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Jennie Björk and Mats Magnusson

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Center for Business Innovation
Chalmers University of Technology
Vera Sandbergs Allé 8
SE-412 96, Göteborg, Sweden
www.cbi.chalmers.se

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Ideation performance in projects and informal groups

Jennie C. M. Björk*

Center for Business Innovation, Department of Technology Management and Economics, Chalmers University of Technology, Sweden.
E-mail: jennie.bjork@chalmers.se

Mats G. Magnusson

Center for Business Innovation, and RIDE, Department of Technology Management and Economics, Chalmers University of Technology, Sweden.
E-mail: mats.magnusson@chalmers.se
* Corresponding author

Abstract: Ideation activities take place in all parts of an organization and in different settings. Received theory points out that both formal and informal groups hold potential for creativity and knowledge creation, but how these groups differ in terms of ideation is not known. The importance of group heterogeneity and access to information and knowledge through network connections has been stressed in earlier research and the performed study has focused on these factors. More specifically, this research explores the ideation performance of project teams and informal groups, respectively, by studying how heterogeneity and network connectivity might influence the quality of the innovation ideas created. Drawing upon an internal database from a large Swedish consumer goods company, all innovation ideas created by both formal and informal group constellations during three years have been analyzed. The investigation showed that a moderate level of heterogeneity in formal groups has a positive influence on the quality of the ideas generated. The ideation performance of informal groups did not reveal any interdependence with heterogeneity. Network connectivity was interdependent with creative performance for informal groups, where a certain amount of connectivity positively influenced the performance of the group. The performance of formal groups did not show this pattern and also revealed no significant relationship with network connectivity. Based on the analysis, implications for management and theory are drawn and discussed.

Keywords: Heterogeneity, Performance, Innovation ideas, Informal groups, Project teams, Ideation, Creativity, Network connectivity

Introduction

The use of informal network constellations is often pointed out as a key factor for successful innovation. A well-known example of this is so-called communities of

practice, which have been proposed to constitute fruitful vehicles for learning and innovation [1-3]. Also formal projects have been pointed out in existing literature as important for new product development and innovation within and between firms. However, the latter have primarily been suggested as a way of bringing together different competences in order to solve a defined task in an efficient manner. That projects are normally executed under substantial time pressure makes it necessary to focus on exploiting already existing knowledge, and normally leaves only limited room for the exploration of new ideas. Nevertheless, bringing together people from different functions, and sometimes even from different companies provides a venue with high potential for cross-fertilization of heterogeneous knowledge sets, which arguably could spark innovation. Heterogeneity has been identified in several earlier studies as a driver of creativity and idea generation, but also as a root of tensions and conflicts that render integration and task execution more difficult [4].

Taken together, formal project teams and informal network constellations appear to create different prerequisites for innovation. Nevertheless, there is still limited empirical evidence for the assumed differences between spontaneously formed groups and formal project teams in terms of their capacity for generating innovation ideas. This research aims to address this gap by comparing the ideation performance of project teams and informal groups, respectively. In order to do so, the performance of these different kinds of groups is investigated, with regard to the number and quality of the innovation ideas they create, taking into consideration the formal or informal nature of the groups' composition as well as their heterogeneity and network connectivity.

Received theory

The process of innovation focuses on the activities that take place over time in developing and implementing new ideas from concept to concrete reality [5]. In contrast to a common linear view of innovation, Schroeder et al. [5] point out that ideas are continuously generated and actualized during the innovation process. In this perspective, ideation is not only an initial step of innovation, but a continuous process that both feeds and is nurtured by other innovation activities. Nevertheless, innovation initiatives always start with some kind of idea(s) coming from individuals' and groups' creative endeavours. In this section, an exposition of previous research on the creative performance of groups is made and thereafter the specific research questions of this study are presented.

Ideation in groups

Considering the micro-level of ideation it has been suggested that ideas are created when two planes of understanding cross each other [6]. As this undoubtedly takes place in one person's brain, the role of individual creativity for ideation cannot be neglected. Embracing a less linear and more social view of the innovation process, as suggested by Schroeder et al. [5], it is however clear that ideation to a large extent is also a social process. This is much in line with the reasoning of Leonard and Sensiper [7], who argue that for innovation activities creative cooperation is more important than individual efforts, and that conscious social interaction consequently facilitates creative activity. Individuals are part of a social context, consisting of a web of connections that continuously influence and change the individuals' knowledge sets. Following this argument, participation in formal and informal groups potentially has a positive effect on individuals' capacity to generate ideas. Based on the above, it appears safe to conclude

that groups have a potential to increase the ideation performance of their participating members – but which are the processes leading to this supposed effect?

Innovation ideas may emerge from all parts of an organization, as well as from its internal interfaces and from outside its organizational boundaries. Irrespective of where an idea shows up, it is clear that what is crucial for creating ideas is knowledge [8]. Hence, the sources of ideas can be anywhere that good opportunities exist for access to information and cross-fertilization of knowledge. The knowledge held by individuals in a group is without doubt important for the ideation performance of groups. Nonaka and Takeuchi [9] point out information redundancy as a key prerequisite for knowledge. In order to have a fruitful exchange of viewpoints it is necessary that there is sufficient shared understanding between group members, as communication and knowledge creation otherwise will suffer. Nonaka [10] however also emphasizes the need for requisite variety, meaning that a group needs to comprise a knowledge set that is broad enough to allow it to handle its task. Other researchers, too, have indicated that heterogeneity of groups is an important aspect that may increase their performance in terms of creativity and knowledge creation. The nature of heterogeneous group, with a higher variety of skills and competences, makes them more adaptable than homogenous groups[11], and hence could be more likely to react to new opportunities in a fruitful way. The diversity of groups is an important factor for understanding the performance of groups [12] and can affect the performance of an organizational group positively [4, 13]. However, while diversity might hold the potential to boost creativity and increase the performance of groups it can also create negative effects. If group members fail to identify themselves with the croup it can result in integration problems and created tensions and communication problem that might affect the performance of the group negatively [4]. Other research has linked the diversity and the performance of groups with conflicts [14], and that conflict potential influences the creativity in innovation teams[15].

A further aspect that is closely related to a group's capacity to generate ideas, knowledge and innovation is its access to external information and knowledge. The importance of acquiring and utilizing knowledge external to an organization in innovation has lately received much attention, both in popular writings promoting the so-called Open Innovation Paradigm [16] and in more academically oriented contributions focusing on absorptive capacity [17]. Groups can in this context be regarded as organizational units that can benefit from their networks within their firm as well as from persons outside the organization. Different forms of connections for information acquisition and combination have been investigated in earlier studies, and the implications in terms of ideation are not straightforward. Granovetter [18] highlighted the role of weak ties, i.e. peripheral contacts bringing in novel information, while other parts of the literature have put more emphasis on tightly connected networks, in which there is a high level of trust and open exchange of information. A particular kind of such tightly knit networks are the so-called communities of practice [1-3]. These normally spontaneously formed networks have been suggested to be a fruitful ground for innovation and learning, even if the heterogeneity of the networks in most cases would be rather limited. On the other hand, the shared understanding and the high levels of openness and trust are definitely factors with a positive influence on learning, as such a setting would foster inquiry rather than advocacy and thereby likely improve also innovation.

Based on the brief exposition of theory above, we can first of all conclude that both groups' composition and network connectivity appear to be important factors for ideation. However, it is also clear that despite the wealth of existing literature there is still

limited consensus regarding how different factors actually influence ideation in groups. In particular, there is a need to investigate different kinds of groups, to see if the factors at work are the same, and if they influence ideation performance in similar ways.

Research questions

Following the reasoning above, the aim of this study is to explore differences in ideation patterns for formal and informal groups and the possible influence of different access to knowledge and information when creating ideas. More specifically, the research aims to study the possible influence of heterogeneity, in terms of group member's organizational belonging within the organization, and the network connectivity, groups' direct connections to other nodes in the network, on the quality of the innovation ideas created. In order to do this, a first important step consists of exploring the structural differences between formal and informal groups, which leads us to our first research question:

RQ1: How do formal and informal groups differ in terms of heterogeneity and network connectivity?

The second step focuses on the interrelationship between the investigated factors, group heterogeneity and network connectivity, and ideation performance, which leaves us with the following specific research questions:

RQ2: How does heterogeneity influence the ideation performance of groups, and does it have the same influence in formal and informal groups?

RQ3: How does network connectivity influence the ideation performance of groups, and does it have the same influence in formal and informal groups?

Method

In order to answer the stated research question an empirical study has been performed at a large Swedish manufacturer of consumer products. Data on all innovation ideas created have been gathered from an internally generated database. This database includes detailed data on several thousand of innovation ideas and their providers. Information about whether the ideas have been created in formal projects is included and hence allows a thorough analysis of the above-mentioned issues. In addition to the data gathered from the innovation idea database, close to thirty interviews with managers at different hierarchical levels of the firm have been performed. Many of the interviews took place as part of a structured innovation audit, which also included the use of web-based questionnaires, and workshops with managers of innovation- and R&D in the company have been conducted. Furthermore, continuous dialogue has taken part with a few key individuals in order to interpret the gathered information and the results of the data analysis.

Innovation ideas created in three years were selected (2004, 2005 and 2006), resulting in 1740 ideas of which 1112 were generated by individuals and 628 by groups. These three years were selected after understanding how the system has evolved and developed over time, and were considered a period when the system has stabilized, in terms of idea evaluation. The innovation ideas are graded by novelty and usefulness on a scale from 1 to 5. According to the grading of the case company, the ideas were assigned to two assemblages, one with low-quality innovation ideas (1 and 2 points) and one with high-quality innovation ideas (3, 4 and 5 points), respectively. The quality of the ideas was

used as a dependent variable for every analysis below where the ideas are the level of analysis. When investigating the influence of heterogeneity and connectivity on the performance of formal project groups and spontaneously formed (informal) groups, the analysis was divided into three parts.

The first part of the analysis looked at the descriptive statistics for formal and informal groups respectively in terms of performance, the mean heterogeneity and the mean connectivity. The means for the different groups were analyzed using SPSS. The Levene statistics were viewed to see if the group variances were equal. Thereafter an ANOVA one-way test was performed to study whether the means were equal or significantly different between the groups.

The second part focused on the possible influence of heterogeneity on the ideation performance of formal and informal groups. The heterogeneity was considered as the diversity in the groups in terms of each individual's readily detectable task-related attribute [19], in this case the belonging to a certain part within the organization. A heterogeneity index was created and a heterogeneity index of 1meant that the group only consisted of members from the same organizational unit. If there were members in the group from more than 1 organizational unit, the heterogeneity index has the same number. This yielded a classification with three heterogeneity categories: one, two and more than two, for formal project group and informal groups respectively. The result was consequently a categorical variable, with a count for the amounts of high-quality and low-quality ideas in each case. To test whether the resulting distribution was independent or not, χ^2 tests were done with MATLAB.

The third and final part focused on the network connectivity of the different groups, divided into three steps. The network of idea providers was established by importing the data of the innovation ideas and their providers into UCINET, software for social network analysis. When more than one person has provided the specific idea, a tie was created between these persons (nodes) in this way creating a network of idea providers in which the ties correspond to whether they have provided ideas together. With UCINET the group degree centrality for the different groups was computed. This is a centrality measurement corresponding to the number of nodes that are adjacent to the selected node, in this case have direct connection with the node where the idea was created [20]. The group degree of centrality was calculated according to Everett and Borgatti [21], and multiple ties from one external node to a group are counted only once. The group degree centrality was normalized according to Everett and Borgatti [21] by dividing the group degree by the number of non-group actors within the network. This was done for the formal and the informal groups respectively. Thereafter the possible interrelationship between groups' normalized degree centrality and the quality of the ideas they created was explored. The data were not linear or normally distributed, and a generalized linear model approach was used to model the data [22]. As mentioned, the ideas were grouped after high and low quality criteria. Taking the distribution of the ideas into consideration, the grouping of the normalized degree connectivity was done with MATLAB using quantiles to create five basically equal-sized data subsets. This created a 2x5 cross-table with 2 different quality assemblages and 5 different categories of degree centrality, A, B, C, D and E, where A represents the least connected category and E the most connected. A χ^2 test was thereafter done with MATLAB to test if the variables were independent or not. The same method was used in order to analyze the innovation ideas that had been created by formal and informal groups, respectively. The five normalized group degree centrality categories for the innovation ideas created by formal groups are therefore not the same as those for informal groups. Consequently the categorization for the

normalized centrality degree is to be regarded as among ideas generated by formal groups and informal groups respectively, not between the two.

Based on the investigation, differences and similarities concerning idea generation between spontaneously formed groups and formal project groups will be outlined hereafter.

Results

Out of the innovation ideas generated by groups during the chosen three years, 353 ideas were generated in formal project teams while 275 ideas came from spontaneously formed (informal) groups.

Table 1 Descriptive statistics for formal and informal groups

	Formal project groups	*Spontaneously formed (informal) groups*
Number of innovation ideas	353	275
Number of high-quality innovation ideas	89	59
Number of low-quality innovation ideas	264	216
Performance	25%	21%
Average heterogeneity	1.64 STDEV: 0.72557	1.44 STDEV: 0.63325
Average connectivity[3]	6.75 STDEV: 3.31	6.25 STDEV: 3.73

In Table 1 the performance, average heterogeneity and average connectivity of the formal groups and informal groups are presented. The performance is measured in terms of the percentage of high-quality innovation ideas generated. The formal groups had a percentage of high-quality ideas of 25% and the informal group 21%. The χ^2 test showed Q=1.2119, p=0.2710 and is hence not statistically significant. For the average heterogeneity, the Levene statistic rejected the null hypothesis that the group variances are equal, and the one-way ANOVA test gave an F value of 12.669 and p=0.00. The results show that the groups differ in some way in this respect. For the average connectivity, the results also showed that the groups somehow differ, with the one-way ANOVA test yielding an F value of 3.083 and p=0.08.

Table 2 Heterogeneity – comparison of ideas generated in formal project groups and in informal groups

	Influence of heterogeneity on performance of formal project groups			*Influence of heterogeneity on performance of spontaneously formed (informal) groups*		
Heterogeneity index	1	2	>2	1	2	>2
High-quality innovation ideas	40 (23%)	44 (31%)	5 (13%)	39 (23%)	20 (21%)	0 (0%)
Low-quality innovation ideas	131 (77%)	99 (69%)	34 (87%)	129 (77%)	76 (79%)	11 (100%)
χ^2 test	Q= 5.8185, p= 0.0545			Q= 3.3353, p= 0.1887		

Table 2 reveals that the influence of heterogeneity on performance for project teams increased from 23% for groups with heterogeneity index 1 to 31% for teams with heterogeneity index 2, and thereafter decreased to 13% for the most heterogeneous formal groups. For the informal groups, a different relationship could be seen. For these groups, the proportion of high-quality ideas decreased from 23% (heterogeneity index 1) to 21% (heterogeneity index 2), and to 0% for the most heterogeneous constellations.

The results showed that the performance of formal groups was initially influenced by the heterogeneity of the groups. The results were statistically significant and showed that moderately increased heterogeneity positively influenced the proportion of high-quality innovation ideas. However, increased heterogeneity thereafter decreased the proportion of high-quality innovation ideas. The results for the informal groups revealed a completely different pattern, with a decreasing proportion of high-quality innovation ideas as heterogeneity increased. However, these results were not statistically significant; the results do not show an interrelationship between performance of informal groups and heterogeneity.

Table 3 Network connectivity – comparison of ideas generated in formal project groups and in informal groups

	Influence of network connectivity on performance of formal project groups					*Influence of network connectivity on performance of spontaneously formed (informal) groups*				
Connectivity Categories	A	B	C	D	E	A	B	C	D	E
High-quality innovation ideas	18 (26%)	13 (25%)	12 (20%)	18 (28%)	28 (26%)	8 (15%)	12 (35%)	14 (38%)	5 (12%)	20 (18%)
Low-quality innovation ideas	52 (74%)	40 (75%)	48 (80%)	46 (72%)	78 (74%)	4 (85%)	22 (65%)	23 (62%)	36 (88%)	91 (82%)
χ^2 test	Q= 1.2563, P= 0.8687					Q=13.7586, P= 0. 0.0081				

In Table 3, the distribution in terms of idea quality within each of the different centrality degree groups is presented, for formal and informal groups respectively. For innovation ideas provided by formal groups, the least connected group had a quota of high-quality innovation ideas of 26%. For the following connected groups the quota was 25%, 20%, 28% and the most connected group had a quota of high-quality innovation ideas of 26%. For the 353 ideas generated by formal groups the χ^2 test showed no significant interrelationship between the two variables investigated (χ^2=1.2563, p=0.8687).

For innovation ideas provided by informal groups, the percentage of good innovation ideas increased from 15% in the least connected group A to the 35% for the group at the next level of centrality degree. Thereafter, however, the percentage of good ideas was 38%, 12% and for the most connected group 18%. For the 275 ideas generated by informal groups the χ^2 test showed a significant interrelationship between the two variables investigated (χ^2=13.7586, p=0.0081), revealing something close to an inverted U-shaped relationship between the connectivity of informal groups and the performance in terms of high-quality innovation ideas generated.

Analysis and Discussion

The results revealed that the influence of heterogeneity in groups and of group degree centrality in their networks was different for formal project groups and for informal, spontaneously formed groups. Formal groups were found to be more heterogeneous and to have higher network connectivity. This appears to be logical, as informal networks more likely are made up by people working closely together. Moreover, heterogeneous groups ought to have less overlap of the group members' individual networks, resulting in larger total networks for the groups. It is here important to stress that all the investigated groups come from a single organization in one specific industry and that we therefore should be careful about generalizing from the observations. Nevertheless, the observed differences underscore the importance of not treating formal and informal groups as one homogeneous category, but rather looking into the differences between them.

The second research question addressed how heterogeneity influences the ideation performance of groups and whether the same pattern could be found for both formal and informal groups. The results show that the performance of formal groups was influenced by their heterogeneity. The results were statistically significant and showed that moderately increased heterogeneity positively influenced the proportion of high-quality innovation ideas. However, increased heterogeneity thereafter decreased the proportion of high-quality innovation ideas. For informal groups the results were quite different and showed another pattern where heterogeneity did not have any significant interdependence with performance. Elaborations on this differences could partly been addressed with the established notion of requisite variety [10, 23], telling us that in order to handle a system with higher variety we need more control variables. Regarding the different natures or the groups one could think that the control variables for spontaneously formed groups can be harder to identity and that these groups have much less, if any, external control. In comparison to formal project teams where the external support and control is more obvious and probably much more apparent and present. Increased level of heterogeneity might be harder for an informal group to handle because they have less external support and coordination mechanisms available, and therefore might not fulfil the possible potential that increased heterogeneity could bring. However, the results showed that the informal groups had no interdependency with heterogeneity at all. Another explanation for why heterogeneity did not significantly affect the informal groups could be that the

innovation activities taking place in informal groups are of a different nature, focusing more on joint solving of shared problems, rather than the creative generation of new ideas, and that these ideas have a different distribution concerning the received score for idea novelty and usefulness. As the performed study does not focus on differences in terms of types of innovation, this remains a question for future investigations.

The third research question addressed how network connectivity influences the performance of groups and whether it is the same pattern for formal and informal groups. The results showed that the extent to which the formal groups were connected in the network did not affect the proportion of high-quality innovation ideas created, i.e. the network connectivity did not show interdependence with the performance of formal groups. For the informal groups, the results revealed a significant interdependence of the groups' network connectivity with performance, resulting in an inverted U-shaped relationship.Hence, the findings suggest that group-external network connections are more important for informal groups, in which the wealth of different knowledge sets, perspectives and viewpoints is more limited than in formal groups. This could be interpreted as though network connectivity at least to some extent may be a substitute for group heterogeneity. In more homogeneous informal groups, the knowledge base may be more limited and access to other information sources then will be of higher relative importance.

To sum up, the empirical results revealed the relationships between performance and the variables of heterogeneity and connectivity for the two kinds of groups as shown in Table 4 below.

Table 4 Interdependence of performance with heterogeneity and network connectivity for formal and informal groups

	Heterogeneity	*Network connectivity*
Formal groups	Inverted U-shaped interdependence	No interdependence
Informal groups	No interdependence	Inverted U-shaped interdependence

From a practical point of view these finding identifies and highlights the need for regarding these ideation activities as parallel activities, of different natures and with different needs when it comes to their ideation performance. Formal projects groups should be moderately heterogeneous composed and informal groups should have the possibility to connect with other persons and groups within the organization.

The performance of informal groups has interdependency with the network connectivity and one could reflect on the potential these groups have of, to the organization, external connections and is an area for further research. The results also opens up for elaborations on if the creativity performance of informal groups can be supported in a way that they can access support/control and/or coordination mechanisms and thus make profit of the potential of increased heterogeneity. However, returning to the differences in the natures of formal project teams and informal groups, this might not be viable idea.

A final observation with managerial implications regards the importance of social aspects for ideation. Just like for innovation as a whole, ideation is influenced by communication and interaction patterns, and this gives rise to questions concerning ideation practices in firms. While most companies use cross-functional project teams in product development, and several companies experiment with the implementation and use of communities of practice, ideation is normally less interfered with. Still, ideation is primarily regarded as an individual creative activity, and that the firm's role in this process is limited to providing systems to store and process ideas that are made explicit. This approach neglects the deliberate use of formal and informal groups for ideation. Collaborative ideation can be facilitated by using cross-functional teams whose task is to come up with ideas - not implement them, and by focusing informal groups' joint ideation efforts through idea campaigns, innovation clubs, etc.

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