The effect of distributed and rotating leadership on collaborative innovation performance

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ABSTRACT
Increasingly more firms engage in collaborations with other firms aiming at increasing their innovation performance. When engaging in such collaborations, proper coordination is important in order to reach collaboration objectives. An important concept within coordination is leadership. This study examines the effect of distributed and rotating leadership as parts of transformational leadership on collaborative innovation performance in an experimental setting. The results show that distributed leadership has a negative effect collaborative innovation performance, while rotating leadership has a positive effect on collaborative innovation performance. The results of this experiment can be seen as a guideline for firms that are engaging in collaborations, when looking for an effective management structure within collaborations.

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Keywords
Collaboration, coordination, innovation, distributed leadership, rotating leadership, transformational leadership

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1. INTRODUCTION

Nowadays, a growing number of firms engage in collaborations with other firms as an attempt to secure their competitive advantage or growth (Kale and Singh, 2009). Ernst (2004) states that by the start of this century, many of the largest companies had invested 20% of their assets and 30% of their annual research expenditures in alliances. Alliances like these, of which pooling resources are an important characteristic, include for example shared R&D efforts, exchange of technology, licensing and direct investment (Gulati, 1995). This is partly due to the fact that it is hard for companies to develop all knowledge needed for effective innovation in-house (Powell, Koput and Smith-Doerr, 1996; Vanhaverbeke, 2006). As Faems, Van Looy and Debackere (2005) and Hoffmann (2007) state, it becomes increasingly important to companies how to engage in different collaborations in order to achieve excellent innovation performance (Faems, Van Looy & Debackere, 2005; Hoffmann, 2007). Also Davis and Eisenhardt (2011) acknowledge that due to distributed and frequently changing resources in more open and dynamic industries, companies rely more on other companies to collaborate with to be able to develop successful innovations. In addition, Rosenkopf and Nerkar (2001) found that using knowledge from other firms has a higher impact on innovation performance than using knowledge of units within the same firm.

However, literature reveals that there are high failure rates among inter-organizational collaborations (Dyer, Kale & Singh, 2001). Among others, Lunnan and Haugland (2008) report failure rates of 50%. In addition, Davis and Eisenhardt (2011) mention that collaborations between partners who have strong innovative capabilities and long-term embedded relationships can still struggle in achieving their collaborative innovation objectives.

Literature mentions conflicts of interest, which can harm commitment and lead to opportunism, as main reason for failures in collaboration (Doz, 1996). However, Gulati, Wohlgezogen and Zhelyazkov (2012) state that when investigating these unsuccessful collaborations, many studies solely look at the failure to cooperate and do not elaborate on coordination, which is argued to be another important aspect within collaboration (Gulati & Singh, 1998). Cooperation is defined as the "joint pursuit of agreed-on goal(s) in a manner corresponding to a shared understanding about contributions and payoffs" (p. 533), whereas coordination is defined as "the deliberate and orderly alignment or adjustment of partners' actions to achieve jointly determined goals" (p. 537). The authors state that collaboration success in the cooperation perspective is mainly based on stability, equity and goal attainment, whereas in the coordination perspective, success is characterized by efficiency, effectiveness, flexibility and adaptiveness of the partnership. The assumption is that even when the interests of the different parties fit perfectly, collaborations can still fail because of problems in dividing labor and task coordination, which is something that is also recognized by Davis and Eisenhardt (2011). Therefore, within the coordination view, the prime focus is on organizational design, communication and process management (Gulati et al., 2012), instead of merely on preventing opportunistic behavior. To prevent failure of coordination they address the importance of hierarchies, authorities and formalization. Also, Kale and Singh (2009) state that coordination between partners is an important factor during the post-formation stage of an collaboration, which is the phase during which the collaboration objectives should be achieved. They address factors that are important to collaboration success, which are similar to those mentioned by Gulati et al. (2012). The processes important in the coordination stage mentioned above are for this study summarized as 'leadership', which is a topic that Davis and Eisenhardt (2011) extensively studied. They investigated the importance of leadership within collaboration aimed at innovation. They mention that high-performing collaborative innovation involves "dynamic organizational processes associated with collaboration partners' leadership roles that solve critical innovation problems related to recombination across boundaries" (Davis & Eisenhardt, 2011, p. 159).

Although the importance of leadership within collaborative innovation performance is acknowledged, there is little knowledge about how specific leadership styles influence this performance. The research question this study will be based on is: 'What is the effect of different leadership styles on collaborative innovation performance?'. A literature review reveals that especially transformational leadership is often associated with innovation performance. This study contributes to current literature by focusing on the effect of components of transformational leadership on innovation performance within the specific context of collaborations: a field that current literature pays little attention to. Another contribution is the fact that this study examines this effect in a controlled, experimental setting. Based on this experiment on collaboration, it will be examined how these components of transformational leadership influence collaborative innovation performance in practice. Besides contributing to literature by providing empirical evidence, another objective of this study is to provide companies practical guidelines in how certain leadership styles are influencing innovation performance and how they might influence the chance of success in alliances.

2. LITERATURE REVIEW AND THEORY

2.1 The effect of transformational leadership on collaborative innovation performance

An important leadership style which is often mentioned together with innovation performance is transformational leadership. Transformational leadership is often compared to a more traditional form of leadership, i.e. transactional leadership. Transactional leadership is based on the exchange between leader and follower. The follower offers something to the leader, e.g. productivity, and the leader provides the follower a reward in return, e.g. a monthly salary. In transformational leadership on the contrary, the focus is more on the interaction between leaders and followers that stimulates creativity and motivation (Burns, 1978). Bass and Avolio (1994) extensively researched the effect of transformational leadership on organizational effectiveness. They refer to the foundation of transformational leadership as what they call the four I's, i.e. idealized influence/inspirational motivation, intellectual stimulation and individualized consideration. Idealized influence/inspirational motivation is concerned with triggering employees' pride for being associated with the leader, motivating followers to go for the good of the entire team, instead of solely for self-interest, reassuring employees that obstacles can be overcome, motivating confidence and achievement, providing a compelling vision for the future accompanied by an optimistic view and image of organizational

change (Bass & Avolio, 1994). Intellectual stimulation includes the promotion of intelligence, rationality and careful problem solving. It aims for seeking different perspectives and suggesting new ways of thinking and make employees reconsidering assumptions (Bass & Avolio, 1994). Lastly, the concept of individualized consideration mainly deals with coaching, teaching and helping others reaching their personal goals (Bass & Avolio, 1994). Several studies have observed a significant positive relationship between transformational leadership and innovation (Keller, 1992; Sosik, 1998; Hussain, Talib & Shah, 2014). According to Bass (1985) this is caused by the employees' engagement levels that are raised by their managers or as Dansereau, Yammarino and Markham (1995) describe, the focus of the leader's role is as support in the development of the followers. Birasnav, Albufalasa & Bader (2013) support this by their definition of transformational leadership, in which they state that transformational leadership is aimed at developing human capital in order to transform an organization into an innovative organization. In this study, the focus will be on distributed leadership and rotating leadership, which can be seen as components of transformational leadership (Leithwood & Jantzi, 1999).

2.2 Distributed leadership as component of transformational leadership and its effect on collaborative innovation performance

Bennett, Harvey, Wise and Woods (2003) describe distributed leadership as an "emergent property of a team or networks of interacting individuals...[in contrast to]...leadership as a phenomenon which arises from the individual" (p. 7). It is often used interchangeably with 'shared leadership', 'team leadership' or 'democratic leadership' and assumes that leadership should be viewed as shared within the team instead of as the monopoly of an individual (Gibb, 1954). Distributed leadership is very similar to transformational leadership, but where interactions between a leader and his/her followers were found to be an important aspect of transformational leadership, for distributed leadership this is extended with the interactions between different leaders (Spillane, 2006). In organizations this is characterized by the constant interaction within teams, which results in shared patterns of communication, learning and action (Spillane, 2006). In contrast to distributed leadership, more traditional leadership approaches are more focused on dominance of the leader and the dependency of follower on this leader (Gronn, 2002); something that also differentiates transformational leadership from transactional leadership (Burns, 1978). To conclude, there are many similarities between transformational and distributed leadership. This is why distributed leadership is discussed to be a component of transformational leadership (Leithwood and Jantzi, 1999). To conclude, when adopting a distributed leadership style, tasks and responsibilities are distributed among several individuals. Day, Gronn and Salas (2004) say that this distribution of leadership might positively influence innovation performance, because it allows teams to be able to react better on the complex and ambiguous environment. They give as main argument that this is caused by the fact that a single leader might be unable to fulfill all necessary leaderships tasks by his- or herself, which is solved when leadership is distributed among more people (Day, Gronn & Salas, 2004).

Although some studies suppose there is a positive relation between distributed leadership and team performance (Hoch, 2007; Day, Gronn & Salas, 2006; Spillane, 2006), other researchers are more critical about the concept. There is lack of empirical evidence in the existing literature, which is also acknowledged by several researchers (Menon, 2011; Timerley, 2005) and according to Corrigan (2013) the concept of distributed leadership lacks theoretical foundation. Corrigan (2013) also mentions that some authors see distributed leadership as a trend or 'the flavor of the month'. He says: "The rise of distributed leadership must be considered within the context of previous leadership models that have not been sustainable in practice" (Corrigan, 2013, p. 70). In addition, literature does not give any conditions or assumptions for the effect of distributed leadership. Firstly, distributed leadership literature has been generated primarily in an educational environment (Bolden, 2011). This is obviously very different from the organizational environment, if it was only because of their entirely different objectives. Therefore, it can be questioned if it's believed effect is generalizable. Also, one could imagine that the effect of distributed leadership is limited, since the interference of too many leaders would possibly lead to inertia and ineffectiveness. However, most literature sees distributed leadership as dichotomous variable: either present or absent. Knowledge about numbers of leaders remain largely unknown. In addition, Harris (2008) rightly mentions that distributed leadership rests on the assumption that each 'leader' has leadership abilities. However, in reality this may not be the case, resulting in lower performance. As several researchers say (Corrigan, 2013; Harris, Leithwood, Day, Sammons & Hopkins, 2007; Timperley, 2005), the quality of distributed leadership is at least just as important as the distribution itself or as Timperley (2005) says: "'distributing leadership over more people is a risky business and may result in the greater distribution of incompetence" (p. 23). This is something that is often forgotten in literature. In addition, Davis and Eisenhardt (2011) mention that distributed leadership in organizations is found to be linked with inefficiencies and disagreements about objectives and unclear decision-making roles. This makes the recombination of knowledge, technologies and other resources harder and in turn negatively influences collaborative innovation performance (Davis & Eisenhardt, 2011).

To conclude, there is no agreement in current literature about the effect of distributed leadership on collaborative innovation performance and some authors even question the entire concept. However, exactly these disagreements makes it interesting and valuable to study the effects of distributed leadership, because the main reason for contradicting literature is the widely varying circumstances. This experiment will contribute to existing literature by studying the effect of distributed leadership in a controlled experiment, so that it's effect can be tested in a very specific situation. For this study, this will be the effect of distributed leadership in a collaboration aiming at innovation, of two teams with their own knowledge and capabilities which differ from the other team they collaborate with. The design of the experiment will be elaborated on in the methods section. In contrast to other studies, in this study distributed leadership seen as a continuous variable, instead of only present yes-or-no. Because literature in the field of business administration expects that the interference of too many 'leaders' will lead to inefficiencies and disagreements within the collaboration, for this experiment distributed leadership is assumed to have a negative effect on collaborative innovation performance. Therefore, for this specific experiment in collaborative innovation performance, hypothesis 1 will be formulated as follows:

H1. *The extent to which leadership is distributed has a negative effect on collaborative innovation performance.*

2.3 Rotating leadership as component of transformational leadership and its effect on collaborative innovation performance

Davis and Eisenhardt (2011) reexamined the influence of distributed leadership in a multiple-case study, namely by researching a specific phenomenon which they call rotating leadership. They differentiate between three leadership styles, of which two, i.e. consensus leadership and rotating leadership, can be positioned under distributed leadership. In consensus leadership, both collaboration partners have a more or less equal contribution in making key decisions, determining innovation objectives and mobilizing participants. In rotating leadership, leadership is also distributed, but shifts between the different partners within the collaboration. The last style in their trichotomy is dominating leadership, in which leadership is not distributed but only one of the collaboration partners act as leader. Davis and Eisenhardt (2011) found out that adopting a rotating leadership style has a significant stronger positive effect on collaborative innovation performance than dominating and consensus leadership styles have. While dominating and consensus leadership styles are likely to be time-saving, rotating leadership triggers access to the capabilities of both collaboration partners and the recombination of knowledge, technologies and other resources increases innovation performance (Davis & Eisenhardt, 2011). Davis and Eisenhardt (2011) saw rotating leadership as a continuous variable and found out that the number of shifts in leadership between the different partners within a collaboration has a positive effect on collaborative innovation performance, therefore hypothesis 2 will be formulated as follows:

H2. *The extent to which leadership rotates between the different partners within a collaboration has a positive effect on collaborative innovation performance.*

The expected relationships between distributed leadership and collaborative innovation performance and rotating leadership and collaborative innovation performance will be tested in the context of collaborations between diverse partners by the experiment that will be described in the method section. The model is to be found in figure 1 below.

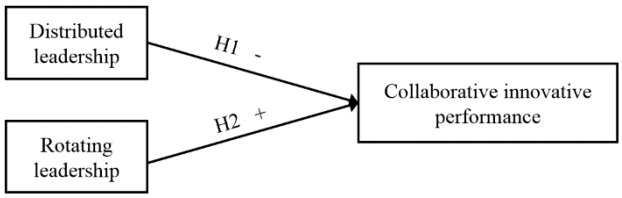

Figure 1: the expected negative effect of distributed leadership (H1) and the expected positive effect of rotating leadership (H2) on collaborative innovation performance

3. METHOD

3.1 Participants

The hypotheses are tested by conducting an experiment in which 210 college-students of the University of Twente participated, mostly from the faculty Behavioural, Management and Social sciences. From the participants that filled in the questionnaires afterwards, 95,8% percent had an age between 17 and 28 years old. The participants were compensated for their participation by a lottery ticket of €3,-.

3.2 Procedure

The experiment[1] consisted of three phases, which all took 30 minutes. In the first phase participants were randomly assigned to a team of 3 to learn how to build either airplane bodies or airplane wings. This was done by using Stickle bricks. The skills were also learned in a certain routine, i.e. in serial routine or in parallel routine. In serial routines, every participant had to add an 'component' to the body or wings, so that every participant had a contribution in the assembly of this body or set of wings. In parallel routines, every participant builds an entire body or set of wings on his/her own. In the second phase – the collaboration phase – teams were randomly assigned to another team that learned to make the other part of the plane than they learned themselves, resulting in 35 teams of 6 participants (2 x a subteam of 3 participants). During this phase the participants had to work together to produce new models of airplanes, e.g. a space shuttle or fighter jet. The teams had to come up with a design themselves and had 30 minutes to complete a maximum of 15 model airplanes. However, the teams were not stimulated to reach a certain goal, e.g. as many models as possible or as innovative as possible. This process was filmed; the recordings will be analyzed for collecting data for this specific study on the influence of leadership on collaborative innovation performance. In the last phase of the experiment, the participants had to complete a questionnaire on the collaboration.

3.3 Measures

3.3.1 Dependent variable

The dependent variable in this study is collaborative innovation performance. As mentioned many alliances are intended at innovation and effective leadership can play a facilitating role in achieving the set objectives. Garcia and Galantone (2002) state that innovativeness can be measured as the potential discontinuity in a product. In this experiment this is done by a method described by Troyer and Youngreen (2009): for every built airplane the frequency of that solution across the total number of solutions in all collaborations in the experiment is calculated as a proportion of all airplane models made. The inverse is taken, so that a more innovative solution results in a higher score. Already calculated innovation scores used in the larger experiment by Spin (2011) were used.[1]

3.3.2 Independent variable

3.3.2.1 Distributed leadership

The first independent variable in the model is distributed leadership, which is the phenomenon in which more people within a team take a leadership role. The concept of distributed leadership is therefore operationalized as the number of people acting as leaders. In order to code the videos for leadership, a coding scheme was developed. Since distributed leadership is assumed to be a form of transformational leadership, this coding scheme is based on the leadership characteristics of the four I's as proposed by Bass and Avolio (1994) (see literature section). This coding scheme can be found in Appendix I. The researchers observed the collaboration and counted which participants showed the transformational leadership

[1] This study is part of a larger experiment that was conducted by Spin (2011). For this study, data for the independent variables was generated by using the videos of the collaborations in phase 2 of the experiment. Data for the dependent variable could be used from the experiment in 2011.

characteristics that were formulated in the coding scheme. This was done by two researchers, so that reliability could be ensured. For distributed leadership the Kappa value equals 0,846, indicating an almost perfect agreement between the two researchers.

3.3.2.2 Rotating leadership

The second independent variable is rotating leadership. This is the phenomenon during which leadership rotates between several partners within the collaboration. Therefore, rotating leadership was operationalized as the number of shifts in leadership between the 2 subteams consisting of 3 persons, within the collaboration team that consisted 6 persons. This because we want to study the effect of rotating leadership between organizations, not between individuals. Since rotating leadership was also assumed to be a form of transformational leadership, the same coding scheme was used, based on Bass and Avolio (1994) (Appendix I). During the observation, it was not only counted which participants showed leadership characteristics, but also in which sequence they acted as leaders. Afterwards, it was counted how often leadership switched between the two teams. This was averaged per model, because not every team made the same number of airplanes. This way, values could be compared between the different teams. The Kappa value for this variable also equals 0,846, indicating again an almost perfect agreement between the two researchers.

The variables, their definitions and their operationalization are to be found in table 1.

Concept	Definition	Operationalization
Collaborative innovation performance	The innovativeness of the airplane models produced by the teams	The inverse value of the frequency of an airplane model across the total number of solutions in all collaborations in the experiment as a proportion of all airplane models made
Distributed leadership	The phenomenon in which different people act as leaders	The number of people acting as leaders
Rotating leadership	The phenomenon during which leadership rotates between different partners within the collaboration	The number of shifts in leadership between the two teams within the collaboration, averaged for the total number of airplanes made

Table 1: Variables and their definitions and operationalization

3.4 Data collection

Data of the dependent variable – the scores for innovativeness – was collected by determining the innovativeness of the airplanes made by the teams. This was already done in the experiment of Spin (2011). Data of the independent variables was collected by coding the videos of the collaborating teams. As mentioned, transformational leadership characteristics were translated into a coding scheme to make the concept more measurable. Each time participants showed the behavior described in the coding scheme, this was counted by the researchers. In addition, researchers wrote down which participant showed the behavior. This way it was possible to determine how many participants showed leadership over the whole collaboration of 30 minutes. In addition, this was written down per airplane model, so that afterwards it was possible to determine how often leadership shifted between the 2 teams of 3 persons. During the coding process it was decided to exclude some teams, for example because they did not follow the rules of the experiment (e.g. they made several airplanes simultaneously or they did not collaborate). This was the case for team 18. Team 61 was excluded because when conducting the experiment in 2011, the researchers were unable to calculate an innovation score, due to technical failures. For team 13 it was not possible to determine who was taking a leadership role, because only 4 out of the 6 people could be seen, which could easily lead to mistakes in the data collection. Therefore, this team was excluded too. This resulted in 32 cases in the dataset to start with.

3.5 Data analysis

The hypotheses are tested by using a regression analysis, which makes it possible to test one or more independent variables can predict the dependent variable. In this study therefore, it is tested to what extent distributed leadership and rotating leadership predict collaborative innovation performance. Since two independent variables are tested in this study, a multiple regression analysis is used.

4. RESULTS

As mentioned, a multiple regression analysis was used to test the assumptions. After excluding two teams during the data collection, the dataset consisted of 32 teams. The data was checked for outliers, indicating one case with z-scores higher than 2. The video of this case (team 44) was reexamined to see if this large z-score could be explained. It turned out that not all participants could be seen, just as was the case with team 13. This could have led to errors in the collection of data, because sometimes it was not clear who of the participants was talking (acting as a leader). This affects both the independent variable distributed leadership (number of people leading) as well as rotating leadership (number of shifts in leadership between the two teams of three). Therefore, this case was removed from the dataset, resulting in a total of 31 teams that were included. The descriptive statistics of the final dataset are to be found in table 2. Before performing the multiple regression analysis, assumptions for linearity were checked. First, the data was checked for normality by conducting a Shapiro-Wilk test. Since $p = 0,05$, the data was concluded to be normally distributed. Correlation coefficients were calculated by using Pearson's Rho and are given in table 3. Since all correlations are less than 0,9, the variables are concluded not to be correlated. In addition, the multicollinearity of the variables was checked by using the Variance Inflation Factor (VIF). Since the calculated VIF was lower than 10, it was concluded that the variables were not (highly) intercorrelated. Lastly, the data was checked for homoscedasticity, by plotting the standardized residuals against the standardized predicted values. Since the points are equally dispersed around zero the assumptions for homoscedasticity are met. The SPSS output for checking the assumptions can be found in Appendix II.

	Mean	Std. Deviation	N
Innovation score	0,5074	0,09489	31
Number of people leading	0,0891	0,10756	31
Number of shifts *in leadership*	2,16	1,319	31

Table 2: Descriptive statistics: means, standard deviations and sample size

	1	2	3
1 Number of people leading	1		
2 Number of shifts in leadership	0,874**	1	
3 Innovation score	0,131	0,311*	1

Note: N=31, * p < 0,05, ** p < 0,01.

Table 3: Correlations by Pearson's Rho

The results of the multiple regression analysis are to be found in table 4. For hypothesis 1, the results show that the number of people acting as leaders has a negative marginal significant effect on collaborative innovation performance (b = -0,043, p (one-sided) = 0,051). The negative direction indicates that teams in which more people act as leaders, are less innovative. Although the effect size is relatively small, the relationship is marginal significant. This is in line with hypothesis 1 and therefore hypothesis 1 is confirmed.

For hypothesis 2, the results show that the number of shifts in leadership has a positive significant effect on collaborative innovation performance (b = 0,732, p (one-sided) = 0,0125). This means that the more often leadership shifts between the two subteams within the collaboration, the more innovative collaborative teams are. The effect size is relatively large and the relationship is strongly significant. This is in line with hypothesis 2 and therefore hypothesis 2 is confirmed too.

	B	Std. Error B	p
Constant	0,535	0,037	
Number of people leading	-0,043	0,025	0,051
Number of shifts in leadership	0,732	0,310	0,0125

Note: N=31, adjusted R^2 = 0,122

Table 4: Results: B, standard error B, Beta and significance

The multiple regression model has an adjusted R^2 of 0,122, which means that 12,2% of the variance is explained by the model. In addition, the p (one-tailed) of the ANOVA analysis equals 0,031, which is less than 0,05 and therefore significant.

5. DISCUSSION

As mentioned hypothesis 1 was confirmed, showing a negative and marginal significant relationship between the number of people acting as leaders and collaborative innovation performance. This means that – in this specific experiment – the more people that act as leaders, the lower the team's collaborative innovation performance. However, it should be mentioned that for this experiment the maximum number of people that could act as leaders was 6, due to the team size of 6 people. As mentioned in the literature section, the effect of distributed leadership may vary widely among different circumstances. In an educational context, often a positive relationship is assumed. Authors in the field of business administration are more critical and expect a negative relationship. This experiment contributed to literature by providing empirical evidence of the negative effect of distributed leadership in the specific case of a collaboration between two different teams.

Hypothesis 2, which assumes that rotating leadership between collaboration partners positively influences collaborative innovation performance, was also confirmed. This means that the more managers shift leadership with the collaboration partner's managers, the collaborative innovation performance is likely to increase. Although only a maximum of 6 people could act as leaders, the number of shifts between the two subteams could be theoretically infinite. By rotating leadership, managers do not only control their own assets, but also those of the collaboration partner, which makes it more easy to transfer knowledge between partners and recombine it. This way, it is easier to assess complementary capabilities and managers are likely to feel more responsible for the partner's assets and are more likely to feel concerned for the partners' capabilities and knowledge.

If the results were to applied in practice, companies might want to hold onto more traditional leaderships styles with only one formal leader based on the results of hypothesis 1. However, rotating leadership was found to have a positive effect on collaborative innovation performance and obviously, the rotating of leadership requires at least two persons (one of each collaboration partner). Although this might seem contradicting with the negative effect of distributed leadership, it is important to remember that distributed leadership was tested on collaboration level: this means that if 2 people acted as leaders, this could be either 2 people from within the same subteam, or 1 from each subteam. For rotating leadership, the unit of analysis were the subteams of 3 and it was observed if leadership shifted between these subteams. Therefore, it is possible for distributed leadership to have a negative effect and for rotating leadership to have a positive effect. In addition, when looking at the effect sizes of the two hypothesis, it can be seen that the negative effect of distributed leadership (b = -0,043) is almost defeasible in comparison to the positive effect of rotating leadership (b = 0,732). This might imply that the effect of rotating leadership is most effective when both partners within the collaboration put forward one manager between who leadership rotates. When more people take the lead, this might slow down decision making, inertia in the innovation process and might result less action being taken due to lack of responsibility, as based on hypothesis 1. However, this should be further examined in future research in order to be able to draw reliable conclusions on which companies can base their organizational structures when engaging in collaborations. On the other hand, this study provides a direct contribution to current literature by offering empirical evidence of the effects of distributed leadership and rotating leadership on collaborative innovation performance.

6. LIMITATIONS

Although the use of experiments has many benefits, there are also downsides. Because experiments simplify situations in order to test causal relationships, it might be harder to generalize the results. In this experiment, a collaboration between two companies was represented by two teams of 3 students. The results tell us that rotating leadership between teams increases collaborative innovation performance.

However, the same effect does not necessarily have to be present organizational level too. In addition, although agreement among researchers was guaranteed and clear coding schemes were developed to make the variables measurable, both concepts of leadership and innovation always leave room for discussion and interpretation by the researchers, which might bias the results. For example should something be coded as leadership if the rest of the team ignores the 'leader's' efforts? Further, this study is based on an earlier conducted experiment and for that reason it was not optimized for this specific study to the effect of leadership. For example, the participants were by purpose not given clear goals and – partly consequently – there were no incentives for high innovation performance, which might influence leadership. Although this might be the same for some collaborations, it is obvious that this may be different when teams are composed for the sole purpose of innovation. Lastly, the variables distributed and rotating leadership were measured on different levels: distributed leadership was tested for on collaboration level. This means that if 2 people acted as leaders, this could be either 2 people from within the same partner, or 1 from each partner. For rotating leadership, it was investigated how often leadership shifts between the 2 subteams within the collaboration. Therefore, it is hard to say something about its interaction effect. In addition, this study did not take into account the quality of leadership and no difference was made between people that acted as leaders just one time in the collaboration or those that performed leadership at a higher frequency during the entire collaboration.

7. FUTURE RESEARCH

As already mentioned, although the results show a negative effect, distributed leadership is at a minimum a condition for rotating leadership, since it needs 2 people of each collaboration partner to be able to rotate leadership between the partners. Therefore, the interaction effect of distributed leadership and rotating leadership should be further investigated. However, as mentioned, in this experiment the variables distributed leadership and rotating leadership were studied independent of each other. By studying the interaction effect, future research might provide knowledge about the conditions for which rotating leadership is most effective. Stock (2006) did something comparable for collaboration, instead of leadership. She says that interorganizationality – which is the degree of collaboration between two or more partners – has a positive effect on team performance. This interorganizationality is highest when both partners put forward an equal number of team members and when power is equally distributed among the team members. In line with this argumentation, the same might be true for leadership, which would mean that when the number of leaders is equal for the different collaboration partners, team performance is higher. Testing a hypothesis like this might give insight in the interaction between distributed and rotating leadership and the conditions for which the effects are strongest.

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APPENDIX I: CODING SCHEME

Characteristics for transformational leadership are to be found in the table below. When participants show one of these leadership characteristics, his/her number is notated in the coding scheme. Using different colored T-shirts enabled the researchers to see to which subteam participants belonged. Team members indicated with the numbers 1, 2 and 3 belong to subteam 1, team members indicated with the numbers 4, 5 and 6 belong to subteam 2.

Transformational leadership characteristics

a. Idealized influence/inspirational motivation	• Leads by doing, gives examples, acts as a role model • Fosters collaboration • Reassures that obstacles can be overcome • Motivates confidence and achievement • Sets goals (e.g. making as many models as possible)
b. Intellectual stimulation	• Seeks different perspectives • Suggests new ways of thinking • Makes participants reconsider existing assumptions/own ideas
c. Individualized consideration	• Coaches, teaches and helps others

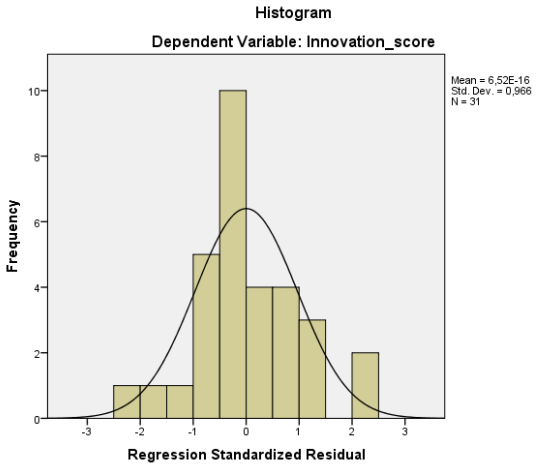
Team number:		
Minute	**Airplane model**	**Person number**
00:00	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	

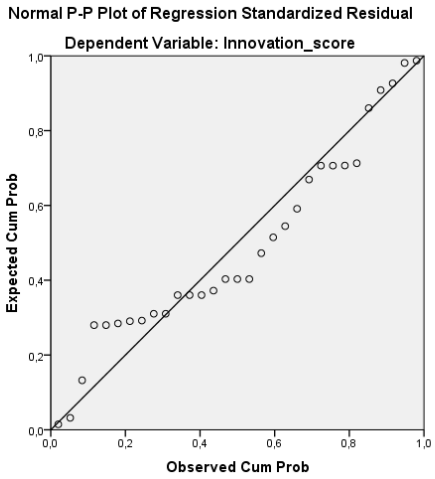
APPENDIX II: TESTING ASSUMPTIONS

Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Innovation_score	,144	31	,100	,932	31	,050

a. Lilliefors Significance Correction





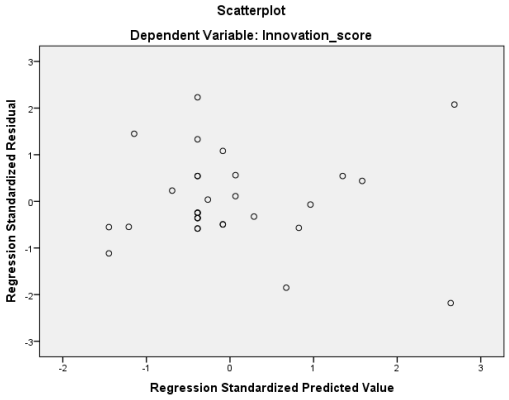
Correlation

		Innovation_score	People_number	Rotating_average
Pearson Correlation	Innovation_score	1,000	,131	,311
	People_number	,131	1,000	,874
	Rotating_average	,311	,874	1,000
Sig. (1-tailed)	Innovation_score	.	,241	,044
	People_number	,241	.	,000
	Rotating_average	,044	,000	.
N	Innovation_score	31	31	31
	People_number	31	31	31
	Rotating_average	31	31	31

Multicollinearity (VIF)

Model		Unstandardized Coefficients		Standardized Coefficients	Collinearity Statistics	
		B	Std. Error	Beta	Tolerance	VIF
1	(Constant)	,535	,037			
	People_number	-,043	,025	-,595	,237	4,228
	Rotating_average	,732	,310	,831	,237	4,228

Homoscedasticity



APPENDIX III: RESULTS FOR MULTIPLE REGRESSION ANALYSIS

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,425[a]	,181	,122	,08883

a. Predictors: (Constant), Rotating_average, People_number
b. Dependent Variable: Innovation_score

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,049	2	,024	3,084	,062[b]
	Residual	,221	28	,008		
	Total	,270	30			

a. Dependent Variable: Innovation_score
b. Predictors: (Constant), Rotating_average, People_number

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,535	,037		14,467	,000
	People_number	-,043	,025	-,595	-1,690	,102
	Rotating_average	,732	,310	,831	2,362	,025

a. Dependent Variable: Innovation_score