INTER-FIRM INNOVATION TEAMS: STRUCTURES FOR RELATIONAL LEARNING

Ricarda B. Bouncken, University of Greifswald, Greifswald, Germany
Thorsten Teichert, University of Hamburg, Hamburg, Germany

ABSTRACT

Learning in innovation alliances is fostered by inter-firm NPD teams. Still, to encourage innovation, those teams have to be carefully designed to fulfil their demanding tasks of learning across the boundaries of the firms. Therefore, this study explores the impact of team design on learning. We research the effects of technical learning and on meta-learning. Team unity and project modularity are found drivers of inter-firm learning. Trade-offs between the two devices of team design are discussed and empirically tested. We show that process measures of modularity can only partly overcome deficits in structure, in particular a missing team unity.

Keywords: *Alliance, Innovation, Teams, Inter-firm Teams*

1. INTRODUCTION

To pursue innovation, which is about identifying and using opportunities to create new products, services, or work operations (Van de Ven, 1986), firms constantly search, create, and utilize knowledge that is distributed asymmetrically across organizations (Hargadon and Sutton, 1997) and form alliances (Lawrence, 2004). Also, it is widely accepted that a firm's capability to innovate is associated with its abilities to learn from other firms (Subramaniam and Youndt, 2005). Alliances enable different forms of learning that improve innovation. First, studies have emphasized alliances as a prominent vehicle to learn from partners (Kale et al., 2002). Second, learning can address the generation of capabilities to improve management of alliances (Anand and Khanna, 2000). To improve innovation and learning, firms form new product development (NPD) teams, often cross-functional (Galbraith and Merrill, 1991). The coordination of NPD teams across firms is different in alliances to the single firm. Even though NPD-teams are regarded an important coordination principle for R&D, the question of inter-firm NPD teams has been neglected to a large degree. Thus, this study aims to research in detail the coordination of NPD teams in R&D alliances. The ideas developed in this study base on the combination two streams of literature. We draw on learning theories to explore the inter-firm and inter-individual process of learning from partners and learning of alliance management. This literature is combined with insights in the field of NPD. As the literature is incomplete on the coordination of NPD teams along the innovation process, we reflect on two sub-theories in the field of NPD. We built on object modularization in and across NPD-teams and from studies on the NPD process.

With regard to the object of coordination, this paper analyzes a modularization of projects, which allows (specialist) teams to follow targets of their modules relatively independently from each other. Thus, this study explores the impact of project modularity on inter-firm learning. Furthermore, teams, whether working in modules or not, require an ongoing coordination of the process. Thus, we introduce the concept of team unity, which indicates the degree of informal, joint, and flexible coordination of teams. In essence, we argue that firms promoting innovation via learning in alliances require insights about team coordination with respect to the degree of interaction and modularity.

2. THEORETICAL BACKGROUND

2.1 Knowledge Generation in NPD Teams

Learning is about finding novel associations between existing knowledge and can be regarded as encouraging innovation, the creation of 'new combinations' (Schumpeter, 1934). Innovation requires a pooling of multiple and specialized knowledge sources so that invention and implementing new ideas becomes a collective achievement (Van de Ven, 1986). For enabling the collective process of learning and development of innovations, firms establish NPD teams in which knowledge is transferred across individuals (Subramaniam and Venkataraman, 2001). NPD-teams play a substantial role in knowledge deployment and transfer in two areas. First, they carry out a transfer of explicit knowledge; information that is codified for actual and future learning in innovation processes (Garud, 1994). Second NPD teams transfer tacit organizational knowledge that concerns not verbalized elements, organizational processes (e.g. team procedures and norms, working routines, informational networks, and general beliefs). It requires direct interaction along with the sharing among individuals and collective entities to allow retrieval and storing of knowledge facilitating learning in NPD teams.

2.2 Learning in Alliances

Alliances improve the portfolio of knowledge. Also, they provide a vehicle of finding new associations between knowledge across partners. Different forms of learning have been discussed in alliances. According to the **process**, scholars have emphasized learning from partners, which essentially involves accessing, internalizing, and utilizing information and knowledge (Lane 1998). Still, the process can also include mutual learning between allying firms. With respect to the **result** of learning in alliance management, scholars have been discussing two forms. One is about learning how to manage an alliance with a specific partner (Dyer, 1997). Such inter-firm, largely mutual learning centers on procedures and routines to improve work as the alliance evolves; it includes learning about partners' intended and emergent goals, how to redefine joint tasks over time, and how to manage the alliance interface through learning, re-evaluation, and re-adjustments (Doz and Hamel, 1998). Partner alliance capability developed herewith improves negotiations, commitments, and adaptation of behaviors, norms and routines (Smith Ring and Van de Ven, 1994). The other form of results addresses learning of how to manage a portfolio of alliances (Anand and Khanna, 2000). This general alliance capability encompasses the development of standardized routines that replicate behavior guiding the choice, evaluation, control, and interaction with partners who contribute heterogeneous knowledge to the R&D alliance (Gulati, 1999). Moreover, learning in alliances can generate private benefits that are associated with unintended knowledge spill-overs, which one of the allies might exploit unilaterally. Instead, common benefits define learning that allying partners are only able to utilize jointly. Both, private and common benefits can refer to technical as well as managerial knowledge.

2.3 Impact of United Teams on Learning of Technical Knowledge

We introduce the term of united inter-firm teams to indicate such endeavors, in which team-members work together on all aspects of the NPD-project. Social processes within teams catalyze the iterative process of knowledge reinforcement and refine the evolving body of knowledge (Subramaniam and Youndt, 2005). In the case of R&D, the majority of the newly generated knowledge of the team is too complex to abstract or summarize. Lane and Lubatkin (1998) argue that close interactive learning in alliances allows acquiring more tacit components of knowledge. Especially, with respect to the utilization of tacit knowledge, not open to verbalization, united teams support a transfer and a preservation of rich technical knowledge (Rosenkopf and Almeida, 2003). Through the transfer of knowledge across team-mates and project leaders, united teams encourage the chance of unplanned, serendipitous information transfer and problem clarification. In contrast, non-united teams have to cope with more separate worlds of thought, technical jargon, and increased perceived personal differences, having the drawback of reducing learning (Griffin and Hauser, 1996). Disadvantages of united teams relate to the danger of information overload, which may be the consequence of their exposure to cross-functionality or knowledge from dissimilar backgrounds unnecessary for specific tasks of the NPD-process. This information overload can be counterproductive for the willingness and ability to learn and increase misunderstanding, misevaluation, and under-estimation of valuable knowledge. This problem multiplies in inter-firm teams if members perceive incompatibilities from different organizational backgrounds of other team members.

United teams lead to further obstacles to learning if they are co-located, which implies locating members distantly from other business functions. Such co-located teams are likely to have difficulty in transferring knowledge within their own firms as individuals who are not involved in knowledge creation face strong barriers in learning. Van den Bulte and Moernart (1998) provide empirical evidence for this by finding that separating subgroups decrease interaction across groups and increase interaction within groups. Consequently, united teams increase intra-team learning of technical knowledge, but decrease the intensity of knowledge transfer within firms. Considering the different, partly controversial effects, inter-firm learning of technical knowledge will be higher, if R&D alliances employ united teams. The higher interrelation including feed-back, serendipitous findings, and adaptation along with higher transparency and receptivity will amplify learning.

H1: The learning of technical knowledge is increased with greater use of united teams.

2.4 United Teams' Impact on Learning of Alliance Management

With respect to learning of alliance management, individuals in united teams that are exposed to a maximum of interaction sequences develop mutual partner-specific knowledge. A broad range of interactions accumulate various insights about knowledge and behavior, which allow experimentation of interaction and newly founded routines. Daft (1984) suggested that rich media and direct personal interaction permits the establishment of trust and generation of mutual understanding, both relevant for inter-firm learning. With respect to alliances, Kale et al. (2000) assume relational capital to be associated with mutual trust, which acts as a component of alliance capability. Relational capital emerges from ongoing interaction between individuals. As such, in united teams the interactive processes increase relational capital that brings forth the learning of alliance management.

H2: The learning of alliance management increases through the greater implementation of united teams.

2.5 The Impact of Project Modularity on Learning of Technical Knowledge

Firms to improve innovation can form sub-teams to which the innovation target is disaggregated into in sub-modules and process-stages (Henderson and Clark, 1990). Then, sub-teams are in charge with the development of specific modules that can address tangible or intangible output along the NPD process. The principle of modularization is to allow specialist teams developing their modules more or less independently from each other (Hoegl, 2004). We here use the term of modular inter-firm team to indicate participation of partners in collaborative R&D projects where the majority of work is done separately, mostly in a sequential style, and in distinct modules. Modules allow utilizing diverse backgrounds and specialization in inter-firm settings, where individuals and sub-teams have diverse backgrounds of different languages, vocabularies, and professional socialization experiences along with intra-firm values and norms. Specialized modules also reduce difficulty in interpersonal understanding (Lovelace et al., 2001). Therefore, collaborating firms can achieve positive effects on learning through modularization.

With respect to technical learning, Ancona and Caldwell (1992) found that the exposure to diverse knowledge of individuals outside teams encourages more creative solutions. Demsetz (1991) argues that the exploitation of knowledge requires the integration of diverse sources of specialized knowledge. As a result, modularization can be advantageous for connecting exploration and exploitation. Similarly, Sanchez and Mahoney (1996) propose that modular couplings of components and sub-systems, increase adaptability and evolutionary development. We conclude that modularization can increase the learning of technical knowledge in alliances. In alliances, firms face the risk of opportunistic behavior in which knowledge is exploited unilaterally, reducing their willingness to share knowledge (Kale et al., 2000). Modularity amplifies causal ambiguities of knowledge exchanged in a way that decreases the risk of knowledge-spill-over. Therefore, modularization advances a targeted merging of technical knowledge. On the one hand, learning increases through the inter-firm level as the merger of technical components achieves a surplus of the product. As such, technical learning enabled by modularization can be considered as joint or common learning. On the other hand, modularity as it gives only a partial picture of the whole process reduces an in-depth learning on a single firm level. However, there are certain drawbacks of project modularity. Learning can decrease due to deficits in intrinsic motivation: When individuals in modular projects feel incapable of fulfilling the complex task, they perceive a lack of understanding of the overall target or do not see the impact of their task. Then, the team will be less intrinsically motivated to learn technical knowledge (Kirkman and Rosen, 1997). Arguing that team-mates will be contented with less complex tasks and will concentrate of their task, which has sufficient meaning and challenge for them, we hypothesize an overall positive effect of modularization on learning.

H3: The learning of technical knowledge in alliances increases with greater implementation of project modularization.

Firms can implement project modularization in united and non-united teams. Modularization improves the inter-firm coordination of specialized knowledge but is associated with formalizations according to the task, the process, and the definition of standardized interfaces in order to combine modular work. As such modularization builds on coordination through standardized programming that to a large degree can substitute mutual adaptation across individuals. In united teams, coordination allows personal interaction, feedback, and mutual adaptation. These can act as a substitute for standardization such as modularization in united teams. Thus, modularization is not necessarily required in united teams to enable learning of technical knowledge. So, we hypothesize an interaction effect as follows:
H4: The learning of technical knowledge is reduced by the greater joint implementation of united teams and project modularization.

2.6 The impact of Project Modularity on Learning of Alliance Management

To be efficient, devices, directives, and rules must be standardized in organizations (Thompson, 1967). Especially modularity has a need of differentiation that calls for integration (Lawrence and Lorch, 1967). Huber (1999) stresses the need for institutionalized practices that facilitate the transfer of team knowledge to the firms. Transferring this concept to the issue of project modularization, teams require standardizations that relate to a general alliance capability. Recurrent collaboration improves the general alliance capability. The learning of general alliance capability includes tools, metrics, databases, dedicated personnel along with intra- and inter-organizational routines that facilitate coordination. Firms that implement project modularity are also using standardization. As such they have experiences with standardization. We argue that firms that already have experiences with standardization will tend to implement these modular structures also in alliances. Through the implementation of project modularity allying partners will also achieve further learning on alliance management. The learning will even be most, when both firms implement project modularity because firms will achieve mutual learning on project modularity and learning.
H5: The learning of alliance management increases with greater implementation of project modularization.

Nevertheless, we are well aware that alliance management capability will have positive effects on further project modularization. To coordinate modules across sub-units of partners, a minimum of alliance capability is required, which is only learned if teams interact. Then, learning will be high if modularization is associated with united teams although they do not necessarily require modularization. As such, we expect in interaction effect between modularity and team unity on learning.
H6: The learning of alliance management increases with greater joint implementation of Modularization and Team Unity.

3. EMPIRICAL STUDY

3.1 Data and Measures

To explore team coordination for learning in R&D alliances, this study researched the biotechnology industry. We used secondary data sources, such as the Hoppenstedt digest on industries as well as internet sources, to identify top-executives to whom we administered the questionnaire. Informants were asked to provide information on their non-equity collaborations. We limited our study to German biotechnology firms to achieve comparable results in one national legal system as R&D in this industry sector is strongly restricted by legal rules. The survey questionnaire was mailed to 334 companies. We received 114 responses at an above average response rate of 34%. Given that the German biotechnology industry only consists of about 350 firms (Ernst&Young, 2004) we were able to achieve a high coverage (32.57%) of firms in the industry. Furthermore, we checked the number of employees and age of the firms and revealed no significant differences between responding and non- responding firms.

The study applied reflexive factor models both out of methodological as well as content considerations (Streiner, 2003). For exogenous variables this study analyzes team unity and project modularity. We measured each with three indicators dealing with the proposed core aspects of these constructs: For describing the phenomenon of team unity, its processes are measured by the extent of feedback loops; its structure by the existence of a joint team for the entire project and its management by the extent of joint project management executed collaboratively by all partners. To capture the construct of project modularity, team processes are investigated with respect to sequential stages, team structure by the modularity of partner's contributions, and team management by the distribution of project stages to partners. Table 1 summarizes the empirical findings for the investigated coordination measures. The high differences of mean values and their corresponding low standard errors indicate significantly different extents of instrument usage. Overall, measures of team proximity are applied to a larger extent than project modularization. The usage of feedback loops clearly stands out as the most central structuring mechanism. In contrast, a sequentializaton of project stages is on average only applied half-way, as indicated by the in-between mean value of this item. Both findings reveal a stronger focus on measures of team unity as compared to measures of project modularization as tool for organizing joint teams.

TABLE 1: COORDINATION MECHANISM UTILIZED BY INTER-FIRM R&D-TEAMS

				Factors	
	N	Mean	Standard error	Unity	Modularity
Feedback loops in between of project stages	104	4.05	0.09	0.787	
Joint project team for the entire project	104	3.48	0.11	0.761	
Project supervision in union by all partners	109	3.03	0.11	0.590	
Sequential project process	107	2.77	0.11		0.771
Modularity of partner's contributions	110	3.54	0.10		0.678
Distribution of project stages to partners (divided/extern)	110	3.51	0.10		0.669
Initial Eigenvalues				1.692	1.410
Cumulated % of total Variance				28.2	51.7

Legend: Assessment of actual team structures on 5-Point Scale with end points: 1 = not at all; 5 = very high

The factor analysis results in two factors of similar size, which reflect the conceptual framework. Each of the indicators loads on a single factor with values of around or more than 0.6, their final communalities surpasses 0.5 in most cases. In contrast, the relatively low explained total variance from both factors indicates a large heterogeneity of instrument usage combinations across firms. This met our expectations as each instrument can in fact be applied independently of the others. In this regard, the aggregation derived from the factorization builds a conservative basis for the following effect analyses, as it accentuates schemes of team coordination shared in current practice. Looking at the first factor of team unity (see first three indicators in table 1), it is interesting to note that joint project management has the smallest factor loading. In addition, the corresponding mean values show that firm apply a joint project supervision less often than a joint project implementation. This indicates some inherent need for centralization of key decisions at one of the project partners and thus implies inherent limitations of achieving equal rights in project supervision. Among all other aspects of project modularity, the item of a sequential stage structure stands out. This item is on the one hand best characterized by the factor (i.e. it has the highest factor loading on modularity), on the other hand less often applied. This is not surprising, as sequentially resembles an especially far reaching coordination mechanism of modularization, because it avoids timely overlaps of modules and thus reduces the need for interfaces to a large extent.

We measured learning as the dependent construct by items on two investigated dimensions: learning of technical knowledge as well as learning of alliance management. Each dimension was operationalized by three indicators, which were designed to encompass a broad scope of learning facets. As for technical learning, a first indicator investigates the one-sided learning of the interviewed partner, a second indicator the perceived two-sided knowledge transfer. Third, the realization of planned innovations was included to assess the immediate, specific outcomes of the learning. Analogously, we measured learning of alliance management threefold as the extent of building up both one-sided and two-sided alliance capabilities in general as well as specific knowledge about current partners. Table 2 summarizes the learning effects realized by the observed joint R&D-teams. We find evidence that effects of technical learning outperform learning of alliance management. While this is not as much of a surprise – given the immediate project goals - it nevertheless indicates a more short-term oriented view towards the execution of joint teams. This is as well indicated by the fact that the specific learning of the other partner outweighs the generic learning of alliance management. Thus, we conclude that R&D practitioners do not put as much emphasis on achieving organizational learning as they do on technical learning. In particular, limited weight is given to the developing of generic alliance capability.

TABLE 2: LEARNING FACETS EXPERIENCED BY R&D-TEAMS IN ALLIANCES

				Factors	
Items	N	Mean	Standard error	Alliance Mgt	Technology
One-sided learning of collaboration team management	112	2.80	0.09	0.862	
Learning how to collaborate with a specific collaboration partner	112	3.13	0.09	0.787	
Two-sided learning of generic collaboration team management	112	2.84	0.08	0.757	
Two-sided learning of generic technical knowledge	112	3.60	0.08		0.837
One-sided learning of generic technical knowledge	112	3.65	0.07		0.743
Realizing the benefits from planned innovations	111	3.80	0.09		0.595
Initial Eigen values				2.149	1.448
Cumulated % of total Variance				35.82	59.95

Legend: Assessment of actual team structures on 5-Point Scale with end points: 1 = not at all; 5 = very high

The factor analysis of the six learning items clearly separates technical from alliance learning. Both factors contribute about equally to the overall explained variance, indicating a coherence of similar size. All indicators load on their proposed factor, their communalities generally surpass the value of 0.5. This confirms the proposed differentiation of the learning construct into the two dimensions. Comparing the factor loadings of the two factors, some striking patterns emerge: in both cases, the immediate learning effects load lowest of all indicators. This suggests larger impact of long-term, capability-oriented learning. While the one-sided learning loads highest on the factor of alliance management learning, the two-sided technical learning loads highest on the factor of technical learning. This suggests a higher need for unity in respect to achieving technical successes as compared to the development of alliance capabilities.

3.2 Method

Observations were grouped provide a robust assessment of realized combinations of the two coordination mechanisms. The groups were created by median-splits of the data on each of both factors, leading to four distinct groups. First we observe that each of the four groups occurs about evenly (table 3). This shows that all combinations of team unity and project modularization are equally likely to occur in actual practice. Team unity and project modularization are thus two distinct coordination mechanisms, which can be applied independently from each other. To investigate the contingencies of the different team coordination types occurring, we investigated the context of the united teams. We expect different forms of coordination in purely research driven and marketing-oriented R&D collaborations due to different tasks and worlds of thought in R&D and marketing. Accordingly, table 3 documents the importance of partners' R&D and marketing contributions as well as provision of access to other partners. This indicates that both united as well as modular teams are more content-driven, whereas provision of access is most important in non-united, non-modularized teams. Furthermore, team unity as a coordination mechanism seems to be slightly more related to the assessment of partners' R&D contribution while project modularity seems to be more related to partners' marketing contributions.

TABLE 3: MODULARIZATION OF R&D-PROJECTS IN ALLIANCES

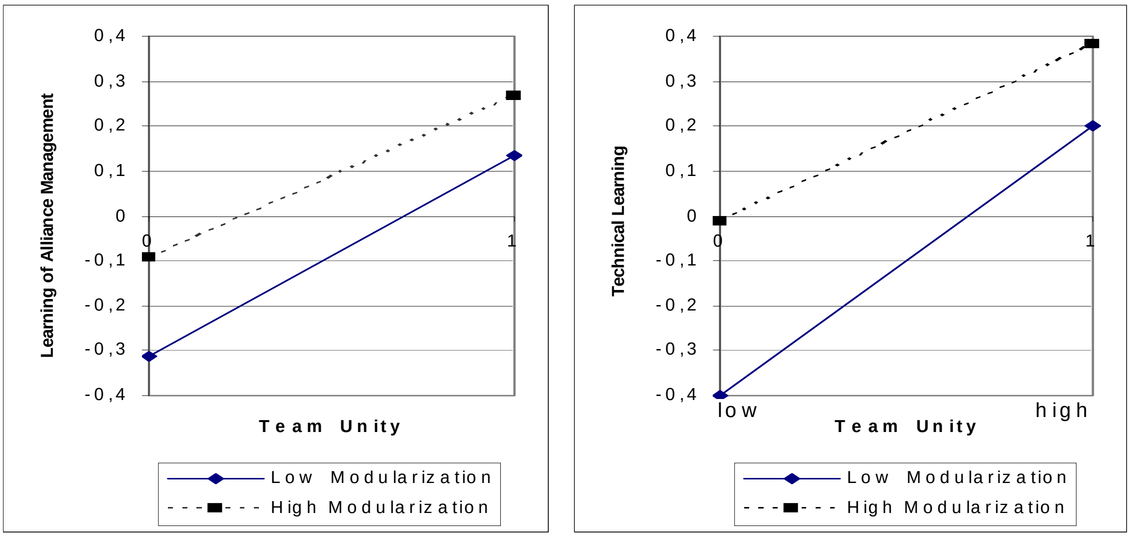
		Non-united Team	United Team
Non-modular	n	30	27
	Importance of Partners R&D Know-How	3.185 (1.039)	3.826 (0.778)
	Importance of Partner's Marketing Know-how	2.037 (1.160)	2.478 (1.563)
	Importance of Contacts to other Companies/Institutions	2.593 (0.888)	2.348 (1.027)
Modular	n	28	28
	Importance of Partner's R&D Know-How	3.556 (0.974)	4.083 (1.100)
	Importance of Partner's Marketing Know-how	2.630 (1.523)	3.083 (1.558)
	Importance of Contacts to other Companies/Institutions	2.556 (1.219)	2.167 (1.049)

4. RESULTS

The categorization into four groups was applied to provide basic insights about both the main effects as well as their interaction effect on the two learning dimensions. For this purpose, the even cell sizes provide a solid basis for in-between group comparisons. However, one has to regard the altogether low absolute numbers of observations per cell, which restrict expected statistical significances to large effects. Figure 1 visualizes the findings of the in-between-group comparisons. From that becomes detectable that the introduction of each coordination mechanism - united team or project modularization – leads to improved learning outcomes. Introducing a united team exerts a visibly larger effect than introducing project modularity on the learning of alliance management. In addition, the parallel effect loops show that benefits are to be derived independent from each other. This implies that both united teams as well as project modularization should be pursued simultaneously to achieve a maximum of alliance management learning. A different picture emerges in describing the effects on technical learning: Here, an especially stronger influence through united teams than modular projects becomes evident. The different slopes of the effect curves (see figure 1) for non-modular as compared to modular projects indicate that both coordination mechanism stay in interaction to each other: a modularization of project structure has a high impact on technical learning, if the project team is not united. However, given that there is already a united project team installed, the additional benefits of modularization exert only a diminishing increase of technical learning. For reaching technical learning objectives, firms should not implement united teams if modularization is already applied. If no modularization has been used, firms should implement united teams since they have a stronger impact on technical learning. Sill, modularity is advisable if geographic distance or partner-specific attributes hinder the use of united teams.

Even though the differences in slopes – as visualized in figure 1 - strongly indicate the discussed effects, it has to be noted that attained significance levels only allow indicative conclusions due to the low number of observations per cell. While the influence of the four coordination typologies on technical learning is highly significant in an ANOVA comparison ($p=0.009$), their influence on alliance management learning is all in all insignificant ($p=0.128$). Accordingly, inter-group comparisons are not significant in all cases: Simple group comparisons by means of LSD-Test indicate for technical (alliance management) learning that only two (one) group comparisons are highly significant and two (one) further comparisons weakly significant. These deficits in statistical traceability of the graphically shown effects are less due to a small intensity of shown effects but are more a consequence of the high remaining standard errors, which result from the low number of observations per group.

FIGURE 1: SLOPES OF HIGH AND LOW MODULARIZATION WITH RESPECT TO TEAM UNITY



5. CONCLUSIONS

Overall our findings provide some important insights into the coordination of NPD team on inter-firm learning. Although most extant literature emphasizes motives and history dependent factors such prior experiences with alliances, our results argue for greater attention how firms manage the post formation of an R&D alliance, especially with regard to antecedents of inter-firm learning. At first our study shows that the two categories of learning with regard to technical knowledge and alliance management in R&D alliances relate to two different dimensions of inter-firm team coordination: team unity and project modularity. Therefore we extend prior studies on team coordination and on project management (Cooper, 1983; Coombs et al., 2001). Results of this study indicate that united teams and modular projects both support learning of alliance management. The findings on team unity are consistent with the literature on tacit knowledge conversion (Nonaka, 1994) and social interaction in learning (Borgatti and Cross, 2003). The results on modularization relate to the literature on modularization (Post, 1997) and disaggregating of project stages in NPD (O'Connor, 1994).

We can recommend firms to implement even both coordination vehicles together. Our results on learning of technical knowledge deliver a different picture. First we uncovered a stronger effect of united teams on technical knowledge. Second and different to learning of alliance management we retrieved unity and modularization two alternatives of a spectrum. Modularization is a successful means to achieve technical knowledge only in non-united teams. In united teams however, modularity has no effect on learning of technical knowledge. This is convincing because implementing united teams does not require defining interfaces between different modules in advance. It can even be assumed that modularization can be counterproductive as far as implementation of highly innovative solution approaches is concerned. In this respect, united teams and modular project structure can be regarded as alternative design elements for enabling technical learning. This is contrary to alliance learning for which a simultaneous implementation of united teams as well as project modularization is recommended.

From our result we can deduce more advice for management of inter-firm NPD teams. For projects that are designed neither in modules nor in unity, a modularization assists for achieving technical knowledge, if firms cannot employ a united team. Such an implementation of united teams is less advisable under the consideration of high transaction costs, high geographic distances, a need to research in local laboratories, risks of unintended knowledge spill-over, or the mismatch of corporate strategies. Moreover, the employment of a successfully working united team can require long-term recruiting and coaching of teams to ensure high teamwork quality and cause transaction cost. Herein we assume that modularization, in particular if restricted to NPD processes, is more easily achieved than setting up united teams. For technical learning, united teams do not require modularization, which otherwise will produce unnecessary transaction cost. The constant feed-back in united teams substitutes for formal and standardized interfaces. Beyond that, we assume that in projects targeting radical innovation, a supplemental modularization act contra-productive as standardization is understood to reduce creativity (Barrett, 1998). Most interesting, our results highlight team unity and project modularity as alternative instruments for achieving technical knowledge. This is contrary to the learning of alliance management, which improves through the simultaneous implementation of united teams and modular projects.

This study is one of the few that tries to examine post-formation R&D alliance management aspects by primary data and there was little empirical precedent to develop most of the measures that we used. Methodologically, this study's single informant approach may have contributed to only a partial view of inter-firm learning. In particular, it would be beneficial to get an assessment from all partners since learning relates to aspects concerning all of them. In this respect, further studies will benefit from the use of multiple informants across different hierarchical and functional levels in the alliance, in particular project workers. We also believe that there is potential to improve and refine some of the measures that have been used.

REFERENCES:

Anand, B. and Khanna, T., "Do firms learn to create value? The case of alliances", *Strategic Management Journal*, Vol. 21, No. 3, 2000, 295-315.

Ancona, D.G. and Caldwell, D.F., "Bridging the Boundary: External Processes and Performance in Organizational Teams", *Administrative Science Quarterly*, Vol. 37, No. 4, 1992, 634-665.

Barrett, F.J., "Creativity and improvisation in jazz and organizations: Implications for organizational learning", *Organization Science*, Vol. 9, 1998, 605-622.

Borgatti, S., P. and Cross, R., "A Relational View of Information Seeking and Learning in Social Networks" *Management Science*, Vol. 49, No. 4, 2003, 432-445.

Coombs, R.; Harvey, M. and Thether, B., "Analysing Distributed Innovation Processes", Rep. Nr. 43. University of Manchester & UMIST, Manchester, 2001

Cooper, R.G., "The new product process. An empirically based classification scheme", *R&D Management*, Vol. 12, 1983, 243-256.

Daft, R.L., "Toward a Model of Organizations as Interpretation Systems", *Academy of Management Review*, Vol. 9, No. 2, 1984, 284-295.

Demsetz, H., "The Theory of the Firm Revised", Williamson, O.E. and Winter, S.G. (Eds.) The Nature of the Firm. Origins, Evolution, and Development, p. 159-178, New York, Oxford, 1991.

Doz, Y.L. and Hamel, G., Alliance Advantage. The Art of Creating Value through Partnering, Boston, Mass, 1998.

Dyer, J., "Effective interfirm collaboration: how firms minimize transaction cost and maximize transaction value", *Strategic Management Journal*, Vol. 18, No. 7, 1997, 535-556.

Ernst&Young, Fifth German Biotech Report. Ernst&Young, Berlin, 2004.

Galbraith, C.S. and Merrill, G.B., "The Effect of Compensation Program and Structure on Sbu Competitive Strategy - a Study of Technology-Intensive Firms", *Strategic Management Journal*, Vol. 12, No. 5, 1991, 353-370.

Garud, R., "Using the brain as a metaphor to model flexible production systems", *Academy of Management Review*, Vol. 19, 1994, 671-698.

Griffin, A. and Hauser, J.R., "Integrating R&D and Marketing: A Review and Analysis of the Literature", *Journal of Product Innovation Management*, Vol. 13, 1996, 191-215.

Gulati, R., "Network location and learning: the influence of network resources and firm capabilities on alliance formation", *Strategic Management Journal*, Vol. 20, 1999, 397-420.

Hargadon, A. and Sutton, R.I., "Technology Brokering and Innovation in a Product Developments Firm", *Administrative Science Quarterly*, Vol. 42, No. 4, 1997, 716-749.

Henderson, R. and Clark, K., "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Existing Firms", *Administrative Science Quarterly*, Vol. 35, March, 1990, 9-30.

Hoegl, M. and Proserpio, L., "Team member proximity and teamwork in innovative projects", *Research Policy*, Vol. 33, 2004, 1153-1165.
Huber, G., "Facilitating Project Team Learning and Contributions to Organizational Knowledge" doi:10.1111/1467-8691.00122, *Creativity and Innovation Management*, Vol. 8, No. 2, 1999, p. 70-76.
Kale, P.; Dyer, J.H. and Singh, H., "Alliance capability, stock market response, and long-term alliance success: The role of the alliance function", *Strategic Management Journal*, Vol. 23, No. 8, 2002, 747-767.
Kale, P.; Singh, H. and Perlmutter, H., "Learning and protection of proprietary assets in strategic alliances: building relational capital", *Strategic Management Journal*, Vol. 21, No. 3, 2000, 217-237.
Kirkman, B.L. and Rosen, B., "A model of work team empowerment", Woodmang, R.W. and Pasmore, W.A. (Eds.) Research in organizational change and development, Vol. 10, 1997, 131-161, Greenwich, CT.
Lane, C., "Introduction: Theories and issues in the study of trust", Lane, C. and Bachmann, R. (Eds.) Trust Within and Between Organizations, Vol., 1998, 1-30, New York.
Lawrence, J.H., "Internationalization of higher education in the United States of America and Europe: A historical, comparative, and conceptual analysis", *Review of Higher Education*, Vol. 27, No. 2, 2004, 281-282.
Lawrence, P. and Lorch, J., Organizations and Environment, Boston, 1967.
Lovelace, K.; Shapiro, D.L. and Weingart, L.R., "Maximizing Cross-Functional New Product Teams' Innovativeness and Constraint Adherence: A conflict communications perspective", *Academy of Management Journal*, Vol. 44, No. 4, 2001, 779-793.
Nonaka, I., "A Dynamic Theory of Organizational Knowledge Creation", *Organization Science*, Vol. 5, No. 1, 1994, 14-37.
O'Connor, P., "From experience: Implementing a stage-gate proces. A multi-company perspective" *Journal of Product Innovation Management*, Vol. 10, 1994, 183-200.
Post, H.A., "Modularity in Product Design, Development and Organization: A Case Study of Baan Company" Sanchez, R. and Heene, A. (Eds.) Strategic Learning and Knowledge Management, 1997, 189-208.
Rosenkopf, L. and Almeida, P. "Overcoming Local Search Through Alliances and Mobility", *Management Science*, Vol. 46, No. 6, 2003, 751-766.
Sanchez, A.M. and Mahoney, J.T., "Modularity, Flexibility, and Knowledge Management in Product and Organization Design", *Strategic Management Journal*, Vol. 17, Winter Special Issue, 1996, 63-76.
Schumpeter, J., The theory of economic development, Cambridge, 1934.
Smith Ring, P. and Van de Ven, A.H., "Developmental Processes of Cooperative Interorganizational Relationships", *Academy of Management Review*, Vol. 19, No. 1, 1994, 90-118.
Streiner, D.L., "Being Inconsistent About Consistency: When Coefficient Alpha Does and Doesn't Matter", *Journal of Personality Assessment*, Vol. 80, No. 3, 2003, 217-222.
Subramaniam, M. and Venkataraman, N., "Determinants of transnational new product development capability: Testing the influence of transferring and deploying tacit overseas knowledge", *Strategic Management Journal*, Vol. 22, No. 4, 2001, 359-378.
Subramaniam, M. and Youndt, M.A., "The influence of intellectual capital on the type of innovative capabilities", *Academy of Management Journal*, Vol. 48, No. 3, 2005, 450-463.
Thompson, J.D., Organizations in Action, New York, 1967.
Van de Ven, A.H., "Central Problems in the Management of Innovation", *Management Science*, Vol. 32, No. 5, 1986, 590-607.

AUTHOR PROFILES:

Prof. Dr. Ricarda Bouncken is professor for Organization, HR, and Innovation at the University of Greifswald, Germany. She has published more than 90 articles and books. The accomplished her Habilitation at the University of Lueneburg, Germany in 2002. She received her Ph. D. from the University of St. Gall, Switzerland in 1997.

Prof. Dr. Thorsten Teichert holds the chair for Marketing and Innovation at the University of Hamburg. Research topics and consulting projects include issues of new product development, global innovation management as well as issues of consumer behavior. Previous to his current position, Prof. Teichert was the director of the Institute for Innovation Management at the University of Berne, CH.