



Supply Chain Path Dependency in Collaborations for New Product Development

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ABSTRACT

This study examines the relationship between partnership structuring dynamics and performance, focusing on integration in co-development partnerships. Through a detailed survey, insights were gleaned from experts in collaborative engineering engaged in NPD. The analysis juxtaposes levels of partnership—synchronized, coordinated, and integrated—with operation, innovation and market performance. Results reveal that early-stage synchronization impacts operational performance more than later stages, and integration enhances innovation and market performance. Further, a post-hoc assessment links integration with vital financial outcomes to validate these findings. Employing resource orchestration theory, this research illustrates the influence of co-development structuring nuances on firm performance, emphasizing the critical balance between path dependency and creation



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INTRODUCTION

Management and supply chain research have embraced co-development and collaboration as major topics of research through the years (e.g. Remko & Chapman, 2006; van Hoek & Chapman, 2007; Ragatz, et. al., 1997; Yenyurt, Henke, Yalcinkaya, 2014). Interest in this topic continues unabated (e.g., Parker, et. al., 2008; Patrucco, Frattini, & Benedetto, 2022; Lau, et al., 2007; Melander et. al., 2014; Ye, et. al., 2018), especially in light of global supply chains in the post Covid world (Wang, et. al., 2021). Co-development also receives further support from the related fields of marketing (e.g., Rubera, et al., 2016; Ferrie, et al., 2008; Fliess and Becker, 2006) and R&D administration (e.g., Chung and Kim, 2003). The larger literature on supplier-customer co-development has evolved gradually, starting with initial contributions focused on the timing, degree of involvement, and integration of partners (e.g., Ragatz, et al., 1997; Peterson, et al., 2003; Chung and Kim, 2003). This research continues to expand followed by calls to explicitly involve the supply chain in the new product development (NPD) process (Remko & Chapman, 2006; van Hoek & Chapman, 2007).

Research has addressed a variety of topics connected to integration and NPD, including the moderating effect of such involvement on NPD outcomes (Ye, et. al., 2018), financial performance (Wang, et. al., 2021), short-term and long-term supplier-manufacturer collaborations (e.g. Van Echtelt, et al., 2008), the extent of integration (Parker, et. al., 2008), and the role of power dynamics and control in such



partnerships (Melander, et. al., 2014). This work extends the previous research by explicitly gauging the nature of relationships in the NPD co-development process, and the different degrees of integration in a partnership structure can lead to differential performance outcomes.

Since the 2000s, work focusing on the structure of collaboration in such partnerships has emerged. For example, Wong, et al. (2011) found that three dimensions of supply chain integration (information sharing, strategic partnerships, joint planning with rapid response) were more strongly associated with outcome performance (e.g., delivery, cost, quality and flexibility) under conditions of high environmental uncertainty. This may explain why industry differences, like positive quality outcomes confined to the electronics industry, often appear in previous studies (e.g., Chung and Kim, 2003). Wong, et al. (2013) follow up their first study with additional theoretical development (i.e., organizational ambidexterity) and find that external integration and complementary integration are “positively associated with product innovation but internal integration and balanced integration are not associated with product innovation” (Wong, et al., 2013, p. 566).

Yet, while occasional mentions of *structure* (Ragatz, et al., 1997) and *co-development processes* (Fliess and Becker, 2006) appear in this literature, the actual opening of the black box of *degrees of cooperation* is rare, and integration continues remains a “...poorly understood concept” (Frankel & Mollenkopf, 2015, p.18). Indeed, in a review of the state of collaboration research, Soosay & Hyland (2015) find that the major themes that have been studied include the “meaning of collaboration; considerations for supply chain collaboration theory; emerging areas in collaboration for sustainability, technology-enabled supply chains and humanitarian supply chains; and the need for a more holistic approach” (pg. 613), but has no mention of the structuring of such partnerships.

There exists little doubt in the positive role of integration in improved firm performance (Frohlich & Westbrook, 2001; Wang et. al., 2021), and in greater performance in the NPD process (Lau, et al., 2007; Ye et. al., 2018). However, this research limits itself to capturing supplier-customer co-development information largely ignoring the question of *how* these relationships are actually structured. Moreover, extant literature has yet to explore the connection between the *dynamics* of this structuring and its connection to firm performance. The ambiguity surrounding the dynamics and structure of partnerships has inadvertently shifted researchers' focus. Instead of addressing the pivotal query of “under what conditions does supply chain integration yield the most significant impact?”, they have predominantly centered their attention on the general importance of integration (Mackelprang et al., 2014, p.85).

This study endeavors to elucidate the relationship between partnership structures and performance outcomes. Our primary research question is: What are the dynamics and mechanisms of partnership integration that result in enhanced performance? To address this, we engaged with technical experts in the New Product Development (NPD) process and those experienced in collaborative engineering. Our aim was to evaluate the nuances of their partnership structuring methodologies and the resultant performance criteria. Our findings reveal that prioritizing the synchronization of co-development partners' actions is pivotal for achieving superior operational performance. This emphasis on synchronization appears more critical than subsequent actions, such as coordination and integration, underscoring the path-dependent nature of resource orchestration. Moreover, our results highlight that while coordination primarily influences operational performance, integration predominantly affects innovation and market performance metrics.



LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

Resource Orchestration

This study's framework draws upon the Resource Orchestration (RO) theory, which was proposed as a solution to certain limitations observed in the dynamic capabilities view and the resource-based view (RBV) theory (Burin et al., 2020). Specifically, these theories were critiqued for their static approach to organizational operations and processes, as well as their lack of an operational perspective (Lewis et al., 2010; Priem & Butler, 2001a, 2001b). The RBV, for instance, posits that merely accumulating resources and capabilities is not adequate for firms to secure a competitive edge unless such capabilities are adeptly managed (Ketchen et al., 2014). RO offers a remedy to this operationalization gap, presenting a comprehensive methodology for the bundling and mobilization of resources. It initially emphasizes a structured approach to resource portfolio construction, akin to the perspectives of Wernerfelt (1984) and Barney et al. (2011). The subsequent stages involve resource bundling to attain synergistic outcomes (Hitt et al., 2016; Sirmon, Hitt, & Ireland, 2007) and leveraging these configurations to harness market opportunities, thus enhancing a firm's financial standing (Barney et al., 2011; Hughes et al., 2018; Sirmon & Hitt, 2009; Sirmon et al., 2011).

RO is versatile, proving applicable both at individual firm levels and broader supply chain contexts (Ellram et al., 2013; Wowak et al., 2016). Its relevance is particularly accentuated in dynamic business environments (Cui & Pan, 2015). RO's increasing prominence in supply chain management research is evident, with studies exploring domains such as e-commerce (Cui & Pan, 2015), reverse logistics (Ketchen et al., 2014), SC integration (Liu et al., 2016), and environmental management within SCs (Wong et al., 2018).

Resource Orchestration (RO) theory predicts competitive advantage is gained through three key mechanisms: structuring, bundling, and leveraging the resources/capabilities of the firm (Sirmon, Hitt, Ireland, & Gilbert, 2011). When viewing RO through the supply chain perspective, such resources can be acquired through leveraging the supply base, though doing so will require greater degrees of collaboration. RO extends the previous research on competitive advantage (Barney, 1991, 1997, 2001) by providing a perspective on how firms adapt over time, particularly to address shifting market conditions by recombining resources in new ways. As such firms are able to create new pathways forward by effectively orchestrating resources held by a firm and its suppliers, though these mechanisms are inherently path dependent. We combine the perspectives of collaboration with that of RO to identify different performance outcomes through the nature of the collaboration. While integration seems to be the most relevant for internal performance improvements, RO is most relevant for external performance improvements. When it comes to structuring partnerships, the role of integration of RO are inherently connected as it bridges internal and external performance. Although collaboration would be particularly beneficial for internal operational performance, as the performance becomes more external, such as innovation and market performance, the ability to generate new pathways forward would be more dependent on effective RO.

We view collaboration research as a lens to better understand how firms are able to achieve greater degrees of internal performance (i.e., operational performance and innovation) and RO to explain how firms use relational resources through integration to promote greater degrees of dyadic/external performance (i.e., innovation performance and market performance). This responds to recent calls for research that explores how firms orchestrate resources to create growth through innovation (Carnes, et al., 2017) as well as extends research focusing on the operational benefits of additional integration (Yan & Dooley, 2014). Combined, these theoretical perspectives have the potential to provide greater insight into how different types of buyer-



supplier collaboration can lead to different types of firm performance, and thereby help to elucidate the structure-performance link.

Path Dependency in the Supply Chain Innovation Process: The RO Link

An important theoretical perspective relatively ignored from the co-development literature is the path-dependency of the innovation process, including the time lag to mount significant new technology projects (Rothaermel and Hill, 2005), and the modification of the phasing methods often needed to accommodate particular corporate cultures (Ettlie & Elsenbach, 2007), and to understand commercial success (Ettlie, 1997). For example, it took 13 years from a working prototype to a commercial introduction of the Gillette Sensor Razor (Hammonds, 1990). New products are likely to impact revenues and market share first and then, later, more traditional accounting measures will register the successful new product offerings. Thus, not only does the NPD process emerge as a phased or staged process, NPD outcomes are also ordered chronologically: first revenues and market share are impacted and then traditional accounting measures like profits follow, but time-lagged. Further, the link between R&D and returns is stronger with greater product market competition (Gu, 2016; Shen & Zhang, 2013).

RO exhibits similar sets of path dependencies, where resources must first be structured, bundled, and then leveraged (Andersén & Ljungkvist, 2021). When connected to NPD, the nature of integration and RO become increasingly important as “resource orchestration for innovation is a process of arrangement of all enterprise resources and external resources to produce the combinative capabilities” (Li & Jia, 2018, p:1136).

The process of integration is similarly path dependent and matches the steps included in RO. As firms integrate over time, they must first structure the relationship in order to effectively communicate information. We discuss this process under the label of *synchronization*. After the structure is established between firms, they are better able to coordinate their resources – effectively bundling the competitive strengths of multiple forms as they jointly engage in the new product development process. This process we discuss as *coordination*. Finally, once the firms have structured and coordinated their resources, they are able to leverage those combined resources in order to achieve market advantage through *integration*.

Supply Chain Synchronization

Synchronization serves the role of initial structuring in RO in partnerships as it delineates the resources available and connects the resources between companies. McLaren, Head and Yaun (2002, p.348) argue that, “a confusing assortment of alternative information systems approaches for supporting collaborative SCM <supply chain management>.... <and present> a framework for understanding the expected costs and benefits of each type of system. These costs include not only the total cost of ownership of the system, but also the partnership opportunity cost – the cost of being tied to a partner due to system inflexibility <and> benefits of collaborative SCM include process, inventory, and product cost reductions as well as increased cycle times, service levels, and market intelligence.” These different information systems provide the ability of firms to synchronize across organizations making such expenses worthwhile given the positive operational outcomes that are possible.

He, et al. (2014) included extensive coverage of supplier integration activities and find that that manufacturing flexibility mediated the impact of supplier integration on customer integration and the direct effects on product performance. This effect is generally supported in the literature (e.g., Chen, Daugherty and Roth, 2009), with recent meta analyses finding “a positive relationship between supplier involvement as



a general organizational practice and focal firm performance” (Suurmond, et. al., 2020, pg. 36). Several scholars distinguish between types of collaboration, including synchronization of processes, and both internal integration and external integration (e.g., Flynn, Huo & Zhao, 2009; Zhao, Selen & Yeung, 2011). Further, research also emphasizes “coordinative integration with customers and suppliers” to remove barriers between organizations, and to reduce information asymmetries (Wiengarten & Longoni, 2015, p.146) thereby leading to heightened operational performance.

Based on the review of the literature on collaboration, we hypothesize that synchronized partnerships will have higher operational performance due to the advantages offered. However, the nature of the collaboration is constrained by the information systems used for integrating across organizational boundaries are both expensive and slow to change. In addition, considerations must also be made with respect to the challenges that exist in this synchronizing stage of the integration process. Perhaps the most basic and persistent historical challenge is the melding of two or more firms in order to contribute best to joint competitive advantage (e.g., Cao et. al., 2015; Fawcett, et al, 2021), in the firm’s “extended manufacturing enterprise,” (Chapman and Corso, 2007). Therefore, we offer the following hypothesis for testing.

H1: Synchronized partnerships have a positive impact on operational performance

Supply Chain Coordination

Coordination serves the role of bundling in RO in partnerships as the resources across groups (supplier-customer) are used simultaneously for joint efforts. Coordination presents a unique position for collaboration as it allows for improvements in internal operational performance as well as the ability to coordinate resources with business partners. Supply chain coordination can accommodate many different types of collaborative goals, and can include operational coordination, innovation coordination, and strategic coordination between organizations. Preston, et al. (2017) explores buyer-supplier relationship and use a social capital theory approach to co-development and find that there are interactions among dimensions of social capital. They show that relational social capital facilitates transfer of knowledge from buyer to supplier, which, in turn, impacts cost efficiency and innovation, suggesting that the effective coordination of information can lead to performance gains both internally and externally vis-à-vis innovation.

Expanding on these effects, Lee, et al. (2019) identify four step-wise effects of collaboration for the phases of the innovation process using innovation characteristics and efficiency as the outcome metrics. This serves as the underpinning of the path-dependency approach we advance in this manuscript. Additionally, DeCampos (2014) found that it was not the extent of collaborative agreement (e.g., alignment or mutual understanding) between suppliers and customers that determined outcomes, but the clarity of their positions and roles during significant new product development projects. This effect has also been shown in other contexts. Specifically, Cheng, Chaudhuri, and Farooq (2016) examine the context of inter-plant coordination within a manufacturing network and find that external integration (i.e. coordination) has a positive impact on operational performance. Given that the evidence demonstrates the importance of coordinated partnerships on both operational and innovation performance, we hypothesize:

H2a: Coordinated partnerships have a positive impact on operational performance

H2b: Coordinated partnerships have a positive impact on innovation performance

Supply Chain Integration: Leveraging

Integration serves the role of leveraging in RO in partnerships as the resources are effectively joined into a unified whole that can lead to external benefits. Barki, et al. (2005, p. 165) define organizational

integration as the “extent to which distinct and interdependent organizational components constitute a unified whole”, and this effect in partnership structures can allow greater combinatory application of the resources than is possible independently, effectively leveraging the synergistic potential of partnerships. Integration requires far more than simple synchronization or coordination, as the assets need to be fully leveraged. Rubenstein (1989, p.142) compiles an inventory of 19 coordinating mechanisms in order to enhance technology sharing among divisions. However, only of a few of these adaptations actually seem to work including delaying rewards for divisional managers until longer-term performance outcomes are obtained, and technology centers which tend to focus efforts on strategic, rather than tactical, issues. This variety of structural adaptations for technological integration would not be necessary if integration were a matter of coordinating assets or resources.

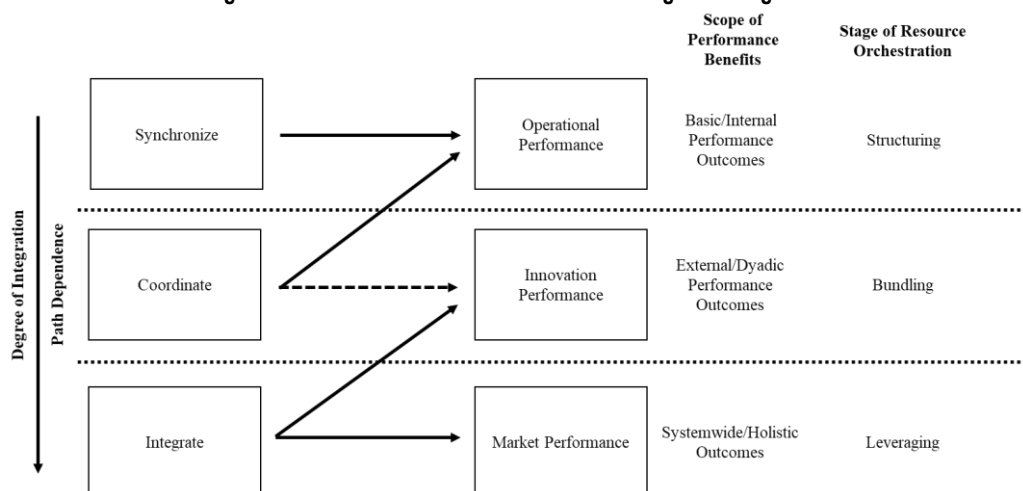
The most recent literature on the importance of integration in the new product development process and utilization of technological assets reinforces the tradition of literature cited herein. Zubair, et al (2021) focus on the timing of suppliers in NPD in the extended enterprise and note that there exist both the positive and negative aspects of knowledge exchange depending upon the levels of uncertainty of requirements (Stock, et al, 2020). In a review of 100 articles on new product development, Panizzon, et al (2021) found that most of these studies converge on the identification of the significant positive relationship of integration in strategic alliances and performance of new product development. De Oliveira, and de Oliveira (2022), based on qualitative data from 101 Brazilian firms, found market orientation moderated the relationship between entrepreneurial orientation and partnerships which suggests markets and innovation ought to be distinguished. Wei, et al (2022) find that competitive threats from outside the firm did not incentivize firms to cooperate on new product development, which suggests looking even closer at suppliers’ collaboration structures. Further, Xu and Zeng (2021) found that the more diverse the R&D alliances the better the NPD performance. Finally, Dubey, et al (2021) it is critical to build alliance management capability and information visibility to obtain desired NPD success. Thus, combining the perspectives of RO and extant work in the integration space, we suggest:

H3a: Integrated partnerships have a positive impact on innovation performance.

H3b: Integrated partnerships have a positive impact on market performance.

A conceptual model of the relationships tested in this study can be found in Figure 1.

Figure 1: Performance Outcomes at Different Stages of Integration



Notes: Solid line indicates a supported ($p < .05$) relationship and dotted line indicates a non-supported ($p > .05$) relationship.



3. METHOD

3.1. Data Collection

The core focus of this research is to understand the connection between the co-development partnership structuring dynamics (i.e. synchronizing, coordination, integration) and their impact on performance (i.e. operational, innovation, and market) by using RO as the theoretical connective tissue. The first phase of this project began with five in-depth case studies of companies chosen for their known, recent experience with interorganizational collaborations. The companies represented a diverse set of industries: eye care, automotive/truck assembly, film and chemicals, and one firm in plastic mold and prototype manufacturing. Members of our team spoke to over a dozen managers and technical support people in these five firms and had two complete demonstrations of collaborative engineering systems in order to begin developing our survey and interview protocols.

Guided by the preliminary work we developed a survey and mailed to firms in manufacturing and related economic sectors. The company or individual lists were obtained from professional societies (e.g., SME, ASME, IEEE, ASAE, TF&B, ISPE, IRI, NSPE). A final list of companies was created that represented firms with the highest R&D spending in the Standard Industrial Classification (SIC) codes 28, 35, 36, 38. Chief Technical Officers were identified as the best possible recipients for that mailing and 1770 qualified survey invites targeted at these experts were mailed. Surveys were returned with the greatest concentration of respondents in Chemicals (SIC 28), Fabricated Metals (SIC 34), Industrial Machinery (SIC 35), Electronics (SIC 36), Transportation Equipment (SIC 37), and Instruments (SIC 38).

A total of 227 surveys to U.S. firms were returned completed. Upon examination, we found 7 unusable surveys (not from target populations) that needed to be eliminated. These were from unidentified respondents. This left us with 220 responses. Our effective response rate was 12.43% (220/1770). Finally, 7 more surveys were removed due to have partial missing data (incomplete) leaving a total of 213 surveys ($n=213$) for our analyses.

We found no evidence of response bias in these returns. Two weeks after the surveys were mailed out to the companies, we made follow-up phone calls to increase the response rate. Companies were chosen by their SIC listing. Of those listings, 20% of non-respondent firms were contacted. Those firms were selected by random number generation and presented a representative sample of firms in that classification. Comparisons were then made between this sample of manufacturing firms and the Hoover's archive compiled on the Fortune 1000. From that analysis, no significant differences were found on sales ($t = 1.65$, n.s.), sales growth ($t = 1.66$, n.s.), employees ($t = 1.65$, n.s.), R&D expenditure ($t = 1.66$, n.s.), ROE ($t = 1.67$, n.s.), and current ratio ($t = 1.66$, n.s.).

3.2. Dependent Variables' Measurement and Validation

The above hypothesis development used three performance measures shown to be outcomes of successful RO: 1) Operational performance (c.f. Yu et al., 2021); 2) Innovation performance (c.f. Carnes et al., 2017); and (3) Market performance (c.f. Choi, Pinsonneault, & Han, 2020). In order to appropriately operationalize these three variables, we note that the original survey instrument included in it a section titled "Outcomes of the New Product Development (NPD) process" wherein it asks respondents "For each statement, please mark the box that best describes the performance (cost, quality, innovation) of your new product development process *relative to your major competitors*" across 12 measures. These 12 measures were: 1. Overall development costs, 2. Efficiency of product development investment, 3. Lead times, 4.

Superiority of commercialization, 5. Improvement in product functionality/quality, 6. Improvements in elements of product technologies, 7. Major innovation in product technologies, 8. Major innovation in products as a whole, 9. Creation of new product concepts, 10. Improvement in NPD process, 11. Reduction in quality problems, and 12. Surprise and delight new product customers.

We then took the data for each of these 12 measures and ran an exploratory factor analysis, using the principal factor method with varimax rotation, and assigned each measure to its corresponding new factor using .40 as a cutoff for assignment of variable to factor. We extracted three factors from the data: the first, which we label Innovation Performance, with item numbers (listed above) 4, 5, 6, 10, and 11 loading on to this factor with a Cronbach's alpha of .70 .The second factor, which we labelled Market Performance, with item numbers 7, 8, 9, and 12 revealed a Cronbach's alpha of .77. Finally, the third factor, which we labelled Operational Performance with item numbers 1, 2, and 3 had a Cronbach's alpha of .71.

As a secondary check, we verified the factor structures extracted in the prior steps. We turned to structural equation modeling to build a measurement model of the factors. The measurement model or confirmatory factor analysis defines how latent variables are measured through observed variables and provides confirmation of the factor structures. We restricted the items to load on their pre-assigned factor and set the latent factors to correlate freely (Gerbing & Anderson, 1988). CFA results revealed adequate fit (NFI = 0.918, NNFI = 0.977, IFI, 0.880, GFI = 0.931, SRMR = 0.069, RMSEA = 0.057) with most goodness of fit indices over 0.9 (Bagozzi and Yi, 2012). The Fornell–Larcker criterion (Hair et al., 2012) demonstrated that all AVEs were higher than the squared interconstruct correlations. All factors had composite reliabilities in excess of .7. Rotated individual factor loadings, information on reliability and validity can be seen in Table 1. All factor scores were created using the regression method.

Table 1: Rotated Factor Loadings for the Dependent Variables

Items	Factor 1	Factor 2	Factor 3	Construct	Cronbach's Alpha	Composite Reliability	AVE
1. Overall Development Costs			0.617	Operational Performance (Items 1, 2, 3)	0.71	.77	.58
2. Efficiency of Product Development Investment			0.657				
3. Lead Times			0.553				
4. Superiority of Commercialization		0.451		Innovation Performance (Items 4, 5, 6, 10, 11)	0.70	.74	.55
5.Improvement in Product Functionality/Quality	0.350	0.531					
6. Improvements in Elements of Product Technologies	0.410	0.554					
7. Major Innovation in Product Technologies	0.730			Market Performance (Items 7, 8, 9, 12)	0.77	.79	.63
8. Major Innovation in Products as a whole	0.781						
9. Creation of New Product Concepts	0.651						
10. Improvement in NPD Process		0.410		Innovation Performance (Items 4, 5, 6, 10, 11)	0.70	.71	.55
11. Reduction in Quality Problems		0.485					
12. Surprise or Delight New Product Customers	0.3987			Market Performance (Items 7, 8, 9, 12)	0.77	.79	.63

Notes: blanks represent abs(loading)<.3,
Principal factor method used with varimax rotation
Scale: 1-Worse than competitors; 2-Same; 3-Better than competitors

3.3. Partnership Organization Constructs

We hypothesized that three core dimensions of partnership structuring, based on RO, would impact firm performance: (1) synchronized (i.e. structuring), (2) integrated (i.e. bundling), and (3) coordinated (i.e. leveraging) partnerships. Albers, et al. (2019) identify “**coordination**” as one of three key dimensions in transnational virtual R&D teams, with such teams radically transforming the way in which new product development (NPD) occurs (Marion and Fixson, 2020). The other two dimensions were communication quality and knowledge transfer. Pavlou and El Sawy (2006, 2011) validated self-report measures of **coordination** (jointly useful and **synchronized**), and **integration** (absorptive capacity) which were subsequently found by Ettlie and Pavlou (2006) to be significantly associated with new product development success as measured by **new product success rate** ($b=.28, p<.05$) and **superior product commercialization** ($b=.24, p<.05$). These collaboration constructs and measures were validated, renamed, and used in the current research, as detailed herein (for further detail on how some of these data were previously used, please also refer to Ettlie, Tucci, and Gianiodis, 2017).

In order to operationalize these dimensions a three-part, 12-item protocol was evaluated by respondents by having them indicate whether or not their new product development process was worse than competitors, neutral, or better than competitors following established processes (Pavlou and El Sawy, 2006, 2011). Then factor analyses were conducted on these data (principal factor and varimax rotation) which generated three structuring dimensions: **synchronized** (five items, Cronbach alpha=.83), **integrated** (four items, Cronbach alpha=.86), and **coordinated** (three items, Cronbach alpha=.84).

We confirmed these factor structures again with a CFA. CFA results revealed adequate fit (NFI = 0.900, NNFI = 0.927, IFI, 0.899, GFI = 0.911, SRMR = 0.067, RMSEA = 0.051) with most goodness of fit indices over 0.9 (Bagozzi and Yi, 2012). The Fornell–Larcker criterion (Hair et al., 2012) was employed to ensure that all AVEs were higher than the squared interconstruct correlations. All factors had composite reliabilities in excess of .7. Rotated loadings, factor assignments, and the questions used in this part of the survey can be seen in table 2. All factor scores were created using the regression method.

Table 2: Rotated Factor Loadings, Factor Assignment, and Survey Protocol for Partnership Dimensions

Variable	Factor 1	Factor 2	Factor 3	Construct	Cronbach's Alpha	Composite Reliability	AVE
1. We ensure that the output of our work (knowledge, expertise, resources) is of a form useful to our partner.		0.426		Synchronized	0.83	.89	.55
2. We ensure that the output of our work is available to our external partner when needed (at the right time).		0.661					
3. We ensure that the output of our work is synchronized with the work of our external partner.		0.642					
4. We ensure that the output of our work is available to our partner where it is needed (at the right place)		0.631					
5. We ensure that an appropriate allocation of resources (e.g. information, time, reports) with our external partner.		0.666					
6. We are able to identify, value and import external knowledge from our external partner.	0.717			Integrated	0.86	.88	.61

7. We have adequate internal routines to analyze the knowledge obtained from our external partner	0.723						
8. We can successfully integrate existing knowledge with new knowledge required from our external partner.	0.531						
9. We can successfully exploit the new integrated knowledge into concrete applications.	0.730						
10. Members from both companies make their contributions to the joint outcome with attention and care			0.740				
11. Members from both companies have a global perspective of each other's tasks and responsibilities			0.690	Coordinated	0.84	.86	.74
12. Members from both companies carefully interrelate actions to each other to maximize joint performance.			0.643				
Notes: blanks represent abs(loading)<.4, principal factor method used with varimax rotation Scale of each question: 1-Much Worse; 2-Worse; 3-Same; 4-Better; 5-Much Better							

3.4. Control Variables

Though we expect that the structuring dimensions noted above will capture much of the heterogeneity involved in the relationship between RO and performance, we also control for several important aspects of these partnerships in order to remain methodologically rigorous. First, we captured the level of internal support (from the technological portion of the organization) for NPD. The survey instrument asked respondents to “Please write the number that best describes how you much you agree or disagree with each statement”, using a 5-Point Likert scale where 1 is “Disagree Strongly” and 5 is “Agree Strongly”, across 16 dimensions of support (language of the questions can be seen in Table 3). We then took these data and performed an exploratory factor analysis with principal factor and a varimax rotation, with the criteria for assigning the variable to a factor set at .40. Upon completion, these 16 dimensions reduced down to three core factors: the first, which we label as Internal Support, onto which 7 items loaded with a Cronbach’s alpha of .90; the second, which we label as Internal Capability onto which 6 items loaded with a Cronbach’s alpha of .89; and the final, which we label as Principal Alignment onto which the remaining 2 items loaded with a Cronbach’s alpha of .78. Note that there was one variable that did not load onto any of these three factors, therefore it was not included in this dimensionality reduction.

All factor variable scores were calculated using the regression method (e.g. DiStefano, Zhu, & Mindrila, 2009). The details of the loadings and associated data is presented in Table 3. Once again we confirmed these factor structures with a CFA. CFA results revealed adequate fit (NFI = 0.899, NNFI = 0.917, IFI, 0.900, GFI = 0.906, SRMR = 0.060, RMSEA = 0.053) with most goodness of fit indices over 0.9 (Bagozzi and Yi, 2012). The Fornell–Larcker criterion (Hair et al., 2012) demonstrated that all AVEs were higher than the squared interconstruct correlations. All factors had composite reliabilities in excess of .7. Factor scores were created using the regression method.

Table 3: Rotated Factor Loadings, Factor Assignment, and Survey Protocol for Internal Support

Variable	Factor1	Factor2	Factor3	Construct	Cronbach's Alpha	Composite Reliability	AVE
1. IT is very capable of performing its NPD support job.		0.780		Internal Capability	0.89	0.91	.57
2. IT is known to be successful at the things it tries to do in NPD support.		0.686					



3. IT has much knowledge about the work that needs to be done to support NPD.		0.708					
4. I feel confident about IT's skills to support NPD.		0.723					
5. IT has specialized capabilities that can increase our performance.		0.521					
6. IT is well qualified.		0.568					
7. IT is very concerned about my welfare and the welfare of engineering.	0.825						
8. My needs and the desires of my group are very important to IT.	0.796						
9. IT would not knowingly do anything to hurt me or engineering.	0.447						
10. IT really looks out for what is important to me and engineering.	0.733			Internal Support	0.90	.90	0.67
11. IT will go out of its way to help me and my group.	0.702						
12. IT has a strong sense of justice (i.e., impartial adjustment of conflicting claims).	0.533						
13. I never have to wonder whether IT will stick to its word.	0.430						
14. I like IT's values.	0.525		0.653	Principal Alignment	0.78	.79	.56
15. Sound principles seem to guide top management's behavior regarding IT.		0.401	0.511				

Notes: (blanks represent abs(loading)<.4).
Scale of each question: 1-Disagree strongly; 2-Disagree; 3-Neither agree nor disagree; 4-Agree; 5-Agree strongly
There was also a 16th variable in this portion of the questionnaire listed as "IT's actions and behaviors are not very consistent." It was not factored as its loading was onto one factor with a variance less than 1 and a loading of -0.4455

We also considered (using self-report indicators) of the percentage of teams using **virtual engineering**, the type of **stage-gate used** (none, informal, traditional and modified, scored 1, 2, 3 and 4, respectively), **partner** status (coded dichotomously where 1 indicates a supplier, and 2 indicates a buyer), **R&D percentage**, the number of **programs fully implemented**, in addition to the **new product profit** and **new product sales**. Taken together, we contend that these control variables reasonably control for issues of omitted variable bias, and other related issues. Correlations and summary statistics for all variables used in this study appear in Table 4.

Table 4: Summary Statistics & Correlations

Variable,	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Operational Performance	-															
2. Innovation Performance	0.067	-														
3. Market Performance	0.050	0.188*	-													
4. Synchronize	0.352*	0.219*	0.229*	-												
5. Coordinate	0.295*	0.172*	0.387*	0.130	-											
6. Integrate	0.086	0.409*	0.282*	0.108	0.195*	-										
7. Internal Capability	0.175*	0.155*	0.097	0.211*	0.255*	0.113	-									
8. Internal Support	0.205*	0.273*	0.102	0.189*	0.215*	0.255*	0.103	-								
9. Principle Alignment	0.077	0.027	0.159*	0.082	0.199*	0.023	0.134	0.133	-							
10. R&D %	0.023	-0.013	-0.046	0.002	-0.069	-0.030	0.150*	0.072	0.018	-						
11. Stage Gate	0.027	-0.056	0.188*	0.119	0.114	0.049	-0.005	-0.085	0.135	-0.220*	-					
12. Supplier(Customer)	0.052	0.031	0.092	0.043	0.076	0.098	0.081	0.011	-0.002	-0.036	-0.056	-				
13. NPD Virtual Teams	0.223*	-0.119	0.086	0.156*	0.169*	0.043	0.176*	-0.062	0.087	0.126	0.258*	0.090	-			
14. # Finished Products	-0.049	0.035	-0.019	-0.106	-0.027	-0.067	-0.042	-0.055	-0.074	0.062	-0.023	-0.091	0.233*	-		
15. New Product Profit	-0.066	0.057	-0.018	-0.038	-0.126	0.240*	0.075	0.115	-0.066	0.405*	-0.091	0.084	-0.045	-0.063	-	
16. New Product Sales	0.146	0.099	-0.049	0.095	-0.037	0.186*	0.250*	0.085	-0.080	0.351*	-0.107	0.007	0.029	-0.087	0.731*	-
Mean	-0.063	-0.081	0.001	-0.081	-0.017	-0.106	-0.002	-0.101	0.009	12.097	2.733	1.429	23.044	4.819	34.048	28.038
Standard Deviation	0.862	0.847	0.760	0.920	0.853	0.879	0.903	0.844	0.722	16.241	0.943	0.497	29.474	14.228	79.453	29.233

* p<0.05

3.5. Model Estimation

Summarized, our hypothesis development suggested that: (1) synchronization (i.e. structuring) will have a positive effect on operational performance; (2) coordination (i.e. bundling) will have a positive effect on operational, and innovation performance; and (3) integration (i.e. leveraging) would have a positive effect on innovation, and market performance. In order to estimate these three distinct equations, we use Ordinary Least Squares (OLS) estimation with robust standard errors, and estimate the following specifications:

Operational Performance

$$= \beta_0 + \beta_1 \text{Synchronize} + \beta_2 \text{Coordinate} + \beta_3 \text{Internal Support} + \beta_4 \text{Internal Capability} + \beta_5 \text{Principal Alignment} + \beta_m \text{Controls} + \varepsilon$$

Innovation Performance

$$= \beta_0 + \beta_1 \text{Coordinate} + \beta_2 \text{Integrate} + \beta_3 \text{Internal Support} + \beta_4 \text{Internal Capability} + \beta_5 \text{Principal Alignment} + \beta_m \text{Controls} + \varepsilon$$

Market Performance

$$= \beta_0 + \beta_1 \text{Integrate} + \beta_2 \text{Internal Support} + \beta_3 \text{Internal Capability} + \beta_4 \text{Principal Alignment} + \beta_m \text{Controls} + \varepsilon$$

where CONTROLS represents the m control variables used (detailed in the above section), ε represents each equation's error term. Also note that although the dependent variables are certainly theoretically related, because we have used a principal factor method and created three distinct constructs (from previously very highly correlated variables) the need for a simultaneous approach to capture the empirical interrelatedness of the dependent variables is not necessary (though, in the robustness section, below we report the results of two such tests to ensure methodological accuracy and rigor).

4. Results

After capturing all relevant control variables and including them in the estimation, the final models were estimated on 105 unique observations. Table 5 presents the results of this estimation. Turning our attention to the fit statistics for each of these models we see that the F-Statistics (df1, df2) are 20.32 (12, 92) and statistically significant ($p < .01$), 3.74 (12,92) and statistically significant ($p < .01$), and 4.01 (12, 92) and statistically significant ($p < .01$), for operational performance, innovation performance, and market performance, respectively. We also note that the RMSE statistics are .753, .779, and .732 for operational performance, innovation performance, and market performance, respectively. Finally, the R^2 statistics are .326, .241, and .170 for operational performance, innovation performance, and market performance, respectively. Taken together we find that the data adequately fit the models.

Table 5: Regression Results

Models	Regression Estimates					
	Operational Performance		Innovation Performance		Market Performance	
Independent Variable	B	Robust S.E.	B	Robust S.E.	B	Robust S.E.
Synchronize	0.281 *	0.088	-	-	-	-
Coordinate	0.212 *	0.087	0.087	0.101	-	-

Integrate	- -	0.380 **	0.084	0.303 **	0.092
Internal Capability	0.0098	0.089	0.048	0.097	0.036
Internal Support	0.120	0.095	0.114	0.105	0.045
Principle Alignment	-0.022	0.115	0.039	0.119	0.107
R&D %	-0.003	0.006	-0.002	0.006	-0.009
Stage Gate	0.036	0.090	0.014	0.096	0.121
Supplier(Customer)	0.102	0.148	-0.056	0.159	0.055
NPD Virtual Teams	0.005 *	0.003	-0.006 *	0.003	-0.001
# Finished Products	-0.002	0.003	0.008 *	0.004	0.001
New Product Profit	-0.003 *	0.001	-0.001	0.001	-0.001
New Product Sales	0.010 *	0.004	0.003	0.004	0.001
Intercept	-0.505	0.360	0.087	0.421	-0.328
Model fit					
Observations	105		105	105	
RMSE	0.753		0.779	0.732	
R-Sq	0.326		0.241	0.170	
F (df1, df2)	20.32**(12,92)		3.74**(12,92)	4.01**(12,92)	
*p<.05, **p<.001,					

H1 posited that synchronization has a positive impact on operational performance. Regression results show that the coefficient ($\beta=.281$) for Synchronize for operational performance is positive and statistically significant ($p<.05$). This lends support for H1. Next, H2 suggested that coordination would have a positive impact on operational, and innovation performance. Our results show that the coefficient ($\beta=.212$) for coordinate on operational performance is positive and statistically significant ($p<.05$). However, the coefficient ($\beta=.087$) on innovation performance is positive but not statistically significant ($p>.1$). These results indicate there is evidence to support H2a, but we were unable to find support for H2b. A possible explanation for this is that the measurement of coordination and innovation performance could not effectively capture these without lagged effects (see Table 2 for measures).

Finally, in H3, we hypothesized that integration would have a positive impact on innovation, and market performance. The coefficient for integrate on innovation performance is positive ($\beta=.380$) and statistically significant ($p<.01$), and for market performance ($\beta=.303$) is positive and statistically significant ($p<.01$). These results indicate that both H3a and H3b are supported by the results of the regression.

Table 6: Hypothesis Summary & Support

Hypothesis	Supported?	Significance
H1 synchronized partnerships have a positive impact on operational performance	Yes	$p<.05$
H2a coordinated partnerships have a positive impact on operational performance	Yes	$p<.05$
H2b coordinated partnerships have a positive impact on innovation performance	No	<i>ns.</i>
H3a integrated partnerships have a positive impact on innovation performance	Yes	$p<.001$
H3b integrated partnerships have a positive impact on market performance	Yes	$p<.001$

4.1. Robustness

To add rigor to the method and to ensure the appropriateness of the methods used, we looked to the seemingly unrelated regression approach (c.f. Zellner, 1962; Zellner & Huang, 1962; Zellner, 1963). First, we note that each of the three dependent variables are theoretically related, and that there is a potential for the standard errors in their empirical estimations would also be related. Thus, we employ the Seemingly Unrelated Regression (SUR) approach which is a simultaneous estimation that uses a feasible generalized least squares regression where the variance-covariance matrix is augmented to capture the potential interdependencies between the error terms. We note that the variables' effect sizes, standard errors, and model fit statistics are all relatively unchanged. In addition, we also test a Breusch-Pagan (Breusch & Pagan, 1980; Godfrey and Yamagata (2011) test of independence as a post-estimation technique on this simultaneous model, wherein the null hypothesis of this method is that there is no correlation between the residuals of the dependent variables that have been jointly estimated under. The χ^2 statistic, with three degrees of freedom, for this test is 2.94 and is not statistically significant ($p > .1$) thereby providing no support for rejection of the null hypothesis, indicating that there is no evidence of correlation between the residuals, which would have otherwise necessitated a simultaneous approach as the primary method of estimation.

4.2. Post-Hoc Analysis

The core question of this research speaks to the path dependent role of partnership dynamics and how they affect performance. The performance dimensions were factors derived from the survey instrument used in the original data collection. While we contend that they are theoretically reflective of three important performance metrics, a more comprehensive approach is to include objective measurements of performance. The team determined that the best approach for this would be to gather financial data; specifically, the team gathered Earnings Before Interest & Taxation (EBIT), Return on Assets (ROA), Cash Conversion Cycle (CCC), and Sales data for the following three years since the survey data responses. These measures are guided by prior studies in these domains consistently (Carnovale, Rogers, & Yenyurt, 2019; Carnovale & Yenyurt, 2015).

For this validation we filtered through the firms included in the original round of data collection and separated out those firms that were publicly traded. This resulted in a reduced sample of 74 firms. Of these 74 firms, there were 32 firms with complete responses for the synchronize, coordinate, and integrate variables, as well as the control variables detailed prior. Then, we estimate a seemingly unrelated regression with EBIT, ROA, CCC, and Sales for the year our dependent variables, and the same independent variables as noted above. In essence:

$$\begin{aligned}
 EBIT &= \beta_{10} + \beta_{11}Synchronize + \beta_{12}Coordinate + \beta_{13}Integrate \\
 &\quad + \beta_{14}Internal\ Capability + \beta_{15}Principal\ Alignment \\
 &\quad + \beta_{1m}Controls + \varepsilon \\
 ROA &= \beta_{20} + \beta_{21}Synchronize + \beta_{22}Coordinate + \beta_{23}Integrate \\
 &\quad + \beta_{24}Internal\ Capability + \beta_{25}Principal\ Alignment \\
 &\quad + \beta_{2m}Controls + \varepsilon \\
 CCC &= \beta_{30} + \beta_{31}Synchronize + \beta_{32}Coordinate + \beta_{33}Integrate \\
 &\quad + \beta_{34}Internal\ Capability + \beta_{35}Principal\ Alignment \\
 &\quad + \beta_{3m}Controls + \varepsilon
 \end{aligned}$$

$$\begin{aligned} \text{Sales} = & \beta_{40} + \beta_{41}\text{Synchronize} + \beta_{42}\text{Coordinate} + \beta_{43}\text{Integrate} \\ & + \beta_{44}\text{Internal Capability} + \beta_{45}\text{Principal Alignment} \\ & + \beta_{4m}\text{Controls} + \varepsilon \end{aligned}$$

where CONTROLS represents a vector of m control variables used (detailed above), ε represents each equation's error term. In this post-hoc, much like the main models, we took into account the percentage of teams using **virtual engineering**, the type of **stage-gate used** (none, informal, traditional and modified, scored 1, 2, 3 and 4, respectively), **partner** status (coded dichotomously where 1 indicates a supplier, and 2 indicates a buyer), **R&D percentage**, the number of **programs fully implemented**, in addition to the **new product profit** and **new product sales**.

Table 7: Post-Hoc Results

Models	Regression Estimates							
	EBIT		ROA		Sales		CCC	
Independent Variable	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Synchronize	-735.180	-1.361	2.721	1.371	-8141.841	-0.810	10.161	0.901
Coordinate	-935.160	-1.500	-0.980	-0.431	-6719.684	-0.571	10.312	0.789
Integrate	1183.931 *	1.870	4.372 *	1.890	22754.532 *	1.903	-15.230	-1.150
R&D %	-15.056	-0.462	-0.411 **	-3.443	5.181	0.011	-0.570	-0.844
Stage Gate	-541.242	-0.961	0.983	0.480	-5121.553	-0.483	-3.153	-0.271
Supplier(Customer)	3070.912 *	3.071	3.660	1.001	9498.491	0.504	-7.431	-0.350
NPD Virtual Teams	-24.322	-1.286	-0.143 *	-1.951	-42.060	-0.122	0.176	0.420
# Finished Products	-34.194	-0.273	0.351	0.764	786.390	0.335	1.080	0.412
New Product Profit	-26.52 *	-2.943	0.040	1.171	-154.703	-0.911	0.091	0.491
New Product Sales	65.49 *	2.365	-0.022	-0.220	44.001	0.083	-0.150	-0.260
Intercept	-1482.73	-0.620	0.221	0.020	26744.190	0.591	93.531 *	1.875
Model fit								
Observations	32		32		32		32	
R ²	0.401		0.606		0.170		0.148	
RMSE	1981.234		7.257		37463.480		41.502	
Chi-Sq	21.400		49.272		6.550		5.582	
*p<.05, **p<.001								

The results reveal a rather noteworthy pattern. Of the three dimensions (i.e. synchronize, integrate, and coordinate) only integrate revealed anything meaningful significance. Specifically, the coefficient for **integrate** on EBIT was 1,183.93 and marginally statistically significant ($p<.1$), on ROA was 4.37 and marginally statistically significant ($p<.1$), and on Sales was 22,754.53 and marginally statistically significant ($p<.1$). The coefficient for CCC was not statistically significant ($p>.1$). In order to be comprehensive, we also tested the effect of these three dimensions on the same dependent variables in the two years following. The results remained largely consistent.

5. Discussion

This study began by asking: what are the integration (i.e. structuring) dynamics/mechanisms of partnerships that lead to increased firm performance? The results of this study indicate support for a path dependent explanation of outcomes of the co-development process for new products (in several manufacturing sectors) of a stable. Essentially, data analysis reveals a significant relationship between the structuring mechanisms of RO and time-dependent outcomes typical of new product innovations. For example, synchronizing co-development partners' actions that impact operational performance takes precedence over subsequent actions like coordinating and integrating, thus the results are largely confirmatory with extant studies on RO. This has never been fully and simultaneously tested in a validated co-development model of the NPD process. We found that coordination impacts operational performance, but not innovation performance. Theoretically this is noteworthy: coordinating seems to have a larger impact on more internal performance dimensions, rather than those focused on the dyad/externally (e.g. innovation performance). Finally, integration impacts innovation and market performances, indicating that when firms combine all the phases of RO, dyadic and externally focused performance gains can be expected. Table 8 summarizes these results, along with the theoretical grounding of the constructs and the practical and theoretical implications of the findings from this study.

Table 8: Consolidated Findings, Implications of, and Sources for Elements of RO

Construct	Literature Sources	Findings & Managerial Implications	Theoretical Implication
Synchronize	Yu et. al., 2021; Carnes et. al., 2017; Choi, Pinsonneault, & Han, 2020	Synchronized partnerships positively impact operational performance, which is a largely internally focused performance metric.	RO (RO) suggests, and the results confirm that synchronizing activities (i.e. acquiring and accumulating assets) is not only a necessary condition for future competitive advantage, but also a necessary condition for subsequent (i.e. path dependent stages of RO).
	Cheng, Chaudhuri, and Farooq, 2016; DeCampos, 2014; De Oliveira, and de Oliveira (2022);	Synchronizing activities <i>within</i> a partnership impact <i>internal</i> performance outcomes.	The findings herein confirm the empirical relationship between structuring and performance, <i>and</i> the path dependent nature of the relationship
Coordinate	Pavlou and El Sawy, 2006, 2011;	Coordinated <i>partnerships</i> positively impact <i>operational</i> performance, but have no demonstrable impact on innovation performance.	RO theory suggests that the bundling of resources is the phase of orchestration where the previously structured resources (i.e. the synchronizing step above) are assembled into capabilities.
	Flynn, Huo and Zhao (2009); Zhao, Selen and Yeung (2011);	Coordinating activities impact <i>internal</i> performance outcomes (i.e. operational performance) but have no demonstrable effect on innovation (i.e. dyadic activities)	The results herein provide confirmation of the role that such bundling has in the process, which is on the internal performance outcomes (i.e. operational performance) rather than



	Simon et. al., 2011		on more externally focused performance outcomes (i.e. innovation performance). Effectively, the results draw a boundary on the effect that bundling has.
Integrate		<p><i>Integrated partnerships have a positive impact on innovation performance, and on market performance.</i></p> <p>In addition, the post-hoc analysis reveals that there are financial benefits to facilitating integrated partnerships. We acknowledge that the sample here is limited. Integration activities within a partnership positively impact innovation and market performance.</p>	<p>RO theory suggests that the leveraging phase of RO focuses on mobilizing the previously structured and bundled resources in order to exploit such activities for performance outcomes.</p> <p>The results provide a theoretical confirmation of this relationship and provides an empirical extension on the structure performance relationship: innovation and market performance can be expected as firms increase their integrative capabilities.</p>

The pattern of RO structuring mechanisms and innovation raises new questions about path dependency and perhaps more accurately, path creation in this context. Path creation is presented by Garud and Karnoe (2012, p.3) as “temporal processes,” and their role in the emergence of novelty. The authors argue that path creation can be viewed as “mindful deviation” for entrepreneurs but use the case study of the development of post-it notes at 3M Corporation. This has important implications for our study since we empirically test the path dependent nature of RO for incumbent manufacturing firms. Given that we find clear, significant relationships between innovation and co-development structuring for integration and not synchronization or coordination, there are important potential implications for path creation in this context:

First, it is quite possible that the first- and second-order benefits of the innovation process are manifest in this empirical pattern. That is, innovation benefits occur in cycles of short and long-range impacts and demonstrate learning effects and other path-dependent challenges. In order to help resolve these challenges, some agreement on the shared information platform and the nuances of the collaboration dynamics (i.e. coordination, then synchronization, then integration) will prove helpful. There are additional complications to note, which may impact the degree of success in such partnership formations. Specifically, the emergence of Industry 4.0 and its impact on supply chain management (Fatorachian and Kazemi, 2020) as well as the security of supply chain transactions, and cybersecurity using blockchain technology (e.g., Ghode, et al, 2020; Carnovale & Yenyurt, 2021). It is also worth noting that this array of issues is greatly complicated by Covid-19’s impact on supply chain management (Alkahtani, et al, 2021; Carnovale & DuHadway, 2021; Fearn, et al, 2021).

Second, the path creation manifestation in this context suggests that integration does not emerge as sufficiently underpinned until synchronization and coordination are achieved. These findings echo and extend previous work suggesting there is an interaction between collaboration and integration (Adams, et. al., 2014). That is, integration is the most demanding of the three types of RO’s dynamics, as has been implied elsewhere (e.g., Rothenberg and Ettlie, 2011). Thus, our research serves to extend findings in this domain.

As firms achieve different levels and types of integration (see: Rothenberg and Ettl, 2011; Cheng, Chaudhuri, and Farooq, 2016) over time, they will garner performance benefits due to this process of integration that also expand based on the scope of integration. Basic levels of integration will provide basic performance outcomes, while additional stages will extend to more holistic performance outcomes, and those related to performance (Wang et. al., 2021). Third, the order in which innovation as a dependent variable emerges in these results as statistically significant suggests that there ought to be consideration of innovation as an independent variable in future research, consistent with the first point above concerning first- and second-order benefits resulting from learning during the development process. The important difference here is that this learning is jointly owned by co-development partners.

Finally, there are additional noteworthy findings that arose from the empirical analysis. First, extant research that examines the partnership formation process (e.g. Carnovale & Yeniyurt, 2014) has shown that the status of the partner (i.e. supplier or customer) can have a significant effect on the formation process (Carnovale, Rogers, & Yeniyurt, 2016; Zhao et. al., 2021). It appears that in the co-development process, this effect is not significant ($p > .1$) when considering the nature of how firms structure their partnerships across all three dependent variables. We also did not find evidence of a statistically significant relationship in three other core control variables: internal support, internal capability, and principle alignment. One interpretation of this might be that for externally focused co-development projects, aligning external actors is far more important for performance outcomes.

6. Managerial Implications

The major managerial takeaway from our findings is that there is an implicit, RO driven, path dependency in efforts to increase performance,. In other words, sequence is key in the acquiring and combining of resources for performance gains. At the most fundamental level, firms that can synchronize (i.e. structure partnerships and bring constituencies together) should experience increases to operational performance. Next, the benefits of the synchronizing efforts are built upon by coordination, and benefits to operational performance may also be expected. Here, there is an important point to note: while clearly there are benefits to coordination, firms looking to explicitly generate improvements to their innovation performance should strive to achieve integration as the ultimate goal. The findings of this study suggest that integration is a driver of both innovation performance, and market performance. However, results also suggest that integration as a partnership structuring mechanism is dependent upon coordination, and synchronization first. Thus, it is not necessarily a choice of “which structuring mode is best?” but rather, what are the necessary steps in the path in order to arrive at the end goal. Also, worth noting is the high level findings from our post-hoc analysis of the effect of these three structuring dimensions on firm performance. Specifically, the integrate dimension of partnership structuring demonstrated marginal statistically supported benefits to EBIT, ROA, and Sales, further highlighting the potential benefits to a more nuanced perspective on partnership structuring dynamics, and providing guidance on how managers drive performance gains, which is increasingly important (Na, 2020).

Distilled into a succinct message of guidance for firms seeking to improve performance, the following can be offered: results suggest that there is a clear path dependent relationship to the partnership formation process, and as the level of involvement increases, different levels of performance may increase. Initially, returns to operational performance may be expected when firms synchronize, and coordinate. Then, after they achieve these two and culminate to more integrated relationships, benefits to innovation performance



as well as market performance may also be expected. Finally, when integrated partnerships are ultimately achieved, financial returns may also be expected.

7. Limitations & Future Research Directions

The findings presented here require careful consideration, especially as they are among the first, to our knowledge, to assess the impact of structured partner co-development. There are some inherent limitations in our study which we acknowledge. First, our data is cross-sectional with a relatively modest sample size. This setup doesn't explore the co-development/partnership structuring process's temporal evolution. Future studies should obtain time-series panel data to affirm the path-dependence of co-development described in this work. Second, many of the measures used were self-reported. We attempted to mitigate potential biases by focusing our sample on key informants who are recognized experts capable of making informed judgments. Nevertheless, subsequent research should incorporate more objective performance metrics (beyond the financial ones used in our post-hoc analysis) to confirm our findings. Third, our final sample is concentrated within a few industries. Even though Gwynne (2015, p.19) highlighted that research productivity varies more within industries than between them, future investigations could benefit from a wider industry representation. Finally, our data was sourced during a period of relative economic stability both in the U.S. and globally in a pre Covid pandemic period. While this context offers its own set of benefits and challenges for external validity, future research might gain from a more diverse global sample. Specifically, examining these theoretical frameworks during economically tumultuous times, like during a significant recession, would be enlightening. Assessing how major external disruptions influence the strategy/structure connection would offer valuable insights into the resilience of our findings.

In essence, while our results provide initial insights, they should be a springboard for more comprehensive, diversified, and temporally varied research in the future. The findings point towards potential theoretical avenues for upcoming research. Sydow, Schreyogg, and Koch (2020) propose three strategies that agents maintaining existing paths might adopt: technological, institutional, or organizational. Notably, the technological approach is especially relevant to recent studies on supply development path dependence. Using lithography's prolonged pursuit as an example, Sydow et al. (2020) demonstrate technological path dependence. They highlight how organizations, trapped in a development mode of *exploitation*, overlooked the more innovative *exploration* strategy. In Table 7, the post-hoc results emphasize the noticeable lagged effects of integration on performance outcomes. Conversely, there are no such effects for synchronizing or coordinating. This indicates the emergence of new paths in this realm. To elaborate, these lagged associations of integration profoundly affect EBIT, ROA, and sales. Both short-term and extended associations are observed, which deviate from prior predictions based on path dependency. It seems that, consistent with Sydow et al. (2020)'s expectation, new paths are being carved out. Such developments warrant further exploration in subsequent studies.



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