

# **Intra-organizational Routines and Collaboration Performance: The Mediating Effect of Variety in Working Processes**

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Intra-organizational collaborations support organizations in enhancing their innovation performance. Variety in working processes plays a minor though vital role in that context. However, academic literature on the effect of variety of working processes on innovation performance is rare. In that sense, it is stimulating to create an understanding by researching that particular effect based on the data from questionnaires of an experiment on collaborative routines. A causal model will test the direct effect of complementary and supplementary routines on collaborative innovation and secondly the effect with variety in working processes as a mediating variable. The findings imply that supplementary intra-organization routines yield more positive results in relation to collaborative innovation as complementary routines. Moreover, the proposed positive effect of variety in working processes on collaborative performance is not significant. In essence, the findings diverge to a large extent from the academic literature, which is however partly attributable to the use of questionnaires rather than video recordings. In that sense, it is recommended to utilize the videos of the experiment to gain insights on the subject.

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## **Keywords**

Intra-organizational Routines, Collaboration Performance, Variety in Working Processes

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## 1. INTRODUCTION

Studies highlight that between 30 - 70 % of alliances prove unsuccessful, which means that the initial objectives and promised benefits are not met (Bamford, Gomes-Casseres, & Robinson, 2004; Das & Teng, 2000). In that sense, it is motivating to find an answer for the prospective causes of alliance failure (Park & Ungson, 2001). Literature suggests that there are three traits namely partner complementarity, -commitment and -compatibility; the history of the collaboration and the access to strategic resources are required to ensure alliance success (Shah & Swaminathan, 2008; Zollo, Reuer & Singh, 2002; Kale & Singh, 2009; Lunnan & Haugland, 2008).

In essence, Collaborations are defined as small social networks of organizations that engage in “an interactive process having a shared purpose and are characterized by explicit voluntary membership, joint decision making, agreed upon rules, and a temporary structure” aimed at gaining access to imperative resources, learning, exploitation of efficiencies and achieving competitive advantage and sometimes secure the company’s survival on the market (Ariño & De La Torre, 1998; Gray & Wood, 2002, p. 6; Duane and Hitt & Vaidyanath, 2002; Todeva & Knoke, 2005).

Generally speaking, the performance side and success of the collaboration is left out in many studies (Lambe, Spekman & Hunt, 2000; Miotti & Sachwald, 2003; Kale & Singh, 2009). Regarding innovation the academic literature elaborates on how to acquire new knowledge and capabilities yet leaves out to measure the innovation in terms of achievements (Sampson, 2007; Schilling & Phelps, 2007). Additionally, Becker (2005) underlines that the characteristics of the interaction pattern (working process) affect the performance of the outcome. This means a positive or negative outcome of the process in relation to performance.

Corresponding, current academic research disregards the process perspective of alliances and concentrates predominantly on structural aspects (Das & Teng, 2002; Sarkar, Echambadi, Tamer Cavusgil & Aulakh, 2001). As a consequence, more research on the development of routines in the cooperation process is desirable (Powell, 1998; Becker, Lazaric, Nelson & Winter, 2005; Chassang, 2010). Due to the scarce research in the field of innovation in relation to variety in working processes it is inspiring to seek new answers in the context of collaboration performance. According to Pavitt there are three reasons that underline the significance for researching work process variety in that respect “(1) practical: ingredients for successful management of innovation and the respective link to corporate strategy, (2) theoretical: routines of managers and influence on strategic management and (3) industrial dynamics and lastly that similar concepts exist that lead to innovation” (2002, p. 3). Likewise, research suggests that rigidity in respect to routines affects innovation in a negative way, which highlights that variety, may lead to enhanced benefits in the setting of collaboration (Collinson & Wilson, 2006). For instance learned and static procedures at work that at practiced and never modified e.g. always gather for new projects in the old meeting room rather than outside on the nice terrace. For the purpose of this study, the following research question was addressed:

How does variety in working processes affect the relationship between intra-organizational routines and collaboration performance?

## 2. THEORY AND HYPOTHESIS

### Complementary and Supplementary Partners

Strategic partners are tools to exploit novel efficiencies secure competitive advantage and sometimes even the company’s survival on the market (Todeva & Knoke, 2005). Partners usually engage over a pre-determined time horizon, which is formulated in form of a law binding agreement. Partner complementarity takes the perspective of the resource-based view and is in many instances the initial motivation for the formation of an alliance (Duane, Hitt & Vaidyanath, 2002; Lin, Yang & Arya, 2009; Sivadas and Dwyer, 2000). For her experiment Spin (2011) researched serial and parallel routines, which she designed corresponding to human resources, by training the probates according to one of these two working routines.

In particular complementary resources of the respective partners are often an enabler for synergies and therefore a significant cost reduction mechanism (Lin, Yang & Arya, 2009; Sivadas & Dwyer, 2000; Harrison, Hitt, Hoskisson & Ireland, 1991). In addition, complementary partners yield better results as their supplementary counterparts this is due to access to specific resources, skills, know-how and further dimensions that benefit the collaboration (Becker & Gerhart, 1996; Geringer, 1991). This is complemented by Spin (2011) who evaluated routines rather than resources and supplies empirical insights that partners with complementary routines demonstrate advanced levels of collaborative innovation as compared to their supplementary routines counterparts. In contrast, supplementary resources are also valuable yet they are the initial step towards the development of absorptive capacity as enabler for innovation (Nieto, 2004). Moreover, supplementary resources of partners can be used to benchmark resources, which supports the performance advancement of the respective partners. Benchmarking enables them to move to a certain performance standard, however it does not extend their capabilities as complementary resources would do. The discussion highlights that complementary resources here in the form of routines, in the context of the experiment, yield significantly better results as compared to supplementary resources.

### Variety in Working Processes and Impact on Performance

Work processes can be regarded as a kind of routine and as the method by which inputs are converted into outputs (Pentland, 2003). Moreover, when work processes are consistent there is less variety, which can be defined as routinization (Van De Ven, Delbecq & Koenig, 1976). The direct opposite is variety and inconsistencies in work processes. With respect to routines Cohen and Bacdayan (1996) explored that it is more challenging to learn simple routines as complex work process that appear occasionally, due to the fact that individuals devote more time and focus to complex assignments. Pentland and Feldman (2005) define three ways on how routines can be approached as a unit of analysis. These are as “(1) black box (undifferentiated), as (2) particular parts of the routine in isolation and as (3) relationships between these parts” (Pentland & Feldman, p.1, 2005). Ariño’s (2003) research adds that during the strategic decision of terminating a collaboration based on the ill-fated outcome performance, an analysis of the process of the collaboration is likely to be executed, due to the fact that certain elements of the process may generate the

insufficient results. Furthermore, in his empirical research Nielsen (2007) analyzed 138 alliances on aspects of performance and found out that there is a significant gap in research in the process category. In that sense, more research on the topic is appreciated by scientists and especially by the business world and public sector for their day-to-day operations. In the recent history, Japanese concepts such as kaizen, which stands for continuous improvement via simple methods, demonstrate that standardized processes and especially the operators that more and more work in teams matter (Monden & Hamada, 1991). Complementary, the impact routines have on performance during collaboration is a significant area of research, which lacks attention from scholars (Collinson & Wilson, 2006; Lunnan & Haugland, 2008; Heimeriks & Duysters, 2007). Becker (2005) states that the characteristics of a working process (e.g. serial/ parallel) impact the performance outcomes. That impact can be of positive or negative nature and can be assessed during the process or in form of resulting outcomes e.g. assembled airplanes at Airbus. Similarly, Pentland (2003) states variability in working processes significantly influences the outcomes of the process, which also emphasizes that videos that record the process are the advanced tool for scientific observation. In contrast, Doz (1996) highlights that the variety in respect to intra – organizational routines can impact collaborative performance in a negative fashion. Nevertheless, the main academic voice is positive on that matter.

However, aspects of governance, pre- and post-performance, outcome performance and equity arrangements are the major themes in the academic literature on the subject (Lee and Cavusgil, 2006; Nielson, 2007; King, Dalton, Daily & Covin, 2004; Ariño, 2003; Yan and Zeng, 1999; Das and Teng, 1998). Arino (2001) states that collaboration aims at gaining competitive advantage and advancing corporate performance. Regrettably, scholar's outline that collaborations are more likely to fail as to succeed "success is regarded as exemption" (Das and Teng, p.51, 2000). Nevertheless, the number of collaborations is likely to grow due to the fact that the potential value outweighs the failure (Duane and Hitt & Vaidyanath, 2002). Throughout the experiment of Spin (2011) probates were trained serial or parallel work routines that they applied to the later assembly of airplanes. Because, these routines are dissimilar it is motivating to research the effect on innovation performance as direct and mediating effect. The brief review above highlights the significance and prominence of the performance topic for businesses and science. Consequently, it is of importance to assess the effect that variety in working processes has on the performance of the collaboration.

## **Collaborative Innovation Performance**

Innovation is in many instances the reason to engage in collaboration typically fired by pressures from the external business environment. Redlich (p. 285, 1951) outlines innovation as "a thing that lays beyond the outer horizon and has not yet taken form". Collaboration, particularly with diverse partners, is said to enhance innovation performance in a constructive way and are frequently created during NPD processes to cope with the tight budget constraints of the respective partners (De Man and Duysters, 2005; Faems, Van Looy & Debackere, 2005; Nieto and Santamaría, 2007). Shipton, West, Parkes, Dawson & Patterson (2006) argue based on their research of 3717 employees in 28 UK manufacturing companies that innovation in the production process is positively impacted by job variety. Additionally, academic literature highlights that variety of knowledge, skills and culture

directly affects innovation during collaboration in a positive manner (Nieto and Santamaría, 2007; Owen, Goldwasser, Choate & Blitz, 2008). Reflecting the above on the micro perspective of collaboration during the experiment of Spin, the small-scale assembly working process, one can assume that variety in working processes has a mediating effect on collaborative innovation. According to Hitt, Hoskisson & Kim (1997) and Rantisi (2002) diverse inputs and variety are the enablers of innovation. Nevertheless, variety is believed to have an inverted u-shaped effect on innovation, due to the fact that too much variety will not lead to more innovation. In other words, if the level of variety exceeds the peak point it will not lead to enhanced innovation as outcome. Likewise, in their study of 16 health and welfare agencies Hage and Aiken (1974) discovered that variety of available technologies and richness of organizational knowledge are likely to affect innovation during collaboration. This is supported by Suchman (1983) who videotaped clerks while they performed routine tasks (filing invoices) and observed that they improvised as they faced new situations (from Jones and Craven, 2001). Innovation is therefore not a routinized encounter since it can conflict with creativity (Adler, Goldoftas & Levine, 1999). Conversely, following Cohen and Levinthal (1990) innovation can be a byproduct of the routine activity or pre- existing knowledge. Additionally, a corporation can broaden its scope of knowledge by developing absorptive capacity through enhanced engagement in its environment to detect external information, which may influence innovation efforts in another direction as compared to routine business (Cohen and Levinthal, 1990; Schilling and Phelps, 2007, Sampson, 2007). That means that the evaluation of external information to develop new insights is a form of variety, since it diverges from the current routine. Jones and Craven (2001) discovered during operations with the Teaching Company Scheme of Aston Business School that change in routines leads to performance advancement and new ideas. Summarizing, academic sources suggest that variety in routines contributes to innovation and related performance advancement.

### **Research hypotheses:**

Hypothesis 1: Complementary intra- organizational routines affect variety in working processes more positively than supplementary intra- organizational routines.

Hypothesis 2: Variety in working processes will have a positive effect on collaborative innovation performance.

Hypothesis 3: Complementary intra-organizational routines affect the overall collaborative innovation performance more positively than supplementary intra-organizational routines.

Hypothesis 4: The positive effect of intra-organizational routines alignment on collaborative innovation performance will be positively mediated by variety in working processes.

The expected relationships are illustrated in the following causal model:

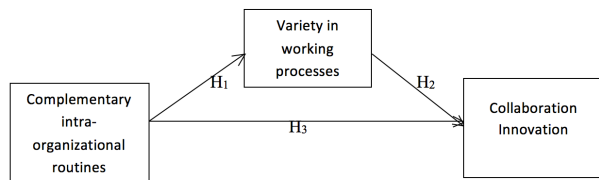


Figure 1. The mediating effect of variety in working processes on the relationship between complementary/ supplementary intra-organizational routines and collaboration performance.

### 3. RESEARCH METHOD

The foundation of the paper is the data from questionnaires on work processes of a previous experiment by Spin (2011) who conducted a two-factor between-subject experimental design to test the hypotheses. During the three-step experiment participants acquired an operational routine either serial or parallel built models in a collaborative setting according to their previously learned scheme and finalized the experiment with a thorough questionnaire. The following subsections will elaborate on the theoretical framework and the operationalization of the independent and dependent variable and analysis.

#### Sample

The population for the experiment consisted of 31 groups of university students, derived from the pool of 192 individual students, with age 17 to 28, which were randomly assigned into groups of six for the treatment. Moreover, 69,47% probates were male and 30,53% were female. These students originate from dissimilar educational disciplines, yet a substantial share studies business administration or technical business administration. Moreover, all probates received a lottery ticket as incentive with a value of 3 Euro.

#### Procedure

The procedure consisted of three phases, namely (1) learning of routine, (2) collaboration and (3) the questionnaire. Each phase took approximately 30 minutes excluding the collaboration phase, which lasted for precisely 30 minutes. Furthermore, the probates were assigned randomly for either complementary or supplementary collaboration.

To start with the experiment probates were exposed to the first treatment, which was the intra-organizational routine. The intra-organizational routine is subdivided into serial and parallel production. Next, the initial routine learning phase prepared the probates for the imminent phases. In a serial routine the probates worked together and each probate executed one step of the design. They were also briefed on the design and quantity to build. Contrarily, parallel production defines that each probate starts and finishes his design by herself/ himself. During parallel production probates were not briefed on the type of model to be built. Stickle bricks are construction bricks similar to LEGO and were utilized to construct the models. Each treatment group, serial or parallel, had to build three models in 30 minutes and depending on their assignment either wings or fuselages.

During the second phase, two groups of three were brought together to form a group of six and collaborated. Furthermore, the groups received customer problems, which were formulated imprecisely. In addition, these customer problems were the basis for the designs and had to be solved in an innovative way (manufacture various categories of aircrafts). Probates had to abide certain guidelines during the experiment: (1) Each group member collaborates, (2) the allocation of time per model has to be decided by consensus and (3) the overall time boundary of 30 min has to be met.

In order to provide material for a future research, all groups were recorded with a video camera during their activities. The final phase invited all probates to fill out a questionnaire, which took 30 minutes.

### Measures

#### Dependent Variable

The main dependent variable within the experiment was *collaborative performance* and was measured by collaborative innovation. In order to measure collaborative innovation, the pictures of the assembled planes per type and group were utilized. Randomization of the respective groups was the initial step to enable the accurate comparison of the various groups by innovativeness of their assembled models. Moreover, the following comparison stage was designed to rank the respective models per group on a point scale from four (very innovative) to one (least innovative). For the respective comparisons per model type, four pictures of four randomized groups were compared according to their innovativeness. For instance groups two, four, five and nine on model eight. In addition, three independent students scored the models in order to test the inter-rater reliability. Following to investigate the inter-rater agreement Cohen's Kappa (.52) was used. The result is defined as moderate agreement (Landis and Koch, 1977). Lastly, averaging the scores of the two independent scorers lead to the final collaborative innovation score for the respective groups. The respective scores were then summed up and divided by the total number of planes assembled by each group to obtain the concluding innovation score per group.

#### Independent Variable and Mediating Variable

The independent variable is *intra-organizational routines* and was operationalized in two forms complementary and supplementary within the experiment (Spin, 2011). However, to enable the application in the experimental production assembly design of the airplanes, the two production process concepts, serial and parallel working routines, were introduced corresponding to the supplementary and complementary intra-organizational routines. In particular, complementary routines are defined by a clear-cut assignment of one parallel routine and a corresponding serial routine group. On the other hand, supplementary routines are either two groups that work in serial routines or two groups that work in a parallel routine.

*Variety in working processes* is the mediating variable in the relationship of intra-organizational routines and collaboration performance. In order to measure variety in working processes within the groups, the questionnaire of Spin (2011) utilized a combination of Perrow's (1970) index of routinization, Van de Ven, Delbecq, and Koenig's (1976) dimension of task variety, and the skill variety dimension of the Job Diagnostic Survey (Hackman and Oldham, 1975). Moreover, the questionnaires consisted of 19 questions of which eight focused specifically on variety of the task in form of different formulations on varying five-point scales (strongly disagree/ strongly agree; very little, none/ very much; not at all/ to a great degree). In addition, to

that eight of the 19 questions were marked with a star, which means that these items are used for reverse coding. Reversed coded items are phrased in the other direction compared to the rest of the questions (Collican, 2004). The advantage is that opinions are asked in different two ways which corresponding to negative/ positive attitude of the probate (Collican, 2004). In order to receive a unified picture of the situation, since the questionnaires were on an individual basis, the results were averaged which lead to an accurate measure of variety in working processes on the group level.

Nevertheless, it was indispensable to aggregate the data from the individual questionnaires to enable the group level measurement of the variable. In addition, a factor analysis via the Kaiser-Meyer-Olkin (KMO = .51) measure had to be completed, that allows investigating the construct validity of the questionnaires (Garratt, Ruta, Abdalla, Buckingham & Russell, 1993; Rattray and Jones, 2007; Babbie, 2007). Or in other words, how many of the 19 questions directly related to the mediating variable variety in working processes. As a result seven out of 19 questions, particularly questions 1,2, 6, 10, 11, 12 and 19, are valid measurements for variety in working processes. In detail, questions 1,2,10,11,12 ranked significantly higher (above .7) as questions 6,19 (above .5). However, the formulation of questions 6 and 19 does not considerably differ, these questions are in simple words the same aspects in a distinctive wording. Following, the reliability test via Cronbach's alpha (Cronbach's  $\alpha$  = .893) highlighted that the seven questions demonstrate significantly high reliability. Concluding after the assessment of validity and reliability, a final step the aggregation of the scores to the group level had to be executed. In order to arrive at an average measure for variety in working processes per group, the individual opinions (values) from the respective questionnaires per candidate were summed up and divided by the number of questions on variety in working processes and number of group members.

## Type of analysis

Although, a major condition for regression analysis is a continuous variable with a adequate measurement level precisely interval or more advanced, it is possible to utilise dummy coding as procedure to transform our dichotomous categorical variable (intra organizational routines) (Field, 2009; De Vaux, Velleman & Bock, 2012). Given the fact, that the experiment had solely two categories, supplementary and complementary, it was simply necessary to modify the original values (complementary = 0; supplementary = 1) rather than creating completely new variables (Field, 2009). Due to the fact, the intention is to investigate our hypotheses and how well certain factors (e.g. variety in working processes) may predict the outcome variable collaboration innovation (performance) regression is an appropriate measurement instrument (Rawlings, 1998; Field, 2009; De Vaux, Velleman & Bock, 2012).

## 4. RESULTS

Table 1. Means, standard deviations and correlations of the variables (N = 31)

	Mean	St. dev.	1	2	3	4
<u>Task_variety</u>	3,29	,07	1			
<u>Task_variety_squared</u>	10,83	0,01	,109	1		
<u>Compl(0) vs. Suppl(1)</u>	,35	,49	-,130	-,115	1	
<u>Innovation_score</u>	2,52	,45	,495	,221	,153	1

Notes: \*p<0.05; \*\*p<0.01 (2-tailed)

Hypothesis 1 was that complementary intra- organizational routines affect variety in working processes more positively than supplementary intra- organizational routines. As a result of the regression analysis, the mean for variety in working processes for supplementary routines (3.38) is not considerably higher as compared to complementary routines (3.29). In addition, the result is not significant (p = .559) and ( $R^2 = .01$ ; Adjusted  $R^2 = -.02$ ).

Table 2

Summary of regression analysis for complementary intra- organizational routines on variety in working processes

Variable	B	SE (B)	$\beta$	t	Sig. (p)
<u>Compl vs. Suppl</u>	.083	.14	.109	.591	.559

Note.

$R^2 = .01$ .

Hypothesis 2 proposed a positive relationship between variety in working processes and collaboration innovation performance. Moreover, the beta coefficient was positive as anticipated (b = .153) yet the results ( $R^2 = .02$ ; Adjusted  $R^2 = -.01$ ) and (p = .412) demonstrate that variety in working processes is rather bad predictor variable that leads to a non- significant result.

Table 3

Summary of regression analysis for Variety in working processes and collaborative innovation

Variable	B	SE (B)	$\beta$	t	Sig. (p)
Variety in Working Processes	.178	.21	.153	.832	.412

Note.

$R^2 = .02$ .

Hypothesis 3 proposed that complementary intra-organizational routines affect collaboration performance more positively than supplementary routines. In contrast to the proposed outcome of the regression analysis, supplementary routines are more positively related to collaborative innovation as complementary routines. In detail the mean innovation score for supplementary groups 2.79 (SD = .447) was higher as for complementary groups 2.38 (SD = .384). In addition, the result is significant (p < .05) and 20 % of the variability of collaboration innovation is described by the model ( $R^2 = .20$ ; Adjusted  $R^2 = .17$ ).

Table 4

Summary of regression analysis for Intra-organizational routines alignment and collaborative innovation

Variable	B	SE (B)	$\beta$	t	Sig. (p)
<u>Compl vs. Suppl</u>	.411	.15	.447	2.694	.012

Note.

$R^2 = .20$ .

Hypothesis 4 proposed a mediating effect of variety in working processes on the relationship between intra- organizational routines and collaboration performance. Nevertheless, resulting

from the insignificant outcomes of the aforementioned tests of hypotheses two and three there was no need to test hypothesis 4. Particularly, the Baron Kenny method can be utilized to test the significance of the coefficients (Baron & Kenny, 1986).

## 5. CONCLUSION

In summary, the results of the tested relationships are not significant excluding the data that confirmed that supplementary routines yield more positive results in relation to collaborative innovation as complementary routines (hypothesis 3), which contradicts with the academic literature (Becker and Gerhart, 1996; Geringer, 1991). Regarding the first hypothesis, which proposed that complementary intra-organizational routines affect variety in working processes more positively, no significant outcome could be uncovered. This is in contrast to the resourced based perspective, which states that complementary resources are the ultimate enabler for alliance success with respect to innovation performance, supplementary resources are in that sense the initial step to develop absorptive capacity as motor of innovation (Becker and Gerhart, 1996; Becker, 2005; Geringer, 1991; Nieto, 2004). Nevertheless, the focus of this particular experiment is on routines rather than resources. Subsequently, there are authors that confirm the direct opposite, yet the literature is extremely scarce, which leaves room for interpretation and demand for further research on the topic. Similar results were confirmed by the statistics on the second hypothesis, the proposed positive relationship between variety in working processes and collaboration innovation performance. Indeed, the relationship is positive as demonstrated by the positive beta coefficient, yet conflicting with the academic literature, which holds the argument that variety in working processes significantly influences collaborative innovation in a positive way (De Man and Duysters, 2005; Faems, Van Looy & Debackere, 2005; Nieto and Santamaría, 2007). In principal, the measures for innovation are too rough, which is highlighted by the low inter-rater reliability and impacts the overall results of this paper. Moreover, it has to be said that Spin (2011) focuses her paper on compatibility of partners rather than the resource perspective and the related supplementary and complementary aspects of resources in during alliances. Additionally, the data of the experiment is perfectly suitable for that particular research aspect yet may not be appropriate and detailed enough for research on variety of working processes. Mainly, a significant body of literature confirms the positive influence of variety in working process on innovation performance. However, most of these findings are based on non-experimental data. Therefore, data collection via the video observation method may yield significant results and consequently confirm the positive relationship. Furthermore, the collected data from the video observation via the software program would potentially lead to an enhanced and detailed statistical data output, which is more appropriate as the compact data from the rough measures that is the foundation of this paper. Consequently, from a technical perspective the statistical tests would yield advanced results for the purpose of this paper. In simple words, it is quite striking that the results diverge so drastically from the literature. Hence, the more practical approach via evaluation of experimental video that could add to the scarce body of literature on routines and innovation performance.

## 6. DISCUSSION AND LIMITATIONS

### Limitations

To begin with this experiment included a significant sample of multinational students, which also varied in age and current status in education e.g. undergraduates, graduates and PhD students. Moreover, the sample included students of different disciplines, yet with a significant share of students with technical knowledge. Consequently, there is some variation in the knowledge on how to build aircraft models, yet also the awareness of certain types. This in turn may affect the performance and the output of models.

Secondly, the measure for innovation is not a reliable indicator in the context of this particular experiment. The idea to judge the models in terms of complexity, number of colors and brigs is only suitable to a certain extent, since merely design is measured. Adding to the aforementioned aspects of inter-rater reliability, the observers vary in their interpretation of the respective airplane models, even though the indicators seem to be quite simple. Hence, increasing the number of indicators and include novel measures such as functional specifications for the models could lead to advanced results in that matter. Moreover, the measure was more outcomes oriented and focused on the final product. Maybe it is possible to assess innovation during the process of assembly via the video recordings of the subsequent groups.

Thirdly, the experimental data was collected from university students that may have lacked motivation during the experiment. In order to enhance the quality of the results from questionnaires and the airplane construction, incentives could be rethought. For instance, instead of 192 times a 3 Euro lottery ticket, an Ipad and two small wins could be bought to elicit the desired participation. Students have big dreams and are short on money for items like I pads, however the three Euros are not high enough to motivate the whole congregation of probates. Yet it has to be ensured the students participate not just for the reason of the potential win of the incentive.

Lastly, increasing the share of students from other academic disciplines for instance from the social sciences and mixing the groups could prevent outliers that yield more significant results. A sample of a more diverse group of disciplines would demonstrate reality, since reality has more than one facet of educational disciplines. However, more diverse groups require more time and resources, which is often not possible due to tight budget and time constraints.

### Future Research

Firstly, the questionnaires are of significant importance, since further research on the composition of the groups with respect to age, gender but also university disciplines e.g. compare students of business and technical background could be executed and may highlight novel facts. Comparing two different groups of student so from two dissimilar studies helps to arrive at better results as compared to the analysis of a uniform group. This could be supported by the in-depth analysis of the working processes from the videos.

Secondly, it was originally anticipated to assess variety in working process and the resulting effect on intra-organization collaborative innovation via the video recordings of the experiment of Spin (2011). This was however cancelled due to issues with the language of the videos, lack of skills for operating the software and especially time constraints. Additionally, there is still a considerable gap in the academic literature on the subject. Hence, research on routines via Pentland's method of sequential variety, would allow to

investigate the respective sequences of the collaboration. A hindernis is the language, almost all videos were recordings with Dutch speaking probates a native speaker is the only option to code the videos. Adding to that it will require a vast amount of time to code all interactions according to the proposed scheme, since there are many interactions within the group of six probates. This is also due to the Observer XT analysis software that puts its emphases on the small interactions of individuals e.g gesture. Nevertheless, a coding scheme that follows Pentland's approach of sequential variety, which investigates "How many different ways is a process performed?" is illustrated in the subsequent section (Pentland, p.532, 2003). Given the fact, that the experiment was videotaped it is more suitable to utilize Pentland's method of sequential variety (sequences of the work process) rather than Perrow's index (work process content), which is more appropriate for the analysis of complex working processes (Becker, 2005). Yan and Zeng (1999) confirm that the focus in measuring alliance performance should be on the dynamics of the process rather than the outcomes of the encounter. In the experiment the participants practiced either serial or parallel working routines. Consequently, the variety can be monitored when participants build the main parts of the air plane A (wings), B (body) and C (landing gear) in form of a serial or parallel routine. The coding scheme is based upon Pentland's and Feldman's academic work on routines in particular the ostensive aspects of a routines namely "as in the case of a written procedure or a policy statement that describes the overall pattern of the routine" (2008, p. 242).

Main Category	Code	Observable Behaviour	Example
Variety in work processes	Consistency of work in collaboration	Probates perform their assigned tasks in the same manner in every instance	Probate always assembles the wings.
	Variety in work in collaboration	Probates perform different tasks during the assembly process	Probate builds landing gear, then sometimes wings or propellers.
	Routine during the assembly process (fixed patterns)	Probates follow the same pattern during the assembly process	Probate first builds wings, next body, then landing gear and lastly unites the parts.
	Repeating the assigned task*	Probates perform the same task over and over again	Probate builds only body for reach model

\*Reassess the reliability of the previous codes consistency and variety in work process in collaboration

Figure 5. Coding Scheme for variety in working processes

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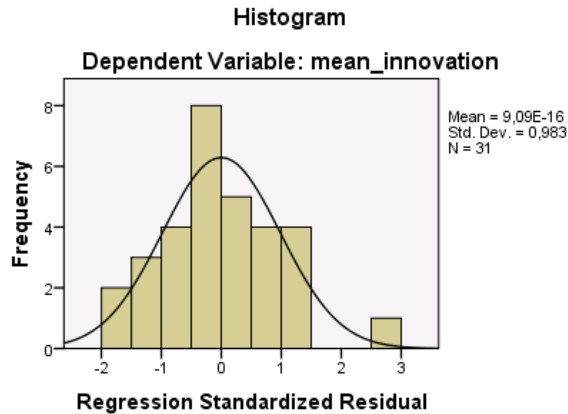
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## 8. APPENDIX

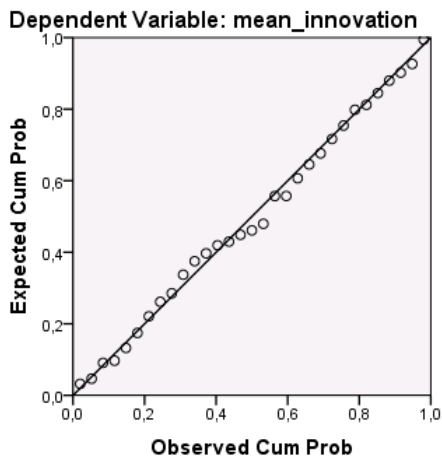
### Definition of Terms

1. Intra-organizational Routines – are the existing intra-organizational routines of the respective partner companies (group routines), which are unified within the collaboration.
2. Complementary Intra-Organizational Routines – dissimilar intra-organizational routines, which are unified within the collaboration e.g. one sub-group follows a serial the other a parallel routine.
3. Supplementary Intra-Organizational Routines – similar routines that are unified within the collaboration e.g. both sub-groups follow either a serial or a parallel routine.
4. Work Process – is the process were goods/ services are manufactured or assembled (Business Dictionary, 2013). During the experiment a small scale manufacturing process of model airplanes was performed.
5. Variety – is the variability in the work process and is related to tasks that are performed by the respective individuals/ machines (Pentland, 2003). Moreover, an individual can perform a single task (assemble wings) or multiple tasks (assemble wings, body, landing gear), which in turn results in greater variety in the work process.
6. Innovation – Redlich (p. 285, 1951) defines innovation as “a thing that lays beyond the outer horizon and has not yet taken form”. Furthermore, innovation can take different forms “administrative or technical, radical or incremental, central or peripheral” (Fiol, p. 1012, 1996). In addition, the process of innovation has five phases namely “awareness, appraisal, adoption, diffusion, and implementation” (Fiol, p. 1012, 1996).
7. Collaboration Performance – deals with aspects of governance, pre- and post-performance, outcome performance and equity arrangements (Lee and Cavusgil, 2006; Nielson, 2007; King, Dalton, Daily & Covin, 2004; Ariño, 2003; Yan and Zeng, 1999; Das and Teng, 1998). In this case the particular focus is on innovative collaborative performance.

## Histogram and residuals for task variety and collaborative innovation performance



Normal P-P Plot of Regression Standardized Residual



## Questionnaire Work processes (type of task)

Type of task was measured using an adaptation and combination of Perrow's (1970) index of routinization, Van de Ven, Delbecq, and Koenig's (1976) dimension of task variety, and the skill-variety dimension of the Job Diagnostic Survey (Hackman and Oldham, 1975). The items were coded so that high values reflected routineness (however some items are reversed-scored in the questionnaire).

1. The type of work done in the collaboration was fairly consistent, so that people did the same job in the same way most of the time.

Strongly disagree	Disagree	Undecided	Agree	Strongly Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. I encountered a lot of variety in the work during collaboration.\*

Strongly disagree	Disagree	Undecided	Agree	Strongly Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. The methods I followed in the collaboration were about the same for dealing with all types of work, regardless the activity.

Strongly disagree	Disagree	Undecided	Agree	Strongly Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. To what extent was there a specific 'right way' to do things in the collaboration?

Not at all	Very little	Moderately	To some extent	To a great extent
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. To what extent were there specific standards which you must meet in the collaboration?

Not at all	Very little	Moderately	To some extent	To a great extent
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. How much variety was there in your work in the collaboration?\*

Very little / none	Little	Not little / not much	Much	Very much
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. How often was your work in the collaboration boring?

Never	Seldom	Sometimes	Often	Almost always
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. How often could you predict how long a task would take?

Never	Seldom	Sometimes	Often	Almost always
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. How much did your work in the collaboration include problem-solving?\*

Very little / none	Little	Not little / not much	Much	Very much
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. How much routine was there in your work in the collaboration?

Very little / none	Little	Not little / not much	Much	Very much
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. To what degree were there set patterns in your work?

Not at all	Very little	Moderately	To some degree	To a great degree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. How often was your work simple?

Never	Seldom	Sometimes	Often	Almost always
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

13. To what extent was the work you did in the collaboration challenging?\*

Not at all	Very little	Moderately	To some extent	To a great extent
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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14. In general (thus not in this particular situation) how much actual 'thinking' time do you usually spend trying to solve such specific problems?\*

Very little / none	Little	Not little / not much	Much	Very much
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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15. To what degree did your work in the collaboration include improvised and unplanned performances (as opposed to planned performances)?\*

Not at all	Very little	Moderately	To some degree	To a great degree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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16. To what degree did your work in the collaboration include being creative?\*

Not at all	Very little	Moderately	To some degree	To a great degree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

17. To what extent was your work tiresome?

Not at all	Very little	Moderately	To some extent	To a great extent
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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18. How often did your work in the collaboration give you a sense of accomplishment?\*

Never	Seldom	Sometimes	Often	Almost always
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

19. To what extent did you feel like you were doing the same thing over and over again in the collaboration?

Not at all	Very little	Moderately	To some extent	To a great extent
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

\*reversed-scored items

## 8.1 Acknowledgements

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