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BOOMERANG RELATIONSHIP PATTERNS IN PROJECT TEAMS

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Abstract

New product development (NPD) as a value proposition process is an important improvement activity normally carried out by NPD project teams. The research on NPD project teams is demanding because of the difficulty to collect sufficient experimental data and the variety of the complementary complex research methodologies required.

The paper applies experimental research for the formulation of project teams, real time collection and surveys for data collection, social network analysis (SNA) for the measurement of social constructs and statistical regression in order to test the impact of the network constructs on project success.

Teams are formed by final year business administration students working on NPD projects in real companies assisted by external advice networks of companies' representatives and consultants from the workplace. A number of social ties between team members have been measured using questionnaires and real time data gathering techniques, and their relevant team social networking attributes have been analyzed. SNA constructs like cohesion has been measured and applied to a subset of social links like friendship, business collaboration, acquaintance, and external advice. The regression analysis is applied on social measures in relation with project effectiveness with project complexity as the moderator variable.

The results reveal curvilinear or inverse U-shape relationships and their evolution are governed by boomerang patterns.

Keywords: NPD, SNA, social relationship, project team

Introduction

Most NPD processes are developed in small groups and the research on the success and effectiveness of NPD projects depend on the suitable formation of those teams. Knowledge on groups or teams working on NPD projects are an area where knowledge is still limited, the most important reason being the scarcity of sufficient suitable data for analysis. This is especially true for NPD projects that are unique in people and other resources, time and budget.

New Product Development

New product and service development or improvements are two alternative categories of value propositions in the context of this paper. Value propositions also include new or improved processes that may facilitate the quality and decrease the cost of product or service developments and improvements.

Project Management Teams
New Product Development (NPD) has been associated with project teams. According to Sutton & Hargadon (1996) the word team is connected with organizations. A work team comprises individuals who consider themselves and others as a social entity (Guzzo & Shea, 1992). Furthermore, the individuals in the team are interdependent on account of the tasks they carry out as a group, and they are embedded in one or several larger social systems. They are also assumed to carry out tasks that affect third parties such as customers or study colleagues.

Social Relationships in Project Teams
In a project setting we can watch new relationships formed and developed within the group after the new project initiation, the evolution of longer term relationships of some members that have been established in the past and interdependencies that all together may result in a variety of social complexities and outcomes within the scope of the project being undertaken. The possible development of intimate relationships might add further to this complexity.

Social Relations and Relationships
The importance of relationships started to become a core concept for researchers in the early 1990s (Holmlund & Tornroos, 1997). Wilkinson, Marks & Young (2008) also stressed that academics and practitioners also pay increasing attention on the importance of business relations and networks in order to sustain a competitive advantage.

Identification of Social Relationships
Holmlund & Tornroos (1997) define that network relationships can be characterized as an interdependence procedure of interactions among two actors. We can identify the types of social relationships by analyzing the structures of the social networks being developed within the group members and with the outside world. The links or ties may represent communication of any type of exchange between nodes Borgatti, Everet & Johnson (2013). The identification and measurement of social structures can be done using social network analysis (SNA) software (Borgatti, Everett & Freeman, 2002). Example structural indicators are density changes, multiplexity, reciprocity and fragmentation (Borgatti, Everet & Johnson, 2013).

Wilkinson, Marks & Young (2008) define that actor bonds arise among actors and firms and bonds refer to affection, trust, dependence, commitment, respect and sympathy. Wong (1998), suggest that adaptation, dependence and trust are essential for the relationship atmosphere. Trust, commitment and adaptation are considered to affect the relationships' interaction within networks (Olkkonen et al. 2000). Trust and commitment seem to be the most significant components for relationships (Wong, 1998). According to Holmlund & Tornroos (1997), commitment, trust, atmosphere, attraction and social bonds appear to be the social relational concepts.

Table 1 presents a review of the social relationship concepts used in our research The proposed table is by no means complete.

Table 1: Review of Social Relationships

Relationship Concepts	Author(s)
Acquaintance	Jehn and Shah (1997)
Communication	Baldwin, Bedell & Johnson (1997); Cummings and Cross (2003); Gluckler and Schrott (2007)
Friendship	Balkundi et al.(2007); Jehn and Shah (1997); Kratzer, Leenders & Van Engelen (2005); Mehra et al. (2006); Shah, Dirks &

	Chervany (2006)

Social Network Analysis
Social network analysis provides the appropriate tools for visual representation of the network relationships among people, teams, or whole enterprises. With the aim of this analysis we can have the opportunity to see the interaction patterns from the network members (Anklam, 2003).

Methodology

The methodology being used is based on similar previous experimental studies (Shah & Jehn, 1993; Jehn & Shah, 1997; Shah, Dirks & Chervany, 2006), with improvements in the standardization of the evaluation processes. The NPD projects are undertaken by final year business administration students of the T.E.I. of Larissa, Greece, forming project teams that may include engineering students from T.E.I. and external engineering and business consultants. The students work on real companies and their external advice network may include one or more of the companies' representatives plus consultants from the workplace. The module uses objective measures for the evaluation of NPD projects based on standardized processes using canvases as described in the business model generation in Osterwalder & Pigneur (2010).

The research approach followed is a combination of experimental design and the use of questionnaires. All 478 final semester students, aged over 22 years, working in new product development groups on their final semester project during the spring 2011 semester to the winter 2014 semester classes at the Technological Institute of Thessaly, Larissa, Greece, participated in this experimental research, forming 66 teams of 7 students on average as internal group members plus developing their own external advice network of a total of 209 external consultants with an average of 3 consultants per team. Their projects required the design and development of prototype business models for new product development presented as value propositions, i.e. product or service development and improvement processes in the related business models. New product development (NPD) value propositions involve research and creativity processes. The internal teams could expand autonomously and/or cooperate with external partners and other teams. This experimental approach has the advantage that the researcher can come back at any time in order to apply new or refined models in order to explain the collected information.

The team formation followed after:

1. A review made by the lecturers of Belbin's (1991) team role theory where each student self-evaluated his/her preferred team roles, i.e. plants, resource investigators, monitor evaluators, coordinators, implementers, completer-finishers, team-workers, shapers, specialists. Students received instructions on how to maximize diversity and avoid conflicts. The minimum number of students as internal team members was 3 and the internal team should remain unchanged for the whole project duration. Teams were allowed to expand at any time by adding external consultants that could be students from other disciplines, professionals and employees from the company that they worked with. The project management or coordination role evolved from within the project team. The selection of a real world company would preferably be a team task. The module leader provided assistance for contacting interested firms in case of difficulty. Teams managed their project schedules independently, their sole

responsibility being to attend the module weekly workshops. The teams worked in real companies on real projects with real work conditions evaluated with a real world framework.

2. A presentation made by the lecturers on [a] project type, [b] quality, time and cost constraints and [c] the project effectiveness evaluation framework. The project involved the selection of a company where the project team would create the current canvas of the company's business model and add canvases for NPD. The quality was evaluated by the lecturers as a function of documented creativity and innovation additions in the Osterwalder & Pigneur (2010) canvas' building blocks. The time was recorded automatically for each new canvas electronic submission on the e-class electronic platform used for teaching and learning support. The cost was counted as the internal team size multiplied by the duration in weeks. The effectiveness measure was a benchmark of total marks between project teams as percentages of the mark awarded to the best project. To find the total mark for a project we used the sum of marks for the canvases, divided it by the cost and then subtracted 5% per day of late project submission. The mark for each canvas was calculated as the sum of the products of quality multiplied by quantity marks awarded for each of the nine building blocks divided with the time elapsed since the previous submission.

In addition to the social network data accumulated on the e-class platform, a structured questionnaire was used for the collection of team attributes and the tabulation of relationships. The standard procedure proposed by Katz *et al.,* (2004) was used where each team member filled their relations with other group members on a relational table included in the questionnaire. The relationships recorded were friendship and/or business collaboration before the project, number of projects that they had collaboration in the past and the communication attributes (frequency, duration, direction) for each of the different communication platforms being used. The boundary of the network was defined by the first level links of the internal members to company members and other commercial consultants that has been the norm in similar studies.

Measuring social relationships requires the use of social network analysis (SNA) methodologies in addition to the traditional statistical analysis. The calculations are facilitated with the use of suitable SNA software. We used the UCINET[1] software for SNA calculations and SPSS[2] for the statistical calculations.

Appendix I presents the general information of the student groups that participated in the experimental study and the UCINET SNA results. The semester column represents the semester of consideration (S stands for Spring, W for Winter and the 2-digit# represents the year, e.g. 11 represents year 2011), the Company column lists the company for which the NPD project work was undertaken and in some cases after the dash (-) the students group name assigned by themselves for their project (e.g. in the first row, Berloni Proteas S.A is the company and Liberatores is the student group name), the column Internals lists the number of students who formed the internal team and the column Externals lists the corresponding number of external

[1] *https://sites.google.com/site/ucinetsoftware/home*

[2] *http://www-01.ibm.com/software/analytics/spss/*

professionals not necessarily from the company under consideration who form the external advice network.

Results

The Complexity variable represents the complexity of the base canvas of the company that the group had to start at first with and varies between 1 and 3 (1=Low, 2=Medium, 3=High). The canvas is being developed using the Osterwalder & Pigneur model. The social network metric being used is the cohesion (density) and the software being used is UCINET. The most common SNA metric used in the SNA literature for the calculation of a friendship social network is cohesion and more specifically the density of the network, i.e. the total number of ties or relations divided by the total number of possible ties (Hanneman & Riddle, 2005). The density of a network is the ratio of all the possible ties that could actually present. A key outcome of limited existing studies (Henttonen, 2010) is that the density of friendship ties within a group results in increased communication between team members that is assumed to increase knowledge transfer and cooperation.

A series of regression analyses have been done in order to select the final variables that would be able to explain the significant contributions of the selected variables in the model. Selected parts of the analyses are presented and explained below.

Table 2 is taken out of the SPSS regression analysis output of project success with the external advice network, friendship cohesion and business relationship cohesion variables. The other variables did not seem to have a significant impact on project outcome. The complexity variable is not taken under consideration in the analysis, ie all project cases regardless of their complexity participate in the sample.

Table 2: Regression of Selected CSTAs with success Regardless of Complexity

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	EXTERNAL ADVICE NETWORK	2,426	,277	,549	8,747	,000	,899	,741	,355	,418	2,392
	FRIENDSHIP COHESION	4,290	,942	,251	4,555	,000	,763	,498	,185	,543	1,840
	BUSINESS RELATIONSHIP COHESION	6,344	1,325	,270	4,787	,000	,783	,516	,194	,516	1,939

a. Dependent Variable: PROJECT SUCCESS

b. Linear Regression through the Origin

The analysis show that NPD project success depends positively on the size of the external advice network, the cohesion (density) of the friendship relationships and the cohesion of the business relationships between the internal group members.

Table: 3 Model Summary and R-Square Parameter Estimates

Dependent Variable:PROJECT SUCCESS,
Independent variable is FRIENDSHIP COHESION

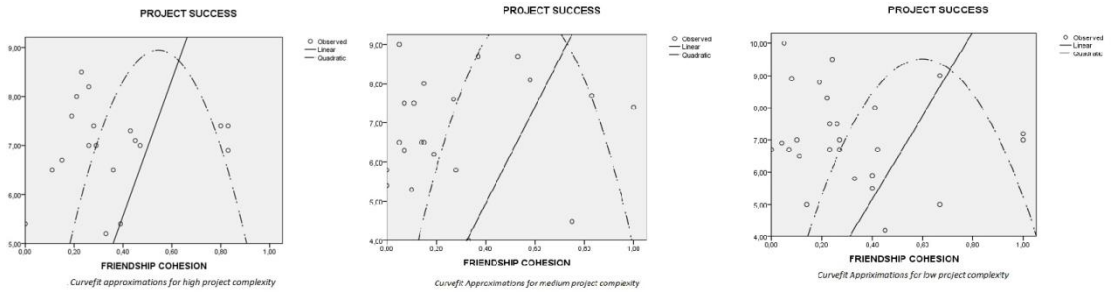
Equation	R Square Model Summary

	Complexity			
	High	Medium	Low	All
Linear	,718	,513	,543	,582
Quadratic	,903	,724	,742	,779

The comparison of the R-square values in table 3 show that the quadratic approximation is a better model fit in all four cases since it explains much greater part of the outcome as measured by R-Square. The highest R-Square is achieved in the cases of high project complexity. The analysis of regression as shown in Appendix II show that higher than 60% density friendship relationships seem to have a negative impact on project success regardless of the project complexity level. These results support the curvilinear or inverted-U shape hypothesis.

Comparing the significance level of the cohesion of the friendship relation we can easily see that for low and medium complexity projects the variable shows positive relation with success at the 5% confidence level . This OUTCOME is in line with general literature on group effectiveness (Shah and Jehn, 1993; Zaccaro and Lowe, 1988) where the majority of studies show a positive relationship between success and friendship density.

The visualization of Appendix II shows a turned boomerang pattern ⟍ to be present in the cases of high friendship density (over 60%). Unfortunately the number of high density cases in our sample is not sufficient to run a statistically acceptable separate regression analysis.



Conclusions

This paper uses experimental research for the formulation of experimental project teams and applies social network analysis methodologies in order to measure the social constructs or attributes of the friendship and business collaboration social relationships between members and statistical regression to test the impact of the network constructs on project success with complexity used as moderating variable.
An experimental setup was used, the laboratory for NPD in the final year group project by students of the Business Department of the TEI of Larissa, Greece. Apart from the information gathered directly from observations on the e-class claroline[3] working platform during the semester, all students answered a detailed questionnaire. SNA constructs like cohesion has been measured and applied to a subset of social links like friendship, business collaboration, acquaintance, and external advice. The complexity and the grades (as effectiveness measure) of the projects have been evaluated by the respective professors. The evaluation of the social

[3] http://en.wikipedia.org/wiki/Claroline

constructs have been done using the UCINET Social Network Analysis (SNA) software and the correlation and partial correlation has been done using the SPSS statistical package.

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