Teaming up to Innovate: The Importance of a Joint Knowledge Base

Companies are increasingly discovering the potential of collaborating with others to create innovative products – often across industries – by combining their specializations in a unique way. A pre-condition for the success of these ventures is to build a common knowledge base, usually by duplicating selected parts of the partner's knowledge. In this article, a case study and a quantitative study seek to elaborate on the unanswered question: Which building blocks constitute a common knowledge base?

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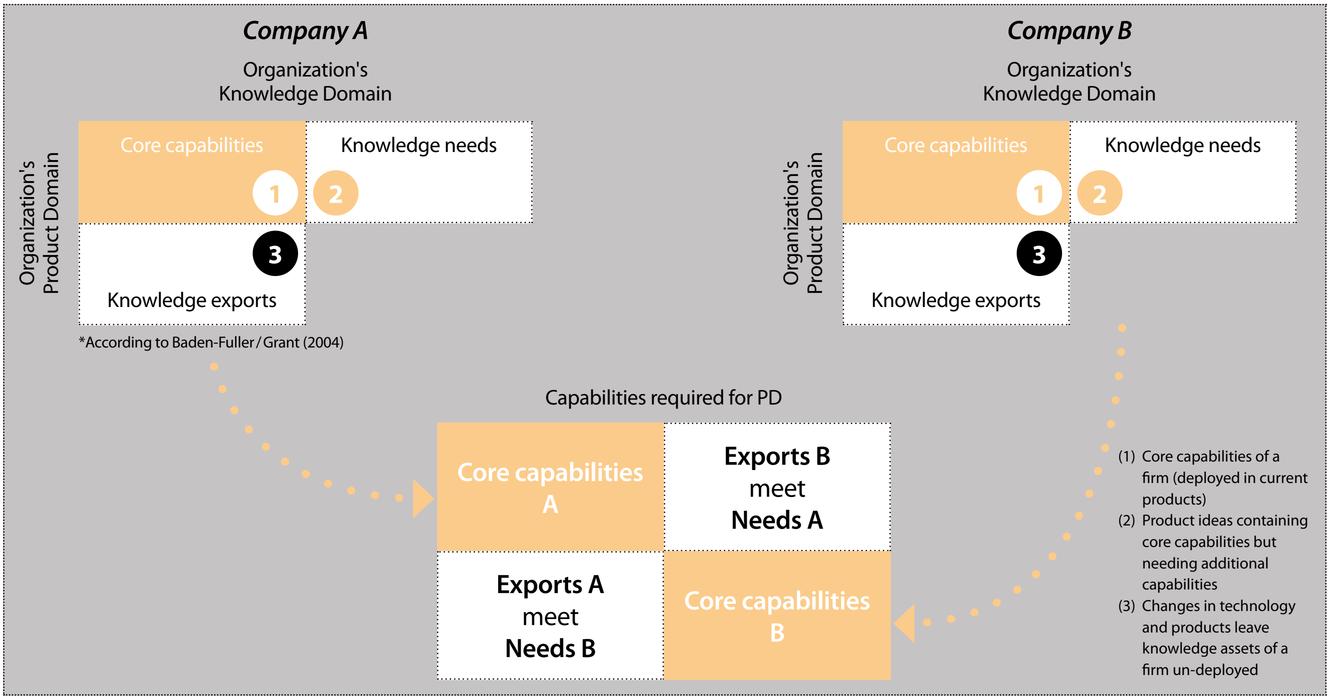
Since the 1980s, we have seen a significant increase in organizations that have entered cooperations or alliances in order to achieve competitive advantage and create value (Hagedoorn 1993). Cooperating in the new product development (NPD) sector is the dominant strategy of many companies (Miotti/Sachwald 2003). Numerous firms strive to increase their efficiency and effectiveness in developing new products by, for example, shortening time-to-market, sharing development-related costs and risks, gaining access to critical knowledge assets, and/or overcoming market entry barriers. Furthermore, by allying with firms that have a very different background (e.g., in technology, culture, markets), companies seek to enhance the generation of novel products, thus strengthening their ability to be innovative and to increase their competitiveness (see figure 1) (Oppat 2008). An example of such an alliance is the cell phone Serenata, jointly developed by Samsung and Bang & Olufsen. Whereas the former offered cell phone technology, the latter provided an exclusive product design.

Product ideas often arise from dissimilar partners' interaction with high levels of cognitive diversity (Hargadon/Sutton 1997; Gassmann 2006; Taylor/Greve 2006). Hence, for the purpose of creating innovative products, cooperating organizations should be as heterogeneous as possible, especially concerning their cognitive bases (Kotabe/Swan 1995; Taylor/Greve 2006). An example of this is the joint development of a high quality webcam by Logitech (consumer electronics) and Carl Zeiss (optics). While partners with similar knowledge bases, organizational structures, and other aspects find inter-organizational activities easier (Lane/Lubatkin 1998), diversity in background entails a challenge with respect to joint activities such as project cooperation in NPD. Such diversity may lead

Fig. 1 Combination of two companies' knowledge portfolios



Source: Oppat 2008 based on Grant/Baden-Fuller 2004

to inefficiencies during discussions and decision-making processes, misunderstandings, or disagreement over strongly held preferences and beliefs that may be almost impossible to reconcile (Hännien/Kauranen 2006). Thus, in order to utilize existing knowledge assets in order to unleash the potentials of the cooperation partners' dissimilarity, organizations have to bridge islands of background, cognition and knowledge. They therefore need to create a limited but purposeful overlap of each other's knowledge base (Brusoni/Princ-ipe 2001). A selection of development cooperations is presented in table 1.

However, despite repeated calls for such an overlap (Cohen/Levinthal 1990; Cummings/Teng 2003; Grant/Baden-Fuller 2004), the literature lacks a closer discussion or description of this overlap. Consequently, a number of questions remain unanswered for scholars and practitioners alike. Some of these questions are: What would the extent of such a required knowledge overlap be? How can firms identify an already existing overlap? How can firms efficiently create the required overlap? How can firms protect their core competencies in such a venture?

Before answering these questions, it is essential to answer another question: What are the building blocks that constitute such an overlap? The literature does not provide satisfactory answers. Relevant references are scarce and vague (Avenel et al. 2007; Cowan et al. 2007; Nonaka 2007). Consequently, we address this gap. Our paper builds on existing literature but also on empiricism, as we have conducted interviews and collected quantitative data.

Case study: Building Blocks of Joint Knowledge Bases

To illustrate our findings, we present a case study. As the firms wish to remain anonymous, the case has been made anonymous.

The co-operating partners are a car manufacturer (Auto Corp.) and a firm specialized in developing sensors (Sensorino Inc.). Joint-

Table 1 Selected development co-operations and date of press release

19.09.2003:	Illuminating membrane for suitcases Lumitec (electroluminescence) and Bayer MaterialScience (materials)
05.12.2005:	Videophone, high quality and web-based Logitech (computer control devices) and Skype (VoIP Service)
28.06.2007:	Webcam, high quality Carl Zeiss (optics) and Logitech (computer control devices)
10.12.2007:	Stylish music cell phone Serenata Samsung (mobile phones) and Bang & Olufsen (Hi-Fi systems, design)
06.05.2008:	Factories and production process of second-generation biofuels Süd Chemie (catalysts) and Linde (gases and engineering)
16.05.2008:	High efficiency cooling systems in passenger cars Modine (cooling and air-con in cars) and BorgWarner (turbo and emission systems)
24.09.2008:	Image processing system for high tech cameras Leica (cameras) and Fujitsu (microelectronics)
20.10.2008:	Process management tool Method Park (software) and Actano (project and process management tools)

ly, they developed an innovative intelligent cruise control system (ICC). If needed, the system can bring a car to a full stop from a speed of 30–180 km/h within a range of 10–150 m. The ICC contains a long distance sensor which recognizes moving and fixed objects. Based on the captured information, the car will react accordingly. Whereas Sensorino is responsible for the ICC capturing all potential collision objects' data, Auto Corp. is responsible for enabling the ICC to process this data into steering commands for the engine and brakes.

The backgrounds of Auto Corp. and Sensorino differ significantly. While the former is all too familiar with cars in general and steering issues in particular, it has no expertise on long distance sensors. The opposite is true of the latter firm. Overall, these partners' knowledge duplication need (common knowledge base) pertains to different areas:

Product: Sensorino needed to know which functions would react to the captured data. The engineers would only then know how and in which direction to optimize signal quality. To recognize fixed objects, for example, it was important to capture the object's size and shape, as this determines whether a reaction is required (traffic jam) or not (empty plastic bottle on the street). With respect to moving objects, the theoretical contact point had to be calculated. Based on this, the system needed to be designed for reaction to prevent a potential collision. Moreover, speedometer and steering angle data were essential to arrive at a correct calculation. Auto Corp. also needed to tell Sensorino how these data are measured and in which form they are available.

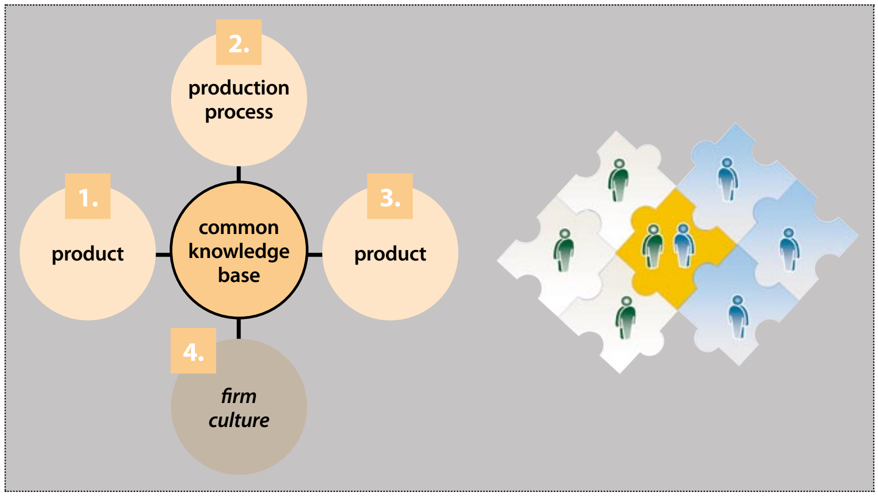
To achieve a sound interplay of the introduced expertise, both firms needed to duplicate the knowledge of those parts of the product they would bring into the partnership. In this case, it was, for example, important that not only Auto Corp. understood sensors, but also that Sensorino had knowledge of the vehicle as a system.

Production processes: At the beginning of the project, the firms did not duplicate their knowledge of the production processes. Sensorino pre-fabricated according to DIN norms while Auto Corp. assembled the ICC in the chassis, steering system, and breaks. The product did not, however, function properly, as it provided inaccurate signals. In the process of searching for the root cause, the partners took a closer look at Auto Corp.'s assembly process. At that point Sensorino discovered that the adjacent radio was interfering with the signals. Once Sensorino had detailed knowledge of the production process, it designed the ICC's casing differently (material and arrangement of components). In addition, the wires from the radio were rerouted.

Overall, it was therefore not enough to know about the dimensions and interconnections of the device within the vehicle, but it was also essential to have knowledge of the assembly process. Hence, a precondition for successful co-development is the duplication of knowledge by, for example, working interactively, bringing prototypes to production plants to test run production tasks.

Organizational structure: At the beginning of the project, both firms learned about each other's organizational structure (e.g., responsibilities, experts, decision makers). Based on this, decision-making authority, roles and duties were assigned. These were increasingly detailed and optimized during the project. Consequently, employees were able to address the right people within the partner firm, or link the experts from both sides with respect to specific tasks.

Fig. 2 Components of a joint knowledge base



"For the purpose of creating innovative products, cooperating organizations should be as heterogeneous as possible, especially concerning their cognitive bases."

As firms have different organizational structures (e.g., large vs. small), it is important to generate an understanding of the partner's structure, routines, decision, working procedures, etc. to ensure an efficient collaboration.

Firm culture: A comparison of Auto Corp. and Sensorino's firm cultures revealed that the former was very structured, while the second was rather flexible. Sensorino adopted its partner's more structured way of working. On several occasions, this hindered the firm (thus the project) from making direct product adjustments, which caused rework and a slightly suboptimal design. In this regard, project representatives described the collaboration as tedious.

Firm cultures differ in various ways. Creating mutual knowledge of the partner's culture has a significant relation to the innovation outcome. Rather unexpectedly at first sight, the relation is a negative one. Duplicating this knowledge also means learning about the partner's internal politics and hierarchical issues. In some cases – especially where collaborations are close and long termed – project teams develop their own

Table 2 Regression analysis

	Dependent variables			
	Attainment of product attributes		Attainment of targeted product costs	
	Model 1	Model 2	Model 1	Model 2
Controls				
Project duration (months)	- 0.10	- 0.26	- 0.14	- 0.36*
Number of core team members (total both partners)	- 0.78	- 0.28*	- 0.19	- 0.41**
Project type I (process development)	- 0.45	- 0.45	- 0.63*	- 1.15***
Project type II (software development)	- 0.41	-0 .47*	- 0.18	- 0.33
Project type III (product development)	0.01	0.15	- 0.30	- 0.53
Product based on completely new technological principle	0.21	0.30*	0.33	0.37
Product provides completely new customer value	0.17	0.50**	- 0.07	0.19
Independent variables				
Knowledge on product / process to be developed		0.46**		0.65**
Knowledge on production processes		0.44*		0.68***
Knowledge on organizational structure		0.78**		0.43
Knowledge on firm culture		- 1.68***		- 0.96**
R-square	0.35	0.73	0.28	0.65
Adjusted R-square	0.12	0.54	0.01	0.39
F-Value	1.52	3.88***	1.05	2.54**

*p<.1, **p<.05, ***p<.01

subculture. However, owing to the culture differentiation between the partners, difficulties might arise regarding coordinative work, which would again hamper product development severely. In addition, corporate cultures are always tied to values and emotions. If the partner's political issues were to be discussed, this would distract the team from the development work, which is counterproductive. Figure 2 illustrates the commented situation of this case.

Empirical Data & Results

We examined more than 50 inter-organizational innovation projects and their knowledge bases. The objective of all these projects was to develop innovative and complex technical products.

The **dependent variables** were product/process quality (e.g., did the product/process attain all functionalities? Was it durable/stable? Factor of 4 Items, Cronb. Alpha = .89) and attainment of the targeted costs of the product/process (in this project, product/process costs were higher/lower than the costs targeted by x %).

The **independent variables** in our study were 4 building blocks of a joint knowledge base pertaining to knowledge of (1) the product/process to be developed, (2) the production process (e.g., assembly), (3) organizational structure (e.g., who is responsible, decides?), (4) firm culture (e.g., hierarchy, value system). We specifically questioned one partner on the number of knowledge types received from the partner (duplicated).

By ascertaining the project duration and the number of core team members (with respect to both partners), we controlled for project size. Taking the firms' industry into account was not feasible as the partners of one cooperation would often stem from different industries. Instead, we controlled for project type, differentiating between a process innovation, a software development, and/or the development of a new physical product. In addition, we controlled the joint product's degree of innovativeness by considering the novelty of the products' technological principle as well as the novelty of the customer value.

In order to avoid single source bias, we had respondents from Partner A answering questions about the dependent variables as well as about several controls. Respondents from Partner B answered with respect to the independent variables. A total of 28 questionnaires with complete data were returned.

The **results** of the conducted regression analysis, shown in table 2, demonstrate that the influence that a knowledge base's different blocks have on the dependent variables is as surmised, with one exception. The duplicated knowledge of the firm's organizational structure did not show a significant relation to the attainment of targeted product/process costs.

As the literature, case studies, and empirical findings suggest, it is important to build a common base before starting to jointly work on an innovation (Grant/Baden-Fuller 2004). Specifically, this common knowledge needs to capture aspects beyond the familiar product specifications and agreed-upon milestones. In our quest to open the black box

'common knowledge base' somewhat, we found three important parts which will enhance project success: product, production process, and organizational knowledge. This work presents new insight regarding the hampering effect that duplicating the knowledge of the teaming firms' cultures has. Relating to this, further research could provide helpful understanding for dealing with different cultures.

Despite the importance of a common knowledge base, a caveat needs to be raised. It is important that the overlap of the partners' knowledge bases is limited. Not only is it inefficient to invest in the time-consuming development of such a knowledge base beyond what is required (Cowan et al. 2007), but this also raises competitive issues. In our case study, Sensorino sold the ICC to other car manufacturers too. While Auto Corp. sought to buy the sensor for a low price – which is possible via economies of scale since Sensorino sells the product to others as well – it feared losing its competitive edge through knowledge spillovers to its competitors. It is a tightrope walk. Hence, future research should, for example, further investigate the success-enhancing and hampering building blocks of a common knowledge base, and/or the necessary extent of these building blocks.

References

Avenel, E./Favier, A. V./Ma, S./Mangematin, V./Rieu, C. (2007): Diversification and hybridization in firm knowledge bases in nanotechnologies, in: Research Policy, 36, 6, S. 864-870.

Brusoni, S./Principe, A. (2001): Managing Knowledge in Loosely Coupled Networks: Exploring the Links between Product and Knowledge Dynamics, in: Journal of Management Studies, 38, 7, S. 1019-1035.

Cohen, W. M./Levinthal, D. A. (1990): Absorptive Capacity: A New Perspective on Learning and Innovation, in: Administrative Science Quarterly, 35, S. 128-152.

Cowan, R./Jonard, N./Zimmermann, J.-B. (2007): Bilateral Collaboration and the Emergence of Innovation Networks, in: Management Science, 53, 7, S. 1051.

Cummings, J. L./Teng, B. S. (2003): Transferring R&D knowledge: the key factors affecting knowledge transfer success, in: Journal of Engineering and Technology Management, 20, S. 39-68.

Gassmann, O. (2006): Opening up the innovation process: towards an agenda, in: R&D Management, 36, 3, S. 223-228.

Grant, R. M./Baden-Fuller, C. (2004): A Knowledge Accessing Theory of Strategic Alliances, in: Journal of Management Studies, 41, 1, S. 61-84.

Hagedoorn, J. (1993): Understanding the rationale of strategic technology partnering: interorganizational modes of cooperation and sectoral differences, in: Strategic Management Journal, 14, S. 371-386.

Hännien, S./Kauranen, I. (2006): A multidimensional product-concept model enhancing cross-functional knowledge creation in the product innovation process: The case of the Suunto t6 training wrist computer, in: Creativity and Innovation Management, 15, 4, S. 400-409.

Hargadon, A./Sutton, R. I. (1997): Technology Brokering and Innovation in a Product Developing Firm, in: Administrative Science Quarterly, 42, 1, S. 716.

Kotabe, M./Swan, S. (1995): The Role of Strategic Alliances in High-Technology New Product Development, in: Strategic Management Journal, 16, 8, S. 621-636.

Lane, P. J./Lubatkin, M. (1998): Relative Absorptive Capacity and Inter-organizational Learning, in: Strategic Management Journal, 19, S. 461-477.

Nonaka, I. (2007): The Knowledge-Creating Company, in: Harvard Business Review, 85, 7/8, S. 162.

Oppat, K. (2008): Disseminative Capabilities: A Case Study of Collaborative Product Development in the Automotive Industry.

Taylor, A./Greve, H. R. (2006): Superman or the Fantastic Four, in: Academy of Management Journal, 49, 4, S. 723-740.

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