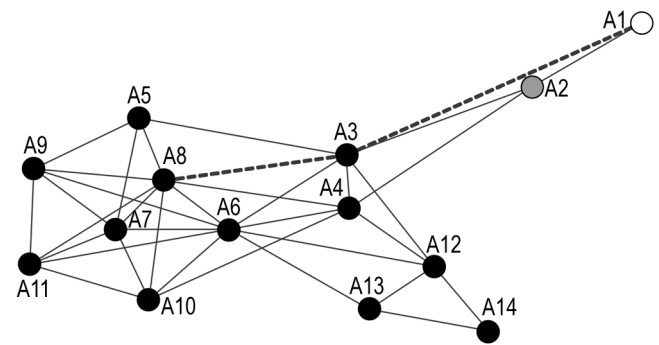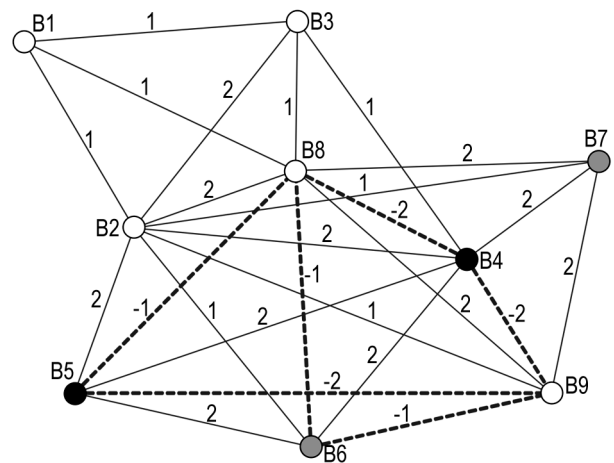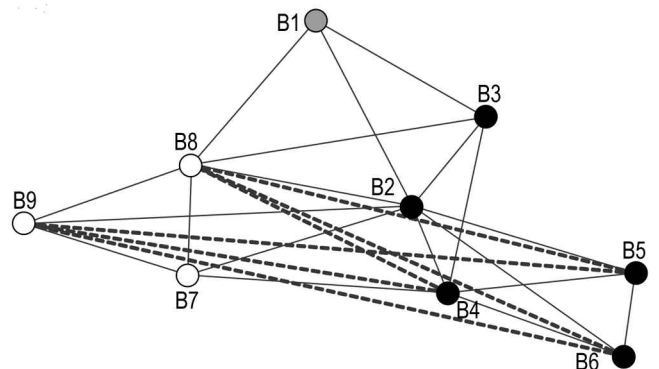

Figure 3. The communication network in the project B

Figure 4. The balanced clustering in the project B network
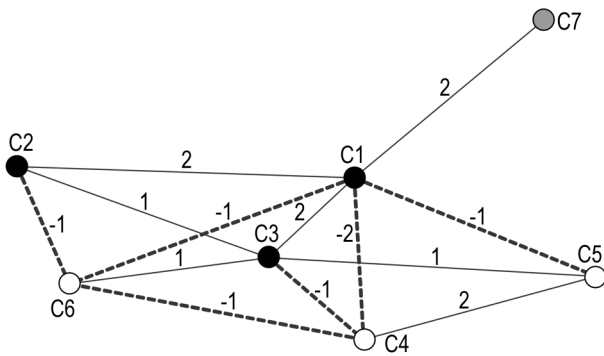
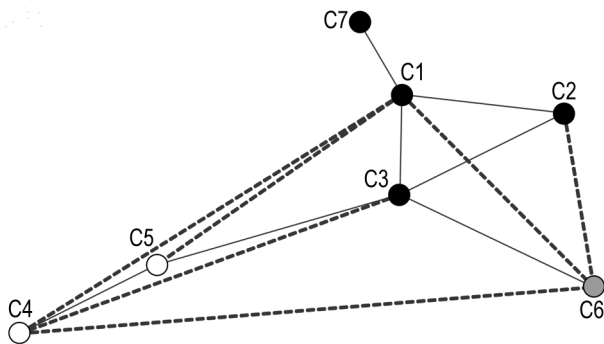*Figure* 5. The communication network in the project C

Figure 6. The balanced clustering in the project C network

Found balanced solutions are presented in the *Figures* 2, 4, 6. In this case used color coding are corresponding its membership of a new subgroup and not to the initial participant's position in the conflict. For example, in the project A the participant A3 initially demonstrated position "Agree" (its vertex in the *figure* 1 is white), but in the balanced network he joined the main subgroups (the black vertices in the *figure* 2). In the *figure* 3 the participant B1 was also marked with "Agree" position, but this project B member is the only participant in the grey-colored subgroup separated from the rest.

Comparing the found solutions with factual information about the projects it can be come to the following conclusions. In the project A there were 7 members in the open contradiction that is half of the total number of participants. The rest showed neutrality. It should be noted that the project A network contain only two negative ties in the communication structure. The balance analysis revealed that the 12 members belonged to the common subgroup. This fact shows about high emotional and psychological stability and cohesion of the project team, which is not influenced by differences of opinion, and therefore, about the high efficiency of communications management. Apparently, it was a significant factor contributing to overcoming conflict stage.

Comparing with project A, there is a big share of negative relations in the communication structure of the project B. It can be assumed that in the situation with project B the conflict this project proceeded in a more critical stage adversely affecting the people relations. It is noteworthy that participants with the "Agree" position more than their opponents (5 vs. 2). But the *figure* 4 with balanced network is showing the presence of 2 subgroups, almost the same number of participants. The nature of the relations between the parties became a potential cause of a more radical separation, and therefore it reduced the level of mutual cooperation. So the negative attitude in the communications of participants B6 with B8 and B9 contributes to transition B6 from the neutral position to the opposition to them. For the participants B2 and B3 who shared the "Agree" position the results are more interesting because next these persons joined to subgroup with one's opponents B4 and B5. Such situation when a network member has better relations with opponents than with supporters is reinforcing the dissociation. Divergent views, the lack of sympathy in relationships with peers have a negative impact on decision making. The participants of the project B pointed to the lack of coherence in the goals understanding. The analysis of the balanced network showed that the participants, among whom there was the nominal consent could turn out to be opponents.

The project C network divided clearly into 3 subgroups, between which negative attitudes are dominated. It can be noted that the participants C4 and C6 have only one positive link with the other that is blocking effective cooperation. Observing the pattern of the balanced network in the project C, the withdrawal of the several team members from the project seems to be in a predictable step. Communications and relationships between the participants are not contributing to the conflict resolution, and therefore, in this case it is hardly to expect achieving the project goals.

In the project A the communication network was stable when a conflict occurred. Its members had opposing points of view but could maintain positive attitudes with their opponents. Consequently, the team remained cohesive and kept the common goals and vision. In contrast, separate subgroups, in opposition to each other were clearly distinguished. Prevailing negative relationships between subgroups hindered information exchange and reduced the overall productivity of the teams. The lack of situation analysis in which the projects B and C were and insufficient efforts in relation to communication management became possible causes of disunity and the project failures.

4. Conclusions

Interproject communications are the integration environment for the participants, transforming them from individual actors into a united team. Using modern approaches in the organization theory, project teams can be classified as specific social networks. Formal and informal communications taken together constitute the project communication environment. Relations characters and their structure depend on project management effectiveness, and, therefore, can serve as indicators of project success.

Using the social network concept as a basis, the authors present the study communication characters and structure in the several projects that were in a conflict state. SNA techniques were chosen in order to examine structural balance of the project network. The analysis results gave opportunities to advance explanations regarding outcomes for each project taking into account social ties and member partitioning in the conflicts.

The use of SNA methods seems promising as a tool for analyzing of communication management effectiveness in addition to traditional methods for assessing quality of project management. This would pay more attention on human and social factors because project participants are the essential elements which deliver project results. **Q-as**

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