# Partner Management Capability and New Product Development Performance: The Moderating Role of Product Lifecycle Management System Capability

Yi-Ming Tai
*National Pingtung University*, ymtai@mail.nptu.edu.tw

Follow this and additional works at: http://aisel.aisnet.org/pacis2017

# Partner Management Capability and New Product Development Performance: The Moderating Role of Product Lifecycle Management System Capability

*Completed Research Paper*

**Yi-Ming Tai**
National Pingtung University
No.51, Min-sheng East Road, 900 Pingtung, Taiwan
ymtai@mail.nptu.edu.tw

## Abstract

*The business value of information technologies and systems can only be created if firms have developed the context-specific management capabilities. In the context of collaborative new product development (NPD), firms can strengthen NPD performance by developing appropriate partner management capabilities. This study investigated the role of two partner management capabilities in influencing NPD performance and how the ability to diffuse and routinize product lifecycle management (PLM) system in NPD (i.e., PLM system capability) moderates the effects of the two partner management capabilities on NPD performance. This study conducted an empirical survey to evaluate the proposed research model. The results revealed that partner alignment capability and relational governance capability significantly influence NPD performance. Moreover, this study observed that PLM system capability plays a complementary role in reinforcing the effect of partner alignment capability on NPD performance.*

**Keywords:**  New product development performance, product lifecycle management system capability, partner management capability, relational governance capability, partner alignment capability

# Introduction

Information systems research has studied how firms can benefit from the implementation of effective information technology (IT) solutions in the context of interorganizational collaboration. However, the benefits of the IT solutions can only be created if the firms have developed the context-specific management capabilities. In the context of collaborative new product development (NPD), firms can strengthen NPD performance by developing appropriate partner management capabilities. Developing new product involves various complex and interdependent activities such as generating and assessing new product opportunities and ideas, translating product requirements into final design specifications, and launching products to market (Pavlou and El Sawy 2006; Hilletofth and Eriksson 2011; Acur et al. 2012). Challenges, such as shrinking product life cycles and heterogeneous customer preferences, have compelled firms to collaborate with external partners in the NPD context. Collaborating with external partners involves intense interorganizational processes and organizational boundary activities that entail establishing mechanisms to coordinate the partners' activities and to integrate the partners' resources (Mishra and Shah 2009; Schilke 2014).

Many firms have come to realize the importance of developing strong ability to align NPD partners' activities (i.e., partner alignment capability) and to govern relationships with the partners (i.e., relational governance capability) (Hilletofth and Eriksson 2011; He et al. 2014). Because when NPD takes place in the context of interorganizational collaboration, the relationships between firms and their NPD partners must be restructured to go beyond operational efficiencies to create an environment that allows the firms to leverage partners' resources to develop a new product (Bendoly et al. 2012; Bellamy et al. 2014). For effectively leveraging partners' resources, firms must govern relationships with the partners and align the partners' activities with their firms' strategic objectives (Acur et al. 2012; Park et al. 2012; Gao and Tian 2014). This has, in turn, created demand for the development of the capability to effectively align and govern NPD partners. Hence, the first research question of this study is as follows: What will the impact of partner alignment and relational governance capabilities be on NPD performance?

In the context of NPD collaboration, firms and NPD partners have to frequently exchange information and knowledge to each other. The firms need for an IT platform supporting them to manage information flows in the interorganizational collaboration processes. Implementing product lifecycle management (PLM) systems allows firms effectively manage collaborative product development projects within an extended enterprise environment. PLM systems provide an integrated collaborative product development platform that facilitates firms in managing the collaborative creation, modification, and exchange of information throughout the entire lifecycle of a product (Stark 2011; Vezzetti et al. 2011; Merminod and Rowe 2012). The ability to diffuse and routinize PLM system in NPD processes (i.e., this study, named "PLM System Capability") allows firms to effectively manage NPD-related information, scheduling NPD-related tasks, and communicating with NPD partners (Cantamessa et al. 2012; Hadaya and Marchildon 2012; Fielding et al. 2014).

Despite the acknowledged importance of PLM systems in NPD, little is known about how PLM systems influence the impact of partner management capability on NPD performance. This study supposes that aligning and governing NPD partners via PLM systems, firms may more favorably leverage the partners' resources to develop a new product as compared to the firms without the assistance of PLM systems. The two partner management capabilities (i.e., partner alignment and relational governance capabilities) together with PLM system capability can be regarded as complementary factors whose joint effects contribute to superior NPD performance. Because the use of PLM systems can not only assist firms to better manage information flows within the collaborative NPD processes, but also increase the interaction between the firms and their NPD partners. To help bridge this gap in the literature, this study investigates the impact of partner alignment and relational governance capabilities on NPD performance while considering the moderating effect of PLM system capability. Specifically, the second research question of this study is as follows: How does firms' PLM system capability moderate the performance impact of partner alignment and relational governance capabilities?

## Hypothesis Development and Research Model

Collaborative NPD involves various complex and interdependent activities that require to effectively align the activities of NPD partners (Hilletofth and Eriksson 2011; Bendoly et al. 2012). NPD success is determined by how NPD partners' resources are integrated and deployed (Stark 2011; Thomas 2013). To ensure interoperability and seamless process synchronization, firms must align NPD partners'

activities during the entire project (Gao and Tian 2014; Sinkovics and Kim 2014). Moreover, successful NPD requires firms to cultivate long-term and high-trust relationship with partners. With the close relationship, NPD partners will be willing to contribute resources and talents to the relationship and give insight into their ways of working. Whether firms can gain partners' relation-specific investments depends on how well the firms can govern the relationship with the partners (Bstieler et al. 2015; Sjoerdsma and van Weele 2015). Hence, this study proposes that achieving excellent NPD performance requires the development of firms' partner alignment and relational governance capabilities.

## Effects of Partner Alignment and Relational Governance Capabilities

NPD involves complex and interdependent interorganizational activities that require alignment efforts (Bendoly et al. 2012; Park et al. 2012; Tavani et al. 2013). Partner alignment capability refers to a firm's ability to develop mechanisms for aligning NPD partners' production strategies with the firms' NPD strategies. A firm's ability to access and leverage the functional and knowledge strengths of partners is identified as a crucial antecedent capability in the path to excellence NPD performance (He et al. 2014; Tavani et al. 2014). Firms that have strong partner alignment capability, meaning they are able to develop mechanisms for aligning NPD partners' production strategies with their NPD strategies. The mechanisms enable firms to synchronize the output of NPD partners' production activities with their NPD plans, thus allowing their NPD strategies to be achieved (Hilletofth and Eriksson 2011; Acur et al. 2012).

Partner alignment capability can be viewed as firms' ability to establish mechanisms to manage their partners' resources and actions. The ability to establish robust partner alignment mechanisms enables firms to react timely and appropriately to market conditions (Acur et al. 2012; Kettunen et al. 2015). Because having robust partner alignment mechanisms in place, firms could effectively employ their partners' capabilities to accomplish their NPD goals. When firms have the capability to align NPD partners' activities effectively and efficiently, the firms can achieve better NPD performance. Therefore, this study proposes Hypothesis 1:

*Hypothesis 1: Partner alignment capability is positively related to NPD performance.*

Successful NPD requires firms to effectively integrate and deploy NPD partners' resources. Whether firms can effectively integrate and deploy partners' resources depends on how well the firms can govern the relationship with the partners (Bstieler et al. 2015; Sjoerdsma and van Weele 2015). Relational governance capability in the NPD context refers to a firm's ability to build tight relationships with NPD partners (Bstieler et al. 2015; Prange et al. 2015). Relational governance capability is a socialization capability across organizational boundaries. The capability enables firms to shape the willingness of NPD partners to enter close and long-term relationships. The willingness permits contractual flexibility when firms introduce extra requirements to their NPD partners (Ma et al. 2012; Chang et al. 2015). Such flexibility allows efficient adaptation to environmental changes. Because relational governance capability can allow firms to enhance their NPD partners' cooperation confidence and reduce the partners' perceived relational risk, the firms that have strong relational governance capability can easily increase their NPD partners' willingness to exchange and adjust domain-specific and process-specific resources. Because of partners' support, NPD activities can be rapidly adjusted in response to environmental changes, resulting in a better NPD performance. Thus, this study proposes Hypothesis 2:

*Hypothesis 2: Relational governance capability is positively related to NPD performance.*

## Moderating Role of PLM System Capability

PLM is an integrated and information-driven strategy used to facilitate firms in integrating product development participants, product development processes, and production technologies (Gecevska et al. 2010; D'Amico et al. 2013; Matta et al., 2013). The information systems designed to support PLM, generally called "PLM systems" enable firms to integrate information and knowledge despite functional and organizational boundaries in NPD contexts (Ding et al., 2011; Cantamessa et al., 2012; Merminod and Rowe, 2012). Firms can employ PLM systems to manage the creation, modification, and exchange of product information throughout the product development cycle (Stark, 2011; Cantamessa et al. 2012). PLM systems are designed to fulfill certain business requirements such as managing large amounts of product information and knowledge and exchanging production information and knowledge among product development participants (Marchetta et al., 2011; Fielding et al., 2014; Segonds et al., 2015). PLM systems integrate product development information in a single

logical database and support the definition and standardization of the workflows and information objects created and used in product development (Vezzetti et al., 2011; Bruunetal., 2015). PLM systems generally include organizational memory, project and resource management, and cooperative work functions (Stark, 2011; Hadaya and Marchildon, 2012; Merminod and Rowe, 2012).

Firms can improve NPD performance through implementing PLM systems in NPD. PLM systems provide a virtual product design platform that enables firms to improve effectiveness, efficiency, and control of their NPD processes. The use of PLM systems helps improve new product decisions and foster the creation of new product knowledge by allowing seamless integration and exchange of information and knowledge among NPD participants (Cantamessa et al. 2012; Fielding et al. 2014). Moreover, PLM systems helps reduce product design mistakes by allowing to easily reuse the past design information, effectively compare the different of design alternative, better identify product architecture and assemblies, and detect the anomaly early in NPD (Hadaya and Marchildon 2012; Bruun et al. 2015). Thus, Hypothesis 3 is proposed:

*Hypothesis 3: PLM system capability is positively related to NPD performance.*

PLM systems act as an interorgnizational management platform that enables firms to conduct NPD effectively by aligning NPD partners' product development activities. The management platform engendered by PLM systems facilitates interactions between firms and their NPD partners (Pol et al. 2008; Stark 2011), thus improving the alignment of partners' production activities with firms' NPD plans. PLM systems enable firms to exchange product information with NPD partners at many levels within their respective organizational hierarchies, from strategy to operations (Gecevska et al. 2010; Hadaya and Marchildon 2012). Implementing partner management on PLM systems allows for knowledge-driven decision support, providing the information and knowledge required for quick and accurate decision making and adjustments (D'Amico et al. 2013; Fielding et al. 2014). Accordingly, partner alignment capability together with PLM system capability is posited as a complementary factor whose joint effects contribute to superior NPD performance. Thus, Hypothesis 4 is proposed:

*Hypothesis 4: PLM system capability moderates the impact of partner alignment capability on NPD performance.*

Using PLM systems enables firms and their NPD partners to conveniently exchange data and information and to communicate in real time (Hadaya and Marchildon 2012; D'Amico et al. 2013). PLM systems help firms increase interactions with their partners and improve mutual understanding. For example, PLM systems allow firms to electronically communicate with NPD partners, enabling the firms to effectively develop appropriate interaction methods for different partners. Using appropriate interaction methods to govern relationships improves the structure and quality of social ties between firms and their NPD partners (Acur et al. 2012; Chang et al. 2015). Accordingly, relational governance capability together with PLM system capability is posited as a complementary factor whose joint effects contribute to superior NPD performance. Thus, Hypothesis 5 is proposed:

*Hypothesis 5: PLM system capability moderates the impact of relational governance capability on NPD performance.*

Based on the proposed hypotheses, this study developed a research model (Figure 1) and evaluated it empirically in the NPD context. Moreover, firm size was a control variable, controlling for the possible spurious effects in the research model. Firm size was specified as a control variable for NPD performance because large firm generally has substantial resources for improving product development, manufacturing processes, and product sales. Such firms benefit from certain economies of scale that might not be accessible to smaller firms. Therefore, firm size was controlled and measured as a natural logarithm value of the number of employees in a firm.

**Figure 1. Research Model**
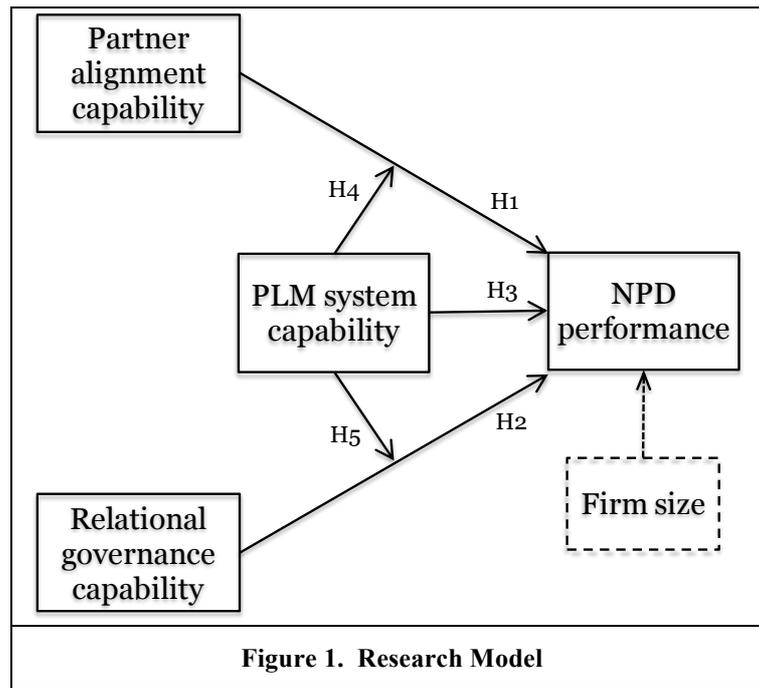
## Research Methodology

### *Measures*

Table 1 presents a summary of the operational definitions of the latent constructs in the research model. A structured questionnaire was developed for measuring the first-order latent constructs. All construct items were evaluated using 7-point Likert-type scales, with anchors ranging from 1 (strongly disagree) to 7 (strongly agree).

| Construct | Definition |
|---|---|
| NPD performance | The extent to which the success of a firm's NPD efforts |
| Relational governance capability | A firm's ability to establish close relationships with NPD partners |
| Partner alignment capability | A firm's ability to develop mechanisms for aligning NPD partners' production strategies with the firms' NPD strategies |
| PLM system capability | A firm's ability to use PLM systems to support NPD activities |

**Table 1. Operational Definitions of the Latent Constructs**

To measure NPD performance, four items were adapted from the literature on NPD and operations management (e.g., Hilletofth and Eriksson 2011; Stark 2011; Bendoly et al. 2012; Thomas 2013; Gao and Tian 2014). The construct of NPD performance was operationalized using items that indicated the extent to which firms can achieve their goals for new products' performance. PLM system capability was measured on a four-item scale adapted from the literature on PLM systems (e.g., Gecevska et al. 2010; Marchetta et al. 2011; Hadaya and Marchildon 2012; Merminod and Rowe 2012). The construct of PLM system capability was operationalized using items that indicated the extent to which firms use PLM systems to manage NPD-related information and activities. Partner alignment capability was operationalized using items that indicated the extent to which NPD partners' activities are aligned with focal firms' business strategies. The construct of relational governance capability was operationalized using items that indicated the extent to which firms felt their NPD partners believed that they are willing to enter close and long-term relationships.

### Data Collection

Our study context was the manufacturing industry. We mailed questionnaires to the firms that agreed to participate in our study. The key informant methodology was used, and only firms' product development executives were requested to respond to the survey. The major determinant of respondent selection was the respondents' positions within their organization; respondents knowledgeable about collaborating with NPD partners for developing new products were preferred. The sample data shows the characteristics of the responding firms; of the total sample, 85.42% of the firms were from the semi-conductors, electronic, and computer peripheral equipment industries, whereas 14.58% of firms were from the chemical, fabricated metal, optoelectronic, and vehicles industries. The sample primarily comprised medium-sized firms. The average work (i.e., product development management) experience of the respondents was 5.32 years in their current position, indicating adequate informant knowledge.

## Data Analysis and Results

The partial least squares (PLS) method was used to test the hypothesized relationships among the study variables displayed in Fig. 1. Data analysis by PLS was performed with SmartPLS 3.0 software (Ringle et al. 2015).

### Evaluating the Measurement Model

The measurement model was assessed via PLS to determine individual item reliability, internal consistency reliability and convergent and discriminant validity. Table 2 exhibits that the loadings of all items are higher than the suggested benchmark of 0.707 (ranging from 0.769 to 0.882), indicating that more than half of the variance is captured by the constructs (i.e., individual item reliability). Table 2 also reports the Cronbach's alpha (ranging from 0.813 to 0.872) and composite reliability values (ranging from 0.876 to 0.913) for each construct. All indicators are above the recommended level of 0.70, indicating adequate internal consistency.

| Construct | Item | Factor loading | Cronbach's Alpha | Composite Reliability (CR) |
|---|---|---|---|---|
| (NPD) NPD performance | NPD1 | 0.872 | 0.872 | 0.913 |
| | NPD2 | 0.853 | | |
| | NPD3 | 0.882 | | |
| | NPD4 | 0.794 | | |
| (PALC) Partner alignment capability | PALC1 | 0.879 | 0.821 | 0.892 |
| | PALC2 | 0.881 | | |
| | PALC3 | 0.808 | | |
| (RGC) Relational governance capability | RGC1 | 0.813 | 0.845 | 0.895 |
| | RGC2 | 0.829 | | |
| | RGC3 | 0.769 | | |
| | RGC4 | 0.785 | | |
| (PLM) PLM system capability | PLM1 | 0.817 | 0.813 | 0.876 |
| | PLM2 | 0.852 | | |
| | PLM3 | 0.812 | | |
| | PLM4 | 0.821 | | |

**Table 2. Factor Loadings and Reliability Estimates**

### Evaluating the Structural Model

Three structural models were built to estimate this study's hypotheses involving moderating effects. The first model contained only main effects and allowed for testing hypotheses 1 to 3. The second model added the interactive effect of PLM system capability to the construct of partner alignment

capability, which allowed for the testing of hypothesis4. The third model added the interactive effect of PLM system capability on relational governance capability, which allowed for the testing of hypothesis5. The PLS results are shown in Table 3 and the results indicate that the control variable (i.e., firm size) does not significantly influence NPD performance.

| Hypothesis | Exogenous variables | Model 1 | Model 2 | Model 3 |
|---|---|---|---|---|
| CV | Firm size | 0.117 (1.713)$^{ns}$ | 0.103 (1.479)$^{ns}$ | 0.111 (1.675)$^{ns}$ |
| Hypothesis1 | PALC | 0.294 (3.615)*** | 0.255 (2.578)* | 0.286 (2.938)** |
| Hypothesis2 | RGC | 0.332 (3.894)*** | 0.293 (2.637)** | 0.315 (3.086)** |
| Hypothesis3 | PLM | 0.191 (2.102)* | 0.170 (2.005)* | 0.183 (2.094)* |
| Hypothesis4 | PLM * PALC | | 0.158 (1.986)* | |
| Hypothesis5 | PLM * RGC | | | 0.062 (0.793)$^{ns}$ |
| $R^2$ | | 0.324 | 0.416 | 0.371 |
| $\Delta R^2$ | | | 0.092 | 0.047 |
| Cohen's $f^2$ | | | 0.158 | 0.075 |

*Notes: CV = control variable, $^{ns}p > 0.05$, \*$p < 0.05$, \*\*$p < 0.01$, \*\*\*$p < 0.001$*

**Table 3. Results of PLS Models**

The first model (Model 1) tested for the impact of PLM system capability, partner alignment capability, and relational governance capability on NPD performance. The results shown in Model 1 of Table 3 provide strong evidence for hypotheses 1 to 3. The two partner management capabilities have significantly positive effects on NPD performance. The path coefficients are 0.294 (t-value = 3.615 > 3.391, p-value < 0.001) and 0.332 (t-value = 3.894 > 3.391, p-value < 0.001), respectively. Hence, this study suggests that partner alignment capability and relational governance capability can be distinctive capabilities, which can explain performance heterogeneity, thus representing two important sources of NPD performance. Moreover, this study found that PLM system capability also can significantly influence NPD performance. The path coefficient is 0.191 (t-value = 2.102 > 1.984, p-value < 0.05), which means that the strong ability to diffuse and routinize PLM system in NPD processes (i.e., strong PLM system capability) allows firms to improve NPD performance.

The second and third model (Model 2 and 3) contains interaction effects between PLM system capability and the two partner management capabilities. Model 2 confirms H4, which assumes a moderating effect of the PLM system capability on the relationship between partner alignment capability and NPD performance. The path coefficient is 0.158 (t-value = 1.986 > 1.984, p-value < 0.05). In model 3, however, H5 is not confirmed by our analysis because the interactive term between relational governance capability and PLM system capability has a non-significant effect on NPD performance. The path coefficient is 0.062 (t-value = 0.793< 1.984, p-value > 0.05). Furthermore, Cohen's (1988) $f^2$ was used to assess the effect size of the moderator to establish whether the interaction effects had a small (0.02), medium (0.15), or large (0.35) effect. The results suggested that the effect of PLM system capability on the partner alignment capability-NPD performance relationship was 'medium' (0.158) and on the relational governance capability-NPD performance relationship was 'small to medium' (0.075). The results are reported in Table 3.

## Conclusion

Through an empirical study of product development executives, this study found that firms can achieve excellent NPD performance if they have superior partner alignment capability and relational governance capability. Moreover, this study also found that firms' ability to diffuse and routinize PLM system in NPD processes (i.e., PLM system capability) influences whether the firms can achieve excellent NPD performance. The empirical results also revealed that PLM system capability moderates the relationship between partner alignment capability and NPD performance, such that the positive relationship is stronger for firms with strong PLM system capability than for firms with weak PLM system capability.

This study raised several crucial implications for research. The study identified two essential partner management capabilities that influence whether firms can achieve excellent NPD performance. Although previous studies have investigated NPD performance, they have paid less attention to the partner management capabilities that are crucial for achieving NPD performance. This study filled the gap by investigating the capabilities required to succeed in managing NPD partners, and subsequently analyzed how such partner management capabilities affect NPD performance. By investigating the partner management capabilities required in the NPD context, this study provides insight into how NPD performance can be improved. Another research implication of this study is related to the role of PLM system capability in achieving excellent NPD performance. This study found that PLM system capability plays a crucial complementary role in influencing the effect of partner alignment capability on NPD performance.

This study also provides practical implications for managers. The research findings confirm that firms should be aware that partner management capabilities can be strengthened through PLM system capability. Firms must evaluate whether their PLM system solutions can enable them to establish tight relationships with NPD partners and increase alignment between their business strategies and NPD partner' activities. The first capability (i.e., establishing tight relationships with NPD partners) refers to strengthening the relational governance capability by using PLM systems to increase the belief of NPD partners that the focal firm is honest and benevolent, thereby increasing their identification with the focal firm. The second capability (i.e., increasing alignment between business strategies and NPD partner' activities) refers to strengthening the coordination capability by using PLM systems to establish NPD partner alignment mechanisms.

Although the research model was proposed based on theoretical inference and was tested through an empirical survey, a limitation should be taken into consideration when generalizing the results of this study. This study used a key informant method for data collection. There are many advantages for using the key informant method, such as it can be performed in a short time and it is useful to reach target respondent groups. Although this method has its advantages, it also suffers from the limitation that the data reflect the opinions of one person. Future studies could consider research designs that allow for data collection from multiple respondents within an organization.

## Acknowledgments

## References

Acur, N., Kandemir, D., and Boer, H. 2012. "Strategic alignment and new product development: drivers and performance effects," *Journal of Product Innovation Management* (29:2), pp. 304-318.

Bellamy, M. A., Ghosh, S., and Hora, M. 2014. "The influence of supply network structure on firm innovation," *Journal of Operations Management* (32:6), pp. 357-373.

Bendoly, E., Bharadwaj, A., and Bharadwaj, S. 2012. "Complementary drivers of new product development performance: Cross-functional coordination, information system capability, and intelligence quality," *Production and Operations Management* (21:4), pp. 653-667.

Bruun, H. P. L., Mortensen, N. H., Harlou, U., Wörösch, M., and Proschowsky, M. 2015. "PLM system support for modular product development," *Computers in Industry*, (67), pp. 97-111.

Bstieler, L., Hemmert, M., and Barczak, G. 2015. "Trust formation in university-industry collaborations in the US biotechnology industry: IP policies, shared governance, and champions," *Journal of Product Innovation Management* (32:1), pp. 111-121.

Cantamessa, M., Montagna, F., and Neirotti, P. 2012. "Understanding the organizational impact of PLM systems: evidence from an aerospace company," *International Journal of Operations and Production Management* (32:2), pp. 191-215.

Chandrasekaran, A., Linderman, K., and Schroeder, R. 2012. "Antecedents to ambidexterity competency in high technology organizations," *Journal of Operations Management* (30:1), pp. 134-151.

Chang, K. H., Chen, Y. R., and Huang, H. F. 2015. "Information technology and partnership dynamic capabilities in international subcontracting relationships," *International Business Review* (24:2), pp. 276-286.

D'Amico, S., Giustiniano, L., Nenni, M.E., and Pirolo, L. 2013. "Product Lifecycle Management as a tool to create value in the fashion system," *International Journal of Engineering Business Management* (5), pp. 1-6.

Ding, L., Ball, A., Patel, M., Mullineux, G., and Matthews, J. 2011. "Lightweight product lifecycle information management for small enterprises," *International Journal of Product Lifecycle Management* (5:1), pp. 21-36.

Fielding, E.A., McCardle, J.R., Eynard, B., Hartman, N., and Fraser, A. 2014. "Product lifecycle management in design and engineering education: International perspectives," *Concurrent Engineering* (22:2), pp. 123-134.

Gao, T., and Tian, Y. 2014. "Mechanism of supply chain coordination cased on dynamic capability framework-the mediating role of manufacturing capabilities," *Journal of Industrial Engineering and Management* (7:5), pp. 1250-1267.

Gecevska, V., Chiabert, P., Anisic, Z., Lombardi, F., and Cus, F. 2010. "Product lifecycle management through innovative and competitive business environment," *Journal of Industrial Engineering and Management* (3:2), pp. 323-336.

Hadaya, P., and Marchildon, P. 2012. "Understanding product lifecycle management and supporting systems," *Industrial Management and Data Systems* (112:4), pp. 559-583.

He, Y., Lai, K., Sun, H., and Chen, Y. 2014. "The impact of supplier integration on customer integration and new product performance: The mediating role of manufacturing flexibility under trust theory," *International Journal of Production Economics*, (147:Part B), pp. 260-270.

Hilletofth, P., and Eriksson, D. 2011. "Coordinating new product development with supply chain management," *Industrial Management and Data Systems* (111:2), pp. 264-281.

Kettunen, J., Grushka-Cockayne, Y., Degraeve, Z., and De Reyck, B. 2015. "New product development flexibility in a competitive environment," *European Journal of Operational Research* (244:3), pp. 892-904.

Ma, C., Yang, Z., Yao, Z., Fisher, G., and Fang, E.E. 2012. "The effect of strategic alliance resource accumulation and process characteristics on new product success: Exploration of international high-tech strategic alliances in China," *Industrial Marketing Management* (41:3), pp. 469-480.

Marchetta, M.G., Mayer, F., and Forradellas, R.Q. 2011. "A reference framework following a proactive approach for Product Lifecycle Management," *Computers in Industry* (62:7), pp. 672-683.

Matta, N., Ducellier, G., and Djaiz, C. 2013. "Traceability and structuring of cooperative knowledge in design using PLM," *Knowledge Management Research and Practice* (11:1), pp. 53-61.

Merminod, V., and Rowe, F. 2012. "How does PLM technology support knowledge transfer and translation in new product development? Transparency and boundary spanners in an international context," *Information and Organization* (22:4), pp. 295-322.

Mishra, A.A., and Shah, R. 2009. "In union lies strength: Collaborative competence in new product development and its performance effects," *Journal of Operations Management* (27:4), pp. 324-338.

Park, Y. W., Fujimoto, T., and Hong, P. 2012. "Product architecture, organizational capabilities and IT integration for competitive advantage," *International Journal of Information Management* (32:5), pp. 479-488.

Pavlou, P.A., and El Sawy, O.A. 2006. "From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development," *Information Systems Research* (17:3), pp. 198-227.

Pol, G., Merlo, C., Legardeur, J., and Jared, G. 2008. "Implementation of collaborative design processes into PLM systems," *International Journal of Product Lifecycle Management* (3:4), pp. 279-294.

Prange, C., Eng, T.Y., Li, J., 2015. "Collaborative new product alliances: A review of the literature and research perspectives," *Strategic Change* (24:4), pp. 351-371.

Ringle, C.M, Wende, S., Becker, J.M., 2015. *SmartPLS 3.0.*, http://www.smartpls.com.

Schilke, O. 2014. "On the contingent value of dynamic capabilities for competitive advantage: The nonlinear moderating effect of environmental dynamism," *Strategic Management Journal* (35:2), pp. 179-203.

Segonds. F., Mantelet, F., Nelson, J., and Gaillard, S. 2015. "Proposition of a PLM tool to support textile design: A case study applied to the definition of the early stages of design requirements," *Computers in Industry* (66:1), pp. 21-30.

Sinkovics, R. R., and Kim, D. 2014. "The impact of technological, organizational and environmental characteristics on electronic collaboration and relationship performance in international customer-supplier relationships," *Information and Management* (51:7), pp. 854-864.

Sjoerdsma, M., van Weele, A.J., 2015. "Managing supplier relationships in a new product development context," *Journal of Purchasing and Supply Management* (21:3), pp. 192–203.

Stark, J. 2011. *Product Lifecycle Management: 21st Century Paradigm for Product Realisation*, London: Springer.

Tavani, N., Sharifi, H., Soleimanof, S., and Najmi, M. 2013. "An empirical study of firm's absorptive capacity dimensions, supplier involvement and new product development performance," *International Journal of Production Research* (51:11), pp. 3385-3403.

Tavani, N., Sharifi, H., and Ismail, H.S. 2014. "A study of contingency relationships between supplier involvement, absorptive capacity and agile product innovation," *International Journal of Operations and Production Management* (34:1), pp. 65-92.

Thomas, E. 2013. "Supplier integration in new product development: Computer mediated communication, knowledge exchange and buyer performance," *Industrial Marketing Management* (42:6), pp. 890-899.

Vezzetti, E., Moos, S., and Kretli, S. 2011. "A product lifecycle management methodology for supporting knowledge reuse in the consumer packaged goods domain," *Computer-Aided Design* (43:12), pp. 1902-1911.