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Unpacking Coordination Benefits in Supply Networks: Findings from Manufacturing SMEs

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This paper examines how coordination among firms in supply networks generates benefits in the short and long terms for firms. It focuses on information technology (IT) and process improvement coordination. Analysis was performed on quantitative and qualitative data from a sample of SMEs in plastics manufacturing in Pennsylvania. Results indicate that coordination on both IT and process improvement leads to short- and long-term benefits. These relationships were mediated by the adoption of innovations (when coordinating on IT) and access to new capabilities (in process improvement coordination). These results extend the understanding of how participation in supply networks benefits individual firms.

Introduction

Increasing product complexity decreases the likelihood of a single firm possessing the knowledge base and production capability needed to design, manufacture and distribute most products and services (Isik 2011). Instead, suppliers within networks add value to one another's activities, eventually creating a differentiated product or service, together with its underlying network of suppliers. This results in competition between networks rather than individual firms (De Souza, Zice, and Chaoyang 2000; Kumar 2001).

Production networks focused on production of goods and services are important industrial structures, having implications for the competitiveness of firms and industries. For industries, the effectiveness of their component networks determines, in part, their overall competitiveness both internationally as well as against competing technologies. For individual firms, understanding the effectiveness of their own and other networks can aid in strategic management and help position them appropriately within the industry (Gardet and Fraiha 2012). In addition, effectiveness in the supply chain in one industry sector can afford improved effectiveness in other sectors to which the firm supplies.

Naturally, this begs the question of what is meant by an effective network. Individually, firm effectiveness can be equated with meeting goals; however, in large networks, it is difficult to pin down which firms' goals are pursued. Also, as suggested by Powell, Koput, and Smith-Doerr (1996), firms join networks to pursue both collective and individual goals. Here, we examine network effectiveness from the member firm perspective.

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Even so, given the heterogeneity of firms in a large production network, effectiveness can have a variety of meanings. One firm may assess network effectiveness from a production perspective, focusing on how quickly goods move from supplier to customer or whether flexibility in production across the network is well managed (De Souza, Zice, and Chaoyang 2000). Alternatively, network effectiveness may be viewed from a purely financial perspective, being assessed on the general financial health of the firms in the network or the perception of how well the end product is faring in the consumer market (Venkatraman and Ramanujam 1986).

These differing interpretations suggest effectiveness has different forms, and this research sought to identify a common factor among them. We propose coordination as this common factor. Networked firms coordinate to achieve a variety of objectives, including reducing transaction costs, increasing efficiency and aligning incentives (Barringer and Harrison 2000). Coordination is achieved by various mechanisms such as standardization or mutual adjustment (Alexander 1995) and can be seen as a minimum behavior for improving network performance. However, although it has been acknowledged that coordination among supply network firms benefits both the network and participating firms, specific ways in which coordination leads to benefits have often been overlooked (Cao and Zhang 2011). To address this issue, this paper explores two specific types of coordination and their relationship to performance: coordination on information technology (IT) and coordination on process improvement.

This study is set in the context of small and medium-sized enterprises (SMEs) in the plastics manufacturing industry in Pennsylvania. Empirically, it is a combination of a survey and interviews with selected companies.

Literature Review

Levels of Network Effectiveness

Regardless of a network's function (e.g., supply, R&D, board memberships), its effectiveness can be conceptualized on at least three levels: the overall network, the end customer, or the individual member organization. A challenge for network researchers is that each of these levels has different criteria for evaluating effectiveness (Provan and Milward 2001). At the network level, effectiveness is typically understood as outcomes arising from the functioning of the network as a whole and whose benefits accrue to all members, although not necessarily equally (Provan and Milward 2001). Examples of effectiveness measures for this level include efficient resource management, responsiveness, flexibility and seamless information flows (Beamon 1999; Chen 1997; Souza, Zice, and Chaoyang 2000).

Network effectiveness can also be evaluated from the point of view of the end customer. The customer level differs from the overall network level in that a highly effective network from the perspective of its member firms may have low levels of customer satisfaction. Ensuring both network and customer perspective effectiveness requires communication, as suggested by research on networks of health-care providers (Provan and Milward 2001). In health care, patient care is provided by a network, and its effectiveness is assessed on "overall well-being." Overall network effectiveness can be assessed from the perspective of individual health-care providers but is ultimately tied to the patient or customer perspective.

The third level of network effectiveness is the organizational level. It denotes outcomes arising from the functioning of the network as a whole but with benefits that accrue to individual members (Dyer and Nobeoka 2000; Gronum, Verreynne, and Kastelle 2012; Petrick and Pogrebnyakov 2008). In some cases, a network may be highly effective overall; however, individual members may not accrue benefits. This study focuses on effectiveness at this third, organizational level, which is discussed in more detail in the following section.

Firm Benefits from Supply Network Participation

Individual firms can benefit from participating in supply networks in several ways. First, by providing access to external sources of competence, networks improve the ability of firms to innovate (Gronum, Verreynne, and Kastelle 2012; Kaufman, Wood, and Theyel 2000; Narula 2004; Pogrebnyakov and Kristensen 2011). Second, firms benefit from network membership through knowledge and technology exchange (Mowery, Oxley, and Silverman 1996); (Dyer and Nobeoka 2000). Third, firms that participate in networks are more likely to survive than those with arm's length market relationships (Uzzi 1996), for example by attaining lower sourcing costs.

Firm-level benefits from network participation can be further divided into short-term, such as enhanced resource acquisition or gains in performance, and long-term ones, which include changes in the way individual firms think or act, as well as structural changes in the firm (Human and Provan 1997; Subramani 2004). More specifically, *short-term benefits* include obtaining access to resources and legitimacy (Borgatti and Foster 2003; Human and Provan 1997; Provan and Milward 2001), reducing firm's exposure to risk and uncertainty (Borgatti and Foster 2003; Lee, Lee, and Pennings 2001) and growth in total sales, number of employees, or market share, which in turn positively relates to profitability (Havnes and Senneseth 2001; Wolff and Pett 2006). Examples of *long-term* benefits are learning and innovation (Borgatti and Foster 2003) and geographic extension of markets (Havnes and Senneseth 2001).

Hence, extensive research has established a range of benefits that firms gain from network membership (Maloni and Benton 1997; Nooteboom 1999; Yu, Yan, and Cheng 2001) and coordinating with other network firms (Cao and Zhang 2011). However, less is known about the particular activities within networks that generate these benefits. One factor that appears to be linked to both short-term and long-term benefits is the level of interaction between firms in the network (Chan and Chan 2010). For example, it is likely that firms that work more closely together have greater access to each other's resources (short-term benefits) and also are more likely to learn from one another (long-term). One way to conceptualize this level of interaction is as interorganizational coordination.

It is as yet unclear whether networks help firms obtain both short-term and long-term benefits, or only short-term ones. According to one position, there is no evidence of short-term benefits, such as growth in employment or total sales, resulting from network activities (Havnes and Senneseth 2001). Another view suggests that networks help firms obtain both short-term and long-term benefits, with short-term benefits being similar across networks and long-term ones differing across networks (Human and Provan 1997). However, the view that long-term benefits indeed occur as a result of participating in a network appears to be consistent throughout the literature.

Hence, conceptualizations of network effectiveness will vary with levels, and here, our interest is in the firm-level perspective. A focus on firm-level network effectiveness can help identify some of the mechanisms by which the benefits of network membership, and in turn its overall effectiveness, accrue.

Coordination

Coordination at the most basic level is management of interdependencies between activities (Alexander 1995; Malone and Crowston 1994; Thompson 1967). Coordination in supply networks encompasses multiple forms of relationships between customers and suppliers with different degrees of formality and longevity. Coordination can be practiced in formal and short-term relationships (Kraul and Streeter 1995; Raposo and Fuks 2002; Stephenson 2005), or in longer-lasting relationships with greater amounts of trust and pooled resources (Powell, Koput, and Smith-Doerr 1996; Raposo and Fuks 2002). These longer-lasting relationships are variously labeled as "cooperation" or "collaboration," and in practice, the labels are often used interchangeably. In this paper, we use the term coordination.

Coordination is often divided into operational and strategic types (den Hengst and Sol 2001; Simatupang, Wright, and Sridharan 2002; Stephenson 2005). *Operational coordination* focuses on integrating interdependent processes and data flows (den Hengst and Sol 2001; Simatupang, Wright, and Sridharan 2002). Examples include coordinated purchasing and distribution as well as logistics. *Strategic coordination* includes activities that add value through core competencies of involved firms or create a wider collective innovation horizon than that of each individual firm (Dyer and Nobeoka 2000; New 1996). An example of strategic coordination is coordinated new product development.

This paper considers two types of coordination: IT and process improvement. Though IT coordination has been often associated with operational benefits (Prajogo and Olhager 2012), strategic benefits typically result from coordination on process improvement (Dyer and Nobeoka 2000).

Coordination on IT. The effect of adopting IT on companies has been studied in detail, with mixed results. To gain a better understanding

of research to date, we classify benefits by timeframe (long term versus short term) while focusing on SMEs. One position holds that firms obtain little long-term strategic value from IT. According to this position, most companies have adopted IT in the past two decades, and therefore, IT by definition is not a competitive differentiator (Fawcett et al. 2011). IT does provide short-term and operational gains, for example, through transactions-oriented IT (such as electronic data interchange), which is often used as a means to increase efficiency of firms' operations, rather than to coordinate activities within supply networks (Hill and Scudder 2002). Planning systems, which are often driven by downstream actors in the supply network, have also focused on improving operational efficiency of the network (Kumar 2001). However, according to this view, IT systems that provide such operational advantages are increasingly seen as "must-haves" for companies (particularly ones that participate in supply networks) because others have implemented similar technologies (Bhatt and Emdad 2010).

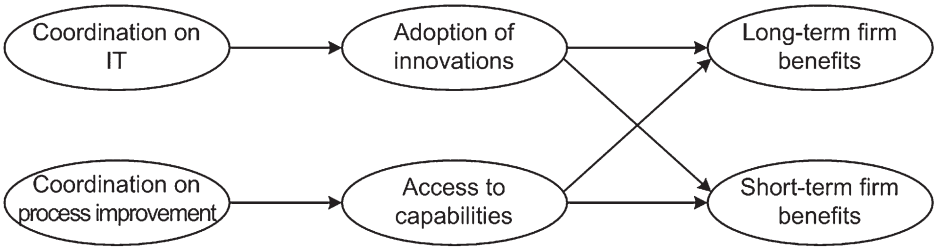
Another understanding of the impact of IT holds that IT does provide both short- and long-term benefits for companies. However, these benefits are not automatic or guaranteed (Nath and Standing 2010). Rather, they follow from the way IT is used (Dibrell, Davis, and Craig 2008; Fawcett et al. 2011). In particular, using IT to interact and coordinate with other companies, particularly in the supply network context, may give rise to hard-to-imitate competitive advantage and thus confer long-term benefits on companies (Adams, Khoja, and Kauffman 2012; Fawcett et al. 2011). Thus, IT typically does not have a direct impact on performance. Rather, this relationship is mediated by other factors such as trust or adoption of other innovations (Dibrell, Davis, and Craig 2008; Gardet and Fraiha 2012), or intermediate payoffs, such as enhanced operational performance, access to new capabilities, or integration with supply network partners (Devaraj, Krajewski, and Wei 2007). Also, the emergence of new collaboration-oriented IT systems may lead to a more long-term impact on the supply network and the benefits derived by individual firms from supply network participation. These collaboration-oriented IT artifacts include wikis, blogs, and other technologies collectively labeled Enterprise 2.0 (McAfee 2009).

Further, SMEs are less likely to invest in IT than larger companies (Niehm et al. 2010). This is because SMEs lack not only financial resources to invest in IT but also technical expertise that would allow them to keep up with the fast-changing technology landscape (Niehm et al. 2010). This may clearly put them at competitive disadvantage, especially compared to their larger peers. One way to alleviate this disadvantage is for SMEs to participate in supply networks and coordinate with other firms on IT (Erosa-Martín and Arroyo-López 2010; Sherer 2003).

However, the extent to which SMEs engaging in such coordination are likely to reap short-term and long-term benefits, as well as the extent to which this relationship may be mediated by the adoption of other innovations, is not clear from the literature. Therefore, our model includes a relationship between coordination on IT and firm benefits, mediated by adoption of other innovations. We expect to observe a positive relationship between coordination on IT and benefits to the firm in both the short and the long terms. Based on the previous discussion, we expect that coordination on IT does not result in direct benefits but instead is mediated by adoption of other innovations by the firm.

Coordination on Process Improvement. Supply networks differ in the types of opportunities they offer to their participating companies. Some networks are well known for various initiatives they undertake to improve processes, increase performance, or disseminate knowledge (Corbett, Blackburn, and Van Wassenhove 1999). An increasing number of networks rely on close coordination on processes from the early stages of new product design to ensure successful development, manufacturing, and marketing of the product (Hsu et al. 2009). Process improvements impact quality and cost, attributes that end customers can use to compare product or service offerings. The central role in such initiatives is often played by a handful of organizations or by one focal company in the network (Gardet and Fraiha 2012). A good example of this is the way that Toyota has been able to take these issues and develop both measurable and perceived differences over its rivals GM, Ford, Chrysler, Hyundai, and others (Fane et al. 2003). As Toyota rose to a leader in sales in the auto industry worldwide, its supply network has

Figure 1
Preliminary Research Model



also benefited. From a strategic perspective, an automotive supplier is better positioned as a supplier within the Toyota network compared with the Chrysler network, for example.

Therefore, when an SME enters a supply network, it may, depending on the network, be engaged by other companies in improving its processes. Though such coordinated process improvement may target internal company processes, the benefits may also spread to the rest of the network (Cao and Zhang 2011), which is why focal firms in some networks are investing in such process improvement initiatives.

Coordinating with other supply network firms on process improvement allows the SME to access capabilities and expertise of these firms (Chen, Daugherty, and Landry 2009; Gardet and Fraiha 2012). This is often the underlying mechanism by which improvements in processes occur: The SME obtains access to resources located elsewhere in the network and is able to improve its own processes by integrating these learnings and applying them to other supplier networks in which the firm participates. Improved processes are typically operational improvements that may nonetheless lead to long-term gains for the SME (Chen, Daugherty, and Landry 2009). Developing process improvement capabilities may also ease future coordination efforts (Zacharia, Nix, and Lusch 2011). Therefore, process improvement considerations are of significant importance for SMEs, particularly for those contemplating which supply network to enter (Street and Cameron 2007).

Extant literature, however, does not devote significant attention to mechanisms through which process improvements may lead to benefits to SMEs. A conceptual article by Chen, Daugherty, and Landry (2009) suggested that process integration may lead to better performance through enhanced capabilities but did not test these propositions. Therefore, our model includes a relationship between coordination on process improvement and firm benefits in both the long and short terms, which is mediated by access to capabilities. We expect to observe a positive relationship between these constructs.

This discussion is summarized in the research model shown in Figure 1.

Methodology

We collected data from manufacturers of plastics products in Pennsylvania. Being a processing industry, plastic manufacturers supply to a variety of other industry sectors and, as the interviews revealed, often characterize themselves based on the industry they supply to rather than belonging to the plastics industry specifically.

A multimethod approach for data collection and analysis was used. Data were collected with surveys and face-to-face interviews and analyzed with structural equation modeling and qualitative analysis methods.

Surveys

The primary goal of the survey instrument was to probe into coordination practices of SMEs, their frequency and outcomes, as well as the outcomes that firms obtain from participating in supply networks as well as from various coordination practices. To that end, the survey instrument included three major sections, in addition to the respondent and firm

demographics[1]: details about the firm's dominant supply network (subsequent questions were based on the dominant supply network), outcomes from supply network participation, and details about coordination activities.

A list of potential respondents of 596 manufacturers, 82.3 percent of which are SMEs, was compiled from the Harris Directory and contacts provided by the network of Pennsylvania Industrial Resource Centers. A four-contact approach was used, beginning with a prenotification letter announcing the upcoming survey, a full survey mailed two weeks later, a postcard reminder, and a full survey follow-up mailing to nonrespondents. We also offered potential respondents a web-based option and made approximately 100 telephone calls to encourage nonrespondents to complete the survey.

As a result, 70 usable surveys were received (11.7 percent response rate). This response rate is lower than the average of 14.8 percent previously reported for four-contact approach studies of SMEs (Hartman et al. 2002; Newby, Watson, and Woodliff 2003). To identify any bias resulting from the response rate, a nonrespondent analysis was conducted. Our samples included several demographic variables, such as company age, number of employees, ownership type (public or private), type of location (headquarters or branch), amount of sales, and credit risk score. We performed t-tests to compare respondents and nonrespondents on these variables and found no statistically significant difference between respondents and nonrespondents.

Interviews

The interviews complemented the quantitative survey data with a more detailed description of firm intent and resulting activities, particularly with regard to coordination practices. We conducted onsite interviews with Pennsylvania plastic manufacturers about their coordination and collaboration activities within the plastics supply chain. Informants consisted of presidents, CEOs, and owners, as well as top managers in sales, strategy, marketing, procurement, production, and supply chain management. Interviews lasted between one to one and a half hours. In total, 58 interviews were conducted. Descriptive statistics of all interviewed companies are shown in Figure 2. Of these, 32 interviews were audio-recorded and later transcribed, coded, and used for systematic analysis.

A semistructured interview protocol was developed to address six major themes: company demographics, relationships with suppliers and customers, the supply network, organizational practices and policies, use of IT, and learning and innovation. Recruitment occurred via phone or email by members of the research team and was based on the same list of 596 Pennsylvania plastics manufacturers that was used for the survey. A standardized script was used during initial contact with potential informants.

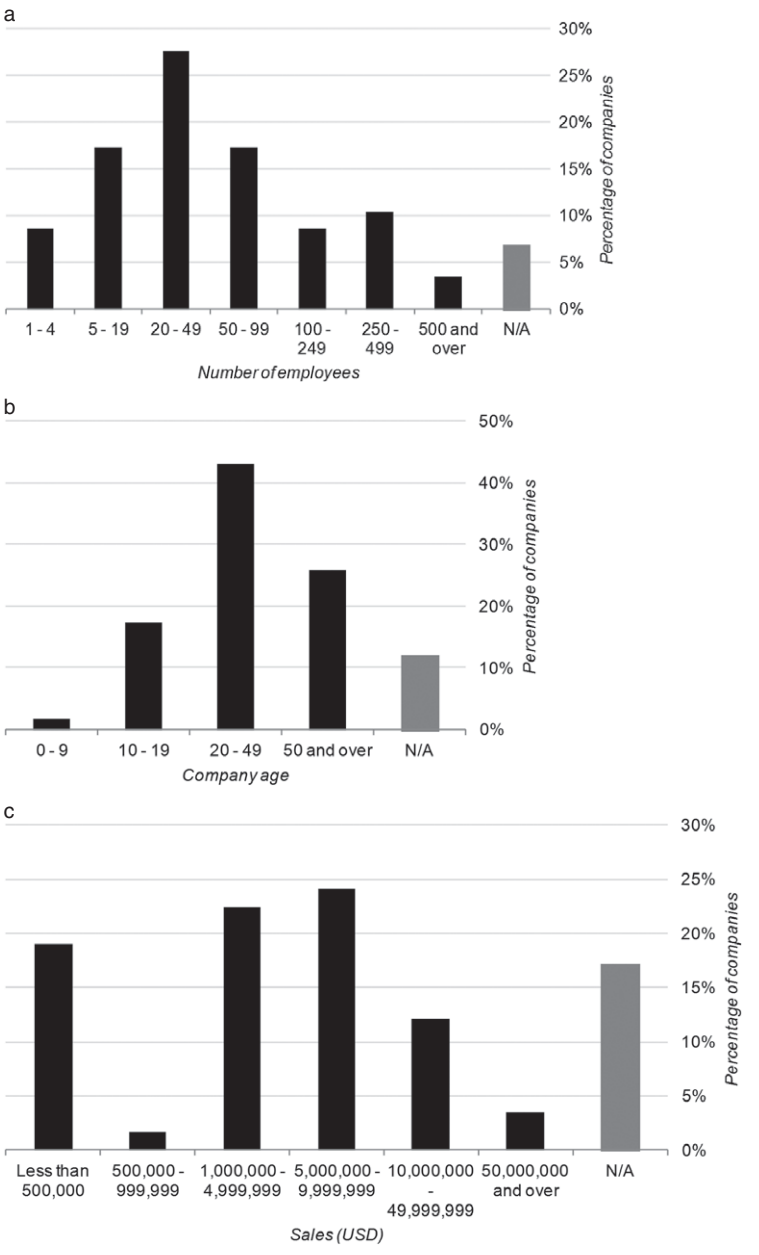
Two criteria for informant selection were used: qualification and geographic location. All informants were asked to qualify themselves as knowledgeable in their company's supply chain activities. If the initial contact did not feel qualified, researchers were often referred to another person within the company. Informants were also recruited based on geographic location in order to gather a sample population representative of the concentration of manufacturers across the state. The state was divided into six major geographic regions with recruitment targeting proportionate distribution of informants from all six regions according to the actual number of manufacturers in that region. Of those contacted, 9.8 percent agreed to be interviewed. Informants were not provided with any form of monetary incentive for participation but were later provided with a copy of the final technical report.

Interviews were conducted on site at an informant's office or work area by a member of the research team. In addition to audio recording (when allowed), notes were also taken throughout the interview process to help capture critical responses and to record aspects of the workplace (informants often articulated a response through the use of artifacts in their workplaces or by touring the researcher around the manufacturing facilities).

Following an iterative two-stage process, interview transcripts were analyzed according to the six major topics. Two sets of codes were developed. First-order data (informant terms) were analyzed through a set of analytic codes according to the sections and questions in the interview guide. Using NVIVO 7.0 software (QSR

[1]The survey instrument is available from the authors upon request.

Figure 2
Descriptive Statistics of Interviewed Companies: (a) the Number of Employees, (b) Company Age, and (c) Sales Amounts (USD)



International, Doncaster, Victoria, Australia), first-order data were coded to the appropriate analytic codes. In some cases, first-order data were coded to more than one analytic code due to the overlap and complexity between questions and responses. Within each analytic code, second-order (researcher terms) concepts were then identified. Researchers then compared

these concepts to those found in the survey to further validate and support survey findings, to resolve discrepancies and conflicts in the survey data, and to identify new findings.

Statistical Analysis

We used AMOS (IBM Corporation, Armonk, NY, USA) to evaluate the statistical model. A two-step approach proposed by Anderson and Gerbing (1988) was followed, which includes a measurement and a structural model. The measurement model is first evaluated and, if necessary, refined using confirmatory factor analysis. The second step is the structural analysis of the model. The advantages of using this approach include the ability to evaluate the goodness of fit of the factor composition and of the model structure separately, which otherwise may influence one another and which may mask a poor fit of one of either the factor composition or the model structure. Furthermore, a two-step approach allows critical evaluation of the trade-off between goodness of fit of the structural model and the degree of causal influence. In other words, although more paths in a model may increase its goodness of fit, they may complicate interpretation of these paths and the concepts they link (Anderson and Gerbing 1988).

Measures of fit were evaluated using several accepted statistics (Bollen 1990; Cordano and Frieze 2000; Seibert, Kraimer, and Liden 2001). The first measure of fit we examined is the chi-squared statistic. A significant chi-squared statistic of either the measurement or the structural model indicates a poor fit. Other measures of fit we report include the comparative fit index (CFI), goodness-of-fit index (GFI), nonnormed fit index (NNFI), and root mean square error of approximation (RMSEA). Values of over 0.9 of all these indices except RMSEA indicate acceptable fit, as do RMSEA values below 0.05 (Cordano and Frieze 2000; Hatcher 1994; Hu and Bentler 1995).

Results

The results of our analysis consist of the quantitative (survey) and qualitative (interview) components. Quantitative analysis was only performed on data from the survey (although quantitative data was collected for some model variables during interviews for triangulation purposes). Structural equation modeling (quantitative analysis) explores relationships between the constructs included in our model, and the qualitative analysis was aimed at gaining more nuanced understanding of the constructs. The interviews also revealed relationships between other characteristics of supply networks.

Structural Equation Modeling

Measurement Model. The measurement model shows a good fit to the data. The chi-squared statistic is not significant ($\chi^2 = 21.75$, $df = 23$, $p < .54$); three fit indices exceed the 0.9 threshold for acceptability (CFI = 1.00; GFI = 0.93; NNFI = 1.04) and RMSEA = 0.00, which is below the 0.05 acceptability threshold. All of these indices demonstrate a good fit between the measurement model and the data.

The four composite constructs of adoption of innovations, access to capabilities, and short-term and long-term benefits were calculated using factor analysis. The underlying items for constructs are based on a series of statements with which the respondents could agree or disagree over a five-item scale. Items included in these factors are shown in Table 1. An example of such statement is "because of participation in this dominant supply network, my company has been able to expand our product sales to new markets." Each of the two coordination variables was based on a dichotomous question regarding the involvement in the coordination practice.

Reliability indices for the four factors are within recommended intervals. Cronbach's α for the adoption of innovations construct is 0.805, for access to capabilities 0.806, for the long-term benefits construct 0.800, and for the short-term benefits 0.627. Thus, all factor loadings are considerably greater than the recommended minimum of 0.4 (Devaraj, Krajewski, and Wei 2007; Gefen, Straub, and Boudreau 2000).

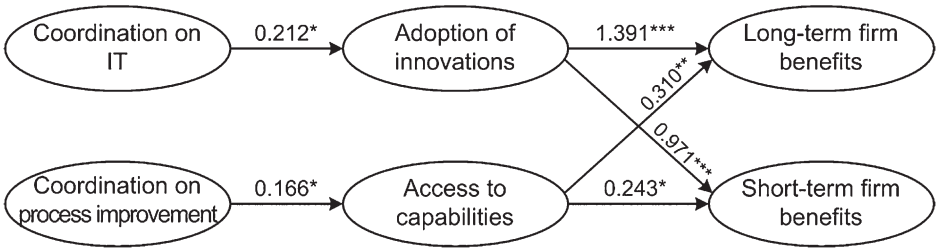
Structural Model. The structural model also exhibits good fit. The chi-squared statistic is not significant ($\chi^2 = 57.03$, $df = 61$, $p < .62$); three fit indices are above the 0.9 threshold (CFI = 1.00; GFI = 0.90; NNFI = 1.02) and RMSEA = 0.00, below the 0.05 acceptability threshold.

Figure 3 graphically shows the relationships between the constructs in the structural model and estimates of the relationships between the constructs. It shows that coordination on IT is associated with greater adoption of innovations. This positive link suggests that companies who participate in shared IT systems are more likely to adopt other innovations that

Table 1
Components of the Four-Factor Constructs: Adoption of Innovations, Access to Capabilities, Long-Term Firm Benefits, and Short-Term Firm Benefits

Adoption of Innovations	Access to Capabilities	Long-Term Firm Benefits	Short-Term Firm Benefits
Because of participation in this dominant supply chain, my company has been able to . . .			
• Adopt innovations that benefit my company *within* this dominant supply chain • Adopt innovations that benefit my company *beyond* this dominant supply chain	• Gain access to *facilities and/or equipment* that we do not have • Gain access to *expertise* that we do not have in our own workforce	• Increase its *market share* • Expand our product sales to *new markets* • Reduce the *uncertainty* in producing this product • Expand our product sales in this dominant supply chain to *new geographic locations* • Participating in this supply chain has contributed to my company's *long-term success*	• Increase its *profits* • Reduce the *risk* involved in bringing this dominant supply chain product to market • Participating in this supply chain has contributed to my company's *short-term success*

Figure 3
Relationships between Constructs in the Structural Model



Only significant relationships are shown. *$p < .05$; **$p < .01$; ***$p < .001$.

benefit them within and outside of their dominant supply chain. Adoption of these innovations, in turn, is associated with benefits in both the short and the long term, as expected.

Figure 3 also shows an association between coordination on process improvement and greater access to capabilities that the firm does not have in house. Firms that coordinate with others on improving processes are more likely to have increased access to facilities and expertise they do not possess themselves. As expected, such access is also linked to long-

term benefits. Additionally, the results suggest that greater access to capabilities is beneficial in the short term.

It is interesting to note that coordination at both strategic and operational levels is linked to short-term and long-term benefits. At the same time, the two types of coordination included in the model were selected because they are examples of coordination at the operational (IT) and strategic (process improvement) levels.

Interviews

The goal of the interviews and the qualitative analysis was to complement structural equation modeling of the relationship between coordination and firm benefits and gain further understanding of these concepts and relationships.

With regard to coordination on IT, most information systems used by the respondents are aimed at improving efficiency and speed of operations. This includes ordering, online payments, inventory tracking, and logistics. One company did not even have any IT systems that were not connected to other companies' systems:

> Interviewer: *Do you have many stand-alone systems or coordinated systems with other companies?*
> Respondent: *I'm not aware of any stand-alone.*

In our interviews, coordination on IT appears to be a customer pull phenomenon. In most cases of collaboration on IT, the firms were required by their customers to use their information systems and sometimes even pay a monthly fee for accessing a system and providing information to the customer. A respondent observed:

> We had to buy software, which came from [our customer] actually; they required it. We buy it [from] them.

A number of respondents indicated that they coordinated activities specifically in the area of process improvement. Coordination on process improvement is often seen not only as an opportunity for building or enhancing customer relations but also as beneficial for the firm. One respondent noted the mutual benefits of such coordination:

> We are going next month to do a value stream mapping of [a product] to try to take some of the waste out of [our supplier's] system. It does two things: it's a benefit on our end because we will ultimately see a cost savings out of it, [and] it's a benefit [to our supplier] because they can utilize what we teach them for our particular product.

Our interviews suggest that initiation of coordination is frequently pursued by larger and more powerful firms in the supply network. Firms may be expected to participate in a coordination activity initiated by another firm (typically a more powerful one) as a condition of participating in the supply chain itself. One of the interviewees indicated that he was forced by a major customer to use an information system that was incompatible with his company's internal systems and to pay a monthly fee for accessing this system. Though the payment condition was not typical across interviews, initiation of coordination by a major supplier or customer, particularly by leading firms in their industries, was indicated several times.

Customers that initiate coordination often seek to remain competitive in the market or expand their market. Suppliers, on the other hand, may initiate coordination when they design new products and proactively share them among firms. The firms may require modifications to the product, which may lead to coordinated effort on design and production.

Furthermore, in many cases, respondents indicated that their firms initiated a coordination practice themselves. Though initiation of coordination in different areas was driven by different motivations, efficiency and cost savings were often reported as two major motives.

Discussion

The results suggest that coordination on both IT and process improvement influences firm benefits in the short and long term. This relationship is mediated by two other variables: adoption of innovations and access to capabilities. This section discusses these findings based on quantitative and qualitative analysis.

Firm Benefits from Supply Network Participation

Although extant research on firm benefits recognizes the multidimensional nature of this construct (Venkatraman and Ramanujam 1986),

to date, only limited empirical evidence exists to demonstrate the source of the benefits of network participation for individual firms (Gronum, Verreynne, and Kastelle 2012). On the other hand, traditional views of firm performance have yet to empirically account for the components of performance that can be attributed to a firm's network relationships. Our statistical model, which exhibits good fit to the data ($\chi^2 = 57.03$, $df = 61$, $p < .62$; CFI = 1.00, GFI = 0.90, NNFI = 1.02, RMSEA = 0.00), as well as interview data, suggests a positive relationship between supply network participation and firm benefits, operationalized as a multidimensional construct.

We conceptualize the components of firm performance that can be attributed to interaction with supply network partners. The supply network was viewed as the totality of supplier relations, which contain vertical as well as horizontal relations in multiple and sometimes overlapping supply chains. This conceptualization provides the basis for operationalizing firm benefits not only as traditional performance-based outcomes, such as expansion of product sales, but also as innovations or improvements that are generated in one supply chain that can be used across a firm's multiple supply chains, thereby capturing the benefits attributable to network participation. This empirically supports conjecture on the impact of process improvement coordination on firm benefits, mediated by enhanced access to capabilities throughout the supply network (Chen, Daugherty, and Landry 2009).

Our measures of firm benefits have two additional important features. First, they include both the short-term (e.g., expansion of sales) and long-term (e.g., improvement of practices and adoption of innovations) components (Human and Provan 1997). Second, they consider firm performance as indirectly related to firm participation in a supply network. The interdependencies of firm performance were further supported by interviews in which managers discussed their efforts to improve the performance of their suppliers and, even in some cases, their customers. By considering two coordination practices simultaneously, and grouping benefits into the two time horizons, the results extend previous recent studies demonstrating the mediated effect of network participation on firm performance (Gronum, Verreynne, and Kastelle 2012).

Results of structural equation modeling indicate that our measures of firm benefits are valid. These measures have high Cronbach's α values (0.627 for short-term and 0.800 for long-term benefits), suggesting that short-term and long-term benefits are indeed distinct. This has theoretical implications for supply networks scholars and calls attention to firm benefits that stem from interactions with firm's network partners. This influence of the network on benefits for individual firms may (and should) be an important determinant of the firm's decision to enter a particular supply network.

Furthermore, this study provides greater nuance to findings of extant research by exploring the link between specific coordination activities and particular benefits to an individual firm (Becker and Murphy 1992). Coordination on process improvement affects learning as well, which is an important component of firm performance. Thus, coordination affects particular benefits that are associated with learning, namely access to new capabilities.

Our findings lend themselves to further research on the impact of coordination on other well-known antecedents of firm benefits, such as goal alignment and trust. We found that coordination appears to play an intermediary role between these antecedents and benefits. We apply this logic to the firm level as well; however, the specifics of the relationship between coordination and trust are an area of potential future research.

Coordination

Past research has emphasized the importance of choosing the appropriate network for the firm since the network is likely to influence the firm in ways particular to that network (Gulati, Nohria, and Zaheer 2000). Although that consideration is beyond doubt important, our results bring attention to the opposite dynamics: the deliberate, strategic construction and use of network relationships by the firm. Our results also suggest that the firm's benefits are expanded when these successful practices are applied to other networks in which the firm participates.

Such agency on the part of the firm may be a competitive differentiator for firms with similar competencies, similar market positions, and similar positions within the supply network. Interviewed firms commented on the initiation of coordination around order processing, inventory control, and material standardization,

noting that the practices added great benefit to their company. They also noted that such coordination also added value to other companies in the supply network. Further, when we compared the top 20 percent of interviewed firms in terms of three-year average revenue growth with the bottom 20 percent, the top performers were initiating coordination much more frequently.

Coordination is premised on the understanding that coordination activities will vary not only on fundamental characteristics, such as frequency or the number of partners involved, but also and perhaps more importantly in their implications for participating firms and for the supply network. Not surprisingly, our analysis indicates that the frequency of participation in individual coordination activities varies. On average, however, coordination on both IT and process improvement has moderate levels of participation.

These findings indicate that coordination activities, which are undertaken with only moderate frequency, present a strong and statistically significant positive, albeit indirect, relationship with firm benefits. This finding, in addition to providing empirical evidence of the benefits of particular types of coordination, also provides greater nuance.

As for specific coordination practices, we found that coordination on IT is associated with both long-term and short-term benefits for firms, and this relationship was mediated by the adoption of other innovations: the relationship between coordination on IT and adoption on innovations was statistically significant at 0.05 level, and between adoption of innovations and both long-term and short-term benefits at 0.001 level. This suggests that supply networks are good vehicles for adoption of IT and other innovations for SMEs. SMEs realize benefits from them at least in part through coordination with other companies. This may help SMEs alleviate their relative technological disadvantage compared with larger companies (Sherer 2003).

Coordination on process improvement is also associated with both long-term and short-term benefits, mediated by access to capabilities. Relationships between coordination on process improvement and access to capabilities, as well as between access to capabilities, were statistically significant at 0.05 level; the relationship between access to capabilities and long-term benefits was significant at 0.01 level. This lends empirical support to past work that suggested such link (Chen, Daugherty, and Landry 2009). These results also indicate how SMEs can benefit from coordinating on process improvement in the supply network context. Such coordination may be associated with tapping into expertise and capabilities of other firms, which in turn is likely to be beneficial for the SME (Gardet and Fraiha 2012).

The results have managerial implications. They suggest action paths for managers of firms that are embedded in supply networks, and areas in which firms should pursue coordination with others to achieve short-term and long-term benefits. Managers may pursue concrete coordination efforts in relationships with their customers and suppliers, knowing that these activities are likely to result in benefits both in the short and the long term. At the same time, coordination with other firms, especially one which may continue for a long period of time, requires careful ongoing management. Such management may, depending on the specific coordination practice, be periodic (e.g., quarterly process improvement sessions) or on the needs basis (e.g., new product design occurs only at specific times of the production cycle). Benefits from coordination arise from better planning and investment in it on the part of the firm. For example, knowing that the development of a new product will take place in prolonged coordination with others, the firm may be more likely to optimize its internal practices and work with the coordination partner to optimize practices on which the two firms interface.

Coordination also requires going beyond the "cost first" logic, which usually results in quick changes of coordination partners. It is unlikely, for example, that the OEM would invest efforts into jointly developing a component with a tier 1 firm, only to abandon it before production starts (assuming no objective reasons, such as unsatisfactory performance of one party). Although cost benefits from coordination may not be immediately apparent, they are likely to materialize eventually, for example, through jointly developed innovations or in the form of savings from the absence of supplier switching.

Thus, participation in supply networks offers additional opportunities for enhancing firm benefits through coordination. These opportunities are in addition to internal activity and characteristics of the firm (e.g., product offer strategy or management quality), which are by all means important.

Conclusions

This paper explored the link between coordination among firms and firm benefits in the context of supply networks. It did so through a combination of quantitative and qualitative analysis. The results suggest that benefits from supply chain participation can be disaggregated into long-term (e.g., gaining access to new markets) and short-term ones (e.g., increase in profits). The relationship between coordination and these benefits is significant and is mediated by other variables, namely the adoption of innovations and access to new capabilities. This research thus extends the literature on benefits of network participation to individual firms (Chen, Daugherty, and Landry 2009; Gronum, Verreynne, and Kastelle 2012) by providing empirical support to this relationship. It also elucidates the mechanism through which SMEs can obtain these benefits, specifically through utilizing capabilities and expertise of other network firms (Gardet and Fraiha 2012). Further, this research examines the details of both coordination and benefits constructs, by considering particular coordination activities (IT and process improvement) and specific benefits to the firm, in both the long and the short terms. In sum, these results shed light on an underexplored area of firm benefits that stem from firm's participation and coordination in the network.

The analysis can be extended in several ways. A more practice-oriented avenue of research may be pursued, and the constructs of coordination may be expanded to include other coordination practices. Furthermore, the model constructed in this paper can be extended to determine whether it can provide insights on relationships between higher-level constructs, such as trust and learning, with coordination and firm benefits.

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