The effect of the continuity of intra-organizational routines and the development of an interorganizational routine on collaborative innovation performance

Author: Ellian Katrien Lebbink
University of Twente
P.O. Box 217, 7500 AE Enschede
The Netherlands

ABSTRACT

Firms increasingly take part in interorganizational collaborations to support their innovativeness. However, high failure rates indicate that a lot of these collaborations are not successful. Therefore, there is a need to understand what determines interorganizational innovation success. This study analyzes the effect of routines on collaborative innovation performance. It is indicated that the firms engaging in a collaboration both have their own set of initial, intra-organizational routines but the partners in the collaboration can also develop together a new interorganizational routine. This study examines the effects of the continuity of intra-organizational routines and the development of an interorganizational routine on collaborative innovation performance. The results based on experimental data show that continuity of intra-organizational routines has a negative effect on collaborative innovation performance while the development of an interorganizational routine affects collaborative innovation performance positively. The results contribute to a better understanding for managers about the influence of routines on the innovativeness of their interorganizational collaborations.

Supervisors:
Ariane von Raesfeld Meijer
Manon Spin

Keywords
alliance, interorganizational collaborations, innovation, coordination, intra-organizational routines, interorganizational routine

5th IBA Bachelor Thesis Conference, July 2nd, 2015, Enschede, The Netherlands.

1. INTRODUCTION

In the current complex and highly competitive business environment, firms are put under pressure to develop fast and cheap innovative products as a firm's innovativeness can positively influence its competitive advantage (Tuominen & Anttila, 2006; Nieto & Santamaría, 2007). To facilitate these innovation activities, companies increasingly engage in alliances and other interorganizational collaborations, like joint ventures (Kale & Singh, 2009; Zheng & Yang, 2014). Authors agree on the fact that firms taking part in such interorganizational collaborations are more likely to create new commercially successful products (Faems, Van Looy & Debackere, 2005; Du Chatenier, Verstegen, Biemans, Mulder & Omta, 2009; Corsaro, Cantu & Tunisini, 2012; Somech & Drach-Zahavy, 2013). However, simultaneously, studies report that interorganizational collaboration initiatives have a failure rate of more than 50% (Gulati, Wohlgezogen & Zhelyazkov, 2012). Therefore, there is a need for managers to understand what determines interorganizational collaboration success and how such collaborations can be managed better to increase the innovation performance.

Different phases with accompanying key drivers are considered to be important for alliance success: 1. Alliance Formation and Partner Selection; 2. Alliance Governance and Design; 3. Postformation Alliance Management (Kale & Singh, 2009). It is stated that many scholars consider the third phase, i.e. the postformation phase, to be most important (Gulati et al., 2012). During this phase day-to-day activities must ensure that the collaborative relationship is managed over time in order to avoid failure and termination of the collaboration before it achieves its objectives. In other words, in the postformation phase the alliance must realize the expected benefits and goals of the relationship (Kale & Singh, 2009; Gulati et al., 2012). In order to achieve this, coordination activities are needed. Gulati et al. (2012) define coordination in an interorganizational context as "the deliberate and orderly alignment or adjustment of partners' actions to achieve jointly determined goals" (p. 537). The need for coordination within interorganizational collaborations is pointed out by Schilke and Goerzen (2010). First of all, dependencies between parties create a need for coordination as interdependent resources that are dispersed over different individuals need to be harmonized. Second, coordination brings the different interests of partners together. At last, coordination makes it possible for partners to obtain all necessary information, which enables them to align and harmonize activities with each other and to accomplish shared objectives. However, coordination within collaborations is not easily managed and it is indicated that all alliances face coordination challenges (Gulati et al., 2012). Coordination failures may hinder the realization of collaboration goals and may lead partners to question the feasibility of the collaboration and to terminate it. As a result, coordination is important for interorganizational collaboration success. Several factors within the postformation phase can influence the coordination among partners and therefore the performance of the interorganizational collaboration. These factors are identified as process variables and include routines, trust, leadership, conflict and cooperation (Spin, 2011).

Within organizational literature, the standardization of work processes in the form of routines is described as an important coordination mechanism (Mintzberg, 1979). Routines can be defined as "repeated and recognizable action patterns involving multiple individuals" (Miller, Pentland & Choi, 2012, p. 1537). Becker (2004) stresses that routines give regularity, systematicity and unity to a group, support a high level of simultaneity and provide every individual with knowledge of others' behaviors in order to make good decisions. Moreover, Miller et al. (2012) indicate that routinized behavior reduces search for new response to familiar problems and therefore has a positive effect on efficiency. However, it might be that this reduced search for new responses does not have a positive effect on new, innovative responses to existing problems. In addition, Feldman and Pentland (2003) indicate that rigid organizational routines can be regarded as a source of mindlessness and inflexibility which may have a negative effect on innovation. Within the context of interorganizational collaborations, routines can be divided into intra-organizational routines and interorganizational routines. Intra-organizational routines can be described as a firm's initial routines, borrowed from its own organizational context (Doz, 1996). When two firms get together in an alliance, they both have their own set of intra-organizational routines. Holding on to these intra-organizational routines may have a negative effect on innovation because it can lead to inflexibility and mindlessness as discussed above. Interorganizational routines are defined by Zollo, Reuer and Singh (2002) as "stable patterns of interaction among two firms developed and refined in the course of repeated collaborations" (p. 701). These are routines that the partner firms develop together during the collaboration process. In contrast with the continuity of intra-organizational routines, the development of an interorganizational routine may have a positive influence on innovation as it can help to exploit knowledge between the partner firms and support interorganizational learning which can lead to new and creative ideas (Bicic & Ngo, 2013).

In conclusion, both set of routines might influence the innovation performance of a collaboration. Yet, no research has studied the direct relationship of these routines on collaborative innovation performance. Therefore, this study will contribute to existing theory about collaborative innovation performance by analyzing how the continuity of intra-organizational routines affects the innovation performance of interorganizational collaborations. In addition this study analyzes if developing interorganizational routines might have an effect on innovation performance. Hence, the research question is: "What effect has the continuity of intra-organizational routines and the development of an interorganizational routine on collaborative innovation performance?" For practical implementations, this study contributes in general to a better understanding for management regarding routines. More specific, the results of the study may indicate how managers should deal with the partners' initial routines brought into a collaboration in order to improve the collaborative innovation performance. In addition, the results might show management if the development of an interorganizational routine should be encouraged or discouraged to improve collaborative innovation performance. Furthermore this study is based on experimental data. Experiments are a good method to predict phenomena and to explain causation as it enables the comparison of situations in which a proposed cause, in this study a certain intra-organizational routine or the development of a new routine, is present or absent (Field, 2009). In addition, the use of an experiment brings methodological added value to the field of Business Administration, which lacks the use of experiments in comparison with other fields of science.

2. THEORY

2.1 Continuity of intra-organizational routines and the impact on collaborative innovation performance

As discussed above, partners in an alliance both have their own set of initial routines at the start of a collaboration. Pentland, Feldman, Becker and Liu (2012) explain how these organizational routines can continue or change over time. They point out that routines have the tendency to have resistance to change even when external conditions change. This resistance to change may lead to sub-optimal results. Pentland et al. (2012) refer to this as routine inertia. Collinson and Wilson (2006) discuss by referring to Miller (1990) how routine inertia may hinder organizational change and development. First of all, through the deep structural memories, actions are more driven by routines than by analysis of the context. Second, managers stick to actions and activities which were successful in the past but which may not be successful in a new context. At last, established power and politics can suppress change as it might be more beneficial for certain stakeholders to stick to current processes. For innovation sake, this might mean that a lot of new options are missed. Based on this theory, it can be said that the continuity of intra-organizational routines might have a negative effect on collaborative innovation performance.

In addition, Miller et al. (2012) indicate that the effect of continuity of established organizational routines on collaboration performance in changing environments is affected by different kinds of memory. As an interorganizational collaboration can be seen as a change in the environment of the previous separate partners, the results of Miller et al. (2012) may also count for the continuity of routines in interorganizational collaborations. First, it is important to understand the distinction between ostensive and performative aspects of routines. The ostensive aspect includes the abstract patterns that individuals use to refer to specific actions and/or steps of a routine. The performative aspect includes the actual actions by specific people at specific times and places (Pentland & Feldman, 2005). It can be said that the ostensive aspect generates the actual actions of the performative aspect. As a result, the composition of the ostensive aspect is important for understanding the formation of actual routine actions. According to Miller et al. (2012), the ostensive aspect of routines consists of three kinds of memory. Transactive memory, i.e. 'know-who', refers to the use of networks and enables individuals in a firm to access expertise outside oneself. Declarative memory, i.e. 'know-what', refers to routines and procedures which enable individuals to interpret situations and to determine the required steps in order to solve the problem. At last, procedural memory, i.e. 'know-how, emphasizes the often tacit knowledge of performing tasks consciously or unconsciously. Miller et al. (2012) indicate that the distinction between declarative and procedural memory is empirically vague and because procedural knowledge is often tacit, it is hard to identify and evaluate.

The research of Miller et al. (2012) shows that routines linked to transactive memory remain effective in changing environments as they can boost problem-solving efficiency and facilitate adaption to new problems. However, for this study this type of routines will not be taken further into account. Instead, the continuity of routines which determine what is made and how it is made, i.e. routines linked to declarative and procedural memory, are the focus of this research. Mintland et al (2012) state that the continuity of these types of routines has a negative effect on organizational performance in changing environments as it slows down efficiency because individuals keep doing things the same way as before. These results are in line with the study of Gulati et al. (2012), who mention that stickiness to old resources may constrain how fast partners can acquire and integrate new resources, knowledge and routines. For collaborative innovation performance this might indicate that the continuity of intra-organizational routines is unbeneficial as failing to adopt new knowledge does not create new insights and ideas. As this is conforming to the discussion of Collinson and Wilson (2006) about routine inertia, this study assumes that the continuity of intra-organizational routines has a negative effect on collaborative innovation performance. Therefore, this study will test the following hypothesis:

H1. *Continuity of intra-organizational routines has a negative effect on collaborative innovation performance*

2.2 Development of an interorganizational routine and the impact on collaborative innovation performance

The previous section shows that firms enter an interorganizational collaboration with their own set of initial intra-organizational routines. Pentland et al. (2012) indicate that these routines tend to be resistant to change. However, within the same research Pentland et al. (2012) point out that by means of learning, these routines can change and improve over time. In the context of interorganizational collaborations this is explained by the fact that partners can engage in interorganizational learning processes and develop a shared understanding of their collaboration requirements. Those interorganizational learning processes reflect a dynamic capability through which firms leverage know-how about the management of the day-to-day activities of the alliance and whereby they develop routines to achieve their joint goals and a better interorganizational collaboration performance (Kale & Singh, 2007). This is acknowledged by Gulati et al. (2012) who state that firms can incorporate their interorganizational learning in a new interorganizational routine that can improve the collaboration (Gulati et al., 2012). Zollo et al. (2002) define such interorganizational routines as "stable patterns of interaction among two firms developed and refined in the course of repeated collaborations" (p. 701).
According to Zollo et al. (2002), these interorganizational routines affect collaboration performance positively. In addition, other authors indicate that alliances are not successful unless partners develop interorganizational

routines that facilitate coordination in complex collaborations (García-Canal, Valdés-Llaneza & Sánchez-Lorda, 2014; Zheng & Yang, 2015). Moreover, learning capabilities and the subsequent interorganizational routines play an essential role in generating innovations (Hallikas, Kärkkätnen & Lampela, 2009). Bicic and Ngo (2013) indicate that partners in an alliance must learn to work together to exploit new knowledge and find new ideas in order to nurture innovation. Based on these findings, it might be that the development of an interorganizational routine has a positive effect on collaborative innovation performance. Therefore, this study will test the following hypothesis 2:

H2. *The development of an interorganizational routine has a positive effect on collaborative innovation performance*

In conclusion, theory about the formation and continuity of routines indicates that intra-organizational routines tend to be rigid and resistant to change. The continuity of these routines may have a negative effect on collaborative innovation performance, resulting in hypothesis 1. In contrast, theory about interorganizational learning indicates that partner firms should engage in collaborative learning, which supports the development of an interorganizational routine. It is indicated that the development of an interorganizational routine has a positive effect on collaborative innovation performance, resulting in hypothesis 2. Based on these hypotheses and their expected relationships, this research will test the following causal model:

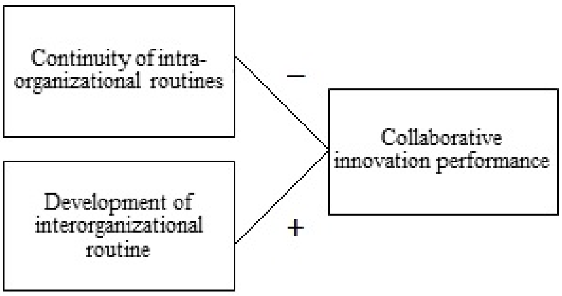

Figure 1. Causal model of the effect of continuity of intra-organizational routines, and development of an interorganizational routine on collaborative innovation performance.

3. METHOD

3.1 Participants

210 students from the University of Twente contributed to this research. Students are within the age range of 17 to 28 year. As an incentive for participation, all participants received a lottery ticket with a value of € 3,--

3.2 Research design and procedure

This research is part of a bigger experimental research on collaborative performance. The unit of analysis is a collaboration of two groups of three individuals, resulting in a unit of analysis of a group of six individuals. In total, 35 groups of six participants conduct the experiment. Within the experiment the units of analysis have to make airplane models, which are used to determine the innovation performance of the collaboration. The experimental procedure consist of two phases:

1. Learning of routines: Each participant is randomly assigned to a group of three participant for treatment where he or she acquires an intra-organizational routine, i.e. batch production of body parts, batch production of wing parts, serial production of body parts or serial production of wing parts. Batch production of body parts means that the participants learn to make the body of an airplane all by themselves, while serial production of body parts means that the participants learn to make the body of an airplane in a serial manner together. The same counts for the batch production of wing parts and serial production of wing parts but here the participants make the wings of the airplane instead of the body part.

2. The collaboration: One group of three participants with a body production routine (batch or serial production) is put together with a group of three participants with a wing production routine (batch or serial production), forming a unit of analysis of a group of six participants. As a result, the unit of analysis always consists of a collaboration of three participants with a body production intra-organizational routine and a group of three participants with a wing production intra-organizational routine. The production of the body and wing parts has been learned in phase 1 either in batch or in a serial manner. Because the two groups of three are put randomly together to form a group of six, different group compositions exist. The unit of analysis can contain two groups of batch production, two groups of serial production or a combination with both a group of batch production and a group of serial production. The different group compositions are shown in Table 1. In the collaboration, the group of six participants needs to produce a number of different airplane models (maximum amount is 15). In total, the collaboration phase takes 30 minutes. The participants in the collaboration can decide for themselves how much time they spend on one single airplane model. However, they can only work on one model simultaneously. After finishing one model they can go to the next one. They also have to follow the sequence of the models as indicated on a list. The actions of the participants in the collaboration are recorded by cameras.

	Serial Body production	Batch Body production
Serial Wing production	*Serial wing Serial body*	*Serial wing Batch body*
Batch Wing production	*Batch wing Serial body*	*Batch wing Batch body*

Table 1. Formation of units of analysis within the experiment

3.3 Measures

3.3.1 Independent variables

Based on the theory and as described in the causal model, two independent variables are identified: the continuity of intra-organizational routines and the development of an interorganizational routine. However, as described in the research design, the participants have learned to produce either body or wing parts and they have learned to produce either in a serial manner or in batch. It can be said that these two group of routines, i.e. body and wing routines together and batch and serial routines together represent two types of intra-organizational routines. Body and wing production routines represent the 'what do I make- routines' while the batch and serial production routines represent 'how do I make it- routines'. This classification can be linked to the declarative 'know-what' and procedural 'know-how' routines as indicated by Miller et al. (2012). Therefore, these two types of routines are separated for measurement, making one independent variable of the continuity of body and wing routines and one independent variable of the continuity of batch and serial routines.

For the measurement of the development of an interorganizational routine, operationalization is done in coherence with research of Pentland et al. (2012). Pentland et al. (2012) introduce the term path dependence. "By path dependence, we mean the process through which past actions influence the likelihood of future actions" (Pentland et al., 2012, p. 1490). Pentland et al. (2012) indicate that path dependence is present both within patterns of action and between patterns of action. Path dependence within a pattern of action makes the pattern recognizable as each action is dependent on the prior action. Path dependence between patterns of actions makes the pattern repetitive as when a pattern of actions responds to a certain stimulus, it is likely that a similar pattern will develop in response to a similar stimulus. For this study only path dependence between patterns of actions is used to measure the development of an interorganizational routine as this is the best measurable within this experiment. The operationalization of this independent variable therefore focuses on the development of a repetitive aspect during the collaboration. Table 2 describes the measurement of all three independent variables.

Reliability of the operationalization of the variables is accomplished by use of inter-rater reliability which determines consistency among raters. In order to test the inter-rater reliability of the measurement of the independent variables, Cohen's Kappa is used. Cohen's Kappa is a method to measure agreement between two raters whereby agreement by chance is eliminated (Banerjee, Capozzoli, McSweeney & Sinha, 2008). For the independent variable continuity of the intra-organizational routines body and wing, the inter-rater reliability has a value of 0,873. For the continuity of the intra-organizational routines batch and serial the inter-rater reliability has a value of 0,773. After discussion between raters, agreement has been reached resulting in an inter-rater reliability of 0,885. The inter-rater reliability of the development of a repetitive pattern has followed the same procedure. First an inter-rate reliability of 0,438 was measured. During discussion it became clear that this low score existed due to differences in the interpretations of the raters. Rater A rated a model only as made the same way as the previous model when exactly the same persons built the airplane model. Rater B did not look at the participants but instead focused on the actions taken by the group and the manner of producing the models. After discussion it is decided to not look at the individual participants but only on the actions to produce the airplane models in order to see whether they are similar to each other or not. As a result, the inter-rater reliability for development of a repetitive pattern has a value of 0,882. This means that for all independent variables the inter-rater reliability is high enough and therefore the measurement appropriate.

3.3.1 Dependent variable

Table 3 describes the measurement of the dependent variable, i.e. collaborative innovation performance. Collaborative innovation performance is hard to operationalize as there is no universally used measure. This study uses the research of Troyer and Youngreen (2009) to operationalize collaborative innovation performance.[1]

3.5 Data collection

Data for the independent variables is collected by coding the recordings of the collaborations. This is done by means of a code scheme, added in Appendix III. For the dependent variable, the data of the collaborative innovation performance is collected by photos of the airplane models made by the units of analysis.

Three groups are not taken into account for analysis. These are the groups numbered as 13, 18, and 61. During observation of the recordings of group 13 it is not visible what three participant are doing as they sit with their back to the camera. Group 18 does not follow the rules of the experiment. The participants work of several models simultaneously and do not follow the sequence of models as indicated on the assignment list. This makes it impossible to observe the continuity of intra-organizational routines per airplane model. For group 61 there is no innovation score calculated. The reason for this is that due to technical problems with the photo camera no pictures were made of the finished airplane models of the group. As a result, 32 groups are taken into account for analysis.

Moreover, during the coding of the recordings it becomes clear that the continuity of batch and serial routines is difficult to observe. Due to attributes laying in front of the hands of the participants, it is often not visible in the recordings how the participants are working, i.e. if they work alone, together or in serial. The body and wing routines are much better recognizable because the participants tell each other which part they are going to work on and most often the two parts come together in the middle of the table to be assembled in an airplane. Based on these problems during observation, it is decided to not take the continuity of batch and serial routines into account for the analysis and to only focus on the continuity of body and wing routines.

3.6 Data analysis

In accordance with Field (2009), a regression analysis is used to test the hypotheses. A regression analysis enables the prediction of values of a dependent variable from one or more independent variables. As this study includes several independent variables, a multiple regression is used. The multiple regression analysis is conducted to determine if continuity of intra-organizational routines and the development of an interorganizational routine predicts the innovation performance of a collaboration.

4. RESULTS

The goal of this research is to study the causal relationships of the effect of the continuity of intra-organizational routines on collaborative innovation

1 The innovation performance scores are derived from a bigger experiment on collaborative performance by Spin (2011).

Concept	Definition	Operationalization
Continuity of intra-organizational routines body and wing production	The degree to which participants continue during the collaboration with the body and wing routines, which they learned in phase 1 of the experiment	The percentage of how many of the total amount of airplane models made by one group are made by the participants continuing with the in phase 1 learned routines of body production and wing production. This means that one or more participants with a body routine make the body part of the airplane model and one or more participants with a wing routine make the wing part. The body and wing routines are interactive. They are only present if the participants of both routines continue with their routine. If for example for airplane model 1 none of the body participants makes the body part, this means that participants having a wing routine must make it. Even if the wing participants also make their own wing part, it still means that they also make the body part which does not belong to their previous learned routine and therefore it is considered that both the wing routine participants as the body routine participants do not continue with their routine. In conclusion, it is stated that either body and wing are both present, or both are not present. As a result, the percentage of the continuity of body and wing routines is calculated with the following formula: $\frac{\text{\# of airplane models made by continuing with both body and wing routines}}{\text{\# airplane models made}}$
Continuity of intra-organizational routines batch and serial production	The degree to which participants continue during the collaboration with the batch and/or serial routines, which they learned in phase 1 of the experiment	The percentage of how many of the total amount of airplane models made by one group are made by participants continuing with the in phase 1 learned routines of batch production and serial production. This means that participants with a serial routine make airplane parts in a serial manner and a participant with a batch routine makes airplane parts alone in batch. The batch and serial routines are not interactive. It is possible that participants with a serial routine do not continue with their serial routine by making airplane parts in batch while the batch participants do continue with their batch routine by also making the parts in batch. Therefore, the percentage of the continuity of batch and serial routines is calculated by: $\frac{(\text{\#of airplane models made by continuing with serial routine}) + (\text{\#of airplane models made by continuing with batch routine})}{(\text{\# airplane models made} * 2)}$
Development of an interorganizational routine	The degree to which participants together develop a new way of working during the collaboration	The percentage of how many airplane models are made in the same way as the previous model, indicates the development of a repetitive pattern. However, because the first model made by a group has no predecessor model to follow, the operationalization divides the total amount of airplane models made in the same way as the previous model by the total amount of airplane models made minus 1. The following formula is used: $\frac{\text{\# of airplane models made in the same way as the previous model}}{\text{\# airplane models made} - 1}$

Table 2. Concepts, definitions and operationalization of the independent variables of this study

Concept	Definition	Operationalization
Collaborative innovation performance	The degree of innovativeness of the airplane models produced during the collaboration	For every airplane model (solution) made by a group, the frequency of that solution across the total number of solutions generated in all collaboration groups in the experiment is calculated. The results of all solutions together divided by the total number of airplane models made gives an average group innovativeness score. The inverse of this percentage will be used, which means that a more innovative solution has a higher score. The following formula is used: $1 - \frac{\text{the sum of the frequencies of all airplane models made}}{\text{\# airplane models made}}$

Table 3. Concepts, definitions and operationalization of the dependent variable of this study

performance and the effect of the development of an interorganizational routine on collaborative innovation performance. The mean and standard deviation of the variables belonging to the 32 units of analysis are shown in Table 4. As the operationalization of the variables gives percentages as outcomes, the mean and standard deviation of the variables are also given in percentages.

	Mean (%)	**SD (%)**	**N**
Innovation	0,51	0,10	32
Body/Wing	44,85	36,78	32
Repetitive pattern	39,60	32,35	32

Table 4. Descriptive statistics of the regression analysis

The regression is checked for assumptions. The independent variables are quantitative with non-zero variance and the dependent variable is quantitative, continuous and unbounded. Table 5 shows the results of Pearson Correlation.

	Innovation	**Body/Wing**	**Repetitive pattern**
Innovation	1,00	0,09	0,32
Body/Wing	0,09	1,00	0,81
Repetitive pattern	0,32	0,81	1,00

Table 5. Pearson Correlation results of the regression analysis

It is visible that the correlation between the development of a repetitive pattern and the continuity of body and wing routines is high, however testing for multicollinearity indicates that there is no perfect multicollinearity (VIF = 2,895). Moreover, the relationship between the predictor variables and the dependent variable is linear. Regarding homoscedasticity, the residuals are equally scattered around the fit line which provides a relatively even distribution and indicates good homoscedasticity. Concerning the assumption of normal distributed errors, the Shapiro Wilk test shows that this assumption is not met ($p < 0,05$). However, a histogram plot of the residuals shows reasonable normal distributed residuals. As an additional check, Field (2009) indicates that it is possible to check the normality of distributed errors for different groups within the study. In this study, four groups can be distinguished based on the group compositions as indicated in Table 1. The outcomes of the Shapiro Wilk tests show that the division in groups does not explain the not normally distributed residuals as only the residuals of two group are normally distributed ($p > 0,05$). To check other explanations for the not normally distributed errors, the p-plot of the residuals is checked. If the residuals would be normally distributed, the points would follow the line. The p-plot shows that the distribution of the residuals is close to normality, just like indicated in the histogram. However, a closer look at the p-plot shows that the data points of the residuals first lay above the estimated regression line, then follow the line in the middle part but lay under the line in the latter part of the plot which means that the residuals are not perfectly normal distributed. If residuals do not follow a normal pattern, this might indicate that omitted variables bias the model (Torres-Reyna, 2007). This means that there could be another predictor variable, which is not included in this model but is interactive with the independent variables measured in this study.

Table 6 presents the results of the multiple regression analysis.

	B	**Std. Error B**	**p (one-sided)**
Constant	0,486	0,027	-
Body/Wing	-0,001	0,001	0,049*
Repetitive pattern	0,002	0,001	0,009*

*Note: N= 32, adjusted $R^2 = 0,127$, * $p < 0,05$*

Table 6. Results of the regression analysis on the effect of the continuity of intra-organizational routines and development of an interorganizational routine on collaborative innovation performance.

For hypothesis 1 the results show that the effect of continuing with body and wing routines on collaborative innovation performance has a negative significant relationship ($b = -0,001$, p (one-sided) < 0,5). Therefore, hypothesis 1 is supported by the results. This means that for the groups in which the people who learned to make body parts continued with making the body parts and the participants with a wing production routine continued with making wings were less innovative then groups in which the participants stack less to their intra-organizational routines. Hypothesis 2 is also supported by the results. For hypothesis 2, the results show that the effect of the development of a repetitive pattern on collaborative innovation performance has a positive significant relationship ($b = 0,002$, p (one-sided) < 0,05). This indicates that the collaborations in which the two groups developed together an interorganizational routine by developing a repetitive production routine has a positive influence on collaborative innovation performance.

The low values of B can be explained by the fact that the grades for innovativeness have a score between 0 and 1. This makes the differences between the groups very small and the slope flat. The R^2 of 0,127 indicates that 12,7% of the variance is explained by the model.

4. DISCUSSION

This study contributes to theory on collaborative innovation performance by analyzing the effect of two types of routines on collaborative innovation performance. With an experimental research design, this study tested two hypotheses, which both found support by the results. In consistency with literature, it is found for hypothesis 1 that the continuity of intra-organizational routines has a negative effect on collaborative innovation performance. This indicates that partners who stick to the routines as learned in their previous organization influence the innovation performance of the collaboration negatively. For practical implications this is an important insight. The results indicate that managers should carefully consider the intra-organizational routines of the partners brought into a collaboration as these can have a significant effect on collaborative innovation performance. Based on the results of this study, it is assumed that managers should try to eliminate the old routines of the partner firms in order to increase collaborative innovation performance.

In addition, the effect as stated in hypothesis 2 is supported. It is shown that the development of an interorganizational routine has a positive relationship on collaborative innovation performance. This result could be explained by that fact that when parties in a collaboration develop a repetitive pattern, they respond with a certain pattern of action to a certain stimulus every time in a similar way. In this study this happened when a group responded with a similar pattern of action to the stimulus of making airplane models. When such a repetitive pattern develops, the parties in a collaboration do not have to spend time on deciding what to do and how to take action. This gives them more time to make the product they are working on (in this study the production of airplane models) more innovative, which can explain the positive relationship between the development of an interorganizational routine and collaborative innovation performance. For practical implications, this means that managers of an interorganizational collaboration should try to encourage the learning between parties in order to achieve interorganizational routines.

5. LIMITATIONS

Like in most studies, this study has a number of limitations to be addressed. First of all, the generalizability of the findings of this study to real-life interorganizational collaborations is limited as this experiment was a very simplified example of a real-life interorganizational collaboration. In this experiment, two groups of three students randomly put together form an interorganizational collaboration. The participating students are not part of real organizational teams which limits the generalization of the results to real-life interorganizational collaborations. In addition, the short duration of the collaboration (30 minutes) cannot be compared to the complex, long-term situations of real collaborations. However, even though the generalizability of the experimental results is limited, the experimental method of this study is useful as it enables the analysis of a causal relationship between the independent variables and the dependent variable. Moreover, even though the collaborations used in this experiment are no real interorganizational collaborations, the social mechanisms observed in this study are applicable to real-life interorganizational collaborations. The analysis of how the continuity of people's initial routines affects innovation performance in collaborations or how the innovation performance is affected by the development of a new routine is very interesting for real-life organizations as these social mechanisms concerning routines are also present in real-life interorganizational collaborations.

Second, it was often difficult to see in the recordings of the collaborations what the participants were exactly doing due to attributes, for example plastic bags, laying in front of the camera. As discussed above, this resulted in the fact that batch and serial routines were not good visible and were therefore not taken into account for the analysis of this study. It might be that the continuity of these procedural routines, i.e. 'know-how routines', has a different effect on collaborative innovation performance then the 'know-what routines' of body and wing as analysed in this study. The result that continuity of intra-organizational routines has a negative effect on collaborative innovation performance can therefore not be generalized to the continuity of all types of intra-organizational routines. Future research can study the relationship between the continuity of 'know-how routines' and collaborative innovation performance further.

At last, the operationalization of collaborative innovation performance might seem questionable. Not all participants had an equal amount of knowledge about how airplane models looked like, which can have influenced the innovation scores. In addition, by calculating the frequency of a solution made by one group over all solutions made by all groups, it is possible that a solution that is made only by one group is considered as very innovative while this solution does not even look like an airplane model. Moreover, by using this operationalization the use of different components is not taken into account. This might result in the fact that a group makes something really simple which is scored as very innovative just because no other group made it this simple. To solve this question of validity, it is determined that the airplane models must at least look like airplane models, otherwise they are not taken into account for the analysis. The argument that a model can be too simple is rejected as small and simple models can also be innovative.

6. FUTURE RESEARCH

The theory section of this study discussed three types of memory and the accompanying routines as introduced by Miller et al. (2012) and the effect of the continuity of these type of routines on collaboration performance. To contribute to the existing literature on collaborative innovation performance, this study has analysed how the continuity of these routines influences particularly collaborative innovation performance. As already indicated in the limitations, future research should try to study the effect of procedural 'know-how routines' on collaborative innovation performance as this study was not able to take them into account for analysis. In addition, transactive routines, i.e. 'know-who routines' were not taken into account, which is also an opportunity for future research. It might be that the continuity of transactive routines has a different effect on collaborative innovation performance than the routines analysed in this study. Transactive memory is acquired through social interactions between members within a team or organization and it enables members to specialize knowledge, because the transactive memory reminds them of 'who knows what' (Ren & Argote, 2011). Transactive memory involves the degree of specialization of a person, the credibility of that person and the belief about the reliability of the person's knowledge (Argote & Ren, 2012). The continuity of the transactive routines might be unbeneficial for innovation within an interorganizational collaboration as it might result in the fact that the members of different firms do not take the knowledge and expertise of the new and unknown people into account. The effect of trust as a moderator variable might be interesting here. Trust may help people in an interorganizational collaboration to let go of transactive routines and to include the knowledge of new members in decision making. This may positively influence innovation performance as it can bring new insights.

Moreover, as mentioned when checking the assumption for normally distributed errors, it might be that there is another explaining factor which is interactive with the independent variables analyzed in this model. Future research should investigate what variable this might be. A suggestion is the degree of interorganizational cooperation. Presence of interorganizational cooperation means that members of both parties within a collaboration contribute to the production of a product. Literature indicates that collaborations are more innovative when the different parties cooperate extensively with each other (Nakata & Im, 2010). Within this study, this would mean that both the participants of the body production group and the participants of the wing production group contribute to the production of an airplane model. It is most likely that in this case, they both continue with their own routine. However, if all airplane models are made in this way, interorganizational cooperation could also point to the development of an interorganizational routine. Therefore, the results of hypothesis 1 and 2 are maybe not just black and white. Future research can take this into account by elaborating further on the data of this research, because there might be groups that score high on both the continuity of intra-organizational routines and the development of an interorganizational routine. If these groups score also high on collaborative innovation performance, this could indicate that managers should not immediately get rid of the intra-organizational routines, but see how they can include the intra-organizational routines in the development of an interorganizational routine by means of cooperation.

At last, future research can extend this study by taking into account the different group compositions of the units of analysis. As indicated in Table 1, there are four different compositions. This division was already used briefly by checking the assumption of normal distributed errors. When taking the group compositions into account, the aspects of supplementary and complementary intra-organizational routines are interesting. With supplementary routines it is meant that the routines that the firms bring into the collaboration are similar to each other, while complementary routines means that the routines of both firms differ from each other (Spin, 2011). It might be that the effect of continuity of intra-organizational routines on collaborative innovation performance is different for collaborations in which partners have supplementary routines than for collaborations with complementary partners. In the context of this study, collaborations with supplementary partners are the collaborations consisting of two groups with a batch production routine or two groups with a serial production routine. Collaborations with complementary partners are the collaborations consisting of one group with a serial production routine (either body or wing) and one group with a batch production routine (either body or wing). Moreover, it is possible that the routines of the partners have an effect on the development of an interorganizational routine as interorganizational routine are maybe easier developed when partners have supplementary routines than with partners with complementary routines.

7. ACKNOWLEDGEMENT

I would like to thank Dr. Ariane von Raesfeld-Meijer (University of Twente), Manon Spin (Spin Around) for their help and support during this study.

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APPENDIX I

Testing Normally Distributed Errors

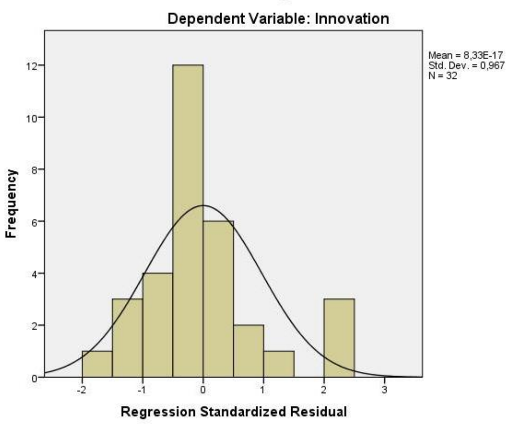
```
EXAMINE VARIABLES=ZRE_21
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

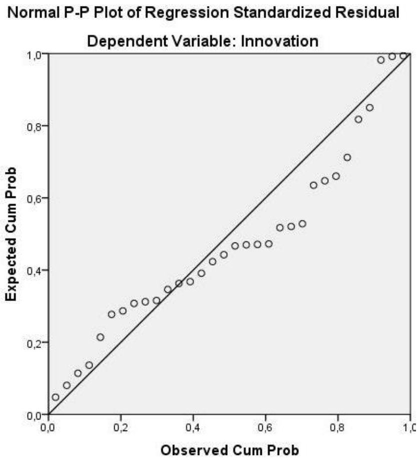
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,190	32	,005	,899	32	,006

a. Lilliefors Significance Correction

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA COLLIN TOL
CHANGE
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT Innovation
  /METHOD=ENTER Body.Wing Repetitive
  /SCATTERPLOT=(*ZRESID ,*ZPRED)
  /RESIDUALS HISTOGRAM(ZRESID)
NORMPROB(ZRESID)
  /SAVE ZRESID.
```





Testing Normally Distributed Errors per Group Composition

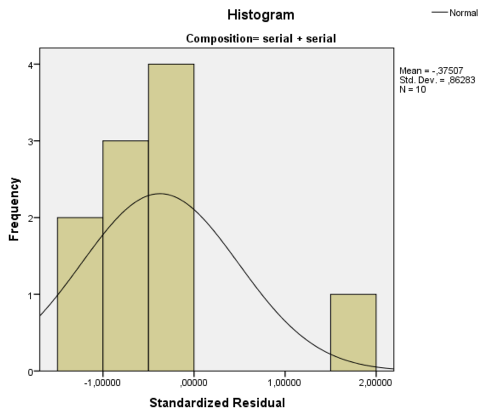
```
DATASET ACTIVATE DataSet1.
SORT CASES  BY Composition.
SPLIT FILE SEPARATE BY Composition.

EXAMINE VARIABLES=ZRE_1
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Tests of Normality[a]

	Kolmogorov-Smirnov[b]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,342	10	,002	,732	10	,002

a. Composition = serial + serial

b. Lilliefors Significance Correction



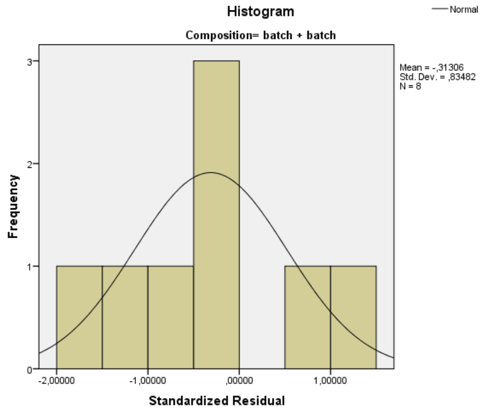
Tests of Normality[a]

	Kolmogorov-Smirnov[b]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,197	8	,200*	,965	8	,859

*. This is a lower bound of the true significance.

a. Composition = batch + batch

b. Lilliefors Significance Correction

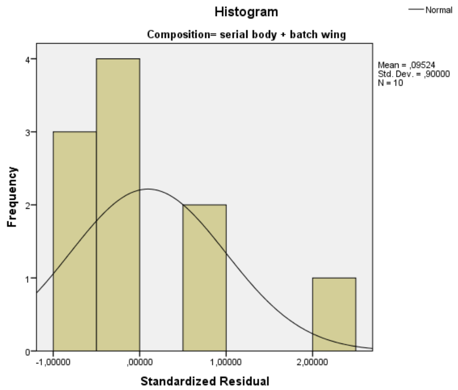


Tests of Normality[a]

	Kolmogorov-Smirnov[b]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,283	10	,023	,805	10	,017

a. Composition = serial body + batch wing

b. Lilliefors Significance Correction



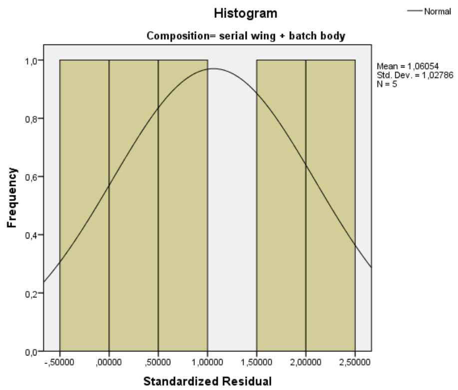
Tests of Normality[a]

	Kolmogorov-Smirnov[b]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,227	5	,200*	,928	5	,583

*. This is a lower bound of the true significance.

a. Composition = serial wing + batch body

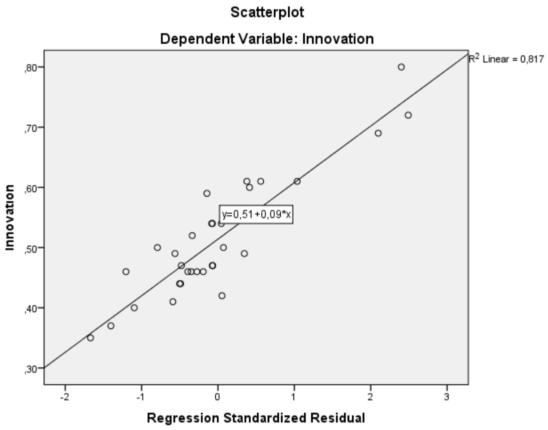
b. Lilliefors Significance Correction



Testing Homoscedasticity

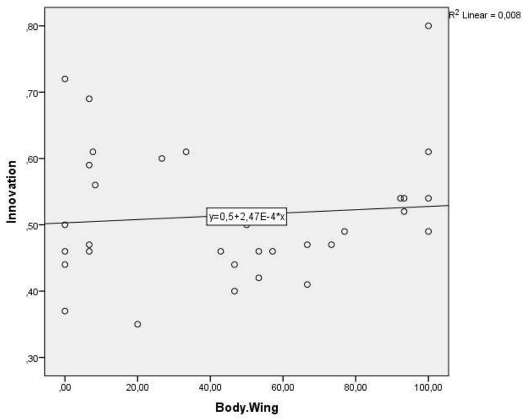
```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
```

/STATISTICS COEFF OUTS R ANOVA COLLIN TOL CHANGE
/CRITERIA=PIN(.05) POUT(.10)
/NOORIGIN
/DEPENDENT Innovation
/METHOD=ENTER Body.Wing Repetitive
/SCATTERPLOT=(Innovation ,*ZRESID)
/SAVE ZRESID.

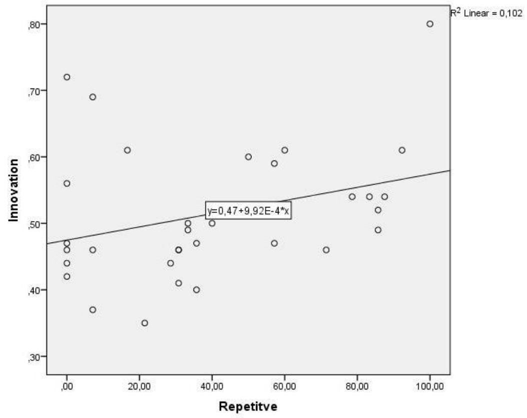


Testing linearity

GRAPH
/SCATTERPLOT(BIVAR)=Body.Wing WITH Innovation
/MISSING=LISTWISE.



GRAPH
/SCATTERPLOT(BIVAR)=Repetitive WITH Innovation
/MISSING=LISTWISE.



APPENDIX II

Results SPSS Syntax and Output

REGRESSION
/DESCRIPTIVES MEAN STDDEV CORR SIG N
/MISSING LISTWISE
/STATISTICS COEFF OUTS R ANOVA COLLIN TOL CHANGE
/CRITERIA=PIN(.05) POUT(.10)
/NOORIGIN
/DEPENDENT Innovation
/METHOD=ENTER Body.Wing Repetitive
/SAVE ZRESID.

Descriptive Statistics

	Mean	Std. Deviation	N
Innovation	,5141	,10054	32
Body.Wing	44,8519	36,77602	32
Repetitve	39,6031	32,35231	32

Correlations

		Innovation	Body.Wing	Repetitve
Pearson Correlation	Innovation	1,000	,090	,319
	Body.Wing	,090	1,000	,809
	Repetitve	,319	,809	1,000
Sig. (1-tailed)	Innovation	.	,312	,038
	Body.Wing	,312	.	,000
	Repetitve	,038	,000	.
N	Innovation	32	32	32
	Body.Wing	32	32	32
	Repetitve	32	32	32

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,428[a]	,183	,127	,09394

a. Predictors: (Constant), Repetitve, Body.Wing

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,057	2	,029	3,257	,053[b]
	Residual	,256	29	,009		
	Total	,313	31			

a. Dependent Variable: Innovation

b. Predictors: (Constant), Repetitve, Body.Wing

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,486	,027		17,798	,000		
	Body.Wing	-,001	,001	-,486	-1,702	,099	,345	2,895
	Repetitve	,002	,001	,712	2,495	,019	,345	2,895

a. Dependent Variable: Innovation

APPENDIX III

Code Scheme

Explanation of column headings

1. Model: Indicates which airplane model the unit of analysis is working on.
2. Body: In this column the continuity of the body routine is coded. This routine is present in every collaboration.
3. Wing: In this column the continuity of the wing routine is coded. This routine is present in every collaboration.
4. Serial/Batch: First, the rater has to determine whether a serial or batch routine is present in the collaboration and if the participants with these routines belong to the body or wing routine group. In this column the continuity of this batch or serial routine is coded.
5. Serial/Batch: First, the rater has to determine whether a serial or batch routine is present in the collaboration and if the participants with these routines belong to the body or wing routine group. In this column the continuity of this batch or serial routine is coded
6. Made the same way as previous model: In this column it is coded if the next model is made in the same way as the previous model. Model 1 cannot be made in the same way as the previous model and therefore has a (-).

Coding the recordings

1. Code per airplane model if the participants continue with their intra-organizational routines.
2. Code per airplane model if the model is made in the same way as the previous model.

X = no
I = yes

Model	**Body**	**Wing**	**Serial / Batch** **Body / Wing** *(circle the one present)*	**Serial / Batch** **Body / Wing** *(circle the one present)*	**Made the same way as previous model**
1					-
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
Percentage					