Increasing Learning and Time Efficiency in Interorganizational New Product Development Teams
Ludwig Bstieler and Martin Hemmert

Despite the growing popularity of new product development across organizational boundaries, the processes, mechanisms, or dynamics that leverage performance in interorganizational (I-O) product development teams are not well understood. Such teams are staffed with individuals drawn from the partnering firms and are relied on to develop successful new products while at the same time enhancing mutual learning and reducing development time. However, these collaborations can encounter difficulties when partners from different corporate cultures and thought worlds must coordinate and depend on one another and often lead to disappointing performance. To facilitate collaboration, the creation of a safe, supportive, challenging, and engaging environment is particularly important for enabling productive collaborative I-O teamwork and is essential for learning and time efficient product development. This research develops and tests a model of proposed factors to increase both learning and time efficiency on I-O new product teams. It is argued that specific behaviors (caring), beliefs (psychological safety), task-related processes (shared problem solving), and governance mechanisms (clear management direction) create a positive climate that increases learning and time efficiency on I-O teams. Results of an empirical study of 50 collaborative new product development projects indicate that (1) shared problem solving and caring behavior support both learning and time efficiency on I-O teams, (2) team psychological safety is positively related to learning, (3) management direction is positively associated with time efficiency, and (4) shared problem solving is more strongly related to both performance dimensions than are the other factors. The factors supporting time efficiency are slightly different from those that foster learning. The relative importance of these factors also differs considerably for both performance aspects. Overall, this study contributes to a better understanding of the factors that facilitate a favorable environment for productive collaboration on I-O teams, which go beyond contracts or top-management supervision. Establishing such an environment can help to balance management concerns and promote the success of I-O teams. The significance of the results is elevated by the fragility of collaborative ventures and their potential for failure, when firms with different organizational cultures, thought worlds, objectives, and intentions increasingly decide to work across organizational boundaries for the development of new products.

Introduction
This paper examines factors that support learning and time efficiency on interorganizational (I-O) project teams in vertical product development partnerships. Vertical partnerships are project-based collaborations between a manufacturer and a customer or a supplier-partner to develop and commercialize new products (Anderson and Narus, 1990).

Within such partnerships, new product development (NPD) teams are increasingly staffed with individuals drawn from the partnering firms and are expected to improve the projects’ chances of maximizing the fit with customer requirements and to enhance mutual learning while still reducing development time (Schilling and Hill, 1998). The performance of these I-O teams is critical for the success of the partnership. However, there are significant challenges involved in making these partnerships work, which can cause many, if not most, to fail or break down prematurely and can inflict financial damage on both partners (Dyer, Kale, and Singh, 2004).

NPD research shows that interorganizational collaboration and teamwork can be very challenging. Organizations will develop their own shared assumptions and values, which shape how firms and individuals behave and cooperate (Smith and Blanck, 2002).
Friction is common when partners from different corporate cultures and thought worlds must coordinate and depend on one another despite differing perceptions of problems, opportunities, or resources. Too often, this friction becomes dysfunctional, as opposing sides focus on the distance that separates them rather than on the common challenges they face (Hagel and Brown, 2005)

Research in social psychology also has revealed that encounters between groups (i.e., organizations) are inherently more competitive and abrasive than within-group encounters, particularly if members conceive their own group as being unique and superior to the other group (Deutsch, 1973). Out-groups and their members—such as partner firms and their representatives—are rarely favorably evaluated or accorded the same value or worth as in-groups and their members (Mackie and Smith, 1998). This self-serving tendency among in-groups frequently turns into resistance, hostility, or out-group derogation (Deutsch; Hewstone, Rubin, and Willis, 2002). All too often, a dominant partner, either the bigger partner or the customer in a customer–supplier pair, takes advantage of the other or has the power to force the other partner to do business its way (Smith and Blanck, 2002).

I-O teams do have access to richer sources of information and a broader range of resources and thus have the potential to work in a more informed fashion—the cross-fertilization of perspectives should by all accounts spawn creativity and innovation and make such teams better equipped to make high-quality decisions (Thompson, 2004). However, team research shows that, within any team, members tend to discuss information held by all members at the expense of unique or novel information, especially early on in the discussion process (Stasser and Titus, 1985). They also prefer information that supports the existent preferences of members (Kerr and Tindale, 2004). By doing so, teams waste time, fail to pool unique information effectively, and instead make decisions that are biased in the direction of commonly shared information and that fall short of integrating member knowledge to create more innovative solutions. This fallacy, known as the common information effect, is particularly pronounced in teams with members from different areas of expertise, backgrounds, priorities, or firms (Thompson).

Given these empirical observations, it is not surprising that many I-O teams do not do well and simply go awry or fail. Often, partnerships fall short of expectations because too little attention is given to nurturing the type of close working relationship that unites the partnering organizations (Hutt et al., 2000). At the same time, the success of these teams requires understanding and working with differences that do exist between the partnering firms.

In this paper a theory about task-related processes, behaviors, beliefs, and governance mechanisms that can assist I-O teams in partnerships is being tested and presented. Given that firms increasingly enter close partnerships for NPD, it is quite striking that researchers have yet to examine closely factors that facilitate success on I-O product development teams. Specifically, it is proposed that creating a safe, supportive, challenging, and engaging environment is particularly important to facilitate productive and collaborative NPD.

The creation of this team environment is essential for the generation and transfer of knowledge and learning. Learning is often a major objective in collaborative development. NPD team learning is a process of knowledge acquisition and integration through understanding and then implementing new ideas or concepts (Crossan, Lane, and White, 1999) into organizational practice to improve operations, to create innovative products, and to compete successfully in the marketplace (Lynn, Reilly, and Akgün, 2000). At the same time, by pooling resources partnering

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**BIOGRAPHICAL SKETCHES**

**Dr. Ludwig Bstieier** is associate professor of marketing in the Whittemore School of Business and Economics at the University of New Hampshire (UNH). Prior to joining UNH he was assistant professor of marketing at the University of Innsbruck and a visiting scholar and lecturer at McMaster University and in Massachusetts Institute of Technology’s (MIT) Sloan School of Management. His research interests include studying the formation, management, and outcomes of close buyer–supplier relationships in industrial new product development and investigating different forms of perceived environmental uncertainty and its impact on product innovation practices. His most recent research on new product development was published in *Journal of Product Innovation Management* and *Journal of World Business*.

**Dr. Martin Hemmert** is professor of international business at Korea University Business School in Seoul. Previously, he held research and teaching positions at the University of Cologne, Hitotsubashi University, DJI Tokyo, the University of Duisburg-Essen, and the National University of Singapore. His research interests include strategic innovation management, innovation systems, organizational boundaries of firms, and university-industry research partnerships. He has published five books and numerous articles in journals such as *Industrial and Corporate Change*, *Research Policy*, *Management International Review*, *Journal of World Business*, and *Journal of Engineering and Technology Management*. 
firms expect to reduce development time. In many industries, time-efficient product development is critical, because this kind of efficiency reduces the odds that markets and market needs will have changed between development and actual commercialization (Cooper and Kleinschmidt, 1994). The objective of this study is to advance the current knowledge on how teamwork in interorganizational NPD can increase both learning and time efficiency.

Theoretical Framework

Team research has investigated the predominant conditions and processes that shape the performance of internal development teams, including team stability (e.g., Cooper and Kleinschmidt, 1994), functional diversity and interaction (e.g., Griffin and Hauser, 1996), team leadership, and team characteristics (e.g., Barczak and Wilemon, 1989; McDonough, 1993); top-management commitment and support (e.g., Cooper and Kleinschmidt, 1987); and evaluation systems and reward structures (e.g., Sarin and Mahajan, 2001). Yet we still know much less about the factors that facilitate performance in I-O project teams than we should.

Four characteristics of I-O development teams govern the choice of the predictor variables: (1) people who must problem solve come from very different backgrounds, hold different perspectives, and lack a generally shared belief in organizational practices and processes; (2) suspicion of members from the outgroup toward in-group members and vice versa as well as perceived lower status of one group compared with the other may increase polarization between the groups; (3) interaction with out-group members raises sensitivity about revealing task-relevant information that may be threatening to the self, the other, or the project; and (4) potential project goal ambiguities and discrepancies originate in the diverse interests of more or less autonomous partner firms.

I-O team members are highly dependent on one another to achieve a joint project objective, and one would expect team members to have instrumental reasons to develop effective working relationships quickly across organizational boundaries to overcome these hurdles. Learning and time efficiency in I-O teams in fact depend on certain task and relational factors that foster an effective engaging environment within which teams can succeed. Both relational and task-related factors are necessary contributors to the performance of I-O project teams, but neither relational (being caring, feeling safe) nor task-related conditions (joint problem solving, management direction) alone are sufficient for the final success of a collaborative project. Further significant effort is required to establish an environment wherein members of I-O project teams will feel secure and find mutual support to operate effectively and efficiently during their interactions.

Shared Problem Solving

One potential advantage of using I-O teams is the integration of unique knowledge from all partners into a collective knowledge through successful collaboration that no individual company team had to begin with. However, this advantage depends on appropriate interaction and the degree to which the knowledge within the team can be effectively shared. I-O teams are composed of representatives from different corporate cultures that then have to negotiate dual loyalties to the I-O team and also their organization. They are thus used to different ways of organizing their work and problem solving. These differences can create unproductive friction when the team is tackling administrative, technical, and managerial problems as the team develops a new product. Misunderstandings can arise, arguments can occur, and valuable time may be wasted (Hagel and Brown, 2005).

Members of I-O teams can succeed in overcoming these coordination losses by engaging in shared problem solving, which provides a forum for interaction among team members and facilitates a middle ground from which to move forward with the project. Shared problem solving is defined as a process of ongoing mutual effort that the partners undertake to diagnose and overcome obstacles that are blocking project effectiveness (Narus and Anderson, 1995). This process enables members of I-O teams to coordinate functions and work out problems “on the fly,” thereby not only enriching the partnership with new solutions and new combinations of ideas (Uzzi, 1997) but also speeding up the NPD. Above all, working closely together on a team facilitates communication and minimizes the risks of designing a product or component that is difficult to manufacture or does not take advantage of the knowledge and expertise of each partner (Asmus and Griffin, 1993).

For instance, designing critical components or products is almost always advanced through joint
problem solving between technical personnel, a comprehensive analysis of trade-offs between cost and performance criteria, and rapid approval of design changes. The partners have the opportunity to try, experiment, err, and then seek instruction and feedback from each other. Repeated over time, the parties may feel increasingly confident in their relationship, begin to share a mutual understanding, and become more trusting (Ring and Van de Ven, 1994).

Such engagement in shared problem solving early on in projects is a key issue in I-O project teams. Learning from the experiences of partner firms at the start can have a significant impact on the course and success of the collaborative development project. If the partners participate significantly in decisions and actions, shared problem solving will not only reduce information asymmetry but will also ensure the buy-in of all partners in general (Saxton, 1997). As a result, values and objectives of partners will be mutually understood and intertwined and will foster more learning. Shared problem solving also means not cutting corners but rather carrying out the development task faster in the long-term by drawing on the knowledge and skills of the involved partner firms to solve development problems.

H1a: Shared problem solving is positively related to learning on interorganizational NPD teams.
H1b: Shared problem solving is positively related to time efficiency on interorganizational NPD teams.

Caring Behavior

When representatives from different firms come together on I-O teams, little is known about the thought world and frame of mind of the out-group. At the same time, working in I-O teams often is also about status relations, where a prestigious customer or supplier works together with another firm. Members of an organization who believe its lower-status position is illegitimate and that a different interorganizational status is achievable may engage in direct interorganizational competition and actively attempt to undermine collaborative efforts (Hogg and Terry, 2000), potentially endangering the success of the I-O team. Thus, beliefs and perceptions about what the other group is like in relation to one’s own group can determine a liking or disliking for the other group, an opinion that in turn dictates either favorable or unfavorable behavior toward that group. This assumed causal sequence implies that positive changes in beliefs and perceptions can promote more I-O team harmony (Mackie and Smith, 1998). The belief that the I-O team feels like one group diminishes intergroup anxiety and, through reduced anxiety, reduces intergroup bias, whereas the perception that the I-O team feels like two subgroups can exacerbate bias against the other group (Hogg and Terry). As a consequence, further efforts are needed to create group cohesion—i.e., effect, overcoming any “us” versus “them” dynamics and creating a common group consciousness of “we.”

Any social assimilation that respects and values the partner representatives fosters emotional integration, contributes toward decreasing the “corporate” distance between partners, reduces intergroup bias between team members, and facilitates a mutual sharing of novel or unique information among team members (Druskat and Wolff, 2001). This social transformation can be fostered by caring behavior within a team.

Through implementation of a caring behavior, defined by Druskat and Wolff (2001, p. 142) as “…displaying positive regard, appreciation, and respect,” team members communicate that the group values the external members’ presence and contributions. At the individual level, this return on investment of one’s self in the currency of constructive physical, cognitive, or emotional energy will promote engagement on the team, will motivate favorable action toward achieving team objectives, and will correct negative stereotypes about any out-group members. Kahn (1990) reported that people who received positive regard, appreciation, and respect experienced meaningfulness—they felt worthwhile, useful, and valuable. They were able and willing to give more to others and to the project work itself. Because team members in a caring environment can concentrate on the tasks at hand—compared with having to struggle to gain or maintain appreciation, respect, or validation—they are more likely to come forward with and share unique information with members of the out-group. Therefore, it is expected that caring behavior impacts learning in I-O teams positively.

Moreover, mutual support among the members of I-O development teams is an important component of relationship quality and was found to contribute to team performance, including time efficiency (Hoegl and Gemuenden, 2001). An environment of mutual respect, care, and support will facilitate the full engagement of team members in the development project and make them more likely to share personal
practices, know-how, and knowledge with others. Such caring behavior is expected to be positively connected to both learning and time efficiency for the I-O teams, especially when it is particularly challenging to accommodate each other.

**H2a:** Caring behavior is positively related to learning on interorganizational NPD teams.

**H2b:** Caring behavior is positively related to time efficiency on interorganizational NPD teams.

**Team Psychological Safety**

Each organization has its own unique mind-set on how to deal with sensitive issues, including bringing up innovative ideas, proposing improvements, taking risks, or dealing with errors or taboos. Working with unlike mind-sets across organizational boundaries is indeed challenging because of mental, structural, or other differences that exist or appear between the partnering firms.

Exemplary statements such as “We encourage revolutionaries; you shoot them” or “In our company, people are encouraged to take risks and we can fail honorably, but in your firm failure is not an option” (Slowinski and Sagal, 2003) illustrate the potential for trouble. Such friction can create significant uncertainty or anxiety among I-O team members about how to communicate knowledge about new technologies or to deal with novel ideas or uncomfortable news in an interorganizational setting or whether to do so at all. The reduction of any potentially unproductive friction is fostered by support of a psychologically secure environment, where it is safe to forward and discuss knowledge about technical procedures and experiment with new ideas. Psychological safety among team members also helps reduce perceived interaction barriers between groups and permits disagreements or misunderstandings to come to the surface, so they can be addressed and resolved without fear of punishment or ridicule (Hagel and Brown, 2005).

Edmondson (1999, p. 354) defined team psychological safety “... as a shared belief among team members that the team is safe for interpersonal risk taking.” The term suggests neither a careless sense of permissiveness nor an unrelentingly positive affect but rather a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up truthfully (ibid.). Team psychological safety then is the belief that the team has created a secure environment for showing and employing oneself without fear of negative consequences to self-image, status, or career (Kahn, 1990). That environment allows people to take risks to facilitate learning and development by serving as a forum that will enable safe reflection on ideas, mistakes, undesired effects, or the conditions that led to them. Without such a psychological safety net, the team or team members are likely to be concerned about the risk of failure and, therefore, reluctant to engage fully in the tasks of the project. Fearing punishment or embarrassment, team members may even try to hide errors or cover up mistakes that could be attributed to them (Tjosvold, Yu, and Hui, 2004).

Working in a psychologically safe environment helps to alleviate concerns out-group members may have regarding reactions to their actions that could be potentially embarrassing or threatening. Interpersonal threat has been identified as another major impediment to learning (Argyris and Schön, 1978). Neutralizing the fear of embarrassment or threat is essential to achieve the necessary reciprocal communication among I-O team members.

In addition, Pisano, Bohmer, and Edmondson (2001) reported that teams with a participative, non-hierarchical group culture allowing all members to speak up learn faster than teams with a more hierarchical or ordered atmosphere. This finding suggests that team psychological safety may have a positive impact not only on learning but also on getting the job done faster.

At the same time, however, a high level of psychological safety can lead to lengthy or partisan discussions within a team because each member feels safe to speak up and express his or her own views frequently. While such discussions may be beneficial for mutual learning, they potentially can result in delays of important related activities when a tight project schedule exists. When in pursuit of design options that exceed a firm’s resources or when running on a tight schedule or budget, such discussion might go on for months before drawing the attention of higher-level managers (Bonner, Ruekert, and Walker, 2002). This tendency can be particularly strong for I-O project teams wherein the behavior of individual team members is not as controllable as in internal settings where hierarchical power and control are more prevalent.

Taken together, while psychological safety is expected to enhance team learning, it is not predicted that it will produce higher or lower time efficiency of I-O teams since the safety net may potentially have
both positive and detrimental effects on this performance dimension.

**H3: Psychological safety is positively related to learning on I-O project teams.**

**Management Direction**

It is important for I-O teams to operate with a common and shared sense of mission and purpose. The management of I-O teams and the interests of the firms behind those teams are generally more dispersed than those of other teams. As a consequence, ambiguities and discrepancies regarding perceived project goals can easily evolve among team members and potentially produce detrimental effects on task-related activities. Therefore, it is a critical requirement for I-O project teams to be able to move forward quickly with an overriding, clear, and shared sense of what must be achieved overall (Hagel and Brown, 2005). Clear, engaging management direction provides this orientation by establishing needed boundaries and expectations that will distinguish a specific project from other projects. When management clearly specifies engaging and challenging performance targets, it facilitates the bonding of diverse people and groups and enables the I-O team to get off to a good start. These targets also foster hard work and clear, precise effort on the project (Bonner et al., 2002; Hackman, 1987).

In general, the practice of setting clear and specific goals will facilitate both individual and group performance (Lynn, Skov, and Abel, 1999; O'Leary-Kelly, Martocchio, and Frink, 1994). Having a clear goal can lead to better outcomes by providing a focus that will motivate a search for information that will help achieve that goal. In contrast, a lack of clear project goals or continuously shifting goals and product definitions makes it difficult for a team to achieve positive outcomes promptly (Barczak and Wilemon, 2003). Specificity is a particularly critical issue for I-O teams where numerous and competing goals can lead to increased ambiguity. As a consequence, having clear management direction will enhance time-efficient product development on I-O teams.

The efficiency required to meet project deadlines and thus develop new products faster may result in aggressive performance goals taking precedence over learning on I-O project teams. Some of the empirical evidence indeed suggests that the creation of clear work procedures and clearly mapped-out processes can have a detrimental effect on creativity and reduce team learning (Druskat and Kayes, 2000). In addition, schedule pressures to meet deadlines can create stress (Barczak and Wilemon, 2003), an aspect that is not necessarily conducive to effective learning. It can be argued as well that a clear management direction, even when focused on the ends and not the means by which the team should pursue those ends and thus leaving a lot of flexibility to the team (Hackman, 2002), in and of itself limits the learning potential of I-O teams. Innovative new products are usually developed through the generation of new knowledge, which is not usually available at the beginning of a development project, at least not as a cumulative experience among team members. Therefore, by giving strong and clear directions about the specifications of a yet-to-be-developed product, the scope of learning may be limited at the onset. Hagel and Brown (2005) noted that the more constraints are imposed on an I-O team in terms of how a product design might meet specific targets, the less room there is for creative problem solving and learning and greater the potential for dysfunctional friction.

However, it seems a bit strong to envision the view that clear direction will actually harm learning. Rather, clarity of project direction will help I-O teams focus on the right issues and help the members identify errors and reflect on the practices that are emerging from the collaboration, in effect then increasing the chances of learning. (The authors owe this suggestion to a reviewer.) When taken together, the positive and negative effects of management direction may actually neutralize each other when learning is the objective.

**H4: Management direction is positively related to time efficiency in interorganizational NPD teams.**

**The Empirical Study**

**Sample Characteristics and Data Collection**

The hypotheses were tested by using data on I-O project teamwork in the South Korean machinery industry. Because of rapid changes over the past decades in this country, interorganizational collaboration and knowledge sharing have become two crucial success factors for many firms (Chang, 2003). South Korea also has become a particularly interesting field for
studying I-O teams due to the specific difficulties associated with building solid relations with out-groups in collectivistic societies, as collectivists focus on bonding within rather than between groups (Hofstede, 2001). As a result of a culturally related low inclination to build nonhierarchical interorganizational ties, NPD partnerships between independent firms used to be rare in Korea and have increased only in recent years in response to stronger competitive pressures in the domestic and global market (Eom, Choi, and Lee, 2005).

The machinery industry is less highly dominated by large firms compared with other manufacturing industries. Most firms in the machinery industry are medium-sized, often with less than a thousand employees, and rely to a great extent on vertical partnerships with customer and supplier firms in the new product development area (Kirchmann, 1994).

The data for this study were collected through the use of a structured questionnaire. The English language version of the survey items was adopted partially from previous studies, was translated into Korean, and then was translated back into English by a different person to secure and ensure the precise identity of the contents. Data were collected from manufacturing firms in the machinery industry that had a minimum size of 50 employees. Company directories for the machinery industry association were used to identify the sample firms; then a preliminary informant—usually the directors of research and development (R&D), marketing, new product development, or new business development—was identified and contacted by phone to make sure the manufacturer was indeed still active in new product development or R&D.

The compiled list revealed a total of 541 machinery firms that had 50 or more employees. Of this number, 83 firms were eliminated after initial phone contact or attempted contact, since they were not actually manufacturing firms, did not exist anymore, or could not be reached. Another 293 firms indicated they either were not developing any new products or did not have any external partnerships associated with such activities. After this screening process 165 firms with external partnerships in NPD remained.

Next, the preliminary informant within the selected firms was approached to solicit participation and to identify the most recent NPD projects conducted in partnership with a customer or supplier firm. Finally, the preliminary informant helped identify a key informant within each selected firm, that is, the person considered most competent and qualified to respond to the survey. This key informant had to be intimately involved in the collaborative project and was then contacted by phone and assessed in terms of role and responsibility as well as knowledge and involvement with the development project. That person was then approached personally for cooperation in the study.

All key informants were carefully instructed about the contents of the study and were asked to respond to the previously identified NPD partnership that had occurred with a customer or a supplier. The informants were also asked to provide their responses at the team level and not the individual level. Originally, an attempt was made to survey multiple members of each I-O development team. However, this intention turned out not to be feasible since the informants were unwilling both to disclose their partners and to provide multiple respondents for one collaborative development project due to time restrictions. The nondisclosure of partner firms, for strategic or confidentiality reasons, also had been expressed in prior research (e.g., Bstieler, 2006). As there was only one respondent from each team completing the survey, individual responses were considered as representative of the whole team. Two standard arguments support this choice. First, the scale items addressed characteristics of the team as a whole—for example, “In this development team both partners tried to accommodate one another’s needs” (Van de Ven and Ferry, 1980). Second, the level of analysis was based on the focal unit of the study (Rousseau, 1985). Eventually, survey responses were received from 61 firms, representing about 37% of the total firm population reporting on recent external NPD partnerships.

A two-part survey was used to collect the data for this study. Part A of the survey included the dependent variables (time efficiency and learning), with some items of the learning construct complemented in Part B, as well as the construct of shared problem solving. Part B of the survey included the items for caring behavior, psychological safety, and management direction. The control variables were spread across Part A and Part B. By doing so, an attempt was made to establish a timely and psychological separation of the items related to the independent and dependent variables to prevent the activation of implicit theories by the respondents (Podsakoff et al., 2003). Furthermore, normative wording was avoided, including performance, caring behavior, or psychological safety.
Part B of the survey was sent five months after Part A to reduce potential common methods bias. As a consequence, nine firms did not respond to Part B of the questionnaire. Two responses were excluded from the sample since they were related to joint development efforts with competitors and not suppliers or customers, thus reducing the number of complete and usable responses in both waves of the study to 50 companies total, or 30% of firm population. The data collected present the perceptions of the manufacturer as perceived by the key informant.

The majority of the development projects in the sample were conducted with domestic partners (80%). Most of the international partners came from neighboring or nearby countries (mostly Japan). The focal manufacturers entered slightly more customer partnerships than supplier partnerships (54% to 46%). On average, the firms had 632 employees. The R&D intensity as a percentage of total sales was slightly over 6%. The responding firms operated in a wide range of classifications within the machinery industry, including plastic working machinery, power machinery and equipment, agricultural machinery, and machine tools.

**Measurement of the Key Variables**

Whenever possible, survey items were adapted from existing scales in the literature. Most items were formatted in a Likert scale from 0 (strongly disagree) to 10 (strongly agree).

**Dependent Variables.** Learning was measured with five items inspired by Lynn et al. (1999). This construct measured the extent to which the manufacturer—by working with the partner—gained new insights into the development of new products, the key tasks involved in the production process, new manufacturing processes, understanding of end-user product needs, as well as personal practice, know-how, and “tricks of the trade.” Time efficiency was measured using two items: (1) whether the project was undertaken in a time-efficient manner; and (2) whether the project was launched on time (Cooper and Kleinschmidt, 1994). This latter performance measure indicated implicitly the extent to which the actual development time was acceptable and met the firm’s expectations in terms of timeliness.

To test unidimensionality of the measures, each multi-item measure was subjected to exploratory factor analysis. In both cases, only a single factor was found suggesting reasonable unidimensionality. The common factor for the five-item learning construct accounted for 60.3% of the total variance with a coefficient alpha of $\alpha = 0.83$. The factor extracted from the two items that measured time efficiency accounted for 76.5% of the total variance. The reliability of this two-item measure was $\alpha = 0.69$, and its correlation was $r = 0.53$.

**Independent Variables.** Shared problem solving was measured using four items adapted from Heide and Miner (1992). These items referred to joint planning and evaluation of the project and its progress, joint agreements on project adjustments, and shared responsibility for the project. Caring behavior was measured using five items inspired by the work of Hamme (2003). These items related to communicating affection, appreciation, and respect for other team members. Psychological safety was measured by using three items of a scale developed by Edmondson (1999). These items gauged whether the team created an atmosphere in which members felt more or less safe in taking on the risks of self-expression and engagement. The construct of management direction was based on the work of Hackman (1987, 2002) and included four items that measured the extent to which the direction for the work of the development team was clear, challenging, targeted, and goal oriented.

Again, all items were subjected to a principal components factor analysis (see Appendix 1). Using varimax rotation, a four-factor solution was extracted for the independent variables. The factor solution conformed closely to the constructs that each item was supposed to measure: all eigenvalues were greater than 1, all items loaded on the expected factors, and all factor loadings were above 0.6, with few cross-loadings greater than 0.3 and only one cross-loading greater than 0.4. On average, the communalities were .70 for the independent variables and did not vary over a wide range. For small sample sizes, the mean level of communality should be .70 or higher, communalities should not vary widely, and factors must be well determined.

Under these conditions, sample size will have relatively little impact on the quality of the solution (MacCallum et al., 1999). Consequently, the analysis suggested that the scales represent independent measures of the underlying constructs. The reliabilities for the four constructs were $\alpha = 0.87$ for shared problem solving, $\alpha = 0.81$ for caring behavior, $\alpha = 0.81$ for psychological safety, and $\alpha = 0.82$ for management direction.
Control Variables. Several variables were included to control for the potential effects of prior experience among the partner firms, product newness, partner type, and firm size. Relationship experience was measured using two items, accounting for former business and cooperation experience between the partner companies. Product newness gauged to what extent the product to be developed was new to the firm and new to the market and whether it was based on a radical technological innovation. The reliabilities of these scales amounted to $\alpha = 0.85$ and $\alpha = 0.68$, respectively. The type of partnership, specifically whether the manufacturer cooperated with a customer or supplier partner, was coded as 1 for a supplier partnership. The number of employees was used to control for firm size.

Results

Table 1 presents the descriptive statistics and correlations among the variables. The hypotheses were tested using multiple regression analysis (Table 2). To check for multicollinearity, the variance inflation factors were calculated. None of those factors exceeded a value of 1.4, suggesting low multicollinearity.

In the first step of the analysis, the dependent variables were regressed on the control variables (Models 1 and 3). Not surprisingly, product newness was positively related to learning but not to time efficiency. None of the other three controls—relationship experience, type of partner, or firm size—significantly related with any of the two performance measures.

As seen in Table 2 (Models 2 and 4), shared problem solving was strongly and positively related to both learning and time efficiency, thus lending support to H1a and H1b. As predicted, the positive relation of caring behavior with the two performance variables was also statistically significant. Thus, H2a and H2b were supported. Team psychological safety was significantly and positively associated with learning, lending support to H3. Further, the relation between management direction and time efficiency was positive, as predicted by H4.

Taken together, the four independent variables showed good explanatory power of both learning and time efficiency, suggesting that all these factors are positively related to the outcomes of I-O team efforts. Furthermore, the positive association of shared problem solving with learning and time efficiency was significantly stronger than the association of the other independent variables with the performance measures ($p < .001$) as revealed by $t$-tests regarding the difference between the relative weights of the independent variables (Johnson and LeBreton, 2004). This result suggests that shared problem solving plays a particularly important role for the successful performance of I-O new product development teams.

Discussion

Despite the growing popularity of collaborative NPD, we do not yet fully understand the processes, mechanisms, or dynamics that leverage performance on I-O development teams. This empirical study revealed a number of interesting findings on how efficient and effective interorganizational teamwork could be best achieved.

To begin with, there are task-related and relational factors that are significantly related to both learning effectiveness and time efficiency of I-O project team

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<td>1. Shared Problem Solving</td>
<td>7.11 (1.96)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Caring Behavior</td>
<td>7.54 (1.18)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Management Direction</td>
<td>7.14 (1.48)</td>
<td>.251*</td>
<td>.437***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Psychological Safety</td>
<td>6.63 (1.90)</td>
<td></td>
<td>.024</td>
<td>.330**</td>
<td>.319**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Relationship Experience</td>
<td>5.82 (3.16)</td>
<td>-.208</td>
<td>-.102</td>
<td>-.015</td>
<td>-.027</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Newness of Product</td>
<td>6.39 (2.26)</td>
<td>.126</td>
<td>.027</td>
<td>.259*</td>
<td>.366***</td>
<td>.324**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Type of Partner</td>
<td>0.46 (0.50)</td>
<td>-.029</td>
<td>.051</td>
<td>-.051</td>
<td>.119</td>
<td>-.197</td>
<td>.070</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Firm Size</td>
<td>632.18 (2,755.48)</td>
<td>.161</td>
<td>.107</td>
<td>.190</td>
<td>.147</td>
<td>.102</td>
<td>.109</td>
<td>-.116</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Learning</td>
<td>6.82 (1.57)</td>
<td>.614***</td>
<td>.350**</td>
<td>.280**</td>
<td>.263*</td>
<td>-.063</td>
<td>.309**</td>
<td>.024</td>
<td>.133</td>
<td></td>
</tr>
<tr>
<td>10. Time Efficiency</td>
<td>6.51 (1.91)</td>
<td>.559***</td>
<td>.375**</td>
<td>.449**</td>
<td>.126</td>
<td>-.039</td>
<td>.181</td>
<td>-.016</td>
<td>.178</td>
<td>.631***</td>
</tr>
</tbody>
</table>

*a* $p < .10$.

**$p < .05$.

***$p < .01$ (two-tailed).
and extensive individual preparation (Edmondson, 1999). Teams and individuals learn through trial and error. Because of the numerous interactions that often occur among members, it may be difficult at times for teams to perform tasks smoothly the first time, despite well-designed training programs and extensive individual preparation (Edmondson, Bohmer, and Pisano, 2001). Thus, creating a psychologically safe team environment within which people will feel free to voice concerns or experiment without expecting personal sanctions appears to foster learning on I-O teams.

Management direction is positively associated with time efficiency. This direction helps to maintain focus and to speed up development efforts. Thus, clear and specific objectives can serve as an important governance mechanism for I-O project teams. In addition, the strongly hierarchical management style in Korean firms (Chung, Lee, and Jung, 1997), where team members rely on and request specific managerial guidance, may also account for the importance of clear management direction for time-efficient product development. Management orientation about the desired outcomes appears to be important for efficient teamwork, regardless of whether the team members are affiliated with one or multiple organizations.

Additionally, shared problem solving is more strongly related to learning and time efficiency than are the other factors. This finding indicates that effective task integration of team members from different firms is particularly important for the performance of I-O teams. Members of I-O teams can be less tightly governed than other teams, because a collaborative project is not under exclusive control of a single party and behaviors on I-O teams are less hierarchically enforceable. Rather, social control mechanisms replace hierarchical control (Choudhury and Sabherwal, 2003), and solutions to problems and disagreements on I-O teams have to be resolved through cooperation (Hoegl and Wagner, 2005). Shared problem solving does play a particularly important role under such circumstances, as for instance in nonhierarchical contexts discussion and information sharing tend to be more intensive than under hierarchical governance modes (Courtright, Fairhurst, and Rogers, 1989).

Contextual factors, such as firm size, type of partner, or the previous relationship experience of partner firms, appeared not to be related to learning or time efficiency of the collaborative projects. This last finding is quite remarkable, given the fact that Koreans strongly emphasize long-term relationships built on social ties (Yee, 2000). The data suggest that such relationships do not necessarily facilitate the performance of I-O teamwork. Not surprisingly, however, team learning is positively related to product newness, that is, a product new to the market, new to the firm, and based on new technology.

Table 2: Regression Analysis for Learning and Time Efficiency

<table>
<thead>
<tr>
<th></th>
<th>Learning</th>
<th>Time Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firm Size</strong></td>
<td>0.113</td>
<td>–.006</td>
</tr>
<tr>
<td><strong>Type of Partner</strong></td>
<td>–.006</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Relationship Experience</strong></td>
<td>–.193</td>
<td>0.050</td>
</tr>
<tr>
<td><strong>Product Newness</strong></td>
<td>0.393**</td>
<td>0.198</td>
</tr>
<tr>
<td><strong>Shared Problem Solving</strong></td>
<td>.597***</td>
<td>.549***</td>
</tr>
<tr>
<td><strong>Caring Behavior</strong></td>
<td>0.292**</td>
<td>0.288**</td>
</tr>
<tr>
<td><strong>Psychological Safety</strong></td>
<td>0.222*</td>
<td>0.027</td>
</tr>
<tr>
<td><strong>Management Direction</strong></td>
<td>0.028</td>
<td>0.311**</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.163</td>
<td>0.578</td>
</tr>
<tr>
<td>$\Delta R^2 (p)$</td>
<td>0.415***</td>
<td>0.415***</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.087</td>
<td>0.493</td>
</tr>
<tr>
<td>$F (p)$</td>
<td>2.14*</td>
<td>6.85***</td>
</tr>
</tbody>
</table>

Notes: p < .10.
**p < .05.
***p < .01 (two-tailed).
teams have been studied extensively at the organizational level, I-O product development teams have been virtually unexplored. This study includes several predictor variables and two outcome variables in the same model, allowing for an examination of the relative and combined effects of these predictor variables on I-O team performance. This research contributes to a better understanding of the relevance of certain task-related and relational factors for productive collaboration on I-O teams. The study further adds to the literature by showing how these factors contribute differently to two specific performance measures important on I-O teams compared with a separate examination of each concept or a single dependent variable. This study also introduces and investigates the construct of “caring behavior,” as that behavior relates to I-O team performance—an attempt that has never before been empirically examined, only proposed. We believe that caring behavior is an important but overlooked mechanism for successfully bringing representatives from different firms together on I-O teams, in particular. Finally, this study was conducted in a non-Western context, more specifically in an East Asian country, thereby contributing to a better understanding of relational and task-related processes and mechanisms that may influence I-O teamwork in a culturally different environment.

The significance of the findings is elevated further by the actual fragility of collaborative ventures and their real potential for failure, when firms with different organizational cultures, mind-sets, objectives, and intentions decide to enter collaborative R&D with domestic or global partners. However, it is questionable whether the immense importance of the realities of the relational processes that can make or break those partnerships is sufficiently acknowledged in most interorganizational arrangements. As such, these findings strongly suggest that firms need to go beyond the important strategic elements of designing, formalizing, and implementing alliances (Slowinski and Sagal, 2003). More specifically, the partnering firms need to foster the “emotional intelligence” of interorganizational groups. I-O teams indeed craft their own contexts by actively choosing and constructing norms that will prescribe how team members treat one another and work together. Such a process creates reinforcing spirals of interrelating, emotional attachments, and effective interaction that result in more effective and more efficient I-O teams (Druskat and Wolff, 2001).

**Limitations and Further Research Directions**

The results of this study should be considered in light of its constraints. Only one broad industry segment in one country was surveyed. In collectivistic societies like Korea, certain factors, such as caring behavior or psychological safety, may play a bigger role in I-O teamwork than in more individualistic cultures. Moreover, the survey sample was relatively small. Despite this small sample size, both learning and time efficiency were satisfactorily explained by the independent variables. The statistical power of the regression models is above .80 (Hair et al., 1998), suggesting that the data were suitable for detecting the significant influences of the independent on the dependent variables with the given sample size. While the results show relatively strong relationships between predictor variables and performance on these I-O teams, any claim regarding the generalization of the findings to other countries or industry segments should be made with caution.

Since collaborative development in this study means that representatives of partner companies worked together on a team, it would have been more valuable to take into account the perceptions of respondents of all the partnering firms. Attempts to obtain information from the partners failed, however, as most of the participating manufacturers were unwilling to disclose the identity of their partners for confidential or strategic reasons. Thus, the data from this study do not capture the bilateral aspects of relational behavior and perception; thus, the findings should be interpreted with this limitation in mind.

In addition, a single key informant was used for all measures. Given the interest in behavioral elements within I-O development teams that the respondents were actively involved with the use of self-report seemed justified for this research. Originally, multiple members of a team would have been surveyed. However, this intention turned out not to be feasible since the informants were unwilling to provide multiple respondents for a collaborative development project. As a compromise, the individual responses were chosen as being representative for the team with the scale items then addressing characteristics of the team as a whole (Van de Ven and Ferry, 1980). This compromise constituted, however, a major limitation regarding the data.

To reduce a potential common method bias, the questionnaire was split into two parts, both of which were forwarded to the respondents in two waves. In a
post hoc test, the responses to a direct question regarding project success (“Overall, this partnership was a success” [yes/no]) were used as a marker variable for social desirability (Podsakoff et al., 2003). None of the correlations between the independent and dependent variables changed significantly when controlled for this variable, and the overall influence of the marker variable was close to zero. Therefore, it is believed that the potential of a common method bias and specifically, of social desirability, is limited. However, the possibility of such a bias cannot be strictly excluded.

Given the limitations of this study, it would be valuable to conduct further research on the joint influence of the factors examined here on the performance of interorganizational NPD teams and gaining dyadic data and multiple responses from team members. The findings also suggest that it is important to consider more than one performance dimension since different factors do appear to be important for different aspects of performance. Further research on relational processes going on within I-O project teams, as well as studies based on data from outside the United States, could verify the results presented here and shed additional light on the importance or universality of relational and task-related factors related to the success of collaborative development. To us, such extensions of I-O team research seem to be a fruitful research topic in an age of increasing globalization and alliance formation. I-O teams today face special conditions and meet unique problems. Thus, examining various differences in the perceptions, motives, and working patterns of internal versus interorganizational NPD teams and how these differences affect team performance could significantly advance current knowledge in this field.

Managerial Implications

New product development today is all about learning and integrating the learning into current and future superior customer solutions in a timely manner. Teams are indispensable for producing and understanding such novel information and developing new products using that information. Working across organizational boundaries to develop new products is becoming an increasingly important model for R&D across a wide range of industries. Thus, it is vitally important to understand how I-O teams can succeed and how to avoid costly misjudgments when dealing with team members from other companies.

The data do indicate the importance of certain task-related and relational factors to the eventual success of I-O project teams. Following are some effective practices and mechanisms that are positively related to team learning and project time efficiency in collaborative development:

- One challenge lies in developing a climate that fosters cooperation among the partners. Management and the I-O team must move toward processes and behavioral mechanisms that support working with one another in such a way to achieve project objectives. More specifically, the data from this research indicate the importance of partner involvement in the project decision-making process, that is, joint planning and coordination of project tasks, jointly agreeing on project-specific adjustments, and ensuring that the working relationship will be mutually rewarding for both sides. This involvement will not only ensure easier reconciliation of differences of opinion among the partners and contribute to learning and time efficiency of the I-O team but will also increase the chances of a higher buy-in by the partners (Mohr and Spekman, 1994).

- This study found that caring behavior among I-O team members is positively associated with both learning and project time efficiency. Thus, management and the team must consider the relational atmosphere that best facilitates the engagement of team members in the development efforts. In particular, communicating appreciation and respect for other team members and their skills, as well as being responsive to requests from team members, is central to creating and reinforcing mutually beneficial interaction processes, to diminishing perceived status differences among the partners, and to producing more effective and efficient I-O product development teams.

- In addition to recommending a caring environment, the data also indicate that team psychological safety is positively related to learning outcomes on I-O development teams. Thus, when learning is an important outcome, managers and teams should create a nonthreatening climate in which members feel safe in taking on the risks of self-expression and engagement and should make sure team members work in an environment that supports reasonable experimentation and does not sanction members for doing just that. Such psychological safety will fully
enable team members to come forward with problems, to foster solid feedback, to tolerate reasonable mistakes, and to liberate individual knowledge for the team’s benefit. All of these factors promote learning.

- The setting of a clear, engaging direction for a team is another effective practice to improve performance of collaborative development, particularly when time efficiency is a primary goal, almost always a management concern. Constantly changing project goals in contrast keep project teams from staying focused and on track (Barczak and Wilemon, 2003). Specifically, an analysis of the data shows that management needs to lay out the ultimate project purpose and the project’s specific performance targets clearly and to establish clear and challenging standards of excellence along with a clear direction regarding what is to be accomplished with the project.

The results of this study also suggest that the relevance of task-related factors and relational processes is not limited to I-O teams and to projects conducted in a U.S. environment but should be seriously considered as well for NPD partnerships in countries and regions outside the United States, specifically in East Asia.

The implementation of these recommendations may be managerially challenging in several ways of courses, as managers may have relatively little direct leverage over external team members and will, therefore, have to coordinate their efforts with the management of the external partner. Likewise, certain practices that can enhance successful teamwork may sometimes interfere with other significant managerial concerns. For instance, management may become concerned about unintended knowledge transfer or uncontrolled information disclosure when promoting shared problem solving with partner representatives. However, this study does suggest that shared planning, coordination, and adjustment are crucial to achieve successful I-O teams. Establishing a trusting relationship with the partner will help balance such concerns and promote the greater ongoing success of I-O development teams.

References


Appendix 1: Factor Analysis for Independent Variables

<table>
<thead>
<tr>
<th>Shared Problem Solving</th>
<th>Management Direction</th>
<th>Caring Behavior</th>
<th>Psychological Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>We shared responsibility to make sure that the relationship is mutually rewarding.</td>
<td>.897</td>
<td>.105</td>
<td>.014</td>
</tr>
<tr>
<td>Adjustments to project specific agreements were mutually agreed upon.</td>
<td>.861</td>
<td>.079</td>
<td>.078</td>
</tr>
<tr>
<td>We jointly planned how this project should be run.</td>
<td>.815</td>
<td>.161</td>
<td>.053</td>
</tr>
<tr>
<td>We jointly reevaluated the progress of our working relationship throughout the project.</td>
<td>.788</td>
<td>.049</td>
<td>-.121</td>
</tr>
<tr>
<td>The ultimate purpose of this project was clearly laid out to the team.</td>
<td>.077</td>
<td>.815</td>
<td>.267</td>
</tr>
<tr>
<td>The team was given specific performance targets to aim for in this project.</td>
<td>-.013</td>
<td>.797</td>
<td>.179</td>
</tr>
<tr>
<td>Senior leaders have established clear and challenging standards of excellence for this project.</td>
<td>.158</td>
<td>.741</td>
<td>.043</td>
</tr>
<tr>
<td>Management provided the team with a clear direction about the supposed accomplishments.</td>
<td>.268</td>
<td>.698</td>
<td>.124</td>
</tr>
<tr>
<td>Our team members treated the partner’s representatives with respect.</td>
<td>.040</td>
<td>.228</td>
<td>.811</td>
</tr>
<tr>
<td>During this project we acted in ways that showed we care about the partner’s representatives.</td>
<td>-.027</td>
<td>.305</td>
<td>.740</td>
</tr>
<tr>
<td>In this development team both partners tried to accommodate one another’s needs.</td>
<td>.178</td>
<td>-.152</td>
<td>.732</td>
</tr>
<tr>
<td>We let the partner’s representatives know that we valued their efforts.</td>
<td>.004</td>
<td>.237</td>
<td>.673</td>
</tr>
<tr>
<td>We always responded quickly to requests from the partner’s representatives.</td>
<td>-.307</td>
<td>.366</td>
<td>.634</td>
</tr>
<tr>
<td>Members of this team were able to bring up problems and tough issues.</td>
<td>-.029</td>
<td>.143</td>
<td>.205</td>
</tr>
<tr>
<td>If someone made a mistake on this team, it was not held against him.</td>
<td>-.030</td>
<td>.242</td>
<td>.063</td>
</tr>
<tr>
<td>It was safe to take a risk on this team.</td>
<td>-.041</td>
<td>.028</td>
<td>.029</td>
</tr>
</tbody>
</table>

*Extracted part of total variance (cumulative: 70.44%)*

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*Principal component analysis. Varimax rotated factors. Bold indicates factor loadings of survey items related to the corresponding construct.*