Intra-organizational routines alignment and collaboration performance: the moderating effect of distributed leadership

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ABSTRACT
This study investigates the effect of distributed leadership on the relationship between intra-organizational routines alignment and collaboration performance, measured in terms of innovativeness. Intra-organizational routines are routines that two groups bring into the collaboration; they can be complementary or supplementary. Distributed leadership refers to more than one individual taking on a leadership role during the collaboration. The effect of those two concepts on collaborative innovation performance was examined in an experimental setting. The results show that teams with supplementary routines are more innovative than those with complementary routines. Additionally, a moderating effect of distributed leadership on the relationship between intra-organizational routines and collaboration performance was not confirmed. However, distributed leadership predicts innovation performance in such a manner that higher levels of distributed leadership lead to greater innovativeness.

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Distributed leadership, collaborative performance, innovation, intra-organizational routines, strategic alliances, partner compatibility, team diversity

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1. INTRODUCTION

An increasing amount of firms are engaging in strategic alliances to grow and gain competitive advantage (Lavie, 2007; Ariño & de la Torre, 1998), while in fact, alliances exhibit a high failure rate (Kale & Singh, 2009). This contradicts the literature on alliances which suggests that alliances create value for companies (Lunnan & Haugland, 2008; Day, 1995; Sivadas & Dwyer, 2000). Research trying to shed light on this paradox has been focusing on the theory behind the drivers of alliance success and the critical factors during the different phases of an alliance.

According to Das and Teng (2000), strategic alliances are "*voluntary cooperative inter firm agreements aimed at achieving competitive advantage for the partners.*" (p. 33). The competitive advantage is created by enhancing a firm's market power, increasing efficiencies, as well as giving access to new resources or capabilities (Kale & Singh, 2009).

In the existing literature, two different perspectives explaining the drivers of successful alliances can be identified (Lui & Ngo, 2005). One focuses on structural partner attributes, which refers to similar as well as complementary resources that the partners bring into the collaboration. This is identified as partner complementarity and compatibility, which are two key drivers that influence the success of a strategic alliance according to Kale and Singh (2009). Partner complementarity refers to the degree to which a partner can contribute resources to the alliance that do not overlap with the resources of the other partner. Research suggests a positive relationship between partner complementarity and alliance success (Kale & Singh, 2009). Partner compatibility, on the other hand, refers to the 'fit' between partners, for instance in reference to their working style or organizational culture (Kale & Singh, 2009).

The second perspective focuses on the process of the collaboration which involves the actions occurring during the cooperation (Lui & Ngo, 2005) such as routines, trust, conflict, leadership or cooperation (Spin, 2011).

This study builds on the experimental research conducted by Spin (2011) who suggests for future research to investigate the effect of resource alignment (supplementary and complementary) as well as different process variables on alliance innovation performance (as in new product development).

Most empirical research has been focused on the structural factors influencing collaboration performance (Lui & Ngo, 2005; Doz, 1996), whereas the impact of process factors on alliance performance has received less attention. One of those process factors is leadership as it is a concept that develops during the collaboration and is not brought into the collaboration (unless a leader is determined prior to the collaboration). Existing studies on leadership mainly examine the influence of one individual in a group, namely the team leader, neglecting the effects of distributed leadership within a team (Carson, Tesluk, & Marrone, 2007; Harris, 2009).

To fill the gap in the literature, this research will investigate the effect of distributed leadership on the relationship between intra-organizational routines alignment and collaboration performance, measured in terms of innovation performance, in an experimental setting. Collaboration performance refers to the performance of a group collaborating together. The results of this study give new insights into the topic of improving collaboration success.

This leads to the following research question.

What is the impact of distributed leadership on the relationship between intra-organizational routines alignment and collaborative performance?

The experimental setting involves a teamwork situation with two different student groups, aimed at replicating the situation of a strategic alliance.

In the following section, the existing literature regarding intra-organizational routines alignment as well as distributed leadership and their effect on collaboration performance will be investigated. Next, the experiment as well as the sample and methods which were used to examine the effect of intra-organizational routines alignment and distributed leadership on collaborative performance will be described. Finally, the results of this study are presented as well as their limitations. Additionally, suggestions for future research are given.

2. LITERATURE REVIEW AND HYPOTHESES

2.1 Intra-organizational routines

Spin (2011) investigated the relationship between intra-organizational routines and collaborative innovation performance by conducting an experiment which will also be used in this study. Intra-organizational routines refer to routines already existing within each firm of the strategic alliance and are brought into the cooperation (Spin, 2011). Complementary and supplementary routines are used in the experiment as an operationalization of intra-organizational routines. Spin (2011) argues that difference in routines promotes learning from each other, which can be beneficial for the innovation performance. The results of the study show that groups with complementary routines were more innovative than those with supplementary routines. As this study uses a different measure for innovation, the hypothesis proposed by Spin (2011) will be tested again.

H1: Complementary intra-organizational routines affect the overall collaborative innovation performance more positively than supplementary intra-organizational routines.

2.2 Distributed leadership defined

Before examining the effect of distributed leadership on collaboration performance, the characteristics of a distributed leadership have to be discussed.

Gibb (1954) coined the term distributed leadership, which is also referred to as shared leadership in the literature. He suggests that there are two types of leadership: focused and distributed. Focused leadership refers to leadership residing in one individual, whereas distributed leadership refers to more than one individual sharing the leadership role (as cited in Carson et al., 2007).

In this study, distributed leadership is defined as an emerging property of teams (Carson et al., 2007; Pearce, Yoo, & Alavi, 2004), which recognizes the existence of multiple leaders (Spillane, Halversone, & Diamond, 2004; Gibb, 1954; Mehra, Smith, Dixon, & Robertson, 2006). Distributed leadership can occur in form of distribution of formal leadership roles and responsibilities, distribution of leadership task performance, referring to the team members actually carrying out the leadership work, and distribution of interpersonal influence (Harris, 2009). The first two indicators assume that a person has influence whereas the latter directly investigates this influence. Those three indicators are not necessarily interrelated, as the possession of a formal leadership role and carrying out leadership tasks may not, however, indicate interpersonal influence (Harris, 2009). This is supported by the study of

Spillane, Camburn, Pustejovsky, Pareja and Lewis (2008) who investigate distributed leadership in schools in the United States and found that approximately two third of the staff that was in possession of a formal leadership role were not nominated as influential by other staff.

Consequently, to investigate the presence of distributed leadership within a team, the link between these three indictors has to be tested instead of assumed (Harris, 2009). Therefore, distributed leadership can be conceptualized based on the amount of team members taking on leadership roles as well as carrying out leadership tasks, with a high level of influence on the team. As suggested by Carson et al. (2007), this conceptualization can be mapped on a continuum where the low end resembles teams following a single leader, while on the high end, most, or even all team members take on the role of an influential leader. This requires the team members to influence and lead in some areas of the teamwork, while following another leader in other areas (Carson et al., 2007).

2.3 Distributed leadership and collaborative performance

Day, Gronn and Salas (2004) explain distributed leadership as an important resource for teams in complex and adaptive situations and therefore, it should enhance collaborative performance (Carson et al., 2007; Ziegert, 2005). There are several studies that have found a positive relationship between distributed leadership and collaborative performance (Carson et al., 2007; Ensley, Hmieleski, & Pearce, 2006; Pearce & Sims Jr, 2002; Taggar, Hackett, & Saha, 1999) while the research of the relationship between distributed leadership and collaborative innovation has been scarce.

2.3.1 Distributed leadership and collaborative innovation

Innovation can be defined as "the introduction of something new" (Merriam-Webster, 2013). Much research has already been conducted to determine factors that influence a team's innovativeness. However, there is only limited research on the influence of distributed leadership.

Hoch (2013) investigated the relationship between distributed leadership and innovative behavior of team members in 43 work teams of different companies. Her study found that distributed leadership has a positive effect on the team members' innovative behavior.

Hauschildt and Kirchmann (2001) studied 133 innovations in the German construction industry. They found that innovation teams with three leaders, so-called promotors, with different leadership skills and characteristics, were more innovative in comparison to other teams with a lower amount of leaders.

Pearce and Manz (2005) argue that teamwork where one person takes on the leadership role does not encourage creativity and innovation. The work of creative thinking is left to the leader while other team members focus on the implementation part. Distributed leadership, on the other hand, encourages the sharing of influence and ideas as well as decision-making and problem solving, leading to increased creativity, knowledge creation and innovativeness (Pearce & Manz, 2005). Knowledge creation is important for innovativeness as the knowledge of several individuals within a team must be integrated to achieve innovation (Bligh, Pearce, & Kohles, 2006). Therefore, distributed leadership is said to be essential for organizations that are striving for innovativeness (Pearce & Manz, 2005).

Table 1. Literature overview

Author	Empirical/not empirical	Findings/Statements
Hoch (2013)	Empirical	Distributed leadership has a positive effect on innovative behavior of team members
Hauschildt and Kirchmann (2001)	Empirical	Teams with more leaders are more innovative
Pearce and Manz (2005)	Not empirical	Distributed leadership promotes sharing influence, ideas, decision-making and problem solving, leading to increased creativity, knowledge creation and innovativeness; distributed leadership is important for innovation
Bligh, Pearce and Kohles (2006)	Not empirical	Knowledge creation is important for innovativeness
Heunks (1998)	Empirical	Innovation depends to a certain extent on creativity
Hooker and Csikszentmihalyi (2003)	Not empirical	Distributed leadership and creativity are positively linked
Pearce (2004)	Not empirical	Creativity requires the input from several individuals
Scribner, Sawyer, Watson and Myers (2007)	Not empirical	Distributed leadership positively impacts creativity

There has been much argumentation about the difference between creativity and innovativeness. According to Heunks (1998), innovation is the successful implementation of an idea, whereas creativity is only the conception of that idea, suggesting that innovation depends to a certain extent on creativity. Hooker and Csikszentmihalyi (2003) research the relationship between distributed leadership and creativity and find that these two constructs are positively linked.

Additional literature regarding the relationship between distributed leadership and creativity suggests that distributed leadership positively impacts creativity (e.g. Scribner, Sawyer, Watson & Myers, 2007; Pearce, 2004) as creativity requires the input from several individuals (Pearce, 2004).

The literature review on the topic of distributed leadership, and its effect on collaborative innovation, leads to the following hypothesis.

H2: The positive effect of intra-organizational routines alignment on collaborative innovation is positively moderated by distributed leadership.

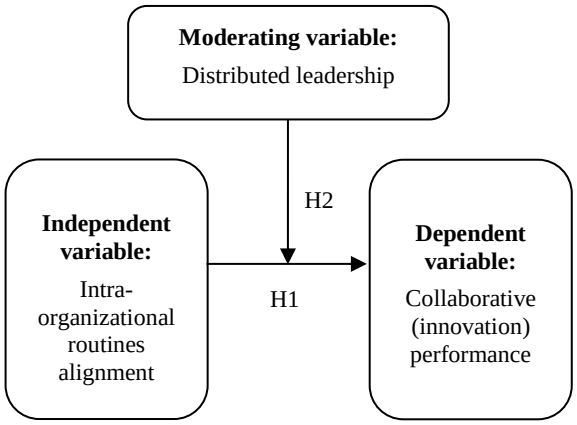

Figure 1. Causal model

3. METHODS

The data collected from a two factor between-subjects experimental design conducted by Spin (2011) will be used to test the hypothesis. An experimental design enables the operationalization of the dependent variable while in real-life situations, such as alliances, it is often difficult to assess performance, and especially innovation performance. During the experiment, the collaboration consisted of the construction of airplane models.

3.1 Study design

The procedure of the experiment conducted by Spin (2011) is split into three tasks.

1. Treatment learning of routine: Each group, consisting of three participants, learns one of four routines: parallel or serial production of the body of an airplane, or wing parallel or serial production of the wings of an airplane. In the serial production, participants produce the airplanes in a serial manner, thus all participants work on each airplane together, whereas in a parallel production, all participants produce a model parallel to each other.

2. Collaboration: Two groups work together as a team to construct airplane models. Each team has 30 minutes to construct a maximum of 15 prototypical airplanes. The groups have either compatible routines (both learned the parallel or serial production method) or complementary routines (one group learned a parallel or serial production method whereas the second group learned the other method).

3. Questionnaire (see appendix A): A questionnaire is handed out to the participants after the collaboration to gather information on the characteristics of the cooperation process as well as the participants.

For each team, no official leader was appointed for the collaboration task.

3.2 Sample

The experiment was undertaken with 192 students who were randomly assigned to groups of three participants. In the collaboration task, two groups worked together, thus six students. In total, the experiment was conducted with 32 teams.

From the 192 students, 132 were male and 58 female. An incentive was given to the participants to take part in the experiment (lottery ticket worth 3€). This sample is very suitable to test the hypothesis as the group size and task were the same for each group. The time span to complete the task did not differ substantially between the teams. This increases the chance that the findings will be generalizable to other populations.

Out of the 32 teams, 31 had valid outcomes for the determination of the innovation performance. From the 31 groups, 185 participants filled out the questionnaire which was used for the calculation of the distributed leadership variable.

3.3 Data collection

Data is collected through video recordings from the collaboration task of the experiment, questionnaires of the participants, as well as photos of the assembled airplane models.

The questionnaire was used to collect data from participants for the distributed leadership variable.

The outcome of the collaboration, hence the produced airplanes, were used to analyze the innovativeness of each team. After the collaboration, photos were taken of all the airplane models a team assembled.

3.4 Measures

3.4.1 Dependent variable: collaborative performance

Collaborative performance is the dependent variable in this research and will be measured in terms of innovation.

Innovation is conceptualized as the product innovativeness of the airplanes produced in the collaboration part of the experiment. Innovation is difficult to quantify and there is no straight-forward measure (Spin, 2011). While innovations on real markets are very different from each other, it is difficult to say which one is more innovative. However, in the experiment of this study, the teams had to produce the same type of new products, namely airplanes, which makes them comparable to each other. Therefore, to measure innovativeness, each assembled model was randomly assigned to a group of four assembled models from the same type but from different teams. Two raters then ranked the models independently from each other on a scale from one to four, four being the highest score for innovativeness. The indicators for innovativeness were creativity, the amount of different colours used, size, as well as the perceived airworthiness.

The inter-rater reliability, which refers to the degree of agreement between two raters, was tested to investigate the reliability of this measure for innovativeness. To prevent the innovation score from being dependent on the group of models a model was rated in, the groups were changed from one model type to another.

The average of the scores of the two raters was constructed to determine the score for each model per team. For each team, the scores were then summed up and divided by the amount of airplanes produced by the team to arrive at the innovation score of the different teams.

3.4.2 Independent variable: Intra-organizational routines alignment

The study by Spin (2011) uses two independent variables, namely intra-organizational routines and inter-organizational routines and analysed their impact on collaborative performance. Intra-organizational routines refer to the structural factors influencing collaborative performance whereas inter-organizational routines describe the process factors.

Intra-organizational routines alignment is the independent variable in this study. As outlined by Spin (2011), it is operationalized as supplementary and complementary intra-organizational routines and manipulated in the experiment. Two different routines are used in the experiment: parallel and serial work processes. By forming teams out of a combination of those groups that learned serial or parallel production processes, supplementary or complementary intra-organizational routines alignment is constructed. Complementary teams consist of one group that learned a parallel work process and one group that was taught the serial work process. Supplementary teams consist of groups that either both learned the parallel or serial production process.

3.4.3 Moderating variable: distributed leadership

Spin (2011) suggests for future research to investigate the effect of resource alignment (supplementary and complementary) as well as different process variables on collaborative innovation performance. In this research, the process variable distributed leadership serves as moderating variable for the relationship between intra-organizational routines alignment and collaborative performance.

Drawing on the study of Harris (2009), the three indicators for distributed leadership are distribution of formal leadership roles, distribution of leadership task performance, and distribution of interpersonal influence. Only the latter directly investigates whether a person exerts influence as a leader and is also perceived as a leader, while the first two indicators may also identify team members who would like to take on a leadership role without being perceived as a leader by the team members. This study uses a questionnaire as a mean of investigating distributed leadership. Via the questionnaires, the perceived leadership by team members can be investigated.

Participants were asked three questions regarding leadership. First of all, whether someone took control during the collaboration. Secondly, if one of the participants could have been regarded as a leader, and thirdly, if the respondent perceived that more than one individual took control in the collaboration. The leadership part of the questionnaire used a three-item Likert scale, with the response scale ranging from 'strongly disagree' to 'strongly agree'.

Although only the last question directly refers to distributed leadership, the first two questions were crucial to determine the validity of the questionnaires. As the questionnaire only consists of three items, Cronbach's alpha could not be used to assess internal consistency of the scale; the standard deviation of the scores was analysed instead. First of all, teams with a high standard deviation between the scores of the first item *('Someone took control in the collaboration'*) and the third one (*'I feel that more than one individual took control in the collaboration')* were investigated. Meaningful answers should have a small standard deviation as a high score for distributed leadership (question 3) implies that someone took control during the collaboration (question 1). Furthermore, the standard deviation within the group was further investigated for each item of the questionnaire to show if the answers of the team members deviated extensively. The result of this analysis was that none of the standard deviations were high enough to exclude any teams or team members as outliers. A certain variation in the answers of the questionnaire items were explained with the fact that those team members who took on the leadership role may not regard themselves as leader and therefore give lower scores in the questionnaire.

The third item of the questionnaire was used solely to assess the overall level of distributed leadership. To determine whether distributed leadership should be measured as a categorical or continuous variable, the video observations of the experiment were used. During the collaboration, most teams did not show consistency regarding the leader(s) of the team, hence determining a specific amount of individuals from a team as leaders was not possible. Distributed leadership was therefore not measured as categorical variable. Instead, team members took on leadership roles for a certain period of time. It was therefore decided to measure distributed leadership as a continuous variable. The ordinal categories of the Likert scale were given points to transfer distributed leadership onto a continuous scale (strongly disagree = 1, disagree = 2, undecided = 3, agree = 4, strongly agree = 5). To derive at the distributed leadership score for each team, the points of each team member for the third item of the questionnaire were summed up and divided by the amount of team members; the higher the score of the team, the greater the level of distributed leadership in a team.

3.5 Data analysis

Cohen's Kappa, which measures chance-corrected categorical scale agreement between two raters (Banerjee, Capozzoli, McSweeney, & Sinha, 2008), was used to test the inter-rater reliability for the dependent variable (collaborative innovation). With a value of 0.515 ($p < 0.001$), the inter-rater reliability was high enough to judge the measurement for the innovation score as appropriate.

With a relatively low sample size, the Shapiro Wilk test was used to investigate whether the quantitative variables in this study are normally distributed. Both collaborative innovation (Shapiro Wilk = .977, p = .765) and distributed leadership (Shapiro Wilk = .963, p = .405) show a normal distribution.

The correlation between the two continuous variables distributed leadership and innovation was calculated with Pearson's r. Due to the fact that intra-organizational routines alignment is a dichotomous variable, the correlation between this variable and distributed leadership as well as innovation performance was calculated by using biserial point correlation.

As the dependent variable is continuous, simple linear regression was used to test the first hypothesis. For the second hypothesis, moderated multiple regression was used. The independent variable (intra-organizational routines alignment) was coded as a dummy variable (0 = cooperating groups used complementary routines, 1 = cooperating groups used

Table 2. Descriptive Statistics

Variable	Mean	SD
Innovation (for groups with complementary routines)	2.38	.39
Innovation (for supplementary routines)	2.79	.45
Distributed leadership (for groups with complementary routines)	3.47	.13
Distributed leadership (for groups with supplementary routines)	3.30	.09

supplementary routines). To test hypotheses 1 and 2, the main effect variable intra-organizational routines alignment (labeled 'Routines') was entered in a first step. In step two, the second main effect variable, distributed leadership (labeled 'Leadership'), was entered, which led to the following main effects only model.

$$\text{Innovation'} = b_0 + b_1 \times \text{Routines} + b_2 \times \text{Leadership}$$

In the third step, the interaction variable, which was obtained by calculating the product of intra-organizational routines alignment and distributed leadership (labeled 'Routines x Leadership'), was entered. This led to the following main-effects plus interaction model (Warner, 2013).

$$\text{Innovation'} = b_0 + b_1 \times \text{Routines} + b_2 \times \text{Leadership} + b_3 \times (\text{Routines} \times \text{Leadership})$$

4. RESULTS

Table 2 gives means and standard deviations for collaborative innovation and distributed leadership for groups with complementary and supplementary routines, and Table 3 gives means and standard deviations as well as correlations.

The results of the regression analysis are presented in Table 4. Intra-organizational routines alignment shows a significant relationship with collaborative innovation ($b = 0.447$, $t(29) = 2.694$, $p = .012$). The means show that the groups with supplementary routines ($M = 2.79$, $SD = .45$) have on average a higher innovation score than those groups with complementary routines ($M = 2.38$, $SD = .39$). This does not support the hypothesis that complementary groups are more innovative than supplementary groups (hypothesis 1). Instead, the results imply that supplementary groups are more innovative than complementary groups.

The result of the regression analysis that assessed the moderating effect of distributed leadership on the relationship between intra-organizational routines and innovation was overall statistically significant ($p = 0.019$).

The main effects plus interaction model (step 3) explained a moderate proportion of the variance in innovation ($R = .552$, $R^2 = .305$, adjusted $R^2 = .228$, $F(3, 27) = 3.949$, $p = .019$). However, there was no statistically significant interaction between the two variables intra-organizational routines alignment and distributed leadership ($b = 1.066$, $t(27) = .660$, $p = .515$). Therefore, the hypothesis that the positive effect of intra-organizational routines alignment on collaborative innovation is positively moderated by distributed leadership was not supported (hypothesis 2). Although the result is not statistically significant, the outcome is nevertheless interesting as the beta value for intra-organizational routines alignment turns negative when the interaction term is included in the analysis. This means that if distributed leadership was indeed moderating the effect between intra-organizational routines alignment and innovation, complementary routines would now have a greater positive effect on innovation than supplementary routines. This is consistent with the fact that complementary teams had a greater distributed leadership score ($M = 3.47$, $SD = .13$) than supplementary teams ($M = 3.30$, $SD = .09$).

As the moderated effect of distributed leadership was not statistically significant, or in other words, the interaction between distributed leadership and intra-organizational routines alignment was not statistically significant, the slope of the regression equation which predicts innovation from distributed leadership is the same for groups with supplementary routines and groups with complementary routines (Warner, 2013). Whether intra-organizational routines alignment and distributed leadership are both predictors of the variable innovation was investigated in step 2. The non-significant interaction term (Routines × Leadership) was not included in the analysis in this step. This allows for a comparison between the mean innovation score for supplementary and complementary routines while statistically controlling for distributed leadership. The results of the regression analysis using this model are statistically significant with a similar explained variance compared to the

Table 3. Descriptive statistics II and correlations

Variable	Mean	SD	1	2	3
1. Intra-organizational routines alignment	.35	.49	-		
2. Distributed leadership	3.40	.50	-.159	-	
3. Collaborative innovation	2.52	.45	.48*	.23[b]	-

[a] Intra-organizational routines alignment: complementary = 0, supplementary = 1.
* $p < 0.5$

Table 4. Results of regression analysis

Variable	Innovation[a]
Step 1	
Intra-organizational routines alignment	.447*
R^2	.200*
Step 2	
Intra-organizational routines alignment	.497*
Distributed Leadership	.310**
R^2	.294*
Step 3	
Intra-organizational routines alignment	-.569
Distributed Leadership	.270
Intra-organizational routines alignment x Distributed Leadership	1.066
R^2	.305*

[a] Estimates are standardized regression coefficients
* $p < .05$
** $p < .10$

main-effects plus interaction model ($R = .542$, $R^2 = .294$, $F(2, 28) = 5.824$, $p = .008$). This leads to the following regression equation:

Innovation' = 1.419 + .497 × Routines + .318 × Leadership

By substituting the value 0 for complementary routines and 1 for supplementary routines, the following two regression equations were obtained.

For complementary routines: Innovation' = 1.419 + .318 × Leadership

For supplementary routines: Innovation' = 1.916 + .318 × Leadership

These two equations are graphed in Figure 2. The slope represents the effect of distributed leadership on innovation performance. As the interaction between distributed leadership and intra-organizational routines alignment was not significant, the effect of distributed leadership on innovation performance is not dependent on the fact whether the teams used complementary or supplementary routines. Therefore, the two equations represent parallel lines which have different intercepts. Both the coefficients for intra-organizational routines alignment ($b_1 = -.497$, $t(28) = 3.087$, $p = 0.005$) and distributed leadership ($b_2 = .310$, $t(28) = 1.926$, $p = 0.064$) are statistically significant. This means that intra-organizational routines alignment and distributed leadership are statistically

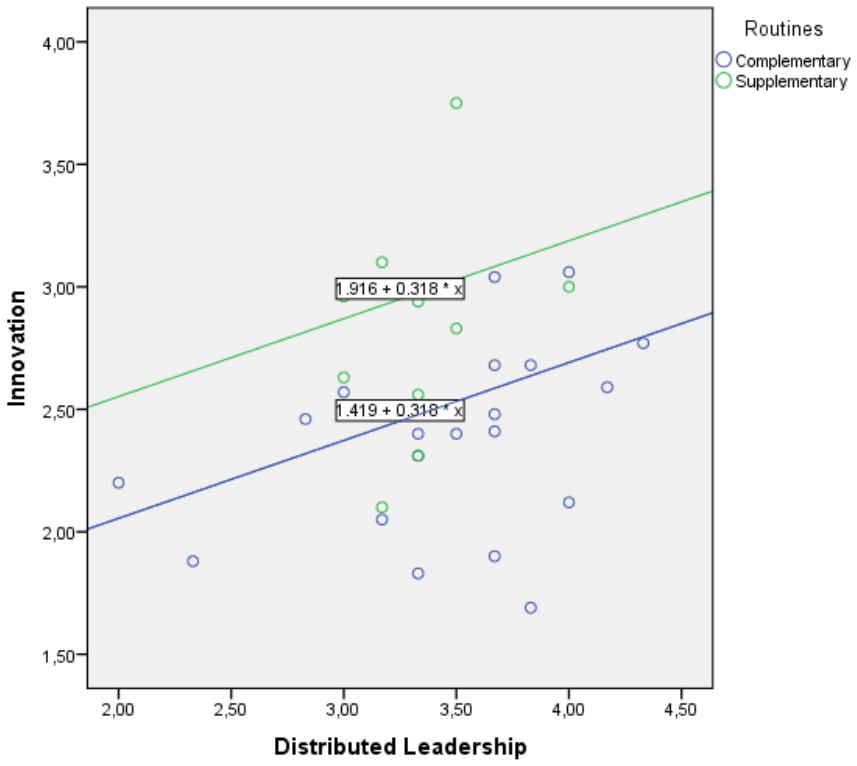

Figure 2. Parallel regression lines for supplementary and complementary routines

significant predictors of collaborative innovation. Intra-organizational routines alignment predicted approximately 24% of the variance in innovation ($sr^2 = .24$) and distributed leadership predicted about 9% of the variance in innovation ($sr^2 = 0.09$).

5. CONCLUSION

This study makes two contributions to the collaborative performance literature. First, the effect of intra-organizational routines alignment on collaborative innovation was examined. It was found that teams with supplementary routines show greater innovativeness than those with complementary routines. This result is contrary to the result of Spin (2011), who used a different measure for innovation, and it is also contrary to the literature, which suggests that complementary routines promote learning and therefore enhance innovativeness.

The second contribution of this study is the examined effect of distributed leadership on collaborative innovation. Literature suggested that distributed leadership would have a positive effect on innovation performance. The results are consistent with the literature as distributed leadership does positively affect innovation performance when controlling for intra-organizational routines alignment. Although a moderating effect of distributed leadership on the relationship between intra-organizational routines alignment and collaborative innovation was not confirmed, the results do show that high levels of distributed leadership are favourable for innovation performance.

If the results of this study were applied to strategic alliances, two partners with supplementary routines and a high level of distributed leadership would predict higher innovativeness compared to two partners with complementary routines and a low level of distributed leadership. Companies might consider encouraging distributed leadership during alliances, for example by not determining a leader prior to the collaboration. Before the start of the collaboration, the two companies should discuss in detail which resources should be brought into the collaboration.

6. DISCUSSION

The experiment itself and the way it was set up might explain partially why supplementary routines turned out to be more beneficial for innovation than supplementary. Although the experiment was meant to replicate the situation of a strategic alliance, many different factors influence teams in an actual strategic alliance situation that were not in place during the experiment. The products developed in strategic alliances are, for example, more complex than the airplane models used in this experiment. Complementary routines may therefore not have been beneficial in a situation where relatively simple airplane models had to be produced. Additionally, the time frame for actual strategic alliances is by far greater than the time frame for the collaboration phase of the experiment, which was only 30 minutes. In such a short time frame, supplementary routines may have been more beneficial for successful communication than complementary routines. A more successful communication could have led to a better innovation performance, which would explain the results for the first hypothesis. Furthermore, the respondents did not have any pressure from their employers, which would be the case in a strategic alliance, meaning pressure to perform well and develop innovative products. This might have been another factor distinguishing the experiment from a strategic alliance situation and therefore leading to a different outcome than predicted from literature.

Another approach to this outcome would be to question whether the variable intra-organizational routines alignment did indeed measure routines alignment. Contrary to the literature, supplementary routines scored higher on innovativeness. The different routines the participants learned, which consisted of a parallel or serial manner of constructing either the wing or body of an airplane, could also be seen as a certain working style the participants learned. Kale and Singh (2009) mention partner compatibility as an important factor in group collaboration. They argue that partners with a similar working style have a greater 'fit' and are therefore more compatible. Sarkar, Echambadi, Cavusgil, and Aulakh (2001) define partner compatibility as "the congruence in organizational cultures and capabilities between alliance partners" (Sarkar et al., 2001, p. 361). They further differentiate between cultural compatibility and operational compatibility. In their study, operational compatibility was partially measured by the degree of similarity of the organizational procedures of the two partners. The routines the participants learned in the experiment could be seen as different procedures to assembly airplane models, or as different working styles. In that case, supplementary routines would refer to more similar working styles or a greater congruence between the learned procedures. According to Kale and Singh (2009) and Sarkar et al. (2001), this would lead to greater partner compatibility, which has a positive effect on alliance performance, and also in particular on collaborative innovation (Dooley & O'Sullivan, 2007). This could explain why in this study, teams with supplementary routines were more innovative than teams with complementary routines. Two partner companies who are engaging in a strategic alliance should therefore ensure that the resources they bring into the collaboration are compatible.

Although the moderating effect of distributed leadership was not statistically significant, it is interesting to see that the results show that distributed leadership affects the relationship between intra-organizational routines and innovation performance in such a way that teams with complementary routines turn out to be more innovative. The mean for distributed leadership was higher for teams with complementary routines, which raises the question whether distributed leadership is more characteristic for teams with complementary routines. As complementary routines mean less congruence between the learned routines or working styles compared to supplementary routines, teams with complementary routines can be regarded as more diverse than those teams with supplementary routines. According to Pearce and Sims (2000), diversity is a team characteristic which is likely to influence the occurrence of distributed leadership. Muethel, Gehrlein, and Hoegl (2012) argue that team diversity has a positive effect on distributed leadership as diversity provides teams with a greater range of skills and perspectives, encouraging team members to contribute to the teamwork and engage in distributed leadership behaviour.

In general, the literature researching the relationship between team diversity and leadership, and especially distributed leadership, is rather scarce (Dionne, Yammarino, Atwater, & Spangler, 2004).

7. LIMITATIONS

The sample consisted of students which limits the generalizability of the findings of the research. Company employees involved in an alliance may behave differently than students during the collaborative process, as they are possibly influenced by other factors as mentioned before. Additionally, the experiment was carried out before the proposal of this research, which limits the formulation of hypotheses, as they can only be investigated with the given data from the

Table 5. Coding scheme

Code	Observable behavior	Example
Information collection (Kunzle et al., 2010)	Collecting information relevant to the task	*"How much time do we have left?"*
Information transfer (Kunzle et al., 2010)	Providing information and knowledge relevant to the task	*"The second model is finished."*
Problem solving (Kunzle et al., 2010)	Formulating a problem, interpreting it, finding a solution and implementation	*"This model is not correct because one part is missing, we can add it in this way."*
Distribution of roles and assigning tasks (Kunzle et al., 2010)	Assigning tasks and roles to members of the team	*"Could you work on this part?"*
Decision about procedures (Kunzle et al., 2010)	Deciding and/or showing how to do something.	*"We will only use this material for this model."*
Initiate an action (Kunzle et al., 2010)	Initiating an action (without being asked to do so)	*"I will start with this part now."*
Structuring work process (Künzle et al., 2010)	Coordination of actions and pace, planning the next steps	*"Let's first finish this part."*
Reward and recognition (Dasborough, 2006)	Recognizing the efforts of individual team members	*"Good job, well done."*
Motivation and inspiration (Dasborough, 2006)	Providing motivation and inspiration	*"We can do this."*
Empowerment (Dasborough, 2006)	Encouraging team members to be involved in the decision-making process	*"What do you think about this idea?" "How should we proceed?"*
Communication (Dasborough, 2006)	Listening, providing direction and feedback	*"It may be easier if you do it this way."*

experiment, and it also limits the different measurement possibilities for the variables.

Regarding the inter-rater reliability, the two raters who scored the innovation level of the teams both had knowledge about the research question and hypotheses, increasing the risk of bias. The measurement of collaborative innovation had a Cohen's Kappa value 0.515 which can be judged as 'moderate agreement'. A concept such as innovation is difficult to measure and is highly dependent on the perception of the rater. The indicators that were used, especially creativity and airworthiness, left much room for interpretation by the rater, limiting the validity of the research outcome. Moreover, the fact that the results for hypothesis 1 were contrary to the outcome of the study of Spin (2011), who simply used a different measurement for innovation, might indicate that the measurement used in this study did not accurately measure innovation. As explained before, innovation is regarded as creating something new. The indicators used (creativity, the amount of different colours used, size and perceived airworthiness) might therefore not have been accurate indicators for innovation. This could have led to the measurement of the innovation variable simply measuring the different indicators, and not innovation performance.

Additionally, distributed leadership was only measured with one item from the questionnaire. It is difficult to assess whether this single item accurately measured distributed leadership. A questionnaire using more items to measure distributed leadership would be more appropriate.

Another limitation of this study is the sample size. To receive a statistical power of .80 to detect interaction in regression using $\alpha = .05$, the sample size of 30 is too small (for $R^2 > 0.25$ for both the main-effects only and main effects with interaction model in step 2 and 3 of the regression analysis) according to Warner (2013).

8. FUTURE RESEARCH

Originally, the distributed leadership variable was supposed to be measured with the data collected from the video recordings of the collaboration task. The video recordings were analyzed using the software The Observer XT which is appropriate for analyzing observational data. The coded occurrences of distributed leadership behavior were based on verbal and non-verbal interactions between the team members. According to Spillane et al. (2004), the distributed leadership perspective can best be understood and analyzed in the interaction between leaders, followers and their situation which therefore served as unit of observation. A coding scheme for leadership behavior (Table 5) was developed based on the work of Künzle, Zala-Mezö, Kolbe, Wacker and Grote (2010), who observed leadership behavior in anaesthesia teams, and Dasborough (2006), who observed leadership behavior in interactions between leaders and employees. Additional indicators for leadership behavior were added according to the coders' judgement after an initial coding of the video recordings.

After the author and a research assistant had coded the video recordings, the inter-rater reliability turned out to be too low to continue with the analysis of video recordings as a mean to investigate distributed leadership. Instead, the questionnaire was used to measure distributed leadership.

Video observations can be a useful tool to analyze distributed leadership from a different perspective. The questionnaires used in this study mainly relied on the perception of the participants

of the experiment, while video observations give the possibility to observe behavior. Although the inter-rater reliability in this study was too low to make use of video observations, it is believed that the low value was caused by the coding scheme which was simply not developed enough. Creating a proper coding scheme requires a longer time-frame than was available for this study. It would therefore be an interesting topic for future research to analyze the success of collaborations by using video observations. The coding scheme which was used in this study could serve as a basis for a more extensive and detailed coding scheme.

Although moderate agreement for the innovation score was determined as sufficient for the purpose of this research, other measurement methods for innovation could be considered, especially since the measure of innovation in this research led to a very different outcome compared to the one from Spin (2011). Alternatively, the measurement method of this research could be improved by determining more detailed indicators for innovation (for example what exactly is meant with 'airworthiness').

To measure distributed leadership, some authors have been using social network analysis (Mehra et al., 2006; Carson et al., 2007). When using a social network approach, the relationships between all individuals within a team are investigated to determine the strength of influence between two individuals. As the questionnaire used in this study does not give the possibility to investigate how each specific team member was perceived as leader by the others, but rather if an individual generally perceived that leadership was distributed during the collaboration, social network analysis could not be used to measure distributed leadership in this research. Additionally, distributed leadership was measured with only one single item from the questionnaire. A questionnaire including more items, which for example measures the perceived leadership of all the team members, might be more appropriate to measure distributed leadership. This way, the social network approach (Mehra et al., 2006; Carson et al., 2007) could be used.

Teams formed for the purpose of strategic alliances can be quite diverse due to the fact that the team members come from different companies and therefore might have a different working culture, different values and goals, different learned procedures, etc. It would be interesting to investigate the relationship between team diversity and distributed leadership as the research on this topic has been scarce. Learning more about this relationship could give insights into how and when distributed leadership in teams emerges and give a better understanding of team-building as well as team performance processes (Dionne et al., 2004).

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11. APPENDIX A

Leadership Questionnaire

	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1. Someone took control in the collaboration.	☐	☐	☐	☐	☐
2. I think one of the individuals in the collaboration could be regarded as the leader.	☐	☐	☐	☐	☐
3. I feel that more than one individual took control in the collaboration.	☐	☐	☐	☐	☐