LUISS Guido Carli

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WHAT MATTERS FOR IDEATION?

A CROSS-LEVEL INVESTIGATION OF

INDIVIDUAL, GROUP, AND NETWORK FACTORS

Candidate:
Mario Losito

SUPERVISOR
Prof. Mats Magnusson
TUTOR
Prof. Paolo Boccardelli

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by

MARIO LOSITO

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Mario Losito
February 29, 2012

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MARIO LOSITO

Supervisor: Professor Mats Magnusson

PhD Coordinator: Professor Paolo Boccardelli

Department of Management

February, 2012

To Your memory.

You have been for me the great role model.

You taught me to uphold high moral values and think about the true value of life.

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ABSTRACT

In this dissertation, I investigate different antecedents of group ideation performance. Group ideation is defined as the ability of a group to collectively generate and develop ideas within an organizational context. Ideation is conceptualized as the act of generating and handling new ideas by a single person or by groups or by whole organizational entities. It is frequently a multiperson-multitask affair that proceeds over time. Considering ideation as the beginning phase of the whole innovation process, when ideas are generated and developed and focusing on intra-organizational group ideation performance, this research effort investigates the antecedents at different levels of group ideation ability. Because of its importance for innovative performance, firms put efforts in understanding and organizing the process during which ideas are generated and developed. The dominant view behind such an organizational efforts is that organizations should collect as many ideas as possible, organize them in the most effective and efficient way, and then give appropriate feedbacks to ideas' providers.

Investigating group performance, management science has demonstrated that factors at different levels may influence group performance. However, to date organizational literature has failed to reconcile the different levels involved in the process of idea generation, and managerial practice calls for a deeper understanding of the different factors affecting idea generation in groups. The literature on creativity in organizations has, for example, generated a significant understanding of the effect of ongoing group and organizational contexts on individual creativity, but

it is less concerned with action and interaction at the collective level, i.e. group level. Focusing on ideation performance within groups, a cross-level framework is proposed to study the antecedents of ideation in groups. Based on the recent development in group composition literature and in social network theory, I propose that group ideation performance could be framed as the results of elements from multiple levels, individual, group, and network. Offering a deep and longitudinal analysis of group production of ideas this research will contribute to the part of management literature involved in understanding how ideas are generated within organizations. To investigate this issue empirically, an internally generated dataset created within a large Swedish consumer goods company, covering all ideas created from 2000 to 2006, will be used. I developed and tested specific hypotheses based on three interrelated empirical studies.

The first study investigates the impact of star presence, indicated by the extent to which group is composed by specialists who have a track of high past ideation performance, on group ideation performance. I argue that stars are central player in groups however their effect on group ideation performance is mixed and it requires great attention from managers.

The second study explores the effects of group heterogeneity and group familiarity on group ideation performance. Specifically, this study found that groups with higher heterogeneity are better equipped for generating and developing higher quality ideas. On the other hand, the effect of group familiarity – i.e. the degree to which group members have worked with one another in the past – on group ideation performance is not always positive. As further discussed in the study, groups seeking to enhance their ideation performance are likely to fail to nurture their knowledge and resources endowments with newer perspectives.

The third study, extending the earlier finding to the network level, tested the role played by temporary structure on the relationship between social network and group ideation performance. The results suggested that network structure (network centrality and structural holes) affects group ideation performance. Moreover, the findings would tell that the emergence network is affected by two complementary forces one that constrains actors' performance and one that exploit actors' performance.

This thesis aims at contributing to organization literature in the following respects: first, the thesis has examined the characteristics of different levels antecedents of group ideation performance; second, this thesis has extended previous findings to an ideation context and demonstrated that the impacts of antecedents depend also on the task the actors are facing; third, this thesis has elucidated two patterns of temporary network structure evolution.

Key Words: *Innovation, Ideation, Ideas, Group Composition, Star Ideators, Diversity, Familiarity, Intraorganizational Network, Temporary Network Structure*

Appended papers

This thesis is based on the three appended papers described below. These are referred to in the text by Roman numerals.

Paper I

Losito M. (2010). The power of star ideators: Does star ideator alone drive the success of ideas? The virtues and limits of star ideator presence in groups. Modified version of a paper presented at the *11*[th] *CINet Conference*, Zurich, September. To be submitted to a scientific journal.

Paper II

Losito, M., and Magnusson, M. (2012). The effect of diversity and group familiarity on performance in ideation groups. Presented at the *XIIIth WOA Conference – Desperately seeking performance in organization*, Verona, May. To be submitted to a scientific journal.

Paper III

Losito, M., Björk, J. (2012). Temporary Network Structure and Group ideation performance - the effect of centrality and structural holes. Presented at the *XIIIth WOA Conference – Desperately seeking performance in organization*, Verona, May. To be submitted to a scientific journal.

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Mario Losito,
Rome, February 2012

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CHAPTER 1

1. INTRODUCTION

In today's fast paced economy, firms need to continuously innovate in order to ensure long-term competitiveness. The process of innovation focuses on the activities that take place over time in developing and implementing new ideas from concept to concrete reality (Schroeder et al., 2000). Consequently, firms also need a continuous stream of ideas as fuel for innovation. Nevertheless, the business world is denoted by an increasing attention to factors affecting idea creation within organizations. Companies try numerous strategies to foster innovation, including restructuring work, selecting people on the basis of their attributes, and behavioral training; however, these strategies are often unsuccessful (Barron & Harrington, 1981; Farr, 1990). It is thus not surprising that the early stage of the innovation process, when innovation ideas are generated and identified, has been recognized as an important phase that has high impact on the success and costs of innovation (Koen et al., 2001; Reid and Brentani, 2004; Zhang and Doll, 2001; Day et al., 1994). Furthermore, some organizations tend to rely on autonomous work groups that are tasked with identifying and solving ill-defined or poorly structured problems that require creative thought (Goodman, Ravlin, and Argote, 1986). Given the increasing use of groups to foster innovation (Mohrman, Cohen, & Mohrman, 1995; Tesluk, Farr, & Klein, 1997, Rulke and Galaskiewicz, 2000; Edmonson and Nembhard, 2009), it is surprising that existing knowledge about the different factors that determine a group's ability to generate ideas is quite limited and controversial. This thesis addresses some of the contrasting evidence from previous literature and it points out so some group characteristics that affect performance. The researcher attention is focused on ideation performance. Ideation is defined as the act of generating ideas that are both novel and useful for the organization (Ford, 1996; Shalley, 1991). In idea generation, factors at several levels are responsible for performance, i.e. individuals, groups, and the overall organization (Van de Ven, 1986; Nonaka, 1994; Leonard and Sensiper, 1998). Building on the basic idea that

ideas are sparked by imaginative and uniquely gifted individuals, extant research has drawn tight boundaries around the "self" as the privileged locus of inquiry (Taggar, 2002; Montuori and Purser 1996; Ford, 1996; Mumford and Gustafson, 1988). Nevertheless, recent evidence by Hargadon and Bechky (2006) suggests that although some ideas can be seen as the products of individual insight, many others are the products of momentary collective processes (Allen, 1977; Van de Ven, 1986; Leonard and Sensiper, 1998). The importance of collective dimension in the ideation phase of the innovation process was already identified by Fleck (1979) who emphasized that innovations are often unsolvable by only one person (Allen, 1977; Van de Ven, 1986). However, early studies did not go into great detail in investigating the specific factors responsible for this collective process. More recent studies have started to use more refined insights (borrowed from group composition and social network fields) to study the antecedents behind the innovation process more closely (Bjork et al., 2011; Amabile et al., 2005; Pirola-Melo et al., 2004). Large parts of the innovation literature agree that certain structural dimensions of group composition influence idea creation within groups (Nonaka, 1994; Williams and O'Reilly, 1998). Furthermore, the use of informal network constellation is often pointed out as a key factor for successful innovation (Ahuja, 2000; Baum, Calabrese, and Silverman, 2000). The information flux within organizational networks enhances the likelihood of obtaining new knowledge and disclose new perspectives, which spark the development of new ideas or the adaptation of new ways of doing things (Perry-Smith and Shalley. 2003; Burt, 2004).

I try to reconcile the disparate pieces of literature mentioned above, offering a cross-level framework (Rousseau, 1985) to analyze antecedents of group ideation performance. Individual level, group level and overall ideation network factors are here regarded as antecedents of group ideation performance (Montuori and Purser 1996; Nonaka, 1994; Leonard and Sensiper, 1998; Perry-Smith, 2006). The research is thereby split in three parts. The first focuses on the individual level antecedents of group ideation performance and is based on the idea that the presence of star ideators within a focal group is central for ideation performance. However, the theoretical framework argues that coordination and organizing problems arise when top talented

professionals are concurrently present within the same group. This perspective is based on the view that star ideators find it difficult to work with peers and when highly skilled employees work together on highly interdependent tasks they often come to collide with each other and the result is the collapse of the focal group.

In the second part, the focus is on two different group characteristics that affect group ideation performance: *i*) group diversity; *ii*) group familiarity. The research thereby focuses on how different aspects of group composition influence group performance in general and specifically in a highly innovative context around generation and development of ideas. The perspective is that different dimensions of group composition explain the ideation ability of groups.

The third part investigates the temporary network structure surrounding groups and is based on the proposition that networks surrounding groups affect the quality of the outcomes of that group. Furthermore, a temporary network investigation concentrates on two mechanisms that explain how current network structure comes about. The perspective we take is that complementary structural forces drive the process of network emergence and actors' performance.

Thereby, based on recent development on the social side of creativity (Perry-Smith and Shalley, 2003) in innovation literature (Gilson & Shalley, 2004; Hargadon and Bechky, 2006) and on group performance (Edmondson and Nembhardt, 2009) in ongoing network-based structure (Zaheer and Soda, 2009) I propose that ideation performance within groups is a fuzzy set comprised of individual contributions, group characteristics and also network features.

Adopting a system view, the research framework is organized as follows (view figure 1) first it looks to the effects of individual contributions to group ideation performance, then the research focuses on two group characteristics influencing group ideation performance, finally it also investigates temporary network determinants of group ideation performance.

To test the proposed research framework, an exploratory study has been conducted in which the antecedents of group ideation performance are investigated and thereby assessing the appropriateness of the developed framework. The focus has intentionally been dynamic, making a longitudinal data collection design at a single firm most appropriate. The longitudinal approach allowed us to follow groups

and ideas in the focal organization. It provides us with the possibility to extensively assess information enabling to construct a picture of the antecedents of group ideation process at different levels.

The single firm strategy clearly hampers the external validity of the results. However, it does create high internal validity ensuring that inter-firm differences do not play a role in the observed process – i.e. the group ideation process.
Interesting managerial implications in terms of formation and ongoing management of groups aiming at generating ideas, resulted from this study.

Figure 1 – The Research Model

IDEATION TEMPORARY NETWORK

PAST
STRUCTURAL
HOLE

CURRENT
STRUCTURAL
HOLE

PAST
CENTRALITY

CURRENT
CENTRALITY

GROUP LEVEL

GROUP
FAMILIARITY

AFFILIATION
DIVERSITY

GROUP
IDEATION
PERFORMANCE

INDIVIDUAL CONTRIBUTIONS

AVERAGE GROUP
MEMBERS' ABILITY

STAR IDEATOR
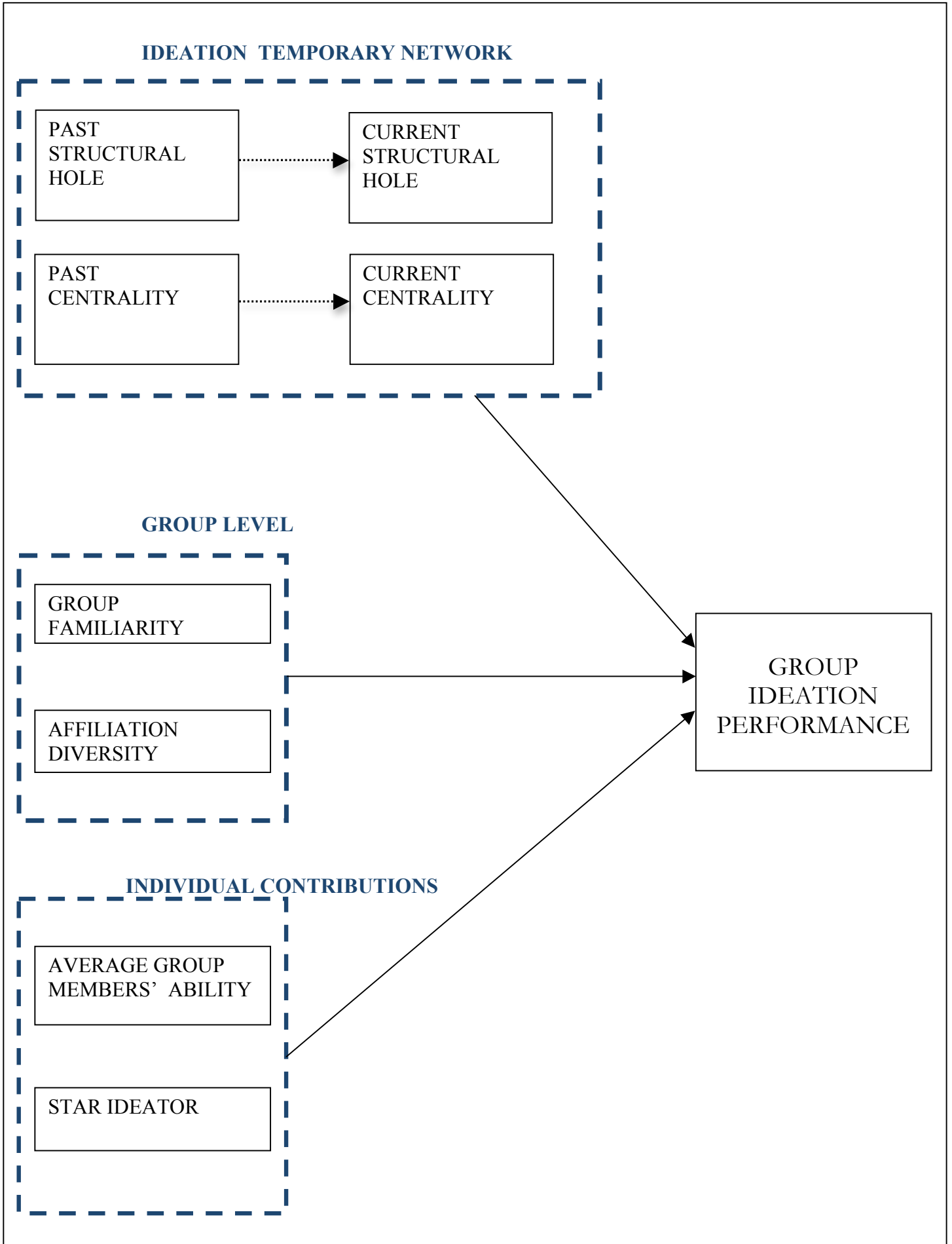
2. MOTIVATION OF THE STUDY

One of the company's most important asset is its creative capital. It consists of a wide array of creative thinkers whose ideas can be turned into valuable products and services. Creative employees pioneer new technologies and products, birth new industries, and power economic growth. Those are the specialists whose primary responsibilities include innovating, designing, and problem solving, what can be called in the firms the '*creative class*'. What is less certain is how to manage the creative class for maximum creativity. How do firms increase efficiency, improve quality, and raise productivity, all while accommodating for the complex and chaotic nature of the creative process?

Many scholars and practitioners have made inroads into this field. Management guru Peter Drucker (1993) identified the role of knowledge workers. The research by Teresa Amabile (1996) and Robert Sternberg (1985) shows that creative people are motivated from within and respond much better to intrinsic rewards than to extrinsic ones. While most students of the creative process have focused on what makes individuals creative (Taggar, 2002), a growing number of thinkers such as Hargadon and Beckhey (2006), John Seely Brown, former chief scientist of Xerox, are unlocking the social and management contexts in which creativity is most effectively nurtured, harnessed, and mobilized. Eric von Hippel (1994) and Henry Chesbrough (2003) have called attention to the critical role played by users and customers in the creative process and to a new model of " innovation." Despite such insights and advances, most businesses have been unable to pull these notions of creativity together into a coherent management framework (Florida and Goodnigh, 2005). What's the secret of ideation success? How to harness the creative energies stored within the firm? How to help employees do their best work by keeping them intellectually engaged in generating and developing ideas? How to make managers responsible for sparking creativity?

Firms approaching the problem of ideation are driven by the assumption that ideation capital is not just a collection of individuals' ideas, but it is a product of interaction (Leonard and Sensiper, 1998). As Burt (2004) has shown, long-lasting intra-

organizational relationships add to a company's bottom line by increasing the likelihood of "*productive accidents*". Nurturing and fuelling such relationships among developers, specialists and employees allows generation and development of ideas thus investing in firm future creative capital.

This research contributes to practical understanding of the process bringing groups to generate and develop ideas, investigating the effect of individual, group and network antecedents of group ideation performance.

In previous literature, the ideation process is generally considered to be an integral part of the whole innovation process, and as such, it has been covered by innovation research stream. The literature on ideation focuses at the micro-level as opposed to the more economics-oriented approach focusing on such topics as innovation in regional clusters and countries and the evolution of certain technology (Brown and Eisenhardt, 1995). Ideation phase in which new ideas are generated and initially developed is a key step in determine firm innovative performance (Crossan and Apaydin, 2010; Ames and Runco, 2005; Day et al., 1994). Ideation can be seen as a source of innovation (Crossan and Apaydin, 2010) and a process for creating and developong ideas (Björk, 2011). Following this stream of literature, ideation can be conceptualized as an ongoing activity that over time nurture firm innovation process with the generation and development of ideas. In this perspective, ideation process is characterized by the generation of ideas as fuel for firms' innovation process. Despite the acknowledgment that all innovation starts with an idea, literature presents scant attention to understanding the phase of idea creation (Dahl and Moreau, 2007). Furthermore, it seems that most common approach has been to encourage the continuous flow of ideas without an effective management of the ideation process (Goldenberg, Mazursky, and Solomon, 1999). Given the poor understanding of these phases, there are substantial benefits to better investigating and improving these stages. Therefore, extent literature still left underexplored some factors responsible for ideation performance.

The theoretical framework of this research project embraces a more social view of the innovation process, as suggested by Schroeder et al. (2000), it is clear that ideation to a large extent is also a social process. This is much in line with the

reasoning of Leonard and Sensiper (1998), who argue that for innovation activities creative cooperation is more important than individual efforts, and that conscious social interaction consequently facilitates creative activity. While individual inventors alone still remain a fundamental resource in the production of ideas (Taggar, 2002), it is acknowledged both by management researchers and scholars that organizations are moving towards more fluid, short-term flexible and network-based work structure (Piore and Sabel, 1984; Schwab and Miner, 2008; Edmondson and Nembhard, 2009). Organizations are increasingly using teams and small groups to accomplish increasingly critical tasks (Lazer and Katz, 2003). **Groups** are defined as "a dynamic whole based on interdependence rather than on similarities" (Lewin, 1951: 184). Seminal research on groups and group work argues that no single variable could explain or produce team effectiveness (Hackman, 1987; McGrath, 1986). Instead, a set of conditions should be in place that enhance the chances of group members working together effectively to get a specific task accomplished (Hackman, 2002). Nevertheless, studies of groups in a variety of organizational settings have shown that effectiveness is a function of a well designed task, appropriate composition and availability of information, resources and rewards (Hackman, 1987, 2002). However, much of this research studied teams and groups conducting relatively routine work with relatively homogenous members that worked almost exclusively on the same task. This findings need to be revised when dealing with group involved in highly innovative task. More recent studies have begun to investigate groups with complex and dynamic tasks and authors have found that different group characteristics make group members feel comfortable to tell their ideas, concerns, are also more likely to collaborate and work in a way that lead to more innovative outcomes (Edmondson, 1999, 2003; Nembhard and Edmondson, 2006). Therefore, the use and success of groups in highly innovative tasks derives from their composition and ability to capitalize on it. Most groups are cross-functional, consisting of individuals from different functional disciplines or departments who have been brought together to contribute their expertise to refine or develop new products. *Cross-functionality* provides groups with the opportunity for integration of different information and perspectives through mechanisms such as increased access to new knowledge and information, facilitated interdepartmental

exchanges, increased high-quality external communication and improved learning experiences (Ancona and Caldwell, 1992). Despite the potential of groups to enhance organizational learning and innovation, the realization of their benefits has been mixed. While some groups deliver on and even exceed their task (Brown and Eisenhardt, 1995), others fail delivering the task with the expected requirements (AitSahlia et al., 1995). Extant research found that variation in group performance occurs not just across organizations (Edmondson, Bohmer, and Pisano, 2001; Iansiti, 1995; Pisano, Bohmer, and Edmondson, 2001) but also within the same organizations (Edmondson, 1999).

In knowledge-intensive context characterized by high rate of innovativeness (for instance new product development, consulting firms, or service delivery) a significant amount of organization's work is realized by fluid groups that aim at generate highly innovative output (Edmondson and Nembhard, 2009). Those groups exist for the duration of a single assignment and are composed of members who join the group for the assignment and leave it at the conclusion of the assignment (Huckman, Staats, and Upton 2009). In context where changes in group composition are constant through time, consideration on group performance would not ignore the effect of changing group composition on group outcomes. Evidence shows that familiarity among group members affects group performance (Huckman, Staats, and Upton, 2009; Moreland et al., 2000; Katz, 1982). *Group familiarity* accounts for the degree to which each member of a group has worked previously with every other member of that group. In context where groups are not stable entities, but change continuously over time, group familiarity is something different than group cumulative experience, as some group members may have worked together previously in other groups that do not involve all other members. Beginning with the seminal work of Katz (1982), scholars have pointed out the effect of group longevity on performance (Edmondsn et al., 2001; Reagans et al., 2005; Huckman et al., 2009). The study addresses group familiarity effect on group performance.

Finally, the research approaches group ideation performance from the level of the overall **ideation network**. Reconciling different levels of analysis we follow the suggestion made early on by Lazer and Katz (2003) "Given the recent surge of interest in social networks and in (*groups*) teams, we argue that the time is ripe to

bring these two research streams back together" (2003: 7). Following the advice of Lazer and Katz, we try to assess which concepts from the network literature can be sensibly applied to the group literature.

Network theory, because it does not reify any particular level of analysis, can allow a researcher to cross levels of analysis. For instance, one may investigate the position of a team in an overarching network structure (Zaheer and Soda, 2009); or describe the intra-group structure of communication (e.g. Sparrowe et al., 2001); or examine the position of each single group member within the group (e.g. Bavelas, 1950). Obviously, this symmetric and isomorphic mapping of network properties across level of analysis needs to be done carefully. There are some network concepts that operates well across levels of analysis and thus can be extrapolated across levels. For instance, looking to the process of diffusion, a network position that is valuable for individuals (e.g. centrality) might reasonably be argued to be isomorphic also to other levels of analysis such as groups (in an intra-organizational network of groups) or the organization (in an inter-organizational network of organizations). The key issue is whether a process or construct works at multiple levels (Brass, 2000). A central concern in group literature is that a given construct lives at the group level (Klein & Kozlowski, 2000). Group level phenomena are often emergent and are the result of group members' influence on one another. Thus models of team constructs must incorporate that interdependence, this facilitates in a way incorporating network perspective to group level investigations.

It is acknowledged that there is a large literature on the consequences of networks. However, there is a small but growing literature investigating network evolution (Burt, 2004; 2005). Given that network structure is subject to the contingency of time, a question can be raised about the evolution of the network structure and its effect on outcomes. The point of departure is the implicit assumption that current outcomes reflect patterns of enduring relations (Powell and Smith-Dorr, 1994). Since current network structure is also the result of past patterns of relations, existing network structure may not completely explain outcomes. A past network, with its accumulated social experience works as a kind of relational memory that persist over time and projects its effect over the current network structure. Extending the concept

of network ties to past and current network structure, the final part of the thesis is intended to focus on the interrelationship between past and current network structure.

3. AIM OF THE THESIS

The overarching framework of the thesis looks to the antecedents at different levels of group ideation performance. Our unit of analysis is ideation group, defined as all specialists connected by work relations aiming at generating and developing an idea. Reconciling different pieces of management literature the main objective of this research effort is to develop and test the appropriateness of a theoretical framework on the idea generation and development. The model concentrates on the effects of individual contributions, group characteristics and temporary network structure on group ideation ability. The resulting framework and results thus address the gap between group composition literature and network theory, focusing on idea generation.

Focusing on group ideation performance, we have thereby specifically gone into tensions in existing literature:

- at the first level we have gone into the tension between the presence of a star, associated with increased resources and reputation, and grouping top-talented professionals, associated with problems of coordination and cooperation;
- at the second level we looked to the tension between group affiliation diversity, associated with novel information, and group members' familiarity, associated with coordinated action;
- at the third level we investigated the tension between a dense temporary network, associated with dense and redundant relations, and a temporary network rich in structural holes, associated with novelty and diversity of information and autonomy.

The first part of this research looks to individual contributions and their effect on group ideation performance, pointing out to the star ideator presence and the effect on group ideation performance. Star ideators are defined as highly skilled ideators who have a positive track record of ideation performance. Star plays a central role in fostering group performance, however going beyond this view of star presence on

group ideation performance the research points out to counterintuitive effects of assembling groups with high number of highly skilled employees.

Second part of the research is intended to investigate the effect of two complementary group characteristics: diversity and familiarity among group members and their effect on group ideation performance. Group composition is a key element that determines group performance, the aim of this part of the research is to extend the insights from the group composition literature in an ideation context. Specifically we use a measure of familiarity among group members that accounts for the degree to which each member of a group has worked with every other group member on other groups. This measure allows us to go beyond the assumption that group membership remains constant over time.

Third part of the research focus on the overall ideation network. Network structure and positions would affect group performance. Applying a network perspective to the idea generation and development we intend to continue and contribute to network theory and ideation study in different way. First, we want to test the effect of different network positions (network centrality and structural holes) on group performance. Second, adopting a longitudinal approach the aim of the last part of the thesis is to investigate the network process through which favourable network structure can emerge.

The research aim of the thesis is three fold:
- first, the effect of individual contributions to group ideation performance is investigated;
- second, the effect of two different group characteristics on group ideation is investigated;
- third, the effect of network positions on group performance is investigated. Nonetheless, based on a temporary network investigation the processes through which network structure can emerge are investigated.

4. OUTLINE OF THE STUDY

The body of this research is organized around three main appended papers.

The first paper looks to the impact of star ideator (i.e. employees that have a proven history of past high performance) presence within group on group idea generation. The main idea of this paper is that the knowledge and competencies of star ideator spills over to the group performance. However, there is also a counterintuitive effect of star ideator presence on group performance. When highly skilled employees work within the same group and on the same idea their competencies and their aspirations come to collide with each other.

The second paper addresses the influence of diversity and familiarity on group idea generation. We see that the effects of diversity on group outcomes are indeed a complex matter and that there is a need for further empirical investigation. Based on the need for a more fine-grained understanding of the dynamics at work in group ideation, the aim of this paper is to contribute to the group literature in highly innovative context testing the effects of diversity and familiarity (in terms of repeated collaboration) among group members on group creative performance.

The basic idea of the third paper is to test the effect of different group network positions (network centrality vs structural holes) on group idea generation. We examine network structure made of interconnected groups. Reconciling group and network research we investigate network antecedents of group ideation performance. Though research on the performance outcomes of social structure is valuable, it raises the question of precisely how social structures come about. Trough a longitudinal approach, ideation temporary structure has been retraced distinguishing between past and current network structure. Finally, we focus on the evolution of network structure, specifically two complementary mechanisms of constraints imposed by and opportunities provided by past network structure have been investigated.

The findings of the three main part of the thesis extend and contribute to existing literature on ideation phase on two main directions. First, we develop a framework

that builds on a broad base of literature including innovation (Dougherty, 1992), creativity (Amabile et al, 1996), group composition (Ancona and Caldwell, 1992), and network literature (Burt, 1992; 2004). We thereby discuss group ideation performance in terms of the individual contributions, group diversity and familiarity and the temporary character of the network structure.

Second, in building on recent trend in social network literature to go beyond a pure structuralist view of network (Adler and Kwon, 2002), we develop and find support for a temporary network perspective, which has thus far hardly been applied in the context of ideation and innovation (Perry-Smith and Shalley, 2003).

CHAPTER 2

1. THEORETICAL BACKGROUND

Firms need to continuously innovate in order to ensure long-term competitiveness. The process of innovation focuses on the activities that take place over time in developing and implementing new ideas from concept to concrete reality (Schroeder et al., 2000). A considerable literature has accumulated on the subject of innovation, which is widely seen as the basis of a competitive advantage (Porter and Ketels 2003). This literature includes evidence that firm competitive performance is dependent upon an organization's effective management of the whole innovation process and investigates factors that relate to successful management of this process (Nembhard and Edmondson, 2006; McDonough, 2000).

Innovation is a complex and multidimensional phenomenon (Wolfe 1994), and it is difficult to find in the management literature a unique and generally agreed upon definition of this phenomenon. We adopt a broad definition of innovation, defined as '*the successful exploitation of new ideas*' (UK Department of Trade and Industry's (DTI 1998)) as it includes the range of possible innovation types (product/service, process, administrative, technological, etc ..) that one could reasonably expect to observe in the concrete reality of an organization.

Many scholars have sought to identify the key activities of the innovation management process (Crossan, and Apadyn, 2010; Smith, Busi, Ball, and Van Der Meers, 2008; Wolfe 1994), some of which have been presented as linear models (Daft 1978), while others have been proposed to be dynamic and recursive, and characterized by processes of feedback and feed-forward loops (Jiménez-Jiménez, and Sanz-Valle, 2011; Schroeder et al. 2000). Nonetheless, the capacity of organizations to innovate is determined by multiple factors that relate both to their own internal organization and to their market environment and the task of generating and then developing ideas into usable and marketable products requires high levels

of intraorganizational co-ordination and integration. (Crossan and Apadyn, 2010; Jiménez-Jiménez, and Sanz-Valle, 2008)

Innovation literature is characterized by the distinctions between contextual factors and work environmental factors affecting firm innovative performance (Smith, Busi, Ball, and Van Der Meers, 2008; Damanpour, Wischnevsky, 2006). The first perspective looks to market environment inhibitors and facilitators of innovative performance (Hee-Jae and Pucik, 2005), while the latter investigates the organizational factors responsible for firm innovative performance (Damanpour and Schneider, 2009).

Macro-level factors referred to the overall context in which firms operate. Previous innovation literature has investigated the effect of contextual factors on firm innovation rate: the types of innovation (Dess, Lumpkin, and Covin, 1997), industry specific differences (Powell, 1996), stage of product/industry/technology life cycle (Draft, 1978), different strategies (Damanpour and Wischnevsky, 2006), age and structures of the firm (Camison-Zornoza, et al., 2004), external technology and market dynamics (Anderson and Tushman, 1990). Those contextual factors are more related to maco-level factors responsible for firm innovation rate.

The influence of contingency factors is a function of several interrelated factors, including the level of competition (Cooper, 1979), the size and growth of the market (Cooper and Kleinschmidt, 1987), the stage of the industry life cycle (Abernathy and Utterback, 1978), the length of product and technology life cycles, the technological change rate (Zhang et al., 2000), and the level of industry innovation (Brown and Eisenhardt, 1995) that affect different levels of the strategy a firm chooses (Bourgeois, 1980) and ultimately the performance of the innovation activities. In slow-cycle markets, firms may effectively compete over relatively long periods of time if they possess the knowledge and capabilities needed to execute accepted industry recipes. By contrast, in fast-cycle markets described as high-velocity environments (Eisenhardt, 1989) and hyper-competition, firms must be concerned with identifying and acquiring the knowledge and capabilities needed to compete effectively in uncertain futures. Learning is often regarded as the only sustainable source of advantage in such markets (Williams, 1992).

On the other side, creative and innovative behaviours appear to be promoted by work environment factors (Mathisen and Einarsen 2004). Indeed, it is clear that organizations can create environments in which innovation can be encouraged or hampered (Dougherty and Cohen 1995; Tidd et al. 1997). This means that organizations would be able to provide sufficient freedom to allow for the exploration of creative possibilities, but sufficient control to manage innovation in an effective and efficient fashion (March, 1991). Literature points out to a range of features that organizations would have to enhance innovative performance: inter-functional communication and cooperation, qualifications and know-how, autonomy and responsibility for the process (Ancona and Caldwell, 1992; Nonaka, 1994; Damanpour, 1996; O'Reilly and Tushman, 1997; Williams and O'Reilly, 1998). Though, research on the antecedents of innovative performance is valuable, the first phases of firm innovative process, when organizational innovative efforts are devote do generate ideas still remain underexplored. The first steps of the innovation process are key in determining firm innovative performance (Koestler, 1989; Day et al., 1994; Crossan and Apaydin, 2010; Ames and Runco, 2005). Indeed, ideation can be seen as a source of innovation (Crossan and Apaydin, 2010) and a process for creating and develop ideas (Björk, 2011).

In today's organizations, ideation tasks require a fast-paced interdisciplinary endeavour, accomplished by groups rather than highly structured functional organizations. Composed of members drawn from different functions, groups are called to integrate deep expertise in heterogeneous areas to conceptualize, develop, and deliver innovative outputs. Continued growth in the use of groups confirmed the critical role of groups within organizations. To date observations and investigations has acknowledged that groups are a fundamental source of organizational innovation and effectiveness (Edomondson and Nembhard, 2009; Leonard-Barton, 1995; Nonaka and Takeuchi, 1995; Senge, 1990). Previous research investigating groups in a variety of organizational setting have acknowledged that group performance is a function of composition, availability of resources and information, and rewards (Hackman, 1987, 2002). However, the lion's share of previous studies has been conducted in groups conducting relatively routine task and composed of relatively homogenous members McDonough (2000). Those findings need to be revised

dealing with ideation groups, which are characterized for being fluid groups composed of members who worked together for accomplishing the specific task in which group members join the group and leave it at the end of the task (Edmondson and Nembhard, 2009). In this research, specific characteristics of fluid groups have been investigated. Specifically the overarching framework of the research is threefold: *i)* the first level looks to individual contributions to group ideation performance; *ii)* the second level of the analysis investigates two complementary group characteristics –i.e. affiliation diversity and group familiarity – and their effect on group ideation performance; *iii)* the third level looks to the evolution of the temporary network structure and its effect on group ideation performance.

An overview of the overarching theoretical framework is presented, distinguishing the three levels of investigation. Then, research questions are stated.

2. INDIVIDUAL CONTRIBUTIONS AND GROUP PERFORMANCE

The relationship between group performance and individual contributions of members is a central concern in management. Indeed, employee contributions can substantially contribute to organizational innovation, effectiveness, and survival (Simonton, 1999). Individual contributions do provide the raw material for group effectiveness. The impact of top talented professionals (stars) on group performance has been the object of a growing body of organizational research (Montuori and Purser 1996; Ford, 1996). Indeed, extant research has drawn tight boundaries around the "*self*" as the privileged locus of inquiry (Taggar, 2002; Montuori and Purser 1996; Ford, 1996; Mumford and Gustafson, 1988). Previous studies dealing with the effect of star presence on group performance rest solely on the positive assumptions of the stars' central role as sources of intellectual capital and for their own knowledge endowment (Zucker and Darby, 2007). Most skilled individuals are, indeed, in demands by organizations that rely on their superior performance to gain the competitive edge. Considering both the task contributions and the enhanced reputation that those individuals can confer to the group to which they belong (Groysberg et al., 2008), it is easy to understand the appeal that the intuition of "*more is better*" has had on the managerial practice, including a range of contexts

like consulting firms, sport teams, film crews, academic departments, start-up business and so forth.

In the same vein, previous studies dealing with individual contributions and ideation have been built on the basic assumption that imaginative and uniquely gifted individuals spark creative ideas. When employees exhibit ideation at work, they produce novel, potentially useful ideas about organizational products, practices, services or procedures (Shalley & Gilson, 2004). Innovation literature points to the importance of the role played by a single individual in generating ideas –i.e. *star ideator* that is a high performer specialist or employee that has proven to consistently generate high quality ideas within a firm (Jenssen and Jorgensen, 2001), while another stream of studies considers the overall capacity of group members as determinant in predicting ideation performance in groups (Taggar, 2002; Pirola-Melo and Mann, 2004). Ideation can occur as individuals work separately on components of the larger project, and can also occur as members interact with each other, as they share, build upon, and critique/filter ideas together (Simonton, 1999; Amabile, 1996). One likely possibility is that ideation is an additive type of task, where each individual's creativity adds to the group's one. Such interactions may stimulate creative ideas among the individuals, but these creative contributions can still be attributed to specific individuals (Steiner, 1972). Alternatively, group creativity may resemble a disjunctive type of task, where the most creative ideas (which may originate from a particular individual) are adopted by the group and determine group creativity (Hargadon and Benchky, 2006).

We try to reconcile those two streams of studies in innovation literature looking to the role played by star ideator in generating and developing ideas within a group. Nonetheless, the model is based on counterintuitive mechanisms that are used to investigate the effect of star ideator presence on group ideation performance. Star presence is undoubtedly beneficial for creative performance. Star ideator uses his or her human and social capital (personal traits, experience, personal relations) and applies a broad repertoire of strategies (networking, communication, etc.) in order to acquire the necessary resources for his or her endeavour (Jenssen and Jorgensen, 2004), both star creators' human and social capital are essential for ideation performance. On the other hand, when group members benefit from collaborating on

highly interdependent tasks star-studded groups may collapse due to stars' egos and prima donna aspirations. Once a group has been designed only with stars, there may be decreasing returns to group performance. Accordingly, when stars and top talented professionals have to interact on a regular base with other individual top performers, their performance may not sum additively (Pfeffer and Sutton, 2006). Extant literature has investigated the effect of stars on group performance pointing out mainly to their positive effect (Jenssen and Jorgensen, 2004). Thereby, received theory has failed to account for the potential contradiction regarding the effect of star ideator presence on group performance. This research disentangled the discussion on the effect of star ideator presence from the effect of grouping together top talented professionals. We have thereby specifically gone into the tension between star ideator presence, associated with increased resources and reputation and grouping top talented professionals associated with coordination problems.

This reasoning leads to our first research question:

R.Q.1 What is the effect of star ideator presence on group ideation performance?

What is the effect of grouping top talented professionals on group ideation performance?

3. GROUP CHARACTERISTICS AND GROUP PERFORMANCE

The use of groups enables the integration of expertise and information across the organizational silos created by functions, business units, and geographically distributed company locations. Groups are defined as "a dynamic whole based on interdependence rather than on similarities" (Lewin, 1951). Previous research has been focused on identifying the range of factors that can lead to enhanced team performance (see Ilgen, Hollenbeck, Johnson, and Jundt, 2005, for a review). Composition research has tended to focus on what could be termed "individual attribute composition". This approach explores how different ways of aggregating individual group members' attributes affect group effectiveness. This body of research has advanced our understanding of the factors affecting group performance (see Humphre, Morgeson, and Mannor, 2009, for a review). Previous research has

suggested that group composition aspects such as group size, diversity and past collaboration patterns affect the success of a group project (Guimera, Uzzi, Spiro & Lazer and Katz, 2003). Conceptually, scholars have suggested that group composition dimensions, such as longevity and diversity, impact on group performance. The use of groups within organizational contexts enables integrating and sharing expertise, information and resources dislocated across organizational units, functions and different organizational sites; avoiding the risk that each organizational unit and function works as isolated silos apart form the whole organization. Therefore, the value of the group approach to work organization is that each group member brings his or her expertise, skills and experience to the overall group task (Hargadon and Bechky, 2006). Previous literature found that successful groups accelerated the innovation process, reduced development costs, and increased the quality of outcomes (Gupta and Wilemon, 1990; McDonough, 2000; Sarin and Mahajan, 2001; Takeuchi and Nonaka, 1986). In large part, their success derives from their composition and ability to capitalize on it. Despite the potential of groups to enhance innovation and organizational performance, the realization of these potential benefits has been found to be far from straightforward. While some groups match, and even exceed expectations (Brown and Eisenhardt, 1995), others fail to fulfil the organizational mandate (AitSahlia et al., 1995). However, much of this literature stresses the effects of group characteristics on group performance with members that are almost exclusively collocated to a single group. Therefore, the validity of these findings need to be investigated in groups that change in composition over time.

As noted above, *fluid groups* are common and occur in a wide range of contexts (Edmondson and Nembhard, 2009). They appear to be especially common in highly competitive settings characterized by pressures for productivity and learning (Milgrom and Roberts, 1992). When constellations of individuals work together, they carry with them their history of past success, their own experiences and background. Each of these factors affects group performance.

First, the idea of diversity plays a major role in creativity management.
Affiliation diversity: is a construct dating back to Ashby (1956), reflects the background composition of group members (Nonaka, 1994). Damanpour (1991)

argues that a diversity of skills and experience permits more differentiated units from which collaborative relationships can emerge and add significant value to innovation outcomes. Although Baldridge and Burnham (1975) argue that demographic characteristics (sex, age, cosmopolitanism, education) do not appear to influence innovative behaviour among individuals, more recent research suggests that innovating groups should comprise individuals with a mix of these characteristics (Amabile, 1998). Members with greater educational attainment with diverse backgrounds have been associated with more innovative teams (Bantel and Jackson 1989). Indeed, variety of backgrounds offers a great opportunity for organization as well as an enormous challenge. Collaborating in the face of meaningful differences is especially difficult (Dougherty, 1992; Nembhard and Edmonson, 2006). Nonetheless, cross-functional groups have primarily been suggested as a way of bringing together different competences in order to solve a defined task in an efficient manner (Mannix and Neale, 2005). Variety along skill- or knowledge-based dimensions (e.g., educational background, functional background, occupational background, range of industry experience) ought to result in a greater variety of perspectives and knowledge sets being considered when making decisions and, thereby, these factors have been suggested to increase the likelihood of creative and innovative solutions to problems (Ancona and Caldwell, 1992; Nonaka, 1994). More specifically, bringing together people from different functions provides a venue with high potential for cross-fertilization of heterogeneous knowledge sets, which arguably could spark innovation (Milliken and Martins, 1996). In the specific case of idea generation it is argued to be the intersection of different ways of thinking that trigger really new and innovative ideas (Koestler, 1989). Diversity does not necessarily solve this issue, as even heterogeneous groups over time may be locked into their shared ways of thinking. Although diversity can yield numerous positive benefits through the processes described above, prior research has shown that achievement of those benefits does not occur with ease. In a review of the literature Williams and O'Reilly (1998) found that the overall effect of functional diversity on performance is negative, especially in times of crisis and change. In addition, diversity is also associated with higher levels of dissatisfaction, turnover, and commitment and job stress (Schippers et al., 2003). Researchers attribute these

negative effects to group functioning mechanisms (Edmondson, 1999, 2003; Nembhard and Edmondson, 2006). Indeed in diverse groups, the hope is that membership diversity will foster creative tensions that is reconciled through collaborative communication, resulting in innovative outcomes. Empirical evidence does confirm a strong positive correlation between diversity and task conflict but also a negative correlation between task disagreement and team performance (De Dreu and Weingart, 2003; Dougherty, 1992; Pelled, Eisenhardt, and Xin, 1999), suggesting that collaborative communication does not always occur. Collaboration is difficult because each profession has its own language, terminology, beliefs about relative importance of performance attributes, approaches to learning, mechanisms for information exchange, goals, (Dougherty, 1992). Therefore, **familiarity** among group members – that captures the cumulative experience of working together – has been argued to affect group performance. With increasing shared experience one may get better at executing existing routines and developing new ones (Nelson and Winter, 1982; Zollo and Winter, 2002). However, the idea that experience and repetition would increase performance is called into question by the idea of competency traps or core rigidities (Levitt and March, 1988; Leonard-Barton, 1992). These concepts instead suggest that groups may become locked into their established ways of doing things and that, as conditions change, the group will not be able to react. Groups that stay together longer become more isolated from information sources and this counteracts the benefits of coordination and internal communication resulting from the experience of working together. While team familiarity allows for deep coordination mechanisms to be embedded within groups, a high level of group familiarity could constrain group ideation ability, resulting in mechanisms that hinder the creation and development of new ideas (Skilton and Dooley, 2001). There is a tension in using groups. On one hand, group diversity offers the potential for the application of the highest level of expertise. On the other hand, members' familiarity presents two counteracting mechanisms one associated with shared understanding and one associated with a problem of lock in shared and cemented ways of doing things and procedures. Nonetheless, received theory dealing with the effect of group composition on group innovative outcomes (De Dreu and Weingart, 2003; Skilton and Dooley, 2001) is characterized by this contradiction between affiliation diversity

and group members' familiarity. In this research we disentangled the discussion on group affiliation diversity from group members' familiarity, investigating the effect of those group characteristics on group ideation performance.

This reasoning leads to our second research question.

R.Q.2: What is the effect of affiliation diversity on group ideation performance?

What is the effect of group familiarity on group ideation performance?

4. NETWORK STRUCTURE AND GROUP PERFORMANCE

Embracing a social perspective of the ideation process (Leonard and Sensiper, 1998; Hargadon and Bencky, 2006) theory has highlighted the importance of considering relations among individuals as a potential source to access new information and knowledge. This leads to a clear proposition of this research, that to enhance our understanding of the ideation process as a collective process we need to investigate closely the network of interconnected ties where ideas reside and are nurtured: that is the ideation network. Social networks have received much attention in organizational research for their capacity to explain performance at different levels. A central assumption of the network theory is that performance are captured not looking to the individual actor alone, but looking to the actors as immersed in a web of ties (Brass et al., 204). In network research organizations are conceptualized as a web of interconnected ties that bind together actors in which resources flows (Tichy et al., 1979). Therefore, we argue that a social network perspective is needed in order to enhance our understanding of the ideation process, especially group ideation performance. In the following sections we split our theory on ideation network into two parts. The first deals with the effect of different network positions on group ideation performance. While, the second one looks to the mechanisms that are responsible for network emergence.

In much of the literature on the role of social networks in organizational processes, the treatment of form and benefits is interwoven. For instance, the recent work by Obstefeld (2005) highlights that sparse and weakly connected networks are associated with creative outcomes, while sparse and densely connected networks lead to more coordinated action. Other examples of such joint treatment of structure and benefits of social networks include the seminal works by Coleman (1988) and Burt (1992). However, more recent studies found support for the benefit of bridging ties in combination with strong ties (McEvily and Zaheer, 1999). Furthermore, studies have pointed out to contextual factors, for instance information complexity and absorptive capacity, as important factors affecting the extent to which a given network form may provide effective benefit (Hansen, 1999; Reagans et al., 2003). Indeed, a great deal of research has focused on network antecedents of favourable outcomes for groups (Reagans, Zuckerman, and McEvily, 2004; Soda, Usai, and Zaheer, 2004). These findings support a need for a separate discussion of network benefits form network structure.

We do so by pointing out to network benefits, namely information and coordinated action drawing on extensive network literature on social capital (Granovetter, 1973; Burt, 1992; Coleman, 1990). We than briefly discuss two separate structural mechanisms, namely network structure exploitation and network structure constraint, through which such benefits are provided in a network structure subordinated to the contingency of time.

The first and most cited benefit of social network is information (Burt, 1992; Granovetter, 1973). Burt (1992) points out to two main forms of network benefits: *i)* the access to valuable information well beyond what the actor could process alone; *ii)* network can ensure that the actor gets informed early. The literature on innovation focuses on the diversity of information that network allow to access. The notion that diverse information, if combined, can lead to creative ideas and products is deeply rooted in innovation (Schumpeter, 1934; Nonaka, 1994) and creativity literature (Guilfor, 1967). The interest of network researchers for the benefit of diverse information in an innovation context dates back to the early studies by Allen (1977)

on interaction patterns of R&D scientists. The role of networks in providing diverse information has also been the foundation of recent network studies at the individual level (Obstfeld, 2005; Burt, 2004; Perry-Smith and Shalley, 2003). The focus of this study is at the group level and in the initial generation of creative ideas.

The second benefit of networks is the ability to facilitate cooperative action and coordinate tasks (Coleman, 1990; Gargiulo and Benassi, 2000). Where information can provide actors with new opportunities and different perspectives, coordinated action can provide the cooperative behaviour needed to explore those opportunities and perspectives (Podolny et al., 1997). Adler and Kwon (2002) split up this benefits into two main categories: the control benefit and cohesion. Control in those studies refers to the influence of an actor resulting from a favourable position in a system with an asymmetric distribution of power and information. On the other hand, cohesion refers to the encouragement actors feel to comply with social norms, rules. The difference is the mechanism through which this coordinated action is created. Control is based on a misalignment of power of a single actor that has disproportionate control of the whole network structure (view Coleman, 1988 study of the power of the Majority Leader of the U.S. Senate). Solidarity refers to the build up of group cooperative and social norms (Reagans et al., 2003). This argument is that people are more likely to demonstrate cooperative behaviour, because if they do not, the news of their "betrayal" will rapidly travel around the group frustrating their future interactions with other group members. This is complemented by views form creativity literature, which highlight that a action or an initiative is valuable only if there is social acceptance of this idea (Simonton, 1989). The main drawbacks of this perspective are based on the risk of groupthink (Janis, 1972) and lock-in (Gargiulo et al., 2000). Both groupthink and lock-in refer to the tendency for group insights to converge over time and block fresh outside perspectives. As Powell and Smith-Doerr (1994) have pointed out "The ties that bind may also turn into ties that blind" (p. 393).

Within an ideation network, social actors form and reciprocate ties in order to create and develop new ideas together. The act of generating an idea together

requires social actors not only to share information but also to be able to deeply coordinate their collaborative activity in a way that allows them to deliver highly creative outcomes. Collaborative and exchange network ties facilitate tacit and explicit knowledge transfer and diffusion within complex organizations (Hansen, 1999; Singh, 2005). Network theory offers a powerful concept, that of network degree, in order to capture focal actor's access to and control over resources. Network members with the most access to other network participants are the most central players in a particular network (Knoke & Burt, 1983; Wasserman & Faust, 1994). Prior research has shown that network centrality can influence the behaviour and outcomes of network members (Barsness, Diekmann, & Seidel, 2005; Ibarra, 1993). Generally, one occupying a more central position will benefit from more information in-flow (Perry-Smith & Shalley, 2003) and resource control (Sparrowe et al., 2001).

On the other side, network theory has stressed the importance of another network position that of structural holes presented in the ego network. More specifically, a structural hole is a position in a network through which an actor can derive benefits by bridging resources and information flows between two otherwise disconnected actors in the network (Burt, 1992). Those bridging structural holes have better chances of being exposed to distant and unique knowledge (Rosenkopf & Almeida, 2003), and are better able to transfer knowledge across boundaries (Reagans & McEvily, 2003). The importance of such network roles for creative performance is well known (Burt, 2004; Obstfeld, 2005). Actors who are active with dissimilar others and who facilitate action among previously unconnected alters, will be more involved in the combinative activity that leads to ideation. Such combinatory activity rests at the roots of innovation, especially dealing with idea generation and development.

As noted, trying to reconcile network theory with innovation literature the researcher is confronted with the problem of overcoming the potential contradictions with the mechanisms associated with those two network positions. While network centrality is associated with access to and control over redundant information and resources (Coleman, 1988), a network position rich in structural holes is on the other hand associated with benefits of accessing diversity and novelty in ideas by tapping into

the capabilities of alters that are disconnected from each other (Burt, 1992). Network literature has thereby faced a tension between the mechanisms of network centrality, associated with enhanced access to resources and information and a network position rich in structural holes associated with access to diverse and novel ideas and knowledge. In this research we disentangle the discussion on network centrality and network position rich in structural holes, focusing on their complementary effect on group ideation performance.

Given the importance of those network positions in the ideation process a logically extended research question would investigate the effect of those two network positions on ideation performance.

This reasoning leads at our third research question.

R.Q.3 What is the effect of group centrality on group ideation performance? What is the effect of holding a position rich in structural holes on group ideation performance?

4.2 Temporary Network Structure

Beyond the consensus that network structure provides various types of benefits, there is still little investigation on the structural mechanisms at the basis of network emergence. Without understanding the temporal sequencing behind the emergence of network structure, knowledge on network emergence and benefits remains incomplete. Network structure tends to change over time, as new ties will be formed and older one could be deleted. As network structures change, this could arguably affect concurrent network structure thus affecting outcomes. This temporal network sequencing describes variations in network structure over time (Powell et al., 2005). Previous studies have been typically extrapolated from research on tie formation. This stream of literature points out that past network structure projects its shadow on the current network through mechanisms of structural inertia (Walker, Kogut, and Shan, 1997; Gulati and Gargiulo, 1999). Indeed, past network structure offers actors a combination of experience, resources, knowledge access, that can

provide opportunities and inducements but also constraints and barriers to the evolution of the structure (Stevenson and Greenberg, 2000). Network structure can emerge from the intersection of two complementary forces provided by past network structure and positions within the network. Positions that have proven to be efficient in the past are reproduced in the current network structure (*exploitation of past network structure*) (White, 1992; Zaheerand Soda, 2009). More precisely, experiences and knowledge that have proven to be efficient in the past in turn motivate and enable actors to recreate and reconfigure past network positions into future beneficial ones.

In a similar vein, past network structure acts as a constraint for the emergence of the current network structure. Past network structure tends to reproduce itself though norms, rules, social pressures creating a kind of inertial forces that affect and constraint actors' behaviour (Parsons, 1951; Fleming and Waguespack, 2007) (*constraint of past network structure*). Inertia and relational lock-in imply that repeated ties become stronger and more durable; time cements network ties. Overall, these arguments suggest that social structures tend to persist over time, and networks with a high degree generates norms, trust, and obligations all of which constrain actor's ability to change its position over time. This reasoning suggests a strong element of stability within network structure, implying that the current network structure is affected by past network structure. These insights suggest that a form of structural persistence characterized the evolution of organizational network structure (Walker, Kogut, and Shan, 1997; Gulati and Gargiulo, 1999).

As our investigation comprises temporary network structure that is continually being created and dissolved over time, we could more clearly disentangle the discussion on the underlying processes of exploitation of past network structure and constraint of past network structure pointing out to the mechanisms that accounts for the emergence of a temporary networks and their performance outcomes. We have thereby specifically gone through the tension between exploitation of past network structure, associated with the benefits of experiences, and knowledge access coming form the past, and constraint of past network structure associated with lock-in with dense, overlapping ties. We focused on the balance between network

constraint and exploitation of opportunities by the focal actor that underlie the activation of a favourable network structure.

This reasoning leads to our fourth research hypothesis

R.Q.4 What is the effect of past network structure on current network structure?

CHAPTER 3

METHODS USED

1. INTRODUCTION

This chapter describes the research design, the research projects, and the models and methods applied in each of the three appended papers.

The research questions investigated in this thesis are aimed specifically at collective ideation performance and explore different levels antecedents of ideation performance. Thus, the questions focus on theory testing and theory development. Consequently, the priority of this research study is to contribute to theory development. Epistemological assumptions are vital in defining the way in which the research has been realized (Van de Ven, 2007), they informed the research design, including research problem, how its arguments are put forward, how data are collected and analyzed.

The research project was conducted to answer to the research questions and satisfy the thesis target. The ideation project focuses on different levels antecedents of group performance. This research project has benefited of an in-depth study of a company that has systematically worked with an idea system over an extensive period of time. The study focuses on the group ideation performance, and at a deeper level it explores what is the effect of different levels antecedents on group ideation performance. In essence, the research project builds on deductive investigation by testing different theoretically driven hypothesis. The case company adopted an IT-based framework to capture, store and evaluate ideas. The system was launched in 1995, and its aim was to sort ideas coming to the patent department. Soon, the system was extended to all ideas created within the company. We had access to data on ideas and their creator(s) thanks to researchers who are affiliated with a research center that is a formal partner of the studied company. Those colleagues had a deep knowledge of how the system had been working and how it evolved over time. This research study have extensively benefited of their involvement in the system. They enriched the contextual knowledge of the setting of the study.

2. UNIT OF ANALYSIS

As indicated earlier, this study attempts to understand different levels antecedents of group ideation performance. More specifically, we are interested in investigating how individual contributions, group characteristics, and network structure affect group ideation performance. As noted, the unit of analysis is therefore the group involved in the task of generating and developing ideas and not individuals. In particular, the study focuses on the first phase of the innovation process, when ideas are generated and developed. First, this phase is a fundamental determinant of firm innovative performance (Ames and Runco, 2005; Day et al., 1994). Second, the ideation phase is intrinsically non-routine, dynamic and uncertain (Kim et al., 2002). In general, the initial idea may be born out of meetings, personal work of scientist or attending conference and often it misses a clear focus and fit with organizational requirements and customer focus. There is frequently substantial uncertainty and ambiguity surrounding the idea and the idea will need further technical refinements before it can be turned into a project proposal. All this work requires highly collaborative and cooperative tasks involving contributions of different specialists coming from different areas of expertise (Kim et al., 2002; Edmondson and Nembhard, 2009).

The group level investigation performed in this study allows us to retrace antecedents to ideation at different levels, when ideas are generated and developed by groups of employees. Organizations are increasingly relying on fluid groups for accomplishing most complex and knowledge-based tasks (O'Leary et al., 2011; Huckman et al., 2009). In management studies fluid groups are defined as groups that exist only for the accomplishment of a specific task and are composed of members who join the group for that specific task and leave the group when the task is accomplished (Edmondson and Nembhard, 2009). In contexts characterized by such fluidity and temporariness of groups, antecedents of group's effectiveness should capture also changes in group composition over time.

The empirical setting chosen for this study would allow the researchers to observe longitudinally groups that generate ideas. We looked to groups in which

links among group members exist if they have collectively generated and developed at least an idea.

3. EXPLORATORY STUDY

To investigate the research questions we used archival data. This type of data would allow researchers to collect a large number of observations on the independent and dependent variables after which averages can be calculated and the causal relations between variables can be tested for statistical significance. This strategy allowed to collect data necessary for theory testing. For the current study, this would require researchers to collect data on ideas generated and developed, assess their eventual success, their value related to the composition of the group and the structure of the ideation network surrounding the group at various point in time.

This creates several problems. First, there is a problem of 'retrospective bias'. Since the outcome of previous ideas is already known, people might be less inclined to be associated with less successful ideas. The use of longitudinal data in the present study helps us to overcome 'retrospective bias' evaluating the interrelations between variables over time. This approach provides evidence of the relationship between group ideation performance and antecedents that are affected by this mechanism. Second, there is a problem of 'survivor bias' (Singleton and Straits, 2004), referring to an overrepresentation of successful ideas. Ideas that prove successful at the very first stages of the ideation process will be more likely to receive an official review and as a result will be found in organizational records. As the aim of the study is to investigate group effectiveness we found that highly ranked ideas are those that need to be investigated deeply.

We had access to company database through the collaboration of other researchers who had a formal relationship partnership with the studied firm. Through the collaborations of these colleagues we had extensive access to the company databases where all the ideas within the company were stored and key information such as the grading of ideas could be found. The firm used an idea management system since 1995 with the aim to manage more effectively the ideation process. This system was created to solve problems in one business area, but soon was turned

into a generic tool serving all of the firm's business areas for capturing and handling all ideas generated and developed. From the beginning the same person was in charge of managing the system full-time.

After interactions with other researchers with a deep knowledge of the system, we opted for a longitudinal field study, which resulted in a seven years study from 2000 to 2006. The time span was selected after investigation on how the system had been established and then modified. The first years of system implementation were turbulent and characterized by a progressive fine-tuning of the system. Then after from 2007 the system changed as there had been created different paths for different ideas. During the seven years window chosen for the analysis there was gathered 4,659 ideas. Due to missing variables and attributes in the overall dataset, the overall sample has been restricted to 3,534 ideas, 1,180 of which generated by groups and the remaining 2,354 generated by individual inventors alone. For the specific purpose of this research, the focus was only on the group level, consisting in 1,180 ideas (table 1 contains description of the ideas collected and then retained within the dataset).

The design of the study enabled us to collect detailed, first-hand information on newly generated ideas. Data collected included the quality of ideas, employees involved in the idea generation and their organizational affiliation. This data was gathered from formal records and archival data allowing for triangulation of attribute data and relational data. In reporting the findings, we have sought to combine the easily comparable nature of quantitative figures with the richness of case-based research. We have used the quantitative measures from group demography and structural network analysis to support our claims.

Clearly, though the analysis is based on a quite large sample of ideas generated, and longitudinal research design has been used, the analysis has several limitations. To what extent can the data be used for hypothesis testing? And how can the result be generalized? The usefulness of first-hand archival and longitudinal data provides room to construct new causal relations between different explanatory variables that were only considered separately and show the relevance of relations. We will go back on this issue in the part showing limitations of the study.

4. RESEARCH SETTING

Data was collected at a Swedish company operating in fast-moving consumer goods industry. The work is largely project-based. In an attempt to better handle the flow of ideas coming to the patent department the company launched an idea system to encourage, collect, evaluate and select ideas.

Employees involved could submit the proposals of ideas at any time. The project started as a mean to effectively handle the increasing flow of ideas coming to the patent department. The system started at a single business unit and rapidly it was extended to the firms' entire business units. Employees had been provided with an opportunity to come up with 'out of the box' ideas, besides their regular ongoing project work, and provide a platform from which these ideas could be founded.

The proposals of ideas had to pass one gate to be assigned a grade. Indeed, the majority of the work on the ideas was done before the gate. A committee composed of about 10 experts coming from the firm's different business units evaluated each idea submitted. Furthermore, a single person was responsible full-time of the whole idea management system. This person assigned the idea to a 'referent' with specific competence in the area of the idea. This expert was in charge of idea pre-evaluation. Thereafter, this preliminary evaluation was presented to the committee for the group final evaluation.

4.1 DATA

Access to company archival data was gained thanks to the collaboration of other researchers who have a long lasting partnership relation with the case firm. These researchers gathered data from the company and allowed to use those data in order to perform the empirical part of this study.

After a confidentially agreement, stating that we would not disclose any specific details on ideas and employees involved, data on ideas and specialists involved were used to understand how the system works.

4.1.1.Sample

As noted, data on ideas that came up during the period 2000-2006 has been retained for the analysis. The idea might came up as a result of an informal process, but also during formal sessions, regular work meetings or private work of employee. Furthermore, each idea was classified into ideas created individually and ideas created in a group context. As noted, the focus of the study was on ideas generated by groups. In this context of analysis a group exists when individuals work together in order to create and develop a new idea. Furthermore, employees are allowed to be part of more than one group. This is a common feature within organizational contexts characterized by high rates of innovation and knowledge. This means that group members are allowed to move to other groups, carrying with them experience and knowledge accumulated in previous groups. In this vein, concurrent group members act similarly to transmit knowledge across groups. Indeed in our sample, we were able to retrace multiple group membership of employees working on ideas. As noted, this generated a total of 4,659 ideas. Due to missing variables and attributes in the overall dataset, the overall sample has been restricted to 3,534 ideas, 1,180 of which ha been generated by groups and the remaining 2,354 generated by individual inventors alone. For the specific purpose of this research, the focus was only on the group level, consisting in 1,180 ideas for the time window used in this study (table 1 contains description of the ideas collected and then retained within the dataset).

Table 1: Description of the number of ideas

	2000	2001	2002	2003	2004	2005	2006	**Tot**
Overall number of ideas generated	519	587	465	668	781	929	710	**4659**
Ideas retained in the sample	458	520	343	472	521	595	625	**3434**
Number of ideas generated by individuals	316	357	231	334	350	360	407	**2354**
Number of ideas generated by groups	142	163	112	139	171	235	218	**1180**

4.1.2.Collection method

In our sample, we were able to retrace multiple group membership of individual employees. As noted, people involved in the ideation system worked together with the aim of generating and developing ideas. Furthermore, individuals are allowed to be part of more than one group. This is a common feature within organizational context characterized by high rate of innovation and knowledge. Using archival and longitudinal data, we were able to retrace multiple group membership of employees. Through pattern of interconnected membership, ideation groups form a large network. In the same vein, investigating group performance in creative industries Lampel and his colleagues proposed "The virtue of such latent structures is that they can provide the means whereby a network of specialists that have previously worked together can … reconstitute the network" (2000: 265). The rationale behind this ideation network is that information, knowledge and experience flow through network ties via individual specialists that connect different groups. The resources that flow through those network connections are vital for nurture focal group ideation performance. In such a co-membership networks, a focal group's alters are defined as those groups on which focal group members either collaborate as current members (*current alters*) or collaborate as past members (*past alters*). As the level of analysis of this research is at the group level, relation among groups have been retraced departing from the pattern of co-group membership in the temporary network, measured as explained deeply in the following section.

Social Network Analysis has been used to analyze the structural characteristics of groups' social capital in the temporary ideation network created on the basis of the co-group membership among groups. The data collection regarding the network was divided into two stages. We distinguished networks on the basis of the years in which ideas had been created within the company, thereby obtaining 7 different "group-x-group" networks (years: 2000, 2001, 2002, 2003, 2004, 2005, 2006). The objective of this study is to test the effect of two different network patterns on performance as subordinate to the contingency of time. UCINET 6 Network Analysis Software network analysis software (Borgatti et al., 2002) has been used both for building our temporal network structure and for measuring our network variables. In order to have a long enough window in the past, allowing us to

investigate past network connections we decided to split the overall sample into different parts: one accounts for the past network structure and the other accounts for the current network structure (tab.2). The network idea is that each group is connected to the past through patterns of co-group membership (i.e. individuals that have worked together in the past in other groups). For instance, each idea generated by groups in 2004 is related to ideas generated in the time window 2000-2003. We decided to account for a four years past-window in order to avoid the so-called problem of relationship decay over time (Zaheer and Soda 2009). Indeed, ideas generated in 2005 are connected to ideas generated in 2001-2004, ideas generated in 2006 connected to 2002-2005.

Table 2: Past network structure and Current network structure

Past Network (past-window)	Current network
2000-2003	2004
2001-2004	2005
2002-2005	2006

We looked also to the current position of each group. 2004, 2005, and 2006 are years for the investigation of current network positions. We account for the current relations among groups per each of the three years of current investigation. Past and current network variables are based on different time-spans within the sample. The past on the four-year time span preceding the focal group's ideation year; while the current variables on the year of ideation. Past and current network measures do not share any overlapping years of network data. Table 1 contains a schematic explanation of the relations among past and current network structure investigated here.

4.2 Cross-level Network Mechanisms

Network theory does not reify any particular level of analysis. It can allow the researcher to cross levels of analysis. Thus, one may examine the position of the group in an overarching network (e.g. Ancona, 1990); describe the internal structure of communication of a particular group (e.g. Sparrowe et al., 2001); or examine the position of a particular individual within the group (e.g. Bavelas, 1950). It is

therefore possible to map network mechanisms from one level to derive propositions at another level. Obviously, this symmetric and isomorphic mapping of network properties across level of analysis needs to be done carefully. We suggest that two assumptions are most sensible in the shift in the level of analysis.
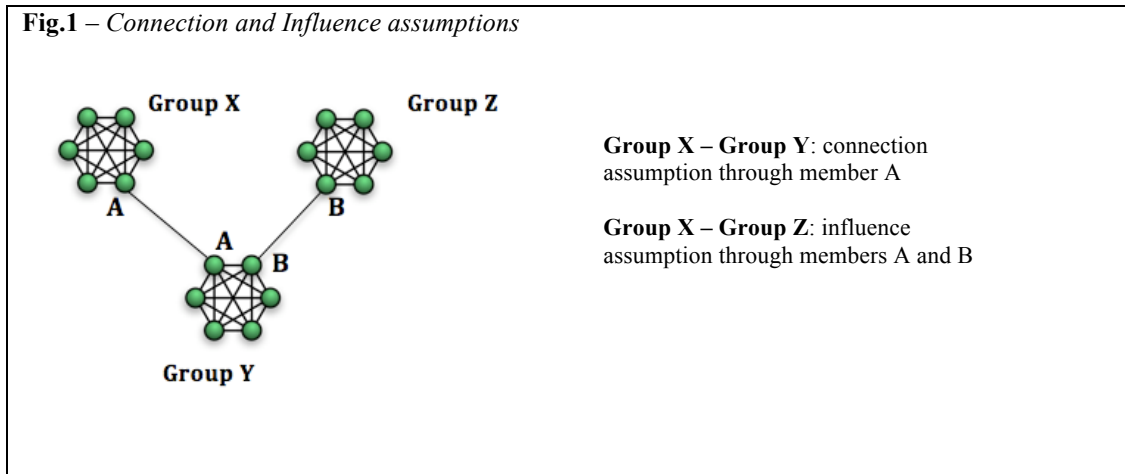
The network investigated in this research traced the relationships among ideation groups within a specific organizational context. It is important to specify theoretically and empirically the properties of this ideation network. Extant research on co-membership networks (organizational groups, groups, Top Management Teams, interlocking directories, movie productions, and so on) has implicitly treated the properties of network of interactions between nodes –i.e. groups, teams, organizations- as symmetric with that of networks among individuals (Mizruchi, 1996; Zajac and Westphal, 1996; Haunschild and Beckman, 1998). This is the case. Under certain conditions, network research on group or group co-memberships can be regarded as isomorphic with network research on individuals (i.e. properties of network nodes at individual level can be symmetrically used at group level). From the perspective of theory, this shift in the level of analysis needs the clarification of two implicit assumptions. The first is what might be called the *assumption of connection*; the second is what we refer to as the *assumption of influence* (Zhaeer and Soda, 2009).

The **connection** assumption is that a network connection between two nodes exists through a single link connecting a part of one group to a part of another group and it represents a link between the two groups as a whole. This assumption states that a network connection between two nodes exists when those two nodes are mutually connected through a network link. While this assumption rests clearly valid when the node is a single person, the underlying logic needs additional justification at higher levels of analysis. Dealing with groups this assumption rests on the fact that close intragroup interactions, collaboration, linkages, and communication processes need to be in place within the focal group. In our study, as illustrated in figure 1, group members do form tightly coupled networks within groups, as they work together in order to create and develop new ideas, involving close interactions, dense communication channels and strong collaboration within the group. In the same vein literature has already benefited of this assumption. For instance, Uzzi and Spiro

(2005) considered Broadway musical crews as fully linked cliques, Zhaeer and Soda (2009) considered TV group production as fully linked clique (a clique is a subset of the vertex set C ⊆ V, such that for every two vertices in C, there exists an edge connecting the two). Consequently, in this context we assume that when two groups share a specialist are mutually linked with each other. For instance, when two groups X and Y share at least a single specialist A are themselves connected, view figure 1. The mechanisms behind this explanation is that all the members of the focal groups (i.e. groups that share the focal specialist) are influenced by that link, because coordination processes are so tightly coupled within the focal group, co-membership relationship between the two groups becomes a knowledge and experience conduit for groups as a whole.

The second assumption is that of **influence**. Network research at the individual level assumes with some justification that network content flows through individual nodes to other nodes that are not linked directly to each other (i.e., content passes from X to Z through Y even though X and Z are not directly linked). Furthermore, this is the explanation at the basis of the power and control benefits of that occupying network position rich in structural holes. Beginning with classic research on the diffusion of ideas and information through networks (Coleman, Katz, and Menzel, 1966; Burt, 2004) this phenomenon has been well illustrated at the individual level of analysis. Again, at higher levels of analysis, it is problematic to automatically assume that this influence process exists, too. To make such an assumption of influence, again we need to clarify theoretically and empirically the mechanisms through which network affects indirectly connected groups. In our case, when two groups X and Y share a specialist (say A) and another specialist (say B) is shared between Y and Z (view fig. 1), influence implies that content passes between groups X and Z through Y. Again in this case, we refer to groups characterized to be tightly coupled. Thus, content is likely to flow through a process that influence groups as a whole. For instance, in the example above group X and Z are linked because content flows from group X to Y through specialists A, while the same content flows form group Y to Z through specialists B, and vice versa (view fig.1).

Even in tightly coupled groups, however, the influence process may be diluted because the process is necessarily mediated through coordination and communication interfaces within the group.

Fig.1 – *Connection and Influence assumptions*

Group X – Group Y: connection assumption through member A

Group X – Group Z: influence assumption through members A and B

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5. VARIABLES

Data used for the analysis was gathered through the access to archival company dataset, thanks to the collaboration with researchers involved in a former partnership relation with the case firm. The indicators were, if possible, adopted from previous research. In the remaining cases, we designed indicators specifically for this study. In the following section the dependent variable of the study is presented, then independent variables of each paper are presented.

5.1 Dependent variable

The dependent variable of this study is *group ideation performance.* The design of this study required a measure of group ideation performance based on the quality of the idea generated. Therefore, group ideation performance: consists of the grade of each idea on a five-point grade received by the committee of organizational experts that summarized the novelty and usefulness of each idea. The variable is designed to take the value of 1 when an idea has low levels of novelty and usefulness, and the value of 5 if an idea is rated as both highly novel and highly feasible. Literature on ideas for innovation points out to two qalities that need to be fulfilled for an idea to be rated as innovative: one is novelty and the second is usefulness (Simonton, 2008). In this study the two dimensions had been evaluated in the view of the company.

Scholars have long debated the way of assessing ideation and creativity in organizational contexts, and to date several different methods have been used (see Amabile and Mueller, 2006). Based on previous assessment of organizational literature (Amabile and Mueller, 2006) researchers revealed that the most common used method to assess ideation involves subjective evaluation, in which experts or peers makes scale-based evaluation of ideation performance (Amabile et al., 1996; Oldham and Cummings, 1996; Amabile et al. 2005).

5.2 Independenta Variables

I PAPER

<u>*Star Ideator Presence*</u>

We defined Star Ideator as an individual employee who had a positive track record of past ideation performance. Therefore, those individuals are those who have a reputation of being highly inventive people. In the first part of the study, we argued that star ideators are key for the effectiveness of group ideation performance. To measure the presence of star ideators within the group, first of all we had to define a threshold level above which individual specialists may be defined star ideators. First we looked at the distribution of each individual past performance. Then, we defined a cutting-point as to distinguish star ideators from the overall population. Individual performance ranged from a minimum value of 0 and a maximum value of 36. After several tests, the cutting-point for star ideators was established at the value of 15 (min 0 - max 36). In the whole sample, we had 8 stars on 278 an overall population of 278 employees.

<u>*Number of ideators*</u>

After having defined and extracted the star ideators (those with a reputation of being highly inventive) from the overall population and counted their number per each idea, we calculated the ratio of star ideators within the group (defined as: *number of stars/group size*). Because the variable values are censored between 0 and 1, we used a logistic transformation as per convention (Fleiss 1981).

Average previous ideation performance

As each group presents its own ideation capability endowment, we accounted also for group members' average past ideation performance. This variable has been designed to control for the presence of highly inventive individuals within the groups. We operationalized average previous ideation ability using the previous two years performance of each group member, and then summed across all grades of ideas in which each individual worked. After that we aggregated this value at the group level, summing across each group member past performance. For instance, assume that the group IDEA is composed of two members: A and B. If A in 2004 and 2005 worked on two ideas which were both graded 4 and B on only one idea graded 3, the overall group ideation ability for IDEA is 3.5=((4+4)/2 + 3/1)/2 (i.e. group size).

II PAPER

Affiliation Diversity

We used Blau's (1970) heterogeneity index to measure the dispersion across functions of the persons involved in generating ideas. We computed the Blau's index in each of the groups represented in our overall data set. Blau's index has been computed as: $(1-\Sigma p_i p_j)/N$, where p_i is the fraction of group members with affiliation to function i and p_j the fraction of group members with affiliation to function j. Blau's index treats the data as categorical.

Group Familiarity

Similar to Reagans et al. (2005), we measure group familiarity by first calculating the number of times each pairing of group members i and j has worked together to create an idea in the focal company within the five years window prior to the current collaboration. We sum this value, PW_{ij} over unique pairs in a group, in order to capture group-specific experience, $\Sigma_{i=1}^N \Sigma_{j=1}^N PW_{ij}/(N(N-1)/2)$, where N represents group size.

III PAPER

The independent variable in the third paper are measured on the current network structure and on the past network structure. In the following section we presented respectively current and past network measures used in the analysis.

Ego network degree: Group degree

To obtain a measure of the ego network dimension, our endogenous variable, we count the number of direct partners of the focal individual, which is his or her Ego network degree. Degree centrality is defined as the number of links incident upon a node (i.e., the number of ties that a node has) (Wasserman and Faust, 1994). Then, this variable has been normalized with the current group size, in order to have a measure of network degree not affected by the focal group size.

$$C'_D(n_i) = \frac{d(n_i)}{g-1}$$

Where $d(n_i)$ is the proportion of ties that are adjacent to the focal ideation group *i*, and g is the network size.

Ego network efficiency: Group efficency

We measured current structural holes, our endogenous variable, as the efficiency index in the network of current ties among ideation groups. We used Burt's (1992) measure of efficiency, which counts the ratio of non-redundant ties to total ties for a focal group as:

$$\left[\sum_j \left(1 - \sum_q p_{iq} m_{jq} \right) \right] \Big/ C_j$$

where p $_{iq}$ is the proportion of the focal ideation group *i's* ties in connection with group q , m $_{jq}$ is the marginal strength of the relationship between group *j* and group *q* , and *Cj* is the total number of ties for group *i*. A high value of efficiency for group *i* indicates that its ego network is non-redundant and thus rich in structural holes. This measure captures the non-redundancy of i's ties as the degree to which a focal group i has many independent ties. More specifically, this measure estimates the degree to which q has a large proportion of j's ties, and i has ties with j.

Past network variables. To compute past network variables, we used three-year moving windows, as we explained earlier. As an example, to compute the past structural holes of group #2790 (a 2004 ideation), which uses as a "past" all ideations produced in the three-year period 2000–2003, we took the following steps: (1) We began with an input dataset of all ties among all ideators in the past time window 2000–2003, which is a "ideators x group" matrix, where xij equals 1 when ideator i is part of group j and 0 otherwise. (2) We then created a vector of size "ideator x 1" for focal group #2790. (3) Next, we joined this vector to the first matrix creating a new matrix "ideators x group", which now included all the potential past alters for group #2790. (4) We then affiliated this latter matrix to make it a co-membership group-by-group matrix "group x group", where xij is a count of the number of ideators shared between group i and group j (in the analysis we controlled for group size). (5) On this co-membership matrix we calculated network measures (e.g., past structural holes, past degree) for group #2790. And (6) finally, we repeated this procedure for all current focal groups in our dataset (the set of ideation groups with "pasts"). By applying the procedure described above and adopting the same efficiency measure and degree measures we used for current network. Past structural holes have been measured as the ratio of past non-redundant ties to total past ties for each focal group. Past group centrality has been measured as the Freeman degree centrality of the focal group in the network of past ties (over a three-year window), normalized by group size.

Control variables: we control that the tested effects were not the spurious effect of group size, formal organization, using the measures described below:

Group Size: increasing group size at low levels would enhance group performance because of the capacities and resources of additional members. While increasing group size at higher levels may increase coordination challenges resulting in decreased performance (Hackman, 2002). We measured group size counting the number of members within the group.

Formal Group: structure of the group could affect group ideation performance. We controlled for the nature of the group, distinguishing between formally appointed

project groups and all other types of groups of a more informal type. We used a Dummy variable (1: formal group; 0: otherwise).

6. DATA ANALYSIS

Different types of data analysis were applied, based on the specific research questions investigated in the appended papers. The first two appended papers (I and II) used an Ordered Logistic Regression. In the III appended paper a two-stage regression analysis has been performed.

In the following sections Models and Econometric strategy chosen are presented per each of the three appended paper.

I e II PAPER

Model I

INDIVIDUAL CONTRIBUTIONS

Model II

GROUP LEVEL
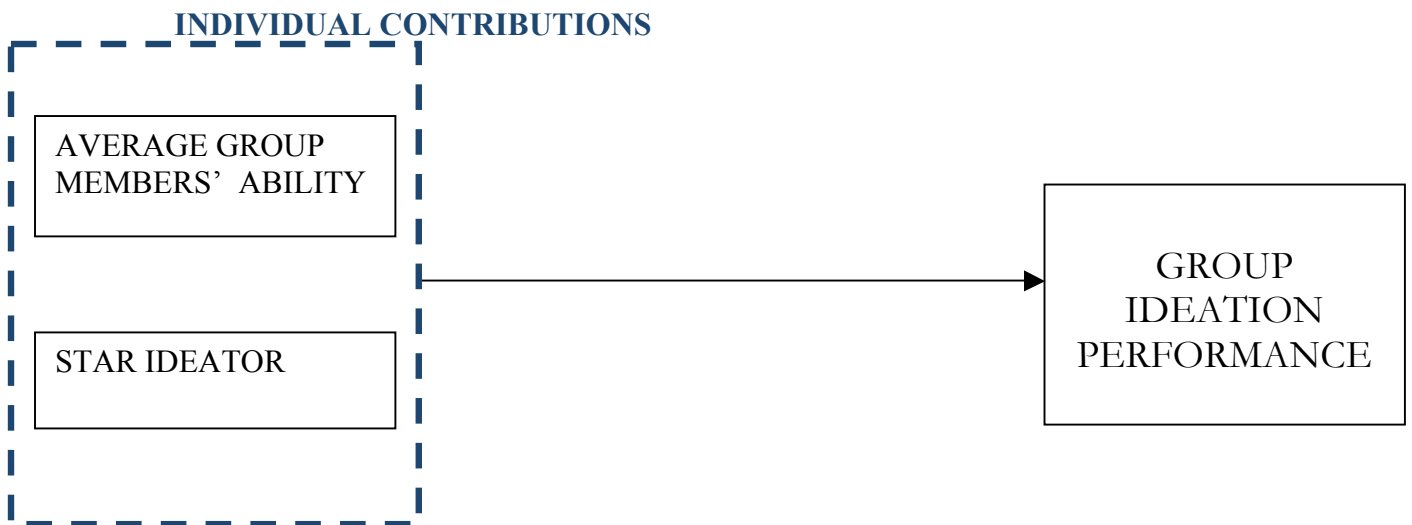
Data Analysis

In the first and second paper we tested the models depicted above with the following Ordered Logistic Regression model. Ordered Logistic Regression has been chosen because our dependent variable, group ideation performance, was bounded between 1 and 5 (Long and Freese, 2001). Furthermore, it has been chosen because data has a natural ordering (1 to 5), but the distances between adjacent levels are unknown. The structure of the econometric model used is as follows:

$$logit(Y \leq i) = \alpha_i + \beta_{i1}X_1 + \ldots + \beta_{im}X_m, \ i = 1, \ldots, k$$

Where α_i is the constant, X_i the single variable included in our models, and Y_i is the dependent variable.

III PAPER

Model III

IDEATION TEMPORARY NETWORK
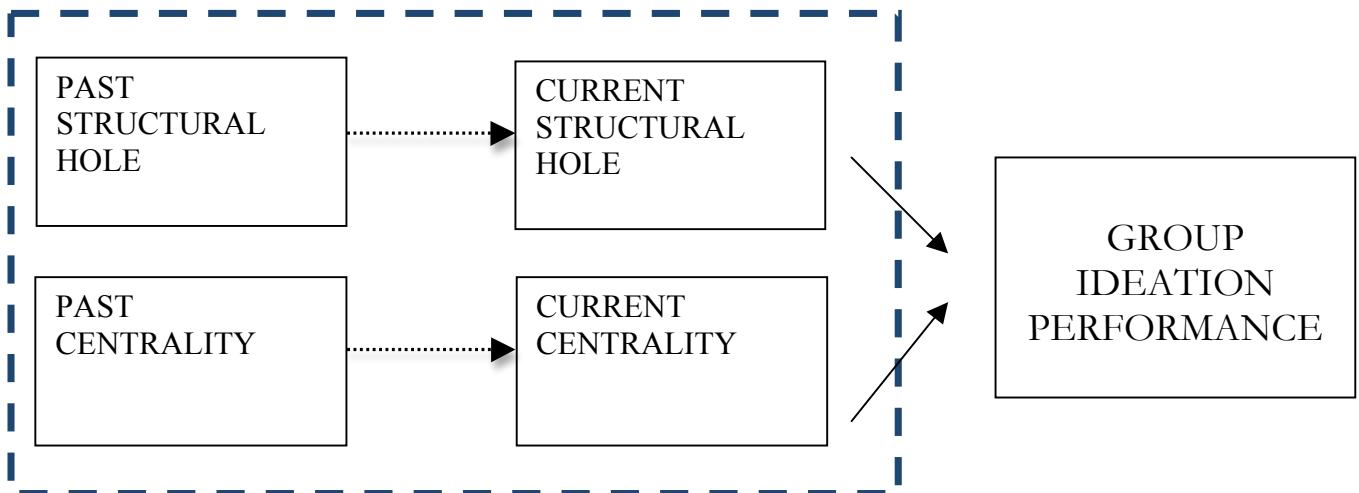
Data Analysis

The aim of the third paper was to test the effect of past network structure on current network structure and the effect of current network structure on group ideation performance. Thus the model used is a two-stage model. We used a 2SLS model with a robust variance estimator to control for the effects of correlation between errors across equations due to endogeneity between network structure and

performance. Although Baron and Kenny (1986) recommended the use of 2SLS only for controlling possible reverse causality from the outcome to the mediator, Shaver (2005) has suggested that 2SLS "is an effective estimation strategy in a much broader set of circumstances . . . even when feedback is not a concern." (2005: 1140). He recommended its use because of the power of the methodology to handle potential correlation among error terms in the equations. The 2SLS procedure takes into account such correlations and produces coefficients that are consistent and unbiased.

Although our endogenous measure of current structural holes (efficiency) is bounded (0–1) as well, Angrist and Krueger (2001) pointed out that in a two-stage procedure, it is not necessary to use limited dependent variable estimation for the first stage, even if the endogenous variable is bounded, to generate consistent estimates in the second stage.

We checked the consistency of and the appropriateness of the 2SLS modeling approach with the Wu-Hausman F-test. The test for endogeneity in which the null hypothesis states that an ordinary least squares (OLS) estimator of the equation would yield consistent estimates, and thus endogeneity among the regressors would not have deleterious effects on OLS estimates.

CHAPTER IV

SUMMARY OF THE PAPERS

The overall framework permeating the thesis is that in today's fast paced economy the role of innovation is a key driver of firm performance. This increasing attention towards the antecedents of firm innovative performance called for a more fine-grained understanding of the overall innovation process. While there is a widespread acknowledgement of the importance of the first phases of innovation, when efforts are devoted to generate and develop ideas, there is still a need to investigate ideation antecedents. Indeed, the analysis of group ideation performance is organized around three appended papers. A brief summary of the papers is presented.

The power of star ideators:
Does star ideator alone drive the success of ideas?
The virtues and limits of star ideator presence in groups.

Much work in knowledge intensive firms is collaborative, spanning the areas of expertise within the organization. Building on the basic idea that individuals can increase their chance of generating new outcomes by having access to diverse sources of information, a growing body of literature has increasingly examined creativity and ideation as a result of a social process (Perry-Smith and Shalley, 2003). Ideation achievements in fields as diverse as science, art and business ventures all exhibit a similar patter in that they all come from networks of interconnected actors who share ideas and act both as critics and supporters of each other work (Simonton, 1999; Cattani and Ferriani, 2008). These findings do not deny the role that individual creativity plays; yet this intuition suggests that individual talents and resources are mobilized and channelled in social context made up of interconnecting relations through which talents are mixed and ideas recombined. Most creative individuals are, indeed, in demands by organizations that rely on their performance to gain the competitive edge. Considering both the task contributions and the enhanced reputation that those individuals can confer to the group to which they belong, it is easy to understand the appeal that the intuition of "more is better" has had on the managerial practice, including a range of contexts like consulting firms, sport teams, and so on… More recently, researchers have begun to question these findings (Groysber et al., 2008). In contexts where people need to collaborate to some degree to perform interdependent tasks, a major concern is that stars may have trouble working together (Overbeck et al, 2005). Indeed, stars have aspirations and egos that often impede their willingness to share information, to cooperate and to perform interdependent tasks (Hambrick, 1994). When star players must interact regularly with other top talents, their performance may not sum additively into an organizational setting (Pfeffer and Sutton, 2006). Using data from a large consumer-goods company, we argue that in highly creative contexts, star presence is undoubtedly beneficial for group ideation performance, however in star-studded

groups team-working dynamics are at risk due to stars' egos and prima donna aspirations. The findings of the analysis showed that the HR philosophy of "*more is better*", i.e. creating group with an high average ideation ability, can lead to unintended collective effects. Even in highly creative environment, the effect of relying only on groups with high ideation ability on group ideation performance is positive but it increases at a decreasing rate. These results mirror the negative group-working dynamics that are likely to emerge in star-studded groups. On one hand the role of star is key for group ideation effectiveness, their presence is a key factor in the kick-off phase of ideation. However, in star-studded groups frictions emerge among members that do not allow group to fully capitalize on its own composition. This paper contributes to group dynamics and group assembly literature, offering more nuanced to the mechanisms operating within groups especially when top talented professionals are called to collaborate and cooperate on knowledge-intensive tasks.

The effect of diversity and group familiarity
on performance in ideation groups

In many contexts, ranging from product development to service delivery, a significant amount of an organization's work is conducted by fluid groups that aim to create innovative output (Edmondson and Nembhard, 2008). Fluid groups exist only for the duration of a single project and are composed of members who join and leave a group during the course of that project. The lion's share of existing literature on these groups does not attend particularly to creative work, even though there arguably are clear differences what regards effects of group diversity between work where the main objective is to integrate already existing knowledge to efficiently achieve a defined outcome and work where the focus is on generating new ideas and knowledge, respectively. We argue that when group composition tends to change over time group familiarity (Katz, 1982; Edmondson et al., 2001; Reagans et al., 2005) and group diversity (Van de Ven, 1986; Clark and Fujimoto, 1991; Ancona and Caldwell, 1992; Dougherty, 1992; Woodman, Sawyer, and Griffin, 1993; Nonaka, 1994; McDonough, 2000; Beckam et al., 2007) affect group performance in generating and developing ideas. As suggested by other researchers, extant research has focused mainly on "intact groups" without accounting for the possibility of changing group composition over time. Groups composed of members with different functional belonging can benefit from human and social capital existing within each single group member's organizational department. Affiliation diversity would therefore have a positive effect on group ideation performance through mechanisms such as increased access to new knowledge and information, facilitated interdepartmental exchanges, increased high-quality external communication and improved learning experiences (Ancona and Caldwell, 1992). Group familiarity, i.e. the degree to which group members have worked with one another in the past, increases the ability of group members to coordinate their activity effectively. Improvements in coordination could result from individuals working together, thereby learning who knows what and building mutual trust, in the end facilitating the coordination of their activities (Uzzi 1996; Edmondson, Bohmer & Pisano 2001; Edmondson et al. 2003; Reagans et al., 2005). While group familiarity allows for

deep coordination mechanisms to be embedded within groups, a high level of group familiarity could constrain group ideation ability, resulting in mechanisms that hinder the creation and development of new ideas (Skilton and Dooley, 2001). Hence, group familiarity can be assumed to have two counteracting effects on group ideation performance. On the one hand, it affects group coordination positively and makes ties between group members stronger over time, facilitating the sharing of information and knowledge. On the other hand, at higher levels of familiarity groups are likely to fail to nurture their knowledge and resources endowments with newer perspectives. We found that the effects of diversity and familiarity are both predictors of group ideation performance. Diversity in terms of functional background seems to be a requisite for increasing group ideation performance. Familiarity among group members provides means to develop group coordination mechanisms and efficient integration for task completion. However, results show that higher levels of familiarity among group members lead to lower group performance. Therefore, stable group relationships (i.e. high group familiarity) actually have a negative effect on group performance. This finding is related to group members' decreased interaction with actors outside the group, increased intragroup communication on less task relevant issues, and more limited environment scanning (Katz, 1982). These findings point out the importance for organizations aiming at enhancing innovative performance to look deeply to the potential detrimental effect of group familiarity and to focus on means to balance this effect.

Temporary Network Structure and Group ideation performance
- the effect of centrality and structural holes

Ideation is not only an individual outcome, but it is also the result of a collective process, involving interaction and collaboration among specialists in a specific social context (Barney and Zajac, 1994; Groysberg et al., 2008). It is acknowledged by the evidence that organizational contexts characterized by high rate of innovation, migrate towards more fluid, short-term flexible and network-based mechanisms governing work structure within organization (Piore and Sabel, 1984; Edmondson and Nembhard, 2008; Schwab and Miner, 2008). In this paper, a temporary network approach is developed in order to capture the overall experience and skills held by groups. Collaborative and exchange network ties facilitate tacit and explicit knowledge transfer and diffusion within complex organizations (Hansen, 1999; Singh, 2005). Network theory offers a powerful concept, that of *network degree*, in order to capture focal actor's access to and control over resources. Because of their numerous connections to others, actors in central network positions have greater access to resources. Consequently, actors who occupy more central position have access to more information and resources that have the potential to positively influence innovation performance (Sparrowe et al., 2001; Tsai, 2001). *Structural holes* are present in an actor's network of relationships when the focal actor (or "ego") is tied to others ("alters") who are not themselves connected (Burt, 1992). Actors who occupy that kind of network position are able to access different and thereby non-redundant sources of information and resources, novel communities, diverse experiences, unique resources, varying preferences and multiple thought worlds, in turn providing greater opportunities to generate good ideas and creativity (Burt, 2004). Prior network studies have typically underexplored the evolution of network as subordinate to the contingency of time. As network structures change, this could arguably affect concurrent network structure thus affecting outcomes. One objective of this research is to test the effect of past network structure on the current network structure. Focal actors tend to reproduce network structure over time. This insight suggests that a form of structural persistence characterized the evolution of organizational network structure (Walker, Kogut, and Shan, 1997; Gulati and

Gargiulo, 1999). We argue that two mechanisms influence this phenomenon we called network persistence. Positions that have proven to be efficient in the past are reproduced in the current network structure (White, 1992; Zhaeer and Soda, 2009). The focal actor tries to exploit past network structure reproducing favourable past network positions (exploitation of past network structure). More precisely, experiences and knowledge that have proven to be efficient in the past motivate and enable actors to recreate and reconfigure past network positions into future beneficial ones. In a similar vein, literature presents evidence that past network structure tends to reproduce itself though norms, rules, social pressures creating a kind of inertial forces that affect and constraint actors' behaviour (Parsons, 1951; Fleming and Waguespack, 2007) (constraint of past network structure). This reasoning suggests a strong element of stability within network structure, implying that current network structure is affected by past network structure. The findings suggest a role for the persistence of networks over time as results showed that a major inhibitor of group ideation performance was the presence of high group centrality. Lock-in with dense, overlapping ties makes it harder for focal actors to break out of redundant network structures (Giddens, 1984). On the other hand, past structural holes predict the formation of current structural holes. We characterized this as a manifestation of opportunity exploitation by the focal actor (Burt, 2004). This finding means that structural holes spanned in the past give rise to future structural holes and pointing out the strength of actor's ability to exploit the opportunities that result in positive performance. Overall, our results provide considerable evidence for the notion that those actors who are able to actively exploit the social structure and opportunities would enhance their performance, even though structural persistence -especially past network centrality- results as a major inhibitor of performance.

CHAPTER V

1. EMPIRICAL RESULTS AND MAIN CONCLUSIONS

      The main objective of the thesis is to look to different levels antecedents of group ideation performance. First, we look to the relationship between individual contributions and group ideation performance, we argue that the effect of group composition in terms of stars ideators would affect group ideation performance. Second, we look at the extent to which group demography in terms of affiliation diversity and group members' familiarity influences group ideation performance. Finally, we investigated temporary network structure and its effect on group ideation performance.

      It is not our intention to claim that those three levels are the sole determining factors affecting the generation and development of ideas by groups. However, the importance of individual contributions, group demography and network structure has been lacking in existing literature on ideation process and this study aims at filling this gap. By providing an in-depth study of the ideation process, we have not only demonstrated that group ideation process is a function of different levels antecedents, but have also shown the importance of a dynamic process that evolves over time. Specifically, our data broaden existing views related to the importance of individual contributions, group characteristics, and network positions, in the initial phase of innovation process, and extended existing insights by showing the importance of adopting a temporal perspective to group ideation performance. Building on recent advancements on group assembly (Groysberg et al., 2008; Edmondson and Nembradt, 2009) and network literature (Zaheer and Soda, 2009; Perry Smith, 2006; Burt, 2004) we have thereby gone into the tensions between different levels antecedents of group ideation performance, associated with enhanced group resources and coordination mechanisms.

Interesting findings are drawn from the three appended papers. The following sections link the results of the appended papers to the thesis research questions,

1.1 What is the effect of star ideator presence on group ideation performance? What is the effect of group ideation ability on group ideation performance?

The results of the first paper show the positive effects associated with star presence in the groups, such as higher human capital higher reputation. The presence of star is key for the 'kick-off' of the idea, his or her presence is fundamental for the human capital, and resources, competencies and skills, and reputation the star brings within the group.

Second, we distinguished between star presence within ideation group and the overall group composition in terms average ideation ability. The effect is positive, even for high levels of group ideation ability but it tends to grow up at a decreasing level due to frictions in team-working dynamics (coordination costs, conflicts, and so forth) that can make it difficult to take all from the members' ideation capabilities. Contribution of group ideation ability on group ideation performance are positive but at a decreasing rate. Nonetheless, counterintuitive mechanisms emerge when top talented professionals are called to collaborate and coordinate their activities.

Third, building on recent trends within group assembly literature we went beyond a pure individual conceptualization of star contributions (Taggar, 2002) to group ideation performance by developing and finding support for a critical perspective to star effect on group performance, that has thus far hardly been applied in the context of ideation and innovation. We developed a theoretical model, finding empirical support for it. Thereby we disentangled the effect of star presence on group ideation performance from the effect of group composition in terms of top talented professionals on group ideation performance. We contribute to the understanding of the different dynamics and mechanisms that operate at individual level and to the group level. Lastly, we improved classic 'HR philosophy' of '*more is better*' that is based on the assumption that assembling stars within a group is directly and solely beneficial for group performance.

1. 2. What is the effect of affiliation diversity on group ideation performance? What is the effect of group familiarity on group ideation performance?

We found that the effects of diversity and familiarity are both predictors of group ideation performance. Diversity in terms of functional background seems to be

a requisite for increasing group ideation performance. Cross-functionality provides the opportunity for integration of critical information, through processes such as increased access to new valuable knowledge and information, higher-quality learning experience, increased inter-departmental resource transfer and sharing. In most successful groups members access not only self-contained information, form their functional background but also knowledge from external personal networks (Keller, 2001). As a result the group become informed of less redundant and more diverse knowledge and perspective increasing group ideation effectiveness. The hope of cross-functionality is that membership diversity will foster creative tensions. In order to realize its benefit diversity implies mechanisms of coordination and collaboration.

Related to the above, we found that group familiarity –i.e. the degree to which group members have worked with one another in the past- yield superior performance. Because of shared experience, individuals develop group human capital, group familiarity fosters learning and intragroup coordination. Finally, group familiarity is likely to increase communication intensity around the ideas. Lacking group longevity, groups experience greater difficulty recognizing and integrating their knowledge for efficient task completion and are subject to greater disruption (Weick, 1993).

Third, findings show that group familiarity effect on group ideation performance presents an invertedly U-shaped effect. In line with the finding of Katz (1982) there is a curvilinear relationship between group familiarity and performance in which performance initially improves and then declines as group familiarity increases. We relate this findings to mechanisms of group closure: for instance, group members' decreased interaction with actors outside the group, increased intragroup communication on less task relevant issues, and more limited environment scanning.

Fourth, we extend existing literature proposing a theoretical framework that built on the need for diversity, and familiarity and that investigate their effect on group ideation performance through a longitudinal lens.

Lastly, we used group membership data and verified a way to assess group members' familiarity contributing to methodological literature in the group composition literature.

1.3. What is the effect of group centrality on group ideation performance? What is the effect of holding a position rich in structural holes on group ideation performance?

First, group network degree centrality affects negatively group ideation performance. The explanation for this result rests on the evidence that high group network centrality means that the focal group has many connections with other groups in the concurrent network structure. Groups with high network centrality suffer form being in a way constrained by the network structure (Uzzi, 1997). The high network cohesion resulting form their patterns of connections in a major inhibitor of ideation ability as it is embedded in a dense web of interconnected ties.

Second, the results showed that the presence of structural holes affects positively group ideation performance. This evidence supports the proposed hypothesis and the positive effect found corroborate the network theory that stresses the privileged position of those bridging holes within the network as those actors maintain control benefits over resources that flow within the network structure (Burt, 1992; 2004). Moreover, the benefits of structural holes operate through mechanisms of brokerage, information asymmetries among disconnected alters (Fleming and Waguespack, 2007). In the context of the ideation network, aggregating information from several different alters enable focal group to exploit its knowledge and resources endowment, thus nurturing idea creation and development. Furthermore, our results reveal that network structure tends to reproduce over time and to maintain stability over time.

Third, we disentangled the effect of two competing network mechanisms: network constraint, associated with dense, overlapping ties makes it harder for focal actors to break out of redundant network structures (Giddens, 1984), and network exploitation, associated with exposure to novel information and different knowledge and resources (Burt, 2004). Network theory is confronted with a double competing perspective. One stream of study (Burt, 1992; 2004) points out the benefit of structural hole in generating high creative performance. In contrast to this view a competing perspective has been proposed by those researcher that highlight the

potential benefit associated with dense network structure (Ahuja, 2000) and with more central position (Tsai, 2001). The empirical results in this study enhance the structural hole argument. More specifically, this result shows that ideation performance is related to group network position and specifically ideation is related to groups spanning structural holes. This finding contributes to the debate in network theory about network-based performance antecedents, and this points out to the need to be aware in generalizing results coming out a single result. This debate seems hitherto open.

1.4. What is the effect of past network structure on current network structure?

In this study, we offered and tested a theoretical perspective that encompasses opportunity exploitation and structural persistence as underlying drivers of network degree and structural holes and their performance outcomes. We showed that network actors are presented regularly with opportunities thanks to and constraints due to their positions in the prior social structure. The opportunities created by networks are not just linked concurrently with favourable outcomes at a point in time but project their shadow over the evolution of network structure. Thus past networks provide actors with experiences, social contexts, and access to knowledge and resources that are opportunities enabling or obstacles constraining actors to enact future structures. Our deep investigation of a specific organizational context reveals that network structures emerge as the result of forces (exploitation and constraint) that include both the replication of past social interactions.

In brief, our results show that past group centrality leads to current group centrality and past structural holes lead to the formation of structural holes in future networks, too. Furthermore, we showed that groups exploit their network position affecting group performance.

Our explanation of opportunity exploitation and structural persistence are not necessarily in opposition to each other. Our overarching theoretical framework included both constraint and opportunities arising from structural persistence. We showed that actors exploit actively the opportunities related to structural

characteristics of past network structure in enacting the processes that culminate in the creation of future networks and specifically in the achievement of superior network positions for themselves (Nohria, 1992). At the same time, by virtue of inertia and constraint, highly embedded structures from the past limit the focal actor's ability to transform past network positions into valuable current network structures.

The findings on the effect of past group centrality suggest a role for the persistence of networks over time as results showed that a major inhibitor of group ideation performance was the presence of high group centrality. Lock-in with dense, overlapping ties makes it harder for focal actors to break out of redundant network structures (Giddens, 1984). Groups with high group centrality in the past will tend to find themselves in tightly linked structures in subsequent periods because future groups will tend to replicate previous positions, resulting in fewer structural holes for the focal group by virtue of structural persistence and lower ideation performance, too.

A central element of the framework developed here points to the role of past structural holes that predict the formation of current structural holes. We characterized this as a manifestation of opportunity exploitation by the focal actor (Burt, 2004). This idea implies a purposeful reactivation of favourable past structures. This finding means that structural holes spanned in the past give rise to future structural holes and pointing out the strength of actor's ability to exploit the opportunities that result in positive performance.

Overall, our results provide considerable evidence for the notion that those actors who are able to actively exploit the social structure and opportunities would enhance their performance, even though structural persistence -especially past network centrality- results as a major inhibitor of performance.

2. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The research aim of this study has been to reconcile different streams of literature, by developing and testing a framework that concentrates on different levels antecedents of group ideation performance. We will be the last to claim that individual contributions, group characteristics and network structure are the sole determining factors affecting the generation and development of ideas. As noted, received theory has been characterized by tensions between mechanisms operating at the three levels of analysis –individual, group and network level. This research has contributed to enlighten the observed theoretical inconsistencies in the literature. However, like any study our has limitations, and one should be careful in generalizing the results.

First, the most obvious imitation is that we look to a single step of the innovation process, namely the first phase in which ideas are generated and developed. The research design and time required to collect the data left us a few options. The choice of focusing on a single step of the innovation process was motivated by the research aim of this study, that is to investigate the antecedents of ideation performance.

A second limitation was that data was collected within a single firm. This has clear implications for external validity of the findings. For instance, we do not assess to what extent the findings found in this study are influenced by the industry in which the firm operated, its organizational structure, the design of the review process or the organizational culture. Future research could thus extend the framework conducting the research in different firms and in different industry. However, as the research aim of this study was to assess ideation process this approach was valid.

A third limitation is that we account for affiliation diversity, without analyzing the effect of other types of diversity (e.g. age, gender, tenure,…) on group ideation performance. However, we have theorized that cross-functionality of groups is one of the major indicators of the richness of information and perspectives necessary for idea generation and development. Future research could account for the effect of different types of diversity on group ideation performance.

Another limitation of the study is that we analyzed exclusively ideation ties, and do not include in the analysis other types of relations, for instance

communication or knowledge sharing relationships. However, one of the aims of the study is to describe the effect of ideation network surrounding groups on ideation performance. Thus, relations generating ideas are the main focus of this study. Nonetheless, future research would deepen our understanding of network effect on ideation investigating different network contents, for instance communication networks or friendship network, and their impact on ideation network and performance. This kind of investigation would contribute to further understand the process leading to idea generation.

A final limitation of this study relates the measure of group ideation performance. The present study uses an evaluation made by the company based on one-dimensional scale of novelty and usefulness of each idea. It would have been better if those two measures were split in two different indexes. However, observation of the grading process acknowledged that committee puts great efforts into the evaluation of each idea. Another solution would be to follow ideas at later stages of their organizational life, or create other performance index either patent-based or indicating market value of the idea. Future research would investigate how ideas move within organization across different stages of idea organizational life (idea, prototype, product) (Kijkuit and van den Ende, 2007). As suggested by Kijkuit and van den Ende (2007) framework, most effective network structure surrounding ideas change from idea generation to selection. This type of evolutionary investigation is needed. This study was an attempt to offer a more longitudinal perspective of ideation. Future research would continue along this way with more longitudinal network examination of ideation.

Furthermore, this study looks in a rather 'general' way to ideas, as they were categorized within a single category. Indeed, this research does not empirically address differences that can be found in the types of ideas created. Future studies could of course investigate deeply the different categories of ideas generated. We do for example not account for possible differences between specific types of ideas, knowledge and resources. For instance, developing deep technological knowledge might be different from developing new business ideas. These different ideation activities are likely to require different group characteristics and different network patterns. More research is needed to investigate such differences. Furthermore,

different types of ideas would affect the structure of group ego network and conversely affect overall network dynamics. Therefore, a more comprehensive understanding of this phenomenon is needed and it may arise form the combination of a network dynamic perspective together with that investigating the processes of group formation and, more broadly, on group dynamics.

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PAPER I

The power of star ideators:
Does star ideator alone drive the success of ideas?
The virtues and limits of star ideator presence in groups.

Mario Losito
Dept. Management & Economics
LUISS Guido Carli, University
00198 Rome, Italy
mlosito@luiss.it

Does group performance benefit by aggregating high skilled members? Though an affirmative answer seems the most plausible, this study offers a more critical view on the relationship between stars assembly within a group and group performance, especially when group members collaborate only occasionally on interdependent and creative tasks. Examining group idea projects within a large consumer-goods company in which each groups strives for resources, we find that groups benefit from aggregating stars but this positive effect yield decreasing returns. Control variables assure that these findings are not a spurious effect of group size, formal organization, or group heterogeneity. Theoretical implications for group dynamics literature are discussed, and we draw interesting managerial implications especially for strategic human resources management.

Keywords: Star presence, Group assembly, Ideation performance.

1. Introduction

Creative efforts permeate the first phases of the innovation process within firms. The phase in which new ideas are originated is considered important for firm performance, due to its impact on the whole innovation process.
Building on the basic idea that creative ideas are sparked by imaginative and uniquely gifted individuals, extant research has drawn tight boundaries around the "self" as the privileged locus of inquiry (Taggar, 2002; Montuori and Purser 1996; Ford, 1996; Mumford and Gustafson, 1988). Individual contributions do provide the raw material for novel and useful ideas. However, despite a well established tradition that portrays individual creativity as a rather mysterious generative process occurring in the mind of the lonely genius, a growing body of research in the field of sociology has demonstrated that creativity is very often embedded within the broader social structure that shapes access to resources and social support (Hargandon and Bechky, 2006). Much work in knowledge intensive firms is collaborative, spanning the areas of expertise within the organization. Building on the basic idea that individuals can increase their chance of generating new outcomes by having access to diverse sources of information, a growing body of literature has increasingly examined

creativity as a result of a social process (Perry-Smith and Shalley, 2003). Creative achievements in fields as diverse as science, art and business ventures all exhibit a similar patter in that they all come from networks of interconnected actors who share ideas and act both as critics and supporters of each other work (Simonton, 1999; Cattani and Ferriani, 2008). These findings do not deny the role that individual creativity plays; yet this intuition suggests that individual talents and resources are mobilized and channelled in social context made up of interconnecting relations through which talents are mixed and ideas recombined.

The impact of top talented professionals (stars) on team performance has been the object of a growing body of organizational research. Previous studies dealing with the effect of star presence on group performance rest on the positive hypothesis of the stars' central role as sources of intellectual capital and for their own knowledge endowment (Zucker and Darby, 2007). Most creative individuals are, indeed, in demands by organizations that rely on their performance to gain the competitive edge. Considering both the task contributions and the enhanced reputation that those individuals can confer to the group to which they belong, it is easy to understand the appeal that the intuition of "more is better" has had on the managerial practice, including a range of contexts like consulting firms, sport teams, film crews, academic departments, start-up business and so forth.

The more top talented persons are the more performance should benefit of their presence. This intuition is apparently widespread among managers, assuming that a group is well designed to succeed when the best performers work together (Boyontan and Fischer, 2005).

More recently, researchers have begun to question these findings (Groysber et al., 2008). In context where people need to collaborate to some degree to perform interdependent tasks, a major concern is that stars may have trouble working together (Overbeck et al, 2005). Stars have aspirations and egos that often impede their willingness to share information, to cooperate and to perform interdependent tasks (Hambrick, 1994). Looking deeply to the personal frictions emerging among stars, one could be concerned by the evidence that the effectiveness of the whole group could be less than the sum of its parts. Once a group has been designed only with stars, there could be also decreasing returns to group performance. Accordingly, when star players must interact regularly with other top talents, their performance may not sum additively into an organizational setting (Pfeffer and Sutton, 2006).

The purpose of this study is to formulate and test hypothesis about the efficacy of assembling groups with star individual performers in the hope of increasing group effectiveness. Accordingly, looking to an highly creative context, the argument put forward is that star presence is undoubtedly beneficial for creative performance, while in star-studded groups team-working dynamics are at risk due to stars' egos and prima donna aspirations. Group and individual dynamics tend to follow different patterns. In the next sections, first we theoretically situate the study and then develop specific hypothesis about how the group composition in terms of stars influence group performance. Connections between the literature on group dynamics and individual reputation have been explored. In doing so, the empirical analysis relied on a sample of individual workers that had been involved in a project for idea creation within a large consumer-goods company, contributing empirical evidence supporting the hypothesis.

2. Ideation performance in groups

In the today fast-paced economy, resources and expertise are often distributed among individuals, and groups are an increasingly common way for organizations to capitalize on the knowledge and expertise of their employees to produce highly innovative outputs (Rulke and Galaskiewicz, 2000). A significant amount of an organization's work is conduct by *fluid groups*. Fluid Groups exist only for the duration of a single project and are composed of members who leave the team at the end of the project (Edmondson and Nembhard, 2008). During the duration of the project, individual work becomes increasingly interdependent. When task interdependence among group members is high, group members need to integrate their own work. The greater the need for integrating individual tasks the greater will be the potential for the group to benefit from collaboration and the greater will be also group performance (Thompson, 1967; Wageman, 2001). Group composition often impacts on the ability to integrate effectively each member works (Hambrick, 1994). Organizational studies abound of findings about the impact of different types of group composition on group performance. Dealing with the problem of the team composition, several dimensions have taken into account, including some studies that examine group members' individual skills and abilities (West and Allen, 1997), together with other studies examining demographic and functional heterogeneity on group performance (Ancona and Caldwell, 1992). This study takes into account the fact that much work in knowledge-intensive task tends to be collaborative. We explore how group composition in terms of stars impact on group achievements. Against the managerial practice of hiring the best performers in the field, the aim of this research is to consider how group composition in terms of stars (best performer individuals) will affect group performance. This study contributes to understanding an important dimension of managing key human resources of a firm. We distinguish the effect of individual and group dynamics on group performance, disentangling the effect of the presence of a star versus the group ideation ability, thus offering a more nuanced understanding of the ideation dynamics playing within ideation groups.

2.1. Group Ideation Ability and Group Performance
In highly creative works, the performance of groups and individuals is to some extant function of the quality of people working within the group (Barney and Zajac, 1994). Scholars who conceptualize firms as a knowledge-creating organizations (Nonaka, 1994; Grant, 1996) emphasize that individuals draw on their colleagues as resources for creating and developing ideas that ultimately enhance firm's success and capabilities. Individuals are regarded as a crucial knowledge asset, in knowledge-intensive environment human capitals is far more important than other resources, such as physical and financial capital (Starbuck, 1992). Individual colleagues are a vital organizational resource on which individuals rely on for information, knowledge and consensus. Having access to superior sources of knowledge and reputation, in the form of high-quality group colleagues, support group performance. Tziner and Eden (1985) found that each members' ability influence group performance depending on the average ability of other colleagues. Specifically, they found that high skilled members reach higher results if they work with uniformly high skilled members than when working with lower skilled colleagues. Working

with high skilled colleagues motivates people to increase both their self-esteem and the informal esteem received by their colleagues striving to show off their best abilities and skills (Zuckerman, 1967). Working with high ability colleagues, who offer information and knowledge cues, stimulates others in generating highly creative ideas (Allison and Long, 1990). Working with skilled colleagues allows knowledge workers to broaden their range of skills and competencies, enhancing their contributions to the group. Groups made up of highly skilled members, primarily can rely on other members' knowledge, experience and abilities. Stars' contributions could directly increase group performance through the knowledge and information cues they put in everyday group life. Besides, stars drive success also indirectly by enhancing group positive standing in the eyes of external constituencies. Groups competing for resources need to increase their reputation as high performing groups, and the simplest and clearer way to do this is by assembling together stars with a positive tracked history of past performance (Elberse, 2007).

The "HR philosophy" of making up groups assembling together highly skilled members rests on the positive assumption that "more is better", i.e. assembling groups with stars (best performers) will automatically reverse in highly positive group performance. More recently, the findings of Groysberg and colleagues (2008) open up a new way of viewing the cumulative benefit of aggregating stars within the same group. They found that aggregating stars within the same group might be detrimental for the group achievement. There are several motives to believe, also, that aggregating high skilled members gives little to group performance enhancement. In Star-studded groups, in which too many stars co-exist, it is more likely that dysfunctional group dynamics may emerge, that can prevent the group working as a whole and succeed (Hambrick, 1994). Star-studded groups are groups where most of the members display high reputation, high self-efficacy, and beliefs on self-control (Blain and Cocker, 1993). In context full of stars it's easy that experts have different opinions and viewpoints that end up in problems of coordination and conflicts among colleagues. Stars tend to care much more to their own personal performance relative to other group members, instead of caring about the overall group performance relative to other groups (Overbeck et al., 2005). Stars have their own egos and prima donnas' aspirations that may hinder them for being willing to share information with their colleagues.

The effect of simply aggregating stars within the same group is somewhat mixed. As shown, there are reasons to believe that more stars enhance group performance creating a positive climate within the group, but there are also other reasons to believe that the effect of the simple aggregation of too much stars within the same group may be detrimental for group performance.

We define *group ideation ability* as the average ideation ability presents within the group, based on each member past ideation performance. Group (average) ideation capability summarizes each group members' ability in generating ideas. Tracing each group member past ideation performance, we are able to measure individual history of past ideation performance. The context of analysis is a well-suited site to test the effect of *group ideation ability* on group performance (Tziner and Eden (1985) largely attribute their findings to the particular nature of the task at hand. As in settings of military tank crews, the process of idea production is complex, requires a close synchronization and is difficult to evaluate in isolation (Elberse, 2007)). Each group has the task of generating novel and useful ideas, starting with a more

conservative view the average *ideation ability* within the group should impact positively on group performance. The creative efforts, that each group member has to lavish, give rise to group ideas. In this context in highly ability groups, increasing group performance are more likely to appear rather than decreasing one. An underlying promise is that stars tend to aggregate in the hope that their joint abilities will result in higher group performance.

However, as discussed above, this widespread hope is often countervailed by the coordination problems and personal conflicts that arise in the working context. Instead of thinking at the relationship between group ideation performance and group ideation ability as a linear positive relationship, this relationship is conceptualized as a non-monotonic relationship. The contribution of group ideation ability on group ideation performance will be positive but at a decreasing rate. The effect is positive, even for high levels of group ideation ability but it tends to grow up at a decreasing level due to frictions in team-working dynamics (coordination costs, conflicts, and so forth) that can make it difficult to take all from the members' ideation capabilities.

> H.1: *Group ideation ability influences group ideation performance positively, but at a decreasing rate*.

2.2. Hiring Stars and Group Performance

The role of stars on the performance of their group is a general theme in organizational studies on group dynamics (Weick and Roberts, 1993; Hargadon and Behky, 2006). Accordingly, a growing stream of research in organizational studies tries to capture what is the effect of hiring stars on group creative achievements (Groysberg et al., 2008). Individuals often benefit from working with talented colleagues, this is proven to be particularly true in knowledge intensive tasks (Cummings and Oldham, 1997). The basic argument is drawn from human capital literature (Becker, 1975). Groups relying on star ideator presence benefit of their talent. Two factors distinguish star ideators form average or merely competent colleagues. First, star ideators are disproportionately more productive. Studies on researchers involved in research and development tasks have found that those who are at the very top of the talented distribution are far more productive than the less talented colleagues (Narin and Breitzman, 1995). In ideation tasks, the ability and skills being brought within the group by the top performer cannot be replaced by a larger number of poorer performers, or by nonhuman assets (Narin, 1993). Knowledge work is often organized in project teams, requiring close collaboration among group members. It means that individual tasks are interdependent and group members tend to rely on each other work. Accordingly, top talented individual performer should boost their group performance, through their own contributions in terms of superior experience, ability and skills. Furthermore, the performance benefit of hiring stars within the group extends far beyond the simple separate contribution of his/her personal skills and ability. A positive multiplicative effect comes from the forces pulling other lower performers' abilities and skills. Star member presence puts production pressure on other group members (Elberse, 2007). The presence of a top individual performer within a group requires that also other low skilled members improve their own performance, as they are working with more knowledgeable and skilled colleague.

Second star ideators are far more visible in their work than ordinary performers (Groysberg et al., 2008). Highly talented individuals enjoy more reputational cues and are in a better position to collect the necessary resources to accomplish their own work (Darby and Zucker, 1996). The star presence helps the group to which they belong to secure materials but also implicit resources needed to perform better (Groysberg and Lee, 2008). Star performers' visibility increases group's reputational advantage creating an halo effect on subsequent evaluations. Stars are prominent in the eyes of external actors (Anderson et al., 2001) who also tend to associate the person –i.e. the star– with the group. The presence of a star within a group enhances that group visibility, in turn increasing the group's chances to access the resources (material, financial, support, legitimization…) needed to succeed.

According to these two mechanisms (*productivity effect* and *reputation halo effect*), the presence of a star within the group is a facilitating condition for the kick off of the idea. In the creative moment the star ideator spills over to the group idea, not only his own experience, or skills but also, and especially, his own reputation and visibility. This halo effect allows the idea to be recognized and legitimized within the organization. It means that the ideas issued by groups with the presence of a star ideator are more likely to obtain positive evaluation from external constituencies. Ideas are validated by the presence of a star ideator.

> H.2: *The presence of a Star ideator within a group influences positively its performance.*

3. Empirical setting & Methodology

3.1. Research setting

The data used to perform the empirical part of the analysis of this study come from a large consumer-goods company that has implemented for a long period an IT-based framework to incentive people contributing to the development of new ideas within the company and to track record of ideas generated within the firm.

We had access to the company database in which ideas were stored, and we collected a quite amount of deep information both about ideas and also about people contributing to the process of idea development.

Given the access to the idea database from the company, it represents a well-suited context where testing our hypothesis about the effect of star assembly on group ideation performance. The market for ideas that we observed within the company is an instructive context where to analyze the impact of star presence and of group ideation ability on group creative performance. First, groups strive to have the best resources to maximize their own output, which makes –as highlight before– the star presence an essential prerequisite for group ideation performance (both in terms of productivity and reputational effects). Second, the idea creation projects represent a context, which involves a high degree of experimentation and the complex task of coordinating and assembling contributions of different professionals. Finally, the idea that star performers can boost creativity and so group performance is a deeply engrained belief within idea management. This "ideation context" appears to be an ideal test case.

After a careful investigation of the database and deep interviews with some managers within the firm, we decided to use for the analysis the ideas generated during the year 2006.

Ideas are generated both by single person and by groups. We restricted the analysis to group ideas only. The total amount of ideas generated in 2006 was 625, of which 402 by individuals and 223 by groups. A committee had carefully graded each innovation idea on a five-points scale; this evaluation had been based on the usefulness and novelty of each idea.

As the aim of this study is to detect the effect of star assembly (group ideation capability and star presence) on group ideation performance, we retained only ideas generated by groups. Per each group ideas we had to collect information about past history of ideation performance realized by each single employees. We decided to look backward, to the tracked history of past individual's performance, since 2004. Each employee could work in more than one idea each single year of investigation, moreover groups do have dotted boundaries which allow the group to be fluid to accept new entrants, besides at the end of the process of idea creation (i.e. when ideas have been submitted to the committee for the evaluation) the group is likely to dissolve.

Per each ideas we had quite deep data, that allowed to control that the tested effects was not the spurious effect of group functional heterogeneity, group formal organization or group size.

4.2. Measures

Dependent variable
Group ideation performance
The dependent variable of this study consists of the grade of each idea. The 223 group ideas we retained for the analysis represent the observations we had for the empirical analysis. For each idea we had the five-points grade received by the committee that summarized the novelty and usefulness of each idea. The mean value of the dependent variable is: 1.83. It represents a generally agreed upon proxy for organizational creativity (view Amabile et al., 2002). The variable group ideation performance is designed to take the value of 1 when ideas are rated as not innovative, and value of 5 if the idea has been rated as both highly innovative and feasible.

Independent variables
- Group ideation ability
Each group presents its own ideation capability endowment. This variable has been designed to measure the degree of highly inventive individuals within group. We operazionalized group ideation ability using the previous two years performance of each persons, and then summed across all grades of ideas in which each individual worked. After that we aggregated this values at the group level, considering the individuals composing the group. For instance, if group IDEA was composed of two memebres: A and B. Let's say that A in 2004 and 2005 worked on two ideas graded both 4 and B on only one idea graded 3. The overall group ideation ability for IDEA is $3.5=((4+4)/2 + 3/1)/2$ (i.e. group size).

To test the hypothesis of a log linear effect of group (idea) degree of starness on performance I used the logarithmic transformation of degree of starness.

- *Star Ideator Presence*

To measure the number of star ideators within the group, first of all we had to define a threshold level above which we had the star ideators.

- *Star threshold level*

We defined a cut-point looking at the distribution of each individual past performance (previous two years). The level has been defined at 15 (min 0 - max 36). In the whole 223 ideas, which are the whole observations we used, seventies have at least one star ideator within the group (in reality, only one group has 2 star ideators). The overall population of stars is of 8 persons on 278 persons.

- *Number of ideators*

After having defined and extracted the star ideators (those with a reputation of being highly inventive) from the overall population and counted their number per each of the 223 ideas. Then I calculated the ratio of star ideators within the group (number of stars/group size). Because the variable values are censored between 0 and 1, we used a logistic transformation as per convention (Fleiss 1981).

Control variables
- Group Size: we measured group size counting the number of members within the group.
- Functional Heterogeneity: we used Blau's (1970) heterogeneity index to measure the dispersion across functions. We computed the Blau's index in each of the 223 group in year 2006
- Formal Group: we controlled also for the formal structure of the group. We used a Dummy variable (1: formal group; 0: otherwise).

4.3. Model Specification

We tested our hypothesis with the following Ordered Logistic Regression model, which we used because our dependent variable, group ideation performance, was bounded between 1 and 5 (Long and Freese, 2001).

Data has a natural ordering (1 to 5), but the distances between adjacent levels are unknown. The structure of the econometric model used is as follows:

$$logit(Y \leq i) = \alpha_i + \beta_{i1}X_1 + ... + \beta_{im}X_m, \ i = 1,...,k$$

Where α_i is the constant, X_i the single variable included in our models, and Y_i is the dependent variable.

5. Results

Table 1 presents the univariate descriptive statistics and correlations between variables.

Table 2 reports the results of the Ordered logit model. In the model we tested whether the star presence within the group has a positive effect on group performance (H1), and whether the group ideation ability has a log-linear effect on group ideation performance (H2). For both hypotheses we had significant effects. We found that the coefficient of Group ideation ability is positive and significant ($p<.05$), meaning that the effect of the overall group ideation ability on the group performance is positive, but it presents decreasing returns. The presence of star ideator within the group has a postive effect on group ideation, and the effect is also significant ($p<.10$). Both H1 and H2 are supported. In this model the Psuedo R^2 is a substitute of the well known R^2 index in OLS regression. The low value of the Pseudo R^2 of the model means that only the model explains a small portion of the variance of the dependent variable. However, it is acknowledged that Pseudo R^2 in Ordered Logistic regression have difficult to interpret value (Long and Freese, 2001).

Table. 1 Means, Standard Deviation and Correlation among Variables

No	Types	Variables	Obs	Mean	Std. dev.	1	2	3	4	5	6
1	Dependent	Group Performance	223	1.83	0.79	1.00					
2	Independent	Group Ideation Ability	223	0.95	0.44	0.102	1.00				
3	Independent	Star Ideator Presence	223	0.35	0.47	0.057	0.201	1.00			
4	Control	Functional Heterogeneity	223	0.48	0.54	0.025	0.095	0.016	1.00		
5	Control	Group Size	223	2.69	0.86	-0.013	-0.045	-0.272	0.159	1.00	
6	Control	Formal Dummy	223	0.58	0.49	-0.029	0.127	0.043	0.173	0.178	1.

Table. 2 Results: Ordered Logistic Regression

Independent Variables	Coef.
Group Ideation Ability	0.623**
Star Ideator Presence	0.519*
Functional Heterogeneity	0.135
Group Size	0.029
Formal Dummy	-0.299
No. Obs	223
Pseudo R^2	1.41%

** Significant at P<0.05

* Significant at P<0.10

6. Discussion and conclusions

The paper has two main findings. First, we tested that star ideator presence has a positive effect on group ideation ability. We found support for this hypothesis. Presence of a star ideator seems a key for effective group ideation ability. The star is the person who with high human and capital brings to the group the resources and reputation needed to generate ad develop highly creative ideas.

Second, we tested that group average ideation ability has a positive, but decreasing effect, on group ideation performance. We found support also for this hypothesis.

Those two results shed new light on the effect of star ideator presence and group average ideation ability on group performance.

The phase in which ideas are generated is considered a fundamental phase of innovative efforts, because of its impact on innovative activities (Day et al., 1994).

However, the widespread hope among managers that grouping together high skilled and high ability members will reverse automatically in group performance enhancement, has been recently questioned. Certainly, having talented individuals is important. But focusing on individuals alone without ever questioning that assumption might also lead to unwanted consequences. Particularly when star players are required to interact and coordinate their work with other top talents, their performance may simply not factor additively (Pfeffer and Sutton, 2006). This study is an attempt to understand the effect of assembling group with too much stars and its effect on organizational performance. Using data from a large consumer-goods company we found that group performance are predicted by the composition of groups in terms of stars. We interpret our findings in light of two theoretical mechanisms. First, the findings add to the research literature on group composition. Previous studies that have analyzed the group performance as function of group composition, have conceptualized the latter in terms of demographic characteristics, functional belonging, educational background. Focusing on dimension of individual past effectiveness in ideation performance, we offer a new way of looking at the group composition (in terms o stars) on group performance.

The findings of the analysis showed that the HR philosophy of "*more is better*", i.e. hiring stars, can lead to unintended collective effects. Even in highly creative environment, the effect of relying only on groups with high ideation ability on group ideation performance is positive but it increases at a decreasing rate. These results account for the counterintuitive team-working dynamics that are likely to emerge in star-studded groups. While some leaders might think that there is no such thing as having too many stars, this study found a log-linear relationship between group ideation ability and overall ideation performance. The findings of the study allow to speculate that having a star help, have a few more doesn't hurt but it helps little to generate good ideas. Frictions emerge among members that do not allow group to fully capitalize on its own composition. When a group is filled with individual stars, the dynamics degenerate because people devote excessive attention to the internal reputation game and competition among each other and hesitate to share information that may help the group as a whole to enhance performance, but will threaten their standing in the group. Put it simply, in star-studded groups people focus on what is best for themselves, see other top performers as people who are in the way rather

than people they should help, and the overall performance of the team seems less important.

The second mechanism, we accounted for, shows that the presence of a star ideator within the group allows the group to increase its own performance.

We contribute to group dynamics and group assembly research focusing on individual dynamics within the group. The presence of the star-ideator is fundamental in the first phases of the process of ideation. The presence of high ability individual facilitates the kick-off of the idea creation process.

Further research on group assembly and group dynamics research should account for the two mechanisms (one referring at the group level and the other at the individual level) that operate at different moments in the ideation process. While the presence of a highly ideative person is a key factor in the kick-off phase of ideation, in the ongoing phases of the process groups have to be formed maintaining the right mix of members, looking at the possible detrimental effects related to the presence of too much stars. The disproportionate presence of stars within a group will result in little performance enhancement, because the group is already equipped with the necessary skills and abilities to produce novel and fruitful ideas.

Managerial implications

The current findings have important practical implications especially for strategic human resources management. Put simply, sometimes managers are attracted by the blind pursuit of the aggregating only top talented players moved by the belief that aggregating best performers will automatically increase the performance of the group to which they belong. Our findings imply that managers attempting to assemble high performing groups sometimes overspend in recruiting the top talented persons. Top professionals have very high salaries and do not bring the corresponding value to the group. Each star is supposed to bring within the group his/her own human capital, made up of knowledge, previous experience, connection within the firm, reputation derived from an history of past success, that will enhance group ideation ability. The findings show that each additional stars contribute to the group less than the previous one. When the proportion of stars reaches extremely high levels negative team-working dynamics -like difficulties in work coordination and cooperation, interpersonal conflicts- will shadow the positive effect of too much stars within the group. For star-studded groups managers should be aware of the potentially detrimental effects of clashing egos, and should be alert to avoid the pitfall of too many stars we found in ideation groups.

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PAPER II

The effect of diversity and group familiarity on performance in ideation groups

Mario Losito[1] and Mats Magnusson[2]

[1]*PhD Student, Management Dpt. LUISS University, Rome, Italy (mlosito@luiss.it)*
[2] *Professor, IPD, School of Industrial Engineering and Management, KTH Royal Institute of Technology, Stockholm, Sweden (matsmag@kth.se)*

Abstract
The main part of the literature on groups within organizations is based on the assumption that groups are stable over time in their membership. In practice, however, this stability is rare, as the composition of groups often change over time and between projects. In this paper, we use data from a Swedish manufacturing firm to explore what is the effect of changes in group composition on group ideation performance. The aim of this study is to attend longitudinally to the factors related to group composition that directly and jointly influence groups' creative outcomes. The results of the study extend what has been observed in previous research about the relationships between group collaboration, diversity, and creativity. More particularly, this study reinforces previous findings that groups characterized by certain levels of diversity tend to be more creative. Moreover, the results provide new nuances to how different factors related to group composition, including changes to groups over time, moderate ideation performance.

Keywords: Innovation, ideas, group ideation, group composition, diversity, group familiarity

1. Introduction

Groups including multiple professions and their associated multiple skill sets are beneficial or even essential to organizations today. In many contexts, ranging from product development to service delivery, a significant amount of an organization's work is conducted by fluid groups that aim to create innovative output (Edmondson and Nembhard, 2008). Fluid groups exist only for the duration of a single project and are composed of members who join and leave a group during the course of that project. In contexts characterized by such fluidity, where changes in group composition are substantial over time, management studies call for a deeper understanding of the factors that capture the overall group experience and skills. In knowledge-intensive contexts, such temporary organizational entities are often created with the specific purpose of fuelling firms' innovative performance with an ongoing addition of ideas and knowledge.

Though the concept of group fluidity is recognized in managerial studies (Arrow and McGrath, 1995; Edmondson and Nembhard, 2008), there is still a lack of empirical

studies that capture the dimensions at the basis of these phenomena (Arrow and McGrath, 1995). Moreover, the lion's share of existing literature on these groups does not attend particularly to creative work, even though there arguably are clear differences what regards effects of group diversity between work where the main objective is to integrate already existing knowledge to efficiently achieve a defined outcome and work where the focus is on generating new ideas and knowledge, respectively.

We contribute to the organization literature dealing with group ideation performance by applying a dynamic perspective investigating different factors responsible for ideation performance within groups, the need for which was already proposed by Van de Ven (1986) in his seminal paper on central problems in innovation management "One of the key questions in the management of innovation then becomes how to trigger the action thresholds of individuals to appreciate and pay attention to new ideas, needs and opportunities" (591).

This study aims at addressing this gap in theory by investigating the role of group heterogeneity and familiarity on idea generation and development in fluid groups. More specifically, our study focuses on different and complementary dimensions that impact on group ideation performance, namely: 1) the heterogeneity in functional belonging of group members; and 2) the familiarity of group members with one another. The specific approach used to capture group fluidity allows for a more fine-grained understanding of the determinants of group performance and a greater granularity in the measurement of accumulation of group experience and development of group skills.

Once we assume that group composition tends to change over time each of this factors gain increasing theoretical interest. Starting from prior works dealing with familiarity among group members (Katz, 1982; Edmondson et al., 2001; Reagans et al., 2005) and diversity (Van de Ven, 1986; Clark and Fujimoto, 1991; Ancona and Caldwell, 1992; Dougherty, 1992; Woodman, Sawyer, and Griffin, 1993; Nonaka, 1994; McDonough, 2000; Beckam et al., 2007) we aim to shed light on the degree to which changes in group composition may affect ideation performance.

The paper is organized as follows. First, a theoretical exposition of relevant bodies of literature is presented, leading to the development of the set of hypotheses. Thereafter, the methods used for data collection and analysis are presented, followed by empirical results and analysis. Finally, the findings of our study are discussed in relation to existing theories and implications for management are derived.

2. Group composition and group performance

Organizational scholars have focused on understanding differences in the rate of ideation across organizations and groups (Huckman et al., 2009; Pisano et al., 2001). Factors suggested to explain this variation are e.g. resources devoted to improvement (Sinclair et al., 2000), group structure, group beliefs (Ancona and Caldwell, 1992; Nonaka, 1994; Edmondson, 1999), and task experience (Schilling et al., 2003).

Previous research has suggested that group composition aspects such as group size, diversity and past collaboration patterns affect the success of a group project (Guimera, Uzzi, Spiro & Amaral, 2005; Katz & Lazer, 2003). Conceptually, scholars have suggested that group composition dimensions, such as longevity and diversity, impact on group performance. The use of groups within organizational contexts enables integrating and sharing expertise, information and resources dislocated across organizational units, functions and different organizational sites; avoiding the risk that each organizational unit and function works as isolated silos apart form the whole organization. Therefore, the value of the group approach to work organization is that each group member brings his or her expertise, skills and experience to the overall group task (Hargadon and Bechky, 2006). Previous literature found that successful groups accelerated the innovation process, reduced development costs, and increased the quality of outcomes (Gupta and Wilemon, 1990; McDonough, 2000; Sarin and Mahajan, 2001; Takeuchi and Nonaka, 1986). In large part, their success derives from their composition and ability to capitalize on it. Despite the potential of groups to enhance innovation and organizational performance, the realization of these potential benefits has been found to be far from straightforward. While some groups match, and even exceed expectations (Brown and Eisenhardt, 1995), others fail to fulfil the organizational mandate (AitSahlia et al., 1995). However, much of this literature stresses the effects of group characteristics on group performance with members that are almost exclusively collocated to a single group. Therefore, the validity of these findings need to be investigated in groups that change in composition over time.

As noted above, fluid groups are common and occur in a wide range of contexts. They appear to be especially common in highly competitive settings characterized by pressures for productivity and learning, such as software development, new product development and consulting (Milgrom and Roberts, 1992). However, as suggested by other researchers, extant research has focused mainly on "intact groups" without accounting for the possibility of changing group composition over time. Despite some scholars' acknowledgement that fluid groups are widespread within organizations, management literature and study investigating in depth the effect of group characteristics on performance is still scant (O'Leary et al., 2011).

The specific context of this research is characterized by the presence of fluid groups, which exist for a defined period of time (usually a year or less) with the specific purpose of generating and developing new ideas enhancing firm innovation performance. In such a context, group members form a group also for the specific aim of generating a new idea. .

When constellations of individuals work together, they carry with them their history of past success, their own experiences and background. Each of these factors affects group performance. First, the idea of diversity plays a major role in creativity management. As has been found in previous studies, the benefits of diversity for group performance are not straightforward (Ancona and Caldwell, 1992), and empirical research has presented conflicting results (for a review of the literature, which is beyond the scope of this research, see Williams and O'Reilly, 1998). Variety along skill- or knowledge-based dimensions (e.g., educational background, functional background, occupational background, range of industry experience) ought to result in a greater variety of perspectives and knowledge sets being

considered when making decisions and, thereby, these factors have been suggested to increase the likelihood of creative and innovative solutions to problems (Ancona and Caldwell, 1992; Nonaka, 1994).

Furthermore, in the specific case of idea generation it is argued to be the intersection of different ways of thinking that trigger really new and innovative ideas (Koestler, 1989). Diversity does not necessarily solve this issue, as even heterogeneous groups over time may be locked into their shared ways of thinking. Specifically, over time, beyond the value of diversity, also the familiarity among group members – capturing the cumulative experience of working together – has been argued to affect group performance. With increasing shared experience one may get better at executing existing routines and developing new ones (Nelson and Winter, 1982; Zollo and Winter, 2002). However, the idea that experience and repetition would increase performance is called into question by the idea of competency traps or core rigidities (Levitt and March, 1988; Leonard-Barton, 1992). These concepts instead suggest that groups may become locked into their established ways of doing things and that, as conditions change, the group will not be able to react to this change. Groups that stay together longer become more isolated from information sources and this counteracts the benefits of coordination and internal communication resulting from the experience of working together.

3. Affiliation diversity

Knowledge accrual and the rise of complexity within many disciplines call for specialization as well as integration of expertise, often making diversity in work groups a necessity (Guimera et al., 2005). As a result, working in more diverse groups can be rewarding as well as challenging (Dahlin, Weingart, & Hinds, 2005; Harrison, Price, & Bell, 1998). Diversity-related challenges begin with the challenge of how to best assemble groups based on considerations regarding diversity. This challenge is especially emphasized for groups engaged in creative activities, such as idea generation (Guimera et al., 2005). A variety of perspectives, skills and experiences should arguably increase the likelihood of creative and innovative solutions to problems (Ancona and Caldwell, 1992; Nonaka, 1994). However, managerial literature presents some evidence that groups that are diverse with respect to background and skills may encounter integration problems, something which presumably limits group ability to generate highly innovative outputs (Smith et al., 1994).

Existing management research has accounted for different types and levels of diversity. Earlier research has found different effects of surface level diversity vs. deep-level diversity (Harrison et al., 1998). Moreover, the management literature has recently focused attention beyond the effects of demographic and attitudinal diversity on group performance. Some scholars have for instance suggested the importance of examining diversity in terms of expertise (Van der Vegt, 2006) and affiliation (Beckam et al., 2007). In groups aiming to generate creative outcomes expertise diversity, i.e. diversity in terms of individuals' skills and capabilities, may constitute an obstacle for information processing ability, preventing groups from benefiting from the individuals' heterogeneous perspectives and information. On the other hand, affiliation diversity, i.e. heterogeneity in employees' organizational belonging,

provides groups with better social and intellectual capital by giving access to wider and larger networks of information, resources, and contacts. Groups composed of members with different functional belonging can benefit from human and social capital existing within each single group member's organizational department. Affiliation diversity would therefore have a positive effect on group ideation performance through mechanisms such as increased access to new knowledge and information, facilitated interdepartmental exchanges, increased high-quality external communication and improved learning experiences (Ancona and Caldwell, 1992).

The reasoning above leads us to generate our first hypothesis:

H1: Affiliation diversity is positively interrelated with group ideation performance.

4. Group familiarity

Beyond the impact of affiliation diversity, we are interested in the impact of group familiarity, i.e. the degree to which group members have worked with one another in the past, on ideation performance. In settings where groups are stable over time in terms of composition or structure, a group's level of familiarity can simply be measured by its cumulative experience. This is often referred to as group tenure (Cohen and Bailey 1997, Hackman 2002). When group composition is not stable over time, as in this study, group familiarity is a distinct concept, different from group cumulative experience, as certain group members may have worked with one another on past projects that did not involve all members of the current group.

As a starting point it is important to consider the reasons why group familiarity leads to higher performance. The explanations can be broken down into two classes of concepts: a) coordination; and b) willingness to be engaged in long-lasting relationships (Reagans et al., 2005).

Familiarity increases the ability of group members to coordinate their activity effectively. Improvements in coordination could result from individuals working together, thereby learning who knows what and building mutual trust, in the end facilitating the coordination of their activities (Uzzi 1996; Edmondson, Bohmer & Pisano 2001; Edmondson et al. 2003; Reagans et al., 2005). Mutual understanding between group members also facilitates the information exchange in the group, increasing the ability to coordinate across specialized roles. If a group is involved in a task that requires joint activity and the knowledge to be shared is tacit (Nonaka, 1994; Polanyi, 1967), familiarity may improve the ability of the group to act in a coordinated manner, by contributing to better work organization and communication patterns within the group (Katz, 1982; Weick and Roberts 1993)). For example, repeated experience with each other may provide a means to share this vital but difficult to transfer information as dialogue around potential solutions becomes more structured (von Hippel, 1994). Because of shared experiences, individuals may develop group human capital (Chillemi and Gui, 1997) or network-specific human capital (Mailath and Postlewaite, 1990), which serves to increase group performance. In a similar vein, literature on transactive memory system (i.e. an awareness of each group member's knowledge) show that the longer individuals work together the higher is group performance (Moreland and Myaskovsky, 2000). This idea of

knowing who knows what and where key expertise resides is especially fruitful in contexts where positions within a group are not predefined (Faraj and Sproull, 2000).

The second class of explanations for a positive relationship between group familiarity and performance is based on the idea that familiarity increases group members' willingness to engage in a long-lasting relationship. Group beliefs, especially group psychological safety, can impact performance positively. Edmondson (1999) showed that group familiarity increases group psychological safety. Organizational literature has also underlined that shared experience creates trust, thereby increasing group members' commitment to their work and facilitating amount and quality of information shared within the group (Granovetter, 1985; McEvily et al., 2003).

Some authors question whether the benefits of group familiarity are always positive. Katz (1982) examined group longevity and found that groups that stay together longer become isolated from external sources of information and that this tendency after a certain point reverses the benefits of internal communication and coordination. Thus, Katz analysis showed that the relationship between group tenure and performance has an inverted U-shape. The same results were obtained by Berman et al. (2002) using data from professional sports. Both of these studies examined longstanding groups. In Katz' study the inflection points occulted only after individuals stayed together as group members for five years (Katz, 1982). He related this finding to members' decreased interaction outside of the group, increased internal communication about less relevant task-related issues, and more limited environmental scanning. Therefore, it seems that companies have to overcome a tension using temporary project-based groups. On the one hand, they offer the potential for exploiting the highest level of expertise within the group. On the other hand, the temporariness of these groups means that member familiarity resulting from group longevity is more limited.

While team familiarity allows for deep coordination mechanisms to be embedded within groups, a high level of group familiarity could constrain group ideation ability, resulting in mechanisms that hinder the creation and development of new ideas (Skilton and Dooley, 2001). Hence, group familiarity can be assumed to have two counteracting effects on group ideation performance. On the one hand, it affects group coordination positively and makes ties between group members stronger over time, facilitating the sharing of information and knowledge. On the other hand, at higher levels of familiarity groups are likely to fail to nurture their knowledge and resources endowments with newer perspectives. Consequently, we hypothesize that:

H2a: The inter-relationship between familiarity among group members and group ideation performance is invertedly U-shaped.

Furthermore, the effect of familiarity among group members on group ideation performance is arguably moderated by group size. When a group is composed by a high number of specialists the effect of group familiarity on group ideation performance is higher. When group size increases group members ought to have more difficulties in coordinating their activities and communication is more likely to suffer when several group members are called to share information and coordinate their activity.

This leads us to formulate hypothesis 2b:

H2b: The effect of familiarity among group members on group ideation performance increases when an increase in group size.

5. Research setting and methods used

Data on all ideas that have been created within a company over an extensive period of time have been collected. The company studied is a large Swedish consumer goods company that has worked extensively with ideation over a number of years, using an IT-based idea management system for collecting, handling and evaluating all ideas generated at the firm. Data from 2000 to 2006 have been collected from this database resulting in 4,659 ideas. However, due to missing variables and attributes, the sample has been restricted to 3,534 ideas. 1,180 of these were generated by groups and the remaining 2,354 generated by individual inventors. For the specific purpose of this research, the focus was only on the group level, consisting of 1180 ideas (table 1 contains description of the ideas collected and then retained within the dataset). After a careful investigation of the database and in-depth interviews with some managers within the firm, we decided to use the ideas generated during the years 2005 and 2006 for the analysis (see Table 1). The total amount of ideas generated by groups in the two years (2005 and 2006) used to test our hypothesis was 453. A committee had carefully graded each innovation idea on a five-point scale, based on the perceived joint usefulness and novelty of each idea. For each group generating ideas we collected information about the past history of collaboration among group members.

In this analysis, a group exists when individuals work together in order to create and develop a new idea. Furthermore, individuals are allowed to be part of more than one group, a common feature within organizational contexts characterized by high rates of innovation and knowledge (Edmondson and Nembhard, 2008) as this flexible arrangement allows groups to be composed by appropriate specialists. This means that group members are allowed to move to other groups, carrying with them experience and knowledge accumulated in previous groups. In our sample, we were able to retrace multiple group membership of individuals. For each individual involved in idea generation, additional data has also been collected regarding organizational belonging and the individual's historical ideation behaviour and performance since 2000.

Given the access to the idea dataset from the company, it represents a well-suited context for testing our hypothesis about the effect of affiliation diversity and group familiarity on group ideation performance. The characteristics of this organizational context made up of multiple groups aiming at creating and developing ideas make it an instructive context where to analyze the impact of affiliation diversity and of group familiarity on group ideation performance. First, groups are made of individuals coming from different organizational departments within the organization, which, as highlighted above, constitutes an essential prerequisite for group ideation performance. Second, individuals may work with different people in different groups.

Table 1: Description of the number of ideas

	2000	2001	2002	2003	2004	2005	2006	Tot
Overall number of ideas generated	519	587	465	668	781	929	710	**4659**
Ideas retained in the sample	458	520	343	472	521	595	625	**3434**
Number of ideas generated by individuals	316	357	231	334	350	360	407	**2354**
Number of ideas generated by groups	142	163	112	139	171	235	218	**1180**

6. Dependent Variable

Group ideation performance

Scholars have long debated the way of assessing ideation and creativity in organizational contexts, and to date several different methods have been used (see Amabile and Mueller, 2006). Based on previous assessment of organizational literature (Amabile and Mueller, 2006) researchers revealed that the most common used method to assess ideation involves subjective evaluation, in which experts or peers makes scale-based evaluation of ideation performance (Amabile et al., 1996; Oldham and Cummings, 1996; Amabile et al. 2005). The design of this study required a measure of group ideation performance based on the quality of the idea generated. Therefore, the dependent variable of this study consists of idea quality, i.e. the grading of each idea. For each idea we had the five-point grade received by the committee that summarized the novelty and usefulness of each idea. The mean value of the dependent variable is: 1.93. The variable group ideation performance is designed to take the value of 1 when an idea has low levels of novelty and usefulness, and the value of 5 if an idea is rated as both highly novel and highly feasible. As observers' assessments of ideas are considered a standard measure of ideation in empirical studies, we used the grading of ideas as a measure of ideation performance.

7. Independent Variables

The independent variables used for the analysis are group affiliation diversity, i.e. the level of functional heterogeneity within each ideation group, and group familiarity, a measure that captures the experience of working together held by members' of each ideation group.

Affiliation Diversity

We used Blau's (1970) heterogeneity index to measure the dispersion across functions of the persons involved in generating ideas. We computed the Blau's index in each of the groups represented in our overall data set. Blau's index has been computed as: $(1-\Sigma p_i \ p_j \ 2)/N$, where p_i is the fraction of group members with affiliation to function i and p_j the fraction of group members with affiliation to function j. Blau's index treats the data as categorical.

Group Familiarity

Similar to Reagans et al. (2005), we measure group familiarity by first calculating the number of times each pairing of group members i and j has worked together to create an idea in the focal company within the five years window prior to the current collaboration. We sum this value, PW_{ij} over unique pairs in a group, in order to capture group-specific experience, $\Sigma_{i=1}^{N}\Sigma_{j=1}^{N} PW_{ij} /(N(N-1)/2)$, where N represents group size.

Interaction: Group Familiarity x Group size

This variable is computed as the interaction of variable group familiarity and group size.

Control variables: we control that the tested effects were not the spurious effect of group size, formal organization, or previous ideation performance, using the measures described below:

- *Group Size*: increasing group size at low levels would enhance group performance because of the capacities and resources of additional members. While increasing group size at higher levels may increase coordination challenges resulting in decreased performance (Hackman, 202). We measured group size counting the number of members within the group.

- *Formal Group* structure of the group could affect group ideation performance. We controlled for the nature of the group, distinguishing between formally appointed project groups and all other types of groups of a more informal type. We used a Dummy variable (1: formal group; 0: otherwise).

- *Average previous ideation performance*: as each group presents its own ideation capability endowment, in our model we control also for group members' average past ideation performance. Group ideation performance is positively affected by the presence of highly skilled ideators who have a positive track record oft ideation performance. This variable has been designed to control for the presence of inventive individuals within groups. We operationalized average previous ideation ability using the previous two years performance of each person, and then summed across all grades of ideas in which each individual worked. After that we aggregated this value at the group level, considering the individuals composing the group. For instance, assume that the group IDEA is composed of two members: A and B. If A in 2004 and 2005 worked on two ideas which were both graded 4 and B on only one idea graded 3, the overall group ideation ability for IDEA is 3.5=((4+4)/2 + 3/1)/2 (i.e. group size).

8. Empirical findings

With our dependent variable being a categorical variable bounded between 1 and 5, the empirical test has been performed using an Ordered Logistic Regression model

(Long and Freese, 2001). Data has a natural ordering (1 to 5), but the distances between adjacent levels are unknown. The structure of the econometric model used is as follows:

$$logit(Y \leq i) = \alpha_i + \beta_{i1}X_1 + \ldots + \beta_{im}X_m, \ i = 1, \ldots, k$$

Where α_i is the constant, X_i the single variable included in our models, and Y_i is the dependent variable.

Table 2

Descriptive Statistics and their correlations

Variable	Mean	S.D.	1	2	3	4	5	6
1. performance	1.93	.81						
2. average past ideation performance	10.83	5.53	.012					
3. group size	4.31	2.59	.085	.85				
4. formal (dummy)	0.34	0.43	-.15	.05	.003			
5. affiliation diversity	.57	.16	.066•	.024	-.042	-.181•		
6. group familiarity	1.97	.92	.045	.061	-.079•	.30	.106	
7. group familiarity x group size	1.54	.98	.19	.13	.18••	.624	.073	.244••

•p<.10; ••p<.05

9. Results and analysis

Table 2 provides descriptive statistics and correlations between the different variables.

Results of the Ordered Logistic Regression analysis are reported in Table 3, showing the relationships between the different constructs of group composition and ideation performance. To test the research hypotheses, a stepwise technique was adopted, with the progressive inclusion of the relevant variables. Model M1 accounts only for controls. Model M2 introduces affiliation diversity. Supportive to hypothesis H1, affiliation diversity is positively and significantly associated with group ideation performance (β=.18, p<.05) (all hypothesis are tested with coefficient values from the fully specified model M4). Hence, groups with high affiliation diversity tend to have a higher ideation performance. Also supportive to H2a, the effect of team familiarity is invertedly -shaped as he effect of group familiarity is positively and significantly associated with group ideation performance (β=.79, p<.01) while the effect of the squared group familiarity impact negatively on group performance (β=-.35, p<.05). Supportive to H2b, group size positively moderated the effect of group familiarity on group ideation performance (β=.23, p<.05).

Table 3

Results of Ordered Logistic Regression (models estimated with robust variance estimator)

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	.31	.45	.63	.58	.63
	(.05)	(.065)	(.019)	(.019)	(.019)
average past ideation performance	.012••	.012••	.05•	.07•	.09•
	(.006)	(.006)	(.001)	(.001)	(.001)
formal (dummy)	.02•	.028•	.02•	.06•	.04•
	(.15)	(.015)	(.004)	(.004)	(.004)
group size	.06•••	.06•••	.19••	.23••	.15••
	(.02)	(.02)	(.008)	(.008)	(.008)
affiliation diversity		.32•••	.30•••	.24••	.18••
		(.06)	(.01)	(.01)	(.01)
group familiarity			.83•••	.67•••	.79•••
			(.007)	(.007)	(.007)
squared group familiarity				-.45••	-.35••
				(.09)	(.02)
group familiarity x group size					.23••
					(.05)
***Prob > chi2 (M5):* .0098**					
***Pseudo R2(M5):* 15.63%**					

•p<.10; ••p<.05; •••p<.01.

Overall, the Ordered Logistic Regression accounts for a good proportion of the variance of the overall model (Pseudo R2=15.63). The results included in the model 5 test the two main hypotheses developed in the study. Both affiliation diversity and team familiarity are correlated with group ideation performance. Group functional heterogeneity is positively correlated with group ideation performance, as the coefficient in the model is positive and significant. Related to the effect of group familiarity on group ideation performance we have theorized that the effect of group familiarity on group ideation performance is inversely U-shaped. Again, we found support for this hypothesis. Finally, the H2b hypothesized that group-size moderated the effect of group familiarity on group ideation performance, that is when group size is higher the effect of group familiarity on group ideation performance would be higher. The reasoning behind this is that in larger groups coordination challenges among members are higher, resulting in lower group performance (Hackman, 2002). The empirical results support the hypothesis that positive mechanisms induced by group familiarity (i.e. mutual understanding and facilitation of coordination) are higher when group size increases

10. Discussion

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The results of the study suggest a number of relevant observations concerning group composition and group dynamics, illustrating how factors related to group composition over time directly and jointly influence group outcomes. The results related to group composition extend what has been observed in previous research about the relationships between group collaboration, diversity, and creativity (Skilton and Dooley, 2001). This study reinforces the previous findings that diverse groups can be more creative. However, by addressing the question with a longitudinal approach, it also adds new nuances to how diversity, familiarity can moderate such influences over time. The study focuses on fluid groups and their potential for nurturing organizational innovative performance. Furthermore, it describes two main forces promoting group performance. First, the advantages for organizations of using cross-functional fluid groups were identified. Second, the benefits and challenges of group familiarity are pointed out. Related to the diversity argument we found support for theory stating the importance of heterogeneity within groups (Ancona and Caldwell, 1992, Beckman et al., 2007). Cross-functional groups link professionals and specialists producing benefits from accessing to and communicating valuable information, the integration of which stimulates creative thinking, and promotes new creative ideas that build upon previously contradictory viewpoints (Edmondson and Smith, 2006; Brown and Eisenhardt, 1995). However, collaboration among diverse members is often difficult, because different professionals have their own language, terminology, and way of thinking (Dougherty, 1992). Overcoming such barriers is a challenge. Research has shown that familiarity among group members breeds intragroup coordination (Moreland et al. 1998). Thus, the longer individuals work together the better would be the group outcome. However, previous literature further showed that the effect of familiarity on group performance is not always positive (Katz, 1982). Our results support this theory, even in a highly innovative context where groups focus on generating and developing ideas. We found that the effects of diversity and familiarity are both predictors of group ideation performance. As diversity in terms of functional background seems to be a requisite for increasing group ideation performance, we found that familiarity among group members is important and has a more nuanced effect on group performance. Familiarity among group members provides means to develop group coordination mechanisms and efficient integration for task completion. However, results show that higher levels of familiarity among group members lead to lower group performance. Therefore, stable group relationships (i.e. high group familiarity) actually have a negative effect on group performance. This finding is related to group members' decreased interaction with actors outside the group, increased intragroup communication on less task relevant issues, and more limited environment scanning (Katz, 1982). These findings point out the importance for organizations aiming at enhancing innovative performance to look deeply to the potential detrimental effect of group familiarity and to focus on means to balance this effect. For instance, an increase of group members' turnover could refresh group expertise and knowledge endowment through the exchange of group members over time. Furthermore, our study invites the thoughtful attention of group leaders and HR managers to balance the potential benefits and drawbacks of diversity and shared history in groups, in order to better support productive collaborative and creative tasks.

11. Conclusions

Our study begins by setting aside the assumption that groups are stable over time and uses unique data to show how affiliation diversity and team familiarity impact on group performance. Our setting is a useful backdrop for exploring this question because we are able to link longitudinal data on group members with verifiable group outcomes.

We point out to the changes in team composition that affect performance. First, we examine a measure of diversity that accounts for functional heterogeneity within the group –the affiliation of group members to different organizational functions. We find that overall diversity affects positively group ideation performance.

Second, we examine the impact of group familiarity on group ideation performance. We point out to a measure of group familiarity that accounts for the degree to which each member of a group has worked with every other group members on other ideas. This measure allows us to go beyond the assumption that group membership remains constant over time. We find that group familiarity has an inverted U-shape effect on group performance.

The findings of this study contribute to the existing knowledge about groups and innovation. A first contribution is that we account for a continuous measure of group familiarity. As we do not use a simple dichotomous measure of familiarity but use longitudinal data, the measure of familiarity captures the differences among groups. For instance, we differentiate a group where 75% of members have already worked together from a group where only 25% of members have done the same, thereby capturing effects of familiarity in a more fine-grained manner.

Second, our findings highlight the curvilinear effect of group familiarity on group ideation performance. Further work should both evaluate this effect in different contexts and explore also a number of related questions. We do for example not account for possible differences between specific type of ideas, knowledge and resources. For instance, group ideation in fluid groups developing deep technological knowledge might be different from group ideation aiming at developing new business ideas. These different ideation activities are likely to require different group characteristics, but more research is needed to investigate such differences. Third, further empirical research should investigate the effect of group characteristics (i.e. diversity and familiarity) on different performance indicators. In this study we focused only on group ideation performance, and there is still a lack of understanding of the antecedents of e.g. group learning and productivity.

Fourth, we do not account for the antecedents of group familiarity. Hence, there is need for additional empirical research and theoretical frameworks to investigate the whole group formation and ideation processes more in depth.

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PAPER III

Temporary Network Structure and Group ideation performance
- the effect of centrality and structural holes

Mario Losito[1] and Jennie Björk[2]

[1]*PhD Student, Management Dpt. LUISS Univesity in Rome, Italy (mlosito@luiss.it)*
[2] *PhD Postdoctoral Researcher at Integrated Product Development at KTH Royal Institute of Technology in Stockholm, Sweden (jenniebj@kth.se)*

Abstract
Focusing on the first phases of the innovation process when ideas are generated and developed by groups, our research aim of this study is twofold. First, we offer a theoretical explanation of two different network properties that affects group ideation performance. Namely, this research investigates the effect of group centrality and the presence of structural holes on group ideation performance. Previous research presented contrasting effects of those two network properties on group performance, and it has not dealt specifically with group ideation performance. Based on the analysis of data collected within a Swedish consumer goods company that has worked systematically with ideation since 1995, using an idea management system for collecting, handling and evaluating all ideas generated at the firm, results showed that network structure affects group ideation performance. While the higher the group centrality the lower its ideation performance, the larger the number of structural holes in an ego network, the higher is the quality of ideas generated by the group. This finding points that group centrality is negatively related to group ideation performance, thus providing interesting input for the debate on the effect of network properties on group ideation performance. Furthermore, we propose a theoretically and empirically based explanation of the emergence of group network structure based on the interplay of two different mechanisms: one of past network exploitation and one of past network constraint. Network literature lacks of study investigating how social structure comes about. The results support both the exploitation argument and the constraints explanation. We found that network structure tends to remain stable over time, offering new insights for future network research.

Key words: *innovation, ideation performance, ideas, groups, temporary network, networks.*

1. Introduction

In today fast paced economy innovation is a fundamental driver of firm performance. Both practitioners and researchers have focused their attention on the antecedents of favorable innovative outcomes for firms. This increasing attention towards the antecedents of innovative performance called for a more fine-grained understanding of the overall innovation process. Though, research on the antecedents of innovative performance is valuable, the first phases of firm innovative process, when efforts are devoted to generate ideas, are still underexplored. Ideation phase in which new ideas are generated and initially developed is a key step in determine firm innovative performance (Björk et al, 2011; Crossan and Apaydin, 2010; Ames and Runco, 2005; Day et al., 1994). Ideation can be seen as a source of innovation (Crossan and Apaydin) and a process for creating and develop ideas (Björk, 2011). Following this stream of literature, ideation can be conceptualized as an ongoing activity that over time nurture firm innovation process with the generation and development of ideas.

In this perspective, ideation process is characterized by the generation of ideas as fuel for firms' innovation processes.

However, gaining a deep understanding of ideation antecedents operating at different levels (individual, group and organizational level) is required to effectively manage the ideation process. Ideation is not only an individual outcome, but it is also the result of a collective process, involving interaction and collaboration among specialists in a specific social context (Barney and Zajac, 1994; Groysberg et al., 2008). Previous studies have underscored that creativity and innovation to a large extent can be conceptualized as the result of a collective process involving different actors linked by social interaction and communication links, and that social interactions, rather than single individual, are at the core of ideation (Leonard and Sensiper, 1998). Therefore, social relations among individuals are key for creation of ideas, as those new ideas are vital for nurturing firm innovative performance (Leonard and Sensiper, 1998; Rulke and Galaskiewicz, 2000). It is acknowledged by the evidence that organizational contexts characterized by high rate of innovation, migrate towards more fluid, short-term flexible and network-based mechanisms governing work structure within organization (Piore and Sabel, 1984; Edmondson and Nembhard, 2008; Schwab and Miner, 2008). We define *fluid groups* as groups that aim at create innovative output and that exist only for the duration of a single project and are composed of members who may join or leave a group during the course of that project (O'Leary et al., 2011; Edmondson and Nembhard, 2008). In settings characterized by such fluidity, classic measures of cumulative experience may not adequately capture group experience, especially when changes in group composition are substantial over time.

In this paper, a social network approach is developed in order to capture the overall experience and skills held by fluid groups. Social network perspective has proven to be a powerful lens in order to understand the antecedents of organizational performance (view Brass et al., 2004 for a synthesis and review). A great deal of research has focused on network antecedents of favourable outcomes for groups (Reagans, Zuckerman, and McEvily, 2004; Soda, Usai, and Zaheer, 2004) and firms (e.g., Ahuja, 2000; Baum, Calabrese, and Silverman, 2000). Though research on the performance outcomes of social structures is valuable, it raises the question of precisely how social structures come about and the processes that shape their evolution over time. Knowledge of network effect on organizational outcomes remains incomplete without understanding the temporal sequencing of network creation and its causal linkages with group performance.

Extending the concept of network ties in order to connect past and current social structures to outcomes, the research aim of this paper is two fold.

- First we want to test the effect of temporary network structure on group ideation performance

- Second we want to investigate the persistence of network structure over time.

The structure of the paper is as follows. First, a theoretical exposition of relevant bodies of literature is presented, leading to the development of hypotheses. Thereafter, the methods used for data collection and analysis are presented, followed by empirical results and analysis. Finally, the findings of our study and its limitations are discussed.

2. Network Structure and Ideation Performance

Conceptualizing ideation as a collaborative practice, literature is starting to investigate the effect of current interactions on creative performance (Leonard and Sensiper, 1998; Perry-Smith and Shalley, 2003; Björk et al., 2011). Social interactions among employees are conducive to the creation and development of new ideas. This focus on social interactions indicates the importance of networks as sources of innovative ideas. The social network perspective is based on the premise that actors are embedded within a network of multiple social relations that affect actors' performance, behavior, attitude, perceptions (Granovetter, 1985; Brass, 2004).

The importance of social network structures and positions within organizations has been well documented in prior research (e.g., Burt, 1992; Gulati, 1995; Uzzi, 1996; Borgatti and Foster, 2003). Network characteristics, at different levels, can have prominent implications for social actors' outcomes (Burt, 2004; Gulati, 1995; Uzzi & Spiro, 2005). Social networks have been found to be beneficial to individual and organizational performance (Burt, 1992; Uzzi, 1996), organizational learning (Gulati, 1995; Burt, 2005), and acquiring additional resources (Haunschild, 1993). Stemming from Granovetter's (1985) arguments about social embeddedness, social network research emphasizes that the activities of social actors are constrained and influenced by their relationships with other social members (Uzzi, 1996). Once network structures are in place, processes of influence embedded in these structures have been shown to affect a wide range of outcomes – for example – individual performance (Brass et al., 2004; Borgatti and Foster, 2003), behaviour, attitudes, preferences and opinions (Friedkin, 1998). Behavioural outcomes that are typically attributed to individuals (for example, performance) are more usefully viewed as the joint product of individual actors tied together in network-based processes that give rise to performance at several levels, therefore relational activities among actors at one level give rise to performance at different levels (Breiger, 2002). Within an ideation network, social actors form and reciprocate ties in order to create and develop new ideas together. The act of generating an idea together requires social actors not only to share information but also to be able to deeply coordinate their collaborative activity in a way that allows them to deliver highly creative outcomes. Thus, investigating temporary network structure and its effect on group ideation performance has the power to show how relational activities among individuals gives rise to group outcomes. Group's outcomes (its content, its characteristics) embody and reflect group members' experience and skills, and this outcome becomes a collectively "owned" group product.

2.1 Centrality and Group Ideation Performance

In organizational context composed of fluid group created for the specific purpose of generate new ideas (O'Leary et al., 2011; Edmondson and Nembhard, 2008) relationships among groups are a vital resource that allow those organizational entities to gain access to new and superior resources and to increase their capacity to generate high valuable outcomes. Relationships between groups are developed through interpersonal ties and shared experience.

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Collaborative and exchange network ties facilitate tacit and explicit knowledge transfer and diffusion within complex organizations (Hansen, 1999; Singh, 2005). Network theory offers a powerful concept, that of *network degree*, in order to capture focal actor's access to and control over resources. Some previous network studies have found that network characteristics exhibit a nonlinear relationship with performance (Uzzi, 1996; Perry-Smith and Shelly, 2003). Because of their numerous connections to others, actors in central network positions have greater access to resources. Consequently, actors who occupy more central position have access to more information and resources that have the potential to positively influence innovation performance (Sparrowe et al., 2001; Tsai, 2001). In large networks, when nodes have ties with most other nodes (Coleman, 1990), the increasing number of direct exchange partners increases the amount of accessible information, ideas and resources (Nahapiet and Ghoshal, 1998). Therefore, numerous direct connections with others are potentially more useful for transferring knowledge that is complex and not easily codifiable (Hansen, 1999). The results of previous studies point to a range of positive effects that networks can have for ideation.
This leads to our first hypothesis:

H1. The higher the group network degree, the higher is the group ideation performance.

2.2 Structural Holes and Group Ideation Performance

Structural holes have attracted considerable interest because they are considered a form of valuable social capital (Adler and Kwon, 2002) and thereby present a social structural antecedent for many kinds of individual, group, and organizational outcomes. Structural holes are present in an actor's network of relationships when the focal actor (or "ego") is tied to others ("alters") who are not themselves connected (Burt, 1992). Structural holes capture, like other related concepts such as weak ties (Granovetter, 1973; Hansen, 1999), range (Reagans and McEvily, 2003), and brokerage (Xiao and Tsui, 2007; Fleming and Waguespack, 2007), a key network structural property, the efficient and non-redundant access to resources and information. A structural hole is a position in a network through which an actor can derive benefits by bridging resources and information flows between two otherwise disconnected (Burt, 1992). Those actors who bridge structural holes have better chances of being exposed to distant and unique knowledge (Rosenkopf & Almeida, 2003), and are able to transfer knowledge across boundaries (Reagans & McEvily, 2003). The importance of such network roles for creative performance is well known (Obstfeld, 2005). Actors who occupy that kind of network position are able to access different and thereby non-redundant sources of information and resources, novel communities, diverse experiences, unique resources, varying preferences and multiple thought worlds, in turn providing greater opportunities to generate good ideas and creativity (Burt, 2004). Groups with a network rich in structural holes access a wide variety of different sources of information and knowledge, nurturing group resource endowment to maximize group creative performance.
This leads to our second hypothesis:

H2. The higher the presence of structural holes in a group's (ego) network, the higher is this group's ideation performance.

3. The origin of temporary network structure

Investigating network structure has proven to be of high importance in explaining performance antecedents at different levels, individual (Burt, 2004; Obstfeld, 2005; Bjork et al, 2011)) group (Reagans at al., 2004; Soda et al., 2004) and firm level (Ahuja, 2000; Baum et al., 2000). However, prior networks study have typically underexplored the evolution of network as subordinate to the contingency of time. Network structure tends to change over time, as new ties will be formed and older one could be deleted. As network structures change, this could arguably affect concurrent network structure thus affecting outcomes. One objective of this research is to test the effect of past network structure on the current network structure. Investigating a temporary network structure, we offer a theoretical explanation of the mechanisms operating, under the contingency of time, on the structure of the ideation network investigated.

Focal actors tend to reproduce network structure over time. This insight suggests that a form of structural persistence characterized the evolution of organizational network structure (Walker, Kogut, and Shan, 1997; Gulati and Gargiulo, 1999). As stated above, within organizations focal actors are subject to network structure that influences their performance. Favourable network structure can emerge from the intersection of two complementary forces provided by past network structure and positions within the network. Two mechanisms influence this phenomenon we called *network persistence*. Positions in past network structure provide focal actors with opportunities that shape future actors' network position. Positions that have proven to be efficient in the past are reproduced in the current network structure (White, 1992; Zhaeer and Soda, 2009). The focal actor tries to exploit past network structure reproducing favorable past network positions (*exploitation of past network structure*). More precisely, the opportunities provided by past network structure are purposively exploited in future periods, experiences and knowledge that have proven to be efficient in the past in turn motivate and enable actors to recreate and reconfigure past network positions into future beneficial ones. In this perspective, Burt's (1992) conception of structural holes as social capital highlights the agency of the network actors in generating this valuable form of social structure.

In a similar vein, literature presents evidence that past network structure constraints actors' behavior. Past network structure tends to reproduce itself though norms, rules, social pressures creating a kind of inertial forces that affect and constraint actors' behavior (Parsons, 1951; Fleming and Waguespack, 2007) (*constraint of past network structure*). Positions in past networks can provide focal actors with constraints and obstacles that shape future network structure). For instance, adopting a similar logic, Powell et al. (2005) suggested that central actors are likely to receive a disproportionate share of future ties.

This reasoning suggests a strong element of stability within network structure, implying that current network structure is affected by past network structure.
Our reasoning leads to two fundamental explanations that can be identified underlying the creation of social structures, which may enable an actor to recreate

past structures: the opportunities inherent in prior networks, and the inertial constraints imposed by prior network structures that constraints actors' current network position.

3.1 Past and Current Centrality

Network centrality is one of the most studied positions in network literature. As stated above, literature presents somewhat countervailing effects of network centrality on performance. Some previous research has indicated that network characteristics exhibit a nonlinear relationship with performance across different level of analysis (Uzzi, 1996; Perry-Smith and Shelly, 2003; Soda, Usai and Zaheer, 2004). Taking the concept of network centrality on the context of the temporary network structure the objective is to show the effect of past centrality on current network centrality. As introduced above, besides the exploitation of past network structure, there exists also a mechanism through which prior patterns of relationships constraints actor's behavior (Giddens, 1984).

In temporal network, as the one studied, the negative constraining effect of past ties on ideation is typified by the concept of past group centrality. Group centrality in the past network structure represents group past connections that constrain ability, motivation and preferences of group members to engage in new patterns of relations (for instance increasing structural holes), while preserving past ones. Furthermore, high past network centrality implies that those actors are embedded in a dense and highly connected web of links that creates social norms through conformity, thus constraining and restricting creativity and free expression (Portes and Sensenbrenner, 1993). Such norms and conformity reinforced through times are supposed to last over longer periods and to create such inertia that could affect negatively group ability to generate ideas (Usai, Soda and Zaheer, 2004). Remaining stuck within the same network structure is supposed to cast a long shadow over the current network structure. In our context, past group network centrality implies that a group is composed of members that had a high network centrality in the past network structure. For instance, groups with high centrality in the past network structure (many prior working relationships) will find themselves in tightly linked structures also in the future because groups composed of members coming form a highly cohesive past group will tend to replicate previous connections, which will result in higher centrality for the focal group (*constraining argument*). When such social bonds are created, they resist rupture, and the persistence that they manifest translates into higher centrality over time. Actors who find themselves in tightly and highly interconnected network begin to develop their own routines, norms and repetitive ways of doing thing that in the end prevent the actor form "refresh" its endowment of resources and knowledge resulting in a sort of creativity abrasion (Skilton and Dooley, 2010). In this context, past group centrality is an expression of accumulated past working relationships that constrains the ability, motivation, and preferences of individual actors of renewing their own network position thus preserving past patterns. Groups with high centrality in the past network structure (many prior working relationships) will tend to find themselves in tightly linked structures in subsequent periods. Groups that employ cohesive members of a prior group will tend to replicate previous connections, which will result in high current centrality for the focal group.

This leads to our third hypothesis:
H3a. The higher the group past centrality, the higher is current group centrality

Group members do form tightly coupled cliques, as they work together in order to create and develop new ideas, involving close interactions, communications and collaboration within the group. At the same time, group members breed connections among groups. This context is characterized by a model of multiple group membership. Multiple group membership –i.e. employees are members of more than one group (O'Leary et al., 2011)- allows groups to be connected. Group size would affect the amount of interactions that the focal group is allowed to create in the network structure. The effect of past network structure on current network structure is likely to be amplified by the group size. The effect of past network centrality on current network centrality is amplified by group size.

This leads to the additional hypothesis:
H3b. The positive effect of past group centrality on current group centrality is positively moderated by group size.

3.2 Past and Current Structural Holes

One of the more fundamental aspects in network literature on structural holes is the evidence that actors spanning structural holes gain brokerage and control benefits from their network position (Simmel, 1922; Burt, 1992). Taking this network idea in the context of a temporary network structure, it means that actors bridging structural holes in the past network structure may exploit network opportunities, recreating structural holes thus maintaining the asymmetry power embodied in this position to gain brokerage and control benefits (White, 1992). The idea proposed here is that, over time, actors may replicate their privileged position, using the social capital accumulated through their past relations (Zaheer and Soda, 2009; Pollock, Porac, and Wade, 2004). Although the specific holes in past structures will vanish over time with the dissolution of both the groups and the past network, the core membership of the focal group may use its power –gained through past network position- to once again create new holes in the new social structure. This kind of network reproduction phenomenon is the result of actors' activity between the past and the current network structure and it is the expression of the exploitation of past network structure, as explained above.
Therefore, groups spanning many structural holes in the past will tend to reproduce their network structure reconfiguring past structure, through the creation of new holes in the current network. The diversity to which focal actors had been exposed in the past offers that actors with the opportunity to increase structural holes bridged in the current network structure by reconfiguring past patterns (*exploitation argument*) (Zaheer and Soda, 2009).

This leads to our fourth hypothesis:
H4a. The higher the presence of structural holes in past group (ego) network, the higher is the presence of structural holes in current group (ego) network

As discussed for the effect of past network centrality on current network centrality, in this specific research context group members determine group connections. The

number of group members affects the entity of interactions that the focal group is allowed to create in the current network. The effect of past structural holes on current structural holes is amplified by group size.

This leads to the additional hypothesis:

H4b. The positive effect of past structural holes on current structural holes in the group ego network is positively moderated by group size.

4. Methods Used

In this section the context of analysis and the empirical model are shown. After a theoretical and empirical description of the two assumptions at the basis of the group network structure investigated, the method used to build the temporary network structure is deeply explained. Then, the econometric model is presented before explaining how dependent and independent variables are measured.

4.1 Expanding Network Theory across levels of analysis

The network investigated in this research traced the relationships among ideation groups within a specific organizational context. The level of analysis is at the group level. However, before going on with the specification of the variables used and the econometric analysis performed to test the hypothesis it is important to specify theoretically and empirically the properties of this ideation network. Extant research on co-membership networks (organizational groups, groups, Top Management Teams, interlocking directories, movie productions, and so on) has implicitly treated the properties of network of interactions between nodes as symmetric with that of networks among individuals (Mizruchi, 1996; Zajac and Westphal, 1996; Haunschild and Beckman, 1998). This is the case. Under certain conditions, network research on group or group co-memberships can be regarded as isomorphic with network research on individuals (i.e. properties of network nodes at individual level can be symmetrically used at group level). From the perspective of theory, this shift in the level of analysis needs the clarification of two implicit assumptions. The first is what might be called the *assumption of connection*; the second is what we refer to as the *assumption of influence* (Zhaeer and Soda, 2009).

The **connection** assumption is that a network connection between two nodes exists through a single link connecting a part of one group to a part of another group and it represents a link between the two groups as a whole. This assumption states that a network connection between two nodes exists when those two nodes are mutually connected through a network link. While this assumption rests clearly valid when the node is a single person, the underlying logic needs additional justification at higher levels of analysis. Dealing with groups this assumption rests on the fact that close intragroup interactions, collaboration, linkages, and communication processes need to be in place within the focal group. In our study, as illustrated in figure 1, group members do form tightly coupled networks within groups, as they work together in order to create and develop new ideas, involving close interactions, dense communication channels and strong collaboration within the group. In the same vein literature has already benefited of this assumption. For instance, Uzzi and Spiro (2005) considered Broadway musical crews as fully linked cliques, Zhaeer and Soda (2009) considered TV group production as fully linked clique (a clique is a subset of

the vertex set C ⊆ V, such that for every two vertices in C, there exists an edge connecting the two). Consequently, in this context we assume that when two groups share a specialist are mutually linked with each other. For instance, when two groups X and Y share at least a single specialist A are themselves connected, view figure 1. The mechanisms behind this explanation is that all the members of the focal groups (i.e. groups that share the focal specialist) are influenced by that link, because coordination processes are so tightly coupled within the focal group, co-membership relationship between the two groups becomes a knowledge and experience conduit for groups as a whole. Furthermore, figure 2 represents the whole co-membership network of groups both concurrently and in the past.

The second assumption is that of **influence**. Network research at the individual level assumes with some justification that network content flows through individual nodes to other nodes that are not linked directly to each other (i.e., content passes from X to Z through Y even though X and Z are not directly linked). Furthermore, this is the explanation at the basis of the power and control benefits of that occupying network position rich in structural holes. Beginning with classic research on the diffusion of ideas and information through networks (Coleman, Katz, and Menzel, 1966; Burt, 2004) this phenomenon has been well illustrated at the individual level of analysis. Again, at higher levels of analysis, it is problematic to automatically assume that this influence process exists, too. To make such an assumption of influence, again we need to clarify theoretically and empirically the mechanisms through which network affects indirectly connected groups. In our case, when two groups X and Y share a specialist (say A) and another specialist (say B) is shared between Y and Z (view fig. 1), influence implies that content passes between groups X and Z through Y. Again in this case, we refer to groups characterized to be tightly coupled. Thus, content is likely to flow through a process that influence groups as a whole. For instance, in the example above group X and Z are linked because content flows from group X to Y through specialists A, while the same content flows form group Y to Z through specialists B, and vice versa (view fig.1).

Even in tightly coupled groups, however, the influence process may be diluted because the process is necessarily mediated through coordination and communication interfaces within the group. At the same time, the moderation of the influence processes may amplify the brokerage power of Group Y (Zaheer and Soda, 2009). Therefore, structural holes in such co-membership networks may therefore be an even more potent source of explanation of group performance and of evolution of the overall group structure.

4.2 The Temporary Network Structure

Data on all ideas that have been created within a company over an extensive period of time have been collected. The company studied is a Swedish consumer goods company that has worked systematically with ideation since 1995, using an idea management system for collecting, handling and evaluating all ideas generated at the firm. Longitudinal data on groups, all their members, and their networks of relations have been gathered from 2000 to 2006 from the company database. Dataset contained information on all 4659 ideas. Due to missing variables and attributes in the company dataset, the overall sample has been restricted to 3,534 ideas, 1180 of which generated by groups and the remaining 2354 generated by individual inventors

alone. For the specific purpose of this research, the focus was only on the group level, consisting in 1180 ideas (table 1 contains description of the ideas collected and then retained within the dataset). In this context of analysis a group exists when individual specialists work together in order to create and develop a new idea. Furthermore, individual specialists are allowed to be part of more than one group, this is a common feature within organizational context characterized by high rate of innovation and knowledge. In our sample, we were able to retrace multiple group membership of individual specialists. This means that group members are allowed to move to other groups, carrying with them experience and knowledge accumulated in previous groups. In this vein, concurrent group members acts similarly to transmit knowledge across groups. This is the rationale behind the construction of the temporary network structure investigated here.

The ideation groups form a large network through the interconnected specialists over time. In the same vein, investigating group performance in creative industry Lampel and his colleagues proposed "The virtue of such latent structures is that they can provide the means whereby a network of specialists that have previously worked together can … reconstitute the network" (2000: 265).

The rationale behind this ideation network is that information, knowledge and experience flow through network ties via individual specialists that connect different groups. The resources that flow through those network connections are vital for nurture focal group ideation performance. In such a co-membership networks, a focal group's alters are defined as those groups on which focal group members either collaborate as current members (current alters) or collaborate as past members (past alters) (fig. 2). As the level of analysis of this research is at the group level, relation among groups have been retraced departing from the pattern of co-group membership in the temporary network, measured as explained deeply in the following section.
Social Network Analysis has been used to analyze the structural characteristics of groups' social capital in the temporary ideation network created on the basis of the co-group membership among groups.

We distinguished networks on the basis of the years in which ideas had been created within the company, thereby obtaining 7 different "group-x-group" networks (years: 2000, 2001, 2002, 2003, 2004, 2005, 2006). The objective of this study is to test the effect of two different network patterns on performance as subordinate to the contingency of time. UCINET 6 Network Analysis Software network analysis software (Borgatti et al., 2002) has been used both for building our temporal network and for measuring our network variables. In order to have a long enough window in the past, allowing to investigate past network connections we decided to split the overall sample into different parts: one accounts for the past network structure and the other accounts for the current network structure (fig.2 and tab.2). The network idea is that each group is connected to the past through patterns of co-group membership (i.e. individuals that have worked together in the past in other groups). Let's say each idea generated by groups in 2004 is related to ideas generated in the time window 2000-2003. We decided to account for a four years past-window in order to avoid the so-called problem of relationship decay over time (Zaheer and

Soda 2009). Instead, ideas generated in 2005 are connected to ideas generated in 2001-2004, ideas generated in 2006 connected to 2002-2005.

We look also to the current position of each group. 2004, 2005, and 2006 are years for the investigation of current network positions. We account for the current relations among groups per each of the three years of current investigation. Past and current network variables are based on different time-spans within the sample. The past on the four-years time span preceding the focal group's ideation year; while the current variables on the year of ideation. Past and current network measures do not share any overlapping years of network data. Table 2 contains a schematic explanation of the relations among past and current network structure investigated here. Moreover, it is important to remark that the focal group themselves are a completely newly formed organizational entity that did not exist in the past. To that extent, there is no scope for any fixed effect or tendency of the group to show auto-correlated errors over time. The lag structure adopted to develop measures of antecedent variables for the current network takes the following form:

$$y_t = \beta_0 + \beta_1 \sum_{i=1}^{7} x_{t-i} + \ldots + \varepsilon_t$$

where y_t is the position investigated in the current network structure for years 2004-2005-2006 (i.e. current group centrality and current structural holes), x_{t-i} are the past network variables measured in the past network structure measured in the past window (view tab. 2) (i.e. past group centrality and past structural holes), β_0 is the constant and ε_t is the error term.

Table 1: Description of the number of ideas

	2000	2001	2002	2003	2004	2005	2006
Overall number of ideas generated	519	587	465	668	781	929	710
Ideas retained in the sample	458	520	343	472	521	595	625
Number of ideas generated by individuals	316	357	231	334	350	360	407
Number of ideas generated by groups	142	163	112	139	171	235	218

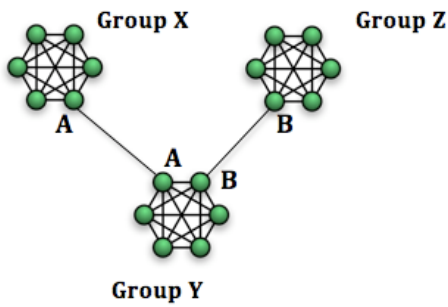**Figure 1:** Connection Assumption and Influence Assumption
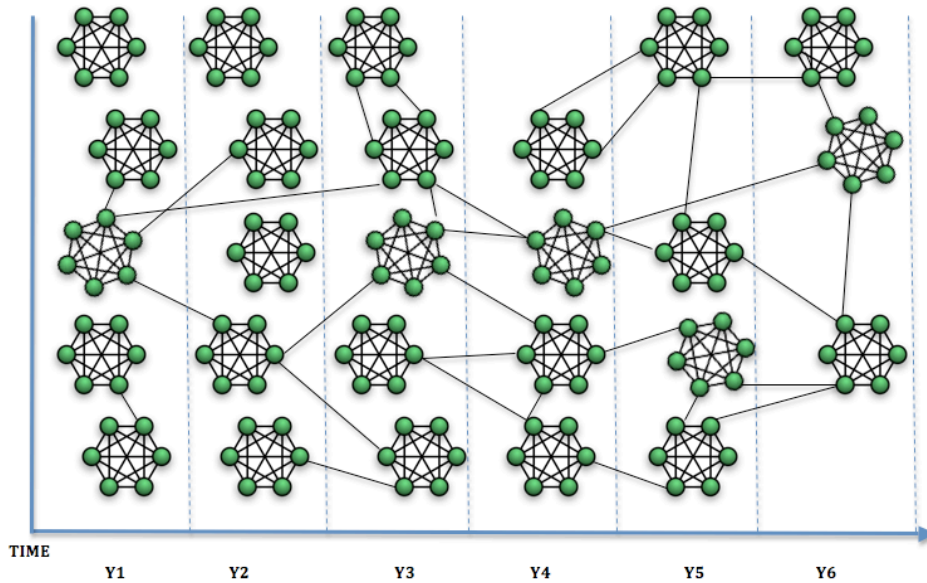
Figure 2: Structure of Temporary network

Table 2: Past network structure and Current network structure

Past Network (past-window)	Current network
2000-2003	2004
2001-2004	2005
2002-2005	2006

4.3 Analysis and Econometric Approach

We used a 2SLS model with a robust variance estimator to control for the effects of correlation between errors across equations due to endogeneity between network structure and performance. Although Baron and Kenny (1986) recommended the use of 2SLS only for controlling possible reverse causality from the outcome to the mediator, Shaver (2005) has suggested that 2SLS "is an effective estimation strategy in a much broader set of circumstances . . . even when feedback is not a concern." (2005: 1140)He recommended its use because of the power of the methodology to handle potential correlation among error terms in the equations. The 2SLS procedure takes into account such correlations and produces coefficients that are consistent and unbiased.

Although our endogenous measure of current structural holes (*efficiency*) is bounded (0–1) as well, Angrist and Krueger (2001) pointed out that in a two-stage procedure, it is not necessary to use limited dependent variable estimation for the first stage, even if the endogenous variable is bounded, to generate consistent estimates in the second stage.

We checked the consistency of and the appropriateness of the 2SLS modeling approach with the Wu-Hausman F-test. The test for endogeneity in which the null hypothesis states that an ordinary least squares (OLS) estimator of the equation would yield consistent estimates, and thus endogeneity among the regressors would not have deleterious effects on OLS estimates.

4.4 Variables

Dependent variable. Scholars have long debated about the way assessing ideation and creativity in organizational context, and to date several different methods have been used (see Amabile and Mueller, 2006). Based on previous assessment of organizational literature (Amabile and Mueller, 2006) researchers revealed that the most common used method to assess ideation involves subjective evaluation, in which experts or peers makes scale-based evaluation of ideation performance (Amabile et al., 1996; Oldham and Cummings, 1996; Amabile et al. 2005). The design of this study required a measure of group ideation performance based on the quality of the idea generated. For each idea we had the five-points grade received by the committee, The Ideas are graded on their novelty and usefulness for the company, ranging from 1 to 5. Group ideation performance was measured as the natural logarithm of the total score reported by ideas developed by each group within the sample. The following example could help in interpreting the measure employed. Let us consider a group who developed a novel idea. If the committee assigns a score of 2 for the idea, the score is computed as follows: log[2].

4.4.1 First-stage Variables
First stage variables are relational, and synthesize some structural characteristics of the network of each group -also known as an *ego network*- within the firm. Studying the ego network requires the definition of a reference player, called ego, and a series of alters -other nodes with whom the ego is connected (Breiger, 2004). The objects of study are both the ego-alter relationships and the existing ties between the alters. In the present study, relationships between the ego and alters are considered by taking into account the "group-x-group" network, derived from ideas generated by each groups. Two main structural characteristics of each ego network are used in this study: the *ego network degree* and *ego network efficiency* (Burt, 1992).

Ego network degree: Group degree
To obtain a measure of the ego network dimension, our endogenous variable, we count the number of direct partners of the focal individual, which is his or her Ego network degree. Then, this variable has been normalized with the current group size, in order to have a measure of network degree not affected by the focal group size.
Interaction : we measured the interacting effect of past group degree and group size

Ego network efficiency

We measured *current structural holes*, our endogenous variable, as the efficiency index in the network of current ties among ideation groups. We used Burt's (1992) measure of efficiency, which counts the ratio of non-redundant ties to total ties for a focal group as:

$$\left[\sum_j \left(1 - \sum_q p_{iq} m_{jq} \right) \right] \Big/ C_j$$

where p_{iq} is the proportion of the focal ideation group i's ties in connection with group q, m_{jq} is the marginal strength of the relationship between group j and group q, and C_j is the total number of ties for group i. A high value of efficiency for group i indicates that its ego network is non-redundant and thus rich in structural holes. This measure captures the non-redundancy of i's ties as the degree to which a focal group i has many independent ties. More specifically, this measure estimates the degree to which q has a large proportion of j's ties, and i has ties with j.

Interaction: we measured the interacting effect of past group structural holes and group size

4.4.2 Instrumental Variables

Past network variables. To compute past network variables, we used three-year moving windows, as we explained earlier. As an example, to compute the past structural holes of group #2790 (a 2004 ideation), which uses as a "past" all ideations produced in the three-year period 2000–2003, we took the following steps: (1) We began with an input dataset of all ties among all ideators in the past time window 2000–2003, which is a "ideators x group" matrix, where x_{ij} equals 1 when ideator i is part of group j and 0 otherwise. (2) We then created a vector of size "ideator x 1" for focal group #2790. (3) Next, we joined this vector to the first matrix creating a new matrix "ideators x group", which now included all the potential past alters for group #2790. (4) We then affiliated this latter matrix to make it a co-membership group-by-group matrix "group x group", where x_{ij} is a count of the number of ideators shared between group i and group j (in the analysis we controlled for group size). (5) On this co-membership matrix we calculated network measures (e.g., past structural holes, past degree) for group #2790. And (6) finally, we repeated this procedure for all current focal groups in our dataset (the set of ideation groups with "pasts"). By applying the procedure described above and adopting the same efficiency measure and degree measures we used for current network.

Past structural holes have been measured as the ratio of past non-redundant ties to total past ties for each focal group. Past group centrality has been measured as the Freeman degree centrality of the focal group in the network of past ties (over a three-year window), normalized by group size.

4.4.3. Control variables

Besides the structural features of temporary network, we considered other important group attribution characteristics, such as the group diversity (measured as functional heterogeneity), the size of the group and the group ideation ability. We used controls of several types in our analysis.

Group Size: we measured group size counting the number of members within the group.

Functional Heterogeneity: we used Blau's (1970) heterogeneity index to measure the dispersion across functions.

Average previous ideation performance: each group presents its own ideation capability endowment. This variable has been designed to control for the degree of highly inventive individuals within group, as theory predicts that groups composed of members with a positive track history of past ideation performance are more likely to have high ideation performance in the present. We operazionalized the average previous ideation performance using the previous two years performance of each persons, and then summed across all grades of ideas in which each individual worked. After that we aggregated this values at the group level, considering the individuals composing the group. For instance, if group "IDEA" was composed of two members: A and B. Let's say that A in 2004 and 2005 worked on two ideas graded both 4 and B on only one idea graded 3. The overall group ideation ability for "IDEA" is 3.5=((4+4)/2 + 3/1)/2 (i.e. group size).

5. Results and Analysis

Table 3 provides descriptive statistics and correlations for the variables. We first test for the appropriateness of treating current structural holes and current group centrality as endogenous variables by using the Wu-Husman F-test [2.87; p = .05 (current structural holes)- 4.07; p = .05 (current group centrality)]. The results of the Hausman test allow us to soundly reject the null hypothesis that current structural holes and current group centrality are exogenous to performance, indicating that it is appropriate to use a 2SLS specification to address the issue of endogeneity.

Results of the 2SLS regression analysis are reported in table 5, testing the hypothesized relationships between the different constructs of groups' ego networks and ideation performance. To test the research hypotheses advanced, a stepwise technique was adopted, as relevant variables for hypothesis testing are progressively included. Model M1 accounts for controls. Model M2 introduces past network patterns (i.e. past group centrality and past group structural holes) and M3 is the fully specified models with the interaction effect between past network position and group size. Supportive to H3a, past group centrality is positively and significantly associated with current group centrality (past group centrality β=.67, p<.01). Also supportive to H3b group size positively mediated the effect of past group centrality on current group centrality (β=.51, p<.01). Supportive to hypothesis H4a, past structural holes are positively and significantly associated with current structural holes (past structural holes β=.07, p<.01) (all hypothesis are tested with coefficient values from the fully specified model M3). Thus groups with high structural holes tend to increase their structural holes in the current network. Also supportive to H4b group size positively mediated the effect of past structural holes on current structural holes (β=.03, p<.01).

Overall, the first stage accounts for a large proportion of the variance in the current network position of groups (Pseudo R^2=.72 for current structural holes and Pseudo R^2=.65 for current group centrality).

Table 3

Descriptive Statistics and Correlations

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9
1. performance	1.93	.81									
2. average previous ideation performance	10.83	5.53	.012								
3. functional heterogeneity	4.31	2.59	.085	.85							
4. group size	2.75	1.02	.15	.05	.23						
5. current structural holes	.57	.16	.066	.024	.042	.181					
6. current group centrality	1.97	.92	.045	.061	-.079	.30	-.106				
7. past structural holes	.46	.16	.053	-.02	-.07	.178	.04	.27			
8. past group centrality	1.86	.89	-.184	.117	-.11	.35	-.012	.16	-.39		
9. past structural holes x group size	1.31	.81	.06	.02	-.21	.68••	.14••	.36	.69••	.02	
10. past group centrality x group size	1.54	.98	.19	.13	-.18	.624••	.073	.244••	-.202••	.88	.33

••p<.05

Table 4

Results of SLS with Endogenous Covariates (models estimated with robust variance estimator)

First Stage (endogenous variable: current group centrality)			
	Model 1	**Model 2**	**Model 3**
Constant	.31 (.05)	.35 (.065)	1.67 (.79)
starness	.012• (.006)	.012• (.006)	.15 (.01)
functional heterogeneity	-.02 (.15)	-.08 (.09)	-.14 (.044)
group size	.06••• (.02)	.06••• (.02)	.39••• (.08)
past group centrality		.48••• (.26)	.67••• (.19)
past group centrality x group size			.51••• (.027)

•p<.10; ••p<.05; •••p<.01.

Second Stage (performance variable: group ideation performance)		
	Model 1	**Model 2**
Constant	1.31 (.07)	2.85 (.065)
average previous ideation performance	.022 (.076)	.018 (.086)
functional heterogeneity	-.04• (.15)	-.038• (.015)
current group centrality		-.049•• (.02)
Wald chi^2	144,66	
Prob > chi^2	0,0016	
R^2	22,89	

•p<.10; ••p<.05; •••p<.01.

Table 5

Results of SLS with Endogenous Covariates (models estimated with robust variance estimator)

First Stage (endogenous variable: current structural holes)

	Model 1	Model 2	Model 3
Constant	.31 (.05)	.35 (.065)	.63 (.019)
average previous ideation performance	.012•• (.006)	.012•• (.006)	.01••• (.001)
functional heterogeneity	-.02• (.15)	-.028• (.015)	-.02•• (.004)
group size	.06••• (.02)	.06••• (.02)	-.19••• (.008)
past structural holes		.08••• (.06)	.07••• (.01)
past structural holes x group size			.31••• (.007)

•p<.10; ••p<.05; •••p<.01.

Second Stage (performance variable: group ideation performance)		
	Model 1	Model 2
Constant	.31 (.05)	.35 (.065)
average previous ideation performance	.012•• (.006)	.012•• (.006)
functional heterogeneity	-.02• (.15)	.028• (.015)
current structural holes		.08••• (.06)
Wald chi^2	125,66	
Prob > chi^2	0,0026	
R^2	22,66	

•p<.10; ••p<.05; •••p<.01.

In the second stage of the 2SLS, we tested hypothesis about the positive effects of current group network position on group ideation performance (H2 and H1 current structural holes and current group centrality respectively). The idea that the effects of structure are largely independent is supported in the results. Structural holes enhances performance (β=.08, p<.01), supporting H2. However, H1 is not supported by our results.

6. Discussions and Analysis

The aim of this research is two-fold. First, we tested the effect of network position on group ideation performance. Specifically we addressed the effect of network degree and the presence of structural holes on group ideation performance. Those two fundamental network positions are supposed to affect group ideation performance, though with different mechanisms.

The results show that group network degree centrality affects negatively group ideation performance. The explanation for this results rest on the evidence that high group network centrality means that the focal group has many connections with other groups in the concurrent network structure. Moreover, groups with high network centrality suffer form being in a way constrained by the network structure (Uzzi, 1997). The high network cohesion resulting form their patterns of connections constrain ideation ability of the focal group as it is embedded in a dense web of interconnected ties.

The results of the econometric analysis showed that the presence of structural holes affects positively group ideation performance. This evidence supports the proposed hypothesis and the positive effect found corroborate the network theory that stresses the privileged position of those bridging holes within the network as those actors maintain control benefits over resources that flow within the network structure (Burt, 1992; 2004). Moreover, the benefits of structural holes operate through mechanisms of brokerage, information asymmetries among disconnected alters (Fleming and Waguespack, 2007). In the context of the ideation network aggregating information from several different alters enable focal group to exploit its knowledge and resources endowment, thus nurturing idea creation and development. Furthermore, our results reveal that network structure tends to reproduce over time and to maintain stability over time.

In this study, we offered and tested a theoretical perspective that encompasses opportunity exploitation and structural persistence as underlying drivers of network degree and structural holes and their performance outcomes. We showed that network actors are presented regularly with opportunities thanks to and constraints due to their positions in the prior social structure. The opportunities created by networks are not just linked concurrently with favourable outcomes at a point in time but project their shadow over the evolution of network structure. Thus past networks provide actors with experiences, social contexts, and access to knowledge and resources that are opportunities enabling or obstacles constraining actors to enact future structures. Our deep investigation of a specific organizational context reveals that network structures emerge as the result of forces (exploitation and constraint) that include both the replication of past social interactions.

In brief, our results show that past group centrality leads to current group centrality and past structural holes lead to the formation of structural holes in future networks, too. Furthermore, we showed that groups exploit their network position affecting group performance.

Our explanation of opportunity exploitation and structural persistence are not necessarily in opposition to each other. Our overarching theoretical framework included both constraint and opportunities arising from structural persistence. We showed that actors exploit actively the opportunities related to structural characteristics of past network structure in enacting the processes that culminate in the creation of future networks and specifically in the achievement of superior network positions for themselves (Nohria, 1992). At the same time, by virtue of inertia and constraint, highly embedded structures from the past limit the focal actor's ability to transform past network positions into valuable current network structures.

The findings on the effect of past group centrality suggest a role for the persistence of networks over time as results showed that a major inhibitor of group ideation performance was the presence of high group centrality. Lock-in with dense, overlapping ties makes it harder for focal actors to break out of redundant network structures (Giddens, 1984). Groups with high group centrality in the past will tend to

find themselves in tightly linked structures in subsequent periods because future groups will tend to replicate previous positions, resulting in fewer structural holes for the focal group by virtue of structural persistence and lower ideation performance, too.

A central element of the framework developed here points to the role of past structural holes that predict the formation of current structural holes. We characterized this as a manifestation of opportunity exploitation by the focal actor (Burt, 2004). This idea implies a purposeful reactivation of favourable past structures. This finding means that structural holes spanned in the past give rise to future structural holes and pointing out the strength of actor's ability to exploit the opportunities that result in positive performance.

Overall, our results provide considerable evidence for the notion that those actors who are able to actively exploit the social structure and opportunities would enhance their performance, even though structural persistence -especially past network centrality- results as a major inhibitor of performance.

7. Conclusions

Although a vast research stream has examined the effects of network structure on performance (Sparrowe et al., 2001; Reagans, Zuckerman, McEvily, 2004; Ahja, 2000), scant attention has been paid to the examination of network structure over time (Zaheer and Soda, 2009). The results of this research primarily stress the importance of the network position on group ideation performance. In organizational context characterized by such a tension towards the first phases of the innovation process in which ideas are generated and developed in order to nurture firm innovative performance, the results discussed in this research stress the importance of the network structure and especially network centrality and the presence of structural holes. As discussed above, group centrality has a negative effect on group ideation performance, while the presence of structural holes increases group ideation performance. Furthermore, we showed that network structure tend to resist change and maintain its structure over time. We proposed two mechanisms through which network structure comes about over time: i.e. past network exploitation and past network constraint. The findings show that both mechanisms are significant in explaining how past and current network structures are related to each other. The research has focused on two characteristics of network structure (i.e. centrality and structural holes). Future research investigating the temporary network structure would point to other characteristics of the whole network, for instance the core-periphery network structure. Network literature calls for a deeply understanding of the dynamics at the basis of network origin and dynamics, departing from the results of this study it would be interesting investigating other network mechanisms through which the network structure would come about.

Furthermore, one step further would be to combine network perspective with theory on group dynamics in order to obtain a more fine grained understanding of different factors influencing network structure evolution. In this study we do not account for the specific category of ideas. This would affect the structure of group ego network and conversely affect overall network dynamics. Therefore, a more comprehensive

understanding of this phenomenon is needed and it may arise form the combination of a network dynamic perspective together with that on the processes of group and group formation and, more broadly, on group dynamics. Departing from this study future research can obtain a more fine-grained understanding of the interrelationships among group ideation performance and network structure. We do not account for the different types of ideas, and knowledge and resources needed for these. For instance, group ideation in fluid groups for deep technology knowledge or for new technologies might be different form the group ideation activities to come up with new business ideas. These different ideation activities are likely to require different network patterns.

Another aspect that deserves theoretical and empirical investigation is that differently organized groups (formal groups vs spontaneously formed groups) being differently composed require different network structure in order to maximize their ideation performance. In the present study, these two types of groups are present but not controlled for. While formal groups are explicitly designed to be more heterogeneous would profit as much from their structural holes position, or do spontaneously formed groups would profit as much from their central position? These research questions remain open for future research.

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