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Enterprise logistics and supply chain structure: the role of fit

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Abstract

The emergence of the extended manufacturing enterprise, a globally dispersed collection of strategically aligned organizations, has brought new attention to how organizations coordinate the flow of information and materials across their supply chains. This paper explores and develops the concept of enterprise logistics [Greis, N.P., Kasarda, J.D., 1997. Enterprise logistics in the information age. California Management Review 39 (3), 55–78] as a tool for integrating the logistics activities both within and between the strategically aligned organizations of the extended enterprise. Specifically, this paper examines the fit between an organization's enterprise logistics integration capabilities and its supply chain structure. Using a configurations approach, we test whether globally dispersed network organizations that adopt enterprise logistics practices are able to achieve higher levels of organizational performance. Results indicate that enterprise logistics is a necessary tool for the coordination of supply chain operations that are geographically dispersed around the world. However, for a pure network structure, a high level of enterprise logistics integration alone does not guarantee improved organizational performance. The paper ends with a discussion of managerial implications and directions for future research.

Keywords: Enterprise logistics; Supply chain structure; Organizational performance

1. Introduction

Recent trends in global production have both increased supply chain complexity and reinforced the notion that logistics strategies and practices are essential elements of business strategy (LaLonde and Masters, 1994; Chow et al., 1995; Stock et al., 1998; Stank and Traichal, 1998). Logistical complexity has increased as organizations have moved from centralized, vertically integrated, single-site manufacturing facilities to geographically dispersed networks of resources that collectively create value for the customer. This extended enterprise may be consonant with a single multinational organization or, as is increasingly the case, a set of strategically aligned companies which partner to capture specific market opportunities. These extended global enterprises are

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designed to provide the speed and flexibility necessary to respond rapidly to windows of market opportunity. Traditional logistics practices and technologies that integrate productive activities within the factory are necessary but not sufficient for competitive success. New logistics practices and technologies must now also link production and logistics processes in *different* organizations across geographically dispersed locations (Greis and Kasarda, 1997; Quinn, 1997; Brunell, 1999). Examples of firms that have employed new logistics practices to improve competitive performance include Hewlett-Packard, IBM, Chrysler, Lear, AlliedSignal, and Wal-Mart (Bradley et al., 1998; Zarley and Torode, 1997; Trunick, 1997, 1998; Gourley, 1998).

In this paper, we explore the relationship between enterprise logistics practices and improved performance of the new extended global enterprise. We begin by introducing a conceptual framework that explicitly recognizes the emerging role of logistics and its importance to new supply chain structures that have evolved in response to current competitive pressures. Specifically, we examine the alignment of logistics practices and supply chain architectures using the notion of ''fit.'' ''Fit'' is defined as an appropriate consistency between logistics practices and supply chain structures. Using a configurations approach, we then examine the implications of the framework to develop and test a set of hypotheses linking logistics–supply chain fit to organizational performance. Sections describing the methodology and empirical results follow. The paper closes with conclusions and implications for future research.

2. Conceptual framework

The idea that firms might develop logistics capabilities that support basic business or manufacturing objectives is not new. Throughout the 1990s, a number of papers have attempted to uncover typologies of logistics strategy that relate individual firm practices to strategy specifications. In particular, a longitudinal study beginning in 1989 and replicated in 1990 and 1994 is one of the first to explicitly link logistics practices and strategic elements (McGinnis and Kohn, 1990, 1993; Kohn and McGinnis, 1997). A similar study investigated linkages between organizational structure and logistics strategy, identifying three distinct logistics strategies — process, market, and information — differing in the breadth, scope and depth of logistics activities within the firm (Bowersox et al., 1989; Bowersox and Daugherty, 1987). A subsequent study by Clinton and Closs (1997) offered limited validation of the Bowersox and Daugherty classification scheme. All of these studies have focused largely on logistics practices and strategies within the firm. While these empirical studies do include supplier–customer linkages in their scale development, none explicitly address the logistical practices that have arisen in the last few years in response to the tremendous speed of globalization — specifically the need to move goods greater distances quickly and efficiently. This paper fills this gap by addressing the logistical coordination of geographically dispersed activities across the extended enterprise, and by considering the logistics practices that are required to support the extended enterprise.

Our proposed framework is shown in Fig. 1. This framework links a firm's supply chain structure and logistics integration approach to organizational performance. There are three principal constructs in this framework: supply chain structure (which is characterized by geographic dispersion and channel governance), logistics integration, and organizational performance. The degree of fit between logistics integration and supply chain structure can be expected to affect the firm's performance. In other words, we expect that certain combinations of supply chain structure and logistics integration will result in higher firm performance than other combinations of these constructs.

In specifying the framework's constructs, we have employed a configurational approach. The configurational approach has been used widely in business strategy and management research (Dess et al., 1993; Ward et al., 1996). Configurations are defined as ''commonly occurring clusters of attributes ... that are internally cohesive'' (Miller and Friesen, 1984, p. 12). They can be embodied as classifications of organizations, such as taxonomies or typologies, which share common characteristics along a number of dimensions. A strength of the configurational perspective is that it takes a more holistic approach and recognizes that many organizational constructs are not easily characterized by simple continuous or

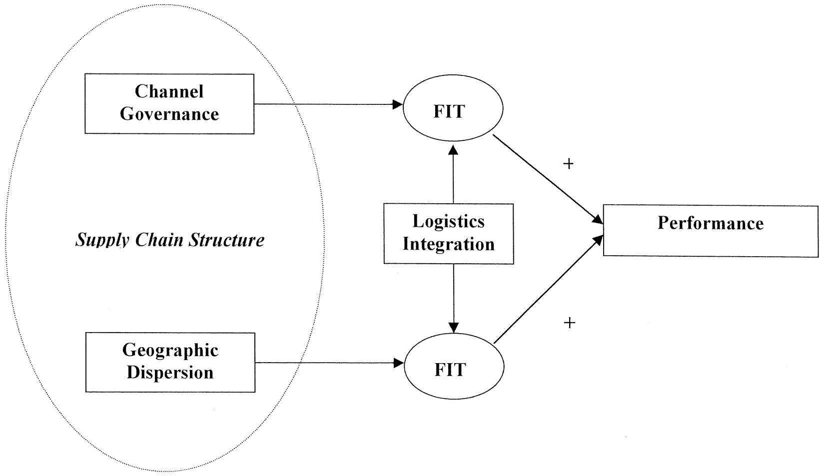

Fig. 1. Proposed framework of fit between logistics integration and supply chain structure elements.

bivariate statistical relationships. We will discuss the details of this approach below as it relates to the specific constructs of our model.

2.1. Elements of the framework

2.1.1. Supply chain structure

Previously, organizational structure, involving ‘‘decisions relating to division of task, authority, and a set of coordination mechanisms’’ (Parthasarthy and Sethi, 1992), has been considered within a single firm or organization (Burns and Stalker, 1961; Habib and Victor, 1991; Ghoshal et al., 1994). Our conceptualization differs from previous research in that structure refers to groups of firms across the extended enterprise — the firm plus its suppliers and customers — in other words, the supply chain. We are therefore interested in task, authority, and coordination mechanisms across distinct firms or organizational units. In addition, we are also concerned with the spatial or geographic attributes of the supply chain. Because the supply chain is concerned with the coordinating the movement and storage of physical items, geographic characteristics would also be expected to relate to how the supply chain is coordinated. We specify two constructs defining supply chain structure. The first is the geographic dispersion of the supply chain — the geographic scope of the locations of the suppliers, production facilities, distributors, and customers in the supply chain. The second is the classification of how the firm's supply and distribution channel (suppliers, production facilities, distributors, and customers) is governed — as a network, hierarchy, or market. We discuss each of these constructs below.

2.1.1.1. Geographic dispersion. Geographic dispersion refers to the extent to which the elements in a firm's supply chain are located across a wide range of geographic regions. Elements of the supply chain include suppliers, production facilities, distributors, and customers. Kotha and Orne (1989) refer to a similar concept as ‘‘geographic manufacturing scope’’ and ‘‘geographic market focus’’ in their model of generic manufacturing strategy. Placement of production facilities across a wide range of geographic locations, sourcing materials or components from a wide range of geographic locations, and serving customers over a wide range of geographic locations can therefore be viewed as an element of supply chain structure resulting from choices intended to meet strategic objectives. A firm with a high level of geographic dispersion would exhibit a low proportion of supply chain units within any individual geographic region; conversely, a low level of geographic dispersion would exhibit a high proportion of supply chain units within one region and low proportions in other regions.

There are three reasons for including geographic dispersion as a dimension of supply chain structure. First, it influences how tasks are allocated within the manufacturing enterprise. Second, the extent to which the supply chain is either concentrated or dispersed geographically most likely has a significant effect on the decision-making authority and coordination within the firm. Finally, the idea of geographic dispersion reflects the recent trend toward the location of production facilities in different markets throughout the world. At a more fundamental level, the coordination of the supply chain requires the physical movement of products from one location to another. Greater distances and a wider range of locations separating the components of the supply chain would therefore likely have significant implications for the management of the supply chain.

2.1.1.2. Channel governance. We consider three different configurations of channel governance here: networks, hierarchies, and markets. Williamson (1975) characterizes two extremes of governance forms — perfectly competitive markets and vertically integrated hierarchies. An intermediate form of governance is the network (Thorelli, 1986; Powell, 1990; Jarillo and Ricart, 1987; Jarillo, 1988; Snow et al., 1992; Miles and Snow, 1986, 1992; Ghoshal and Bartlett, 1990; Storper and Harrison, 1991; Saxenian, 1991; Larson, 1992). There is some disagreement in the literature as to exactly what constitutes a network, but prior research has consistently considered two dimensions to differentiate networks from markets and hierarchies: vertical integration and nature of the relationships or links between members of the supply chain.

Consistent with the literature, in this paper we consider the three basic configurations of channel governance discussed above (hierarchy, market, and network) with respect to how each will differ along these dimensions. We define vertical integration as the extent to which the firm owns the stages of the supply chain from raw materials to distribution. The second dimension, the nature of the relationships, or links, between supply chain members, are characterized by a number of different attributes. Cooperation between suppliers and customers in a relationship is one attribute (Pilling and Zhang, 1992; Heide and Miner, 1992; Landry et al., 1998). The extent to which firms in a network relationship share information regarding production processes, technology, or costs is another (Heide and Miner, 1992; Smeltzer, 1997; Pilling and Zhang, 1992; Mohr and Sohi, 1995; Heide and John, 1992). Interdependence refers to the degree to which the success of each firm in a relationship depends on the actions of the other firms (Larson, 1992; Johnson, 1999; Pilling and Zhang, 1992). Time horizon refers to whether transactions are expected to be one-time or ongoing (Johnson, 1999; Heide and Miner, 1992). Formality is the extent to which transactions between firms are governed by formal contracts or informal arrangements (Mohr and Sohi, 1995; Fram, 1995; Mudambi and Helper, 1998; Dahlstrom et al., 1996). Finally, a supplier–customer relationship can be characterized by the degree of flexibility between the two organizations (Johnson, 1999; Heide and Miner, 1992; Heide and John, 1992; Dahlstrom et al., 1996).

A more recent perspective on linkages within the supply chain considers the role of interorganizational systems, which are sophisticated information systems connecting separate organizations (Kumar and van Dissel, 1996; Samli et al., 1998). Research has shown information technology to be an effective means of promoting collaboration between collections of firms, such as groups of suppliers and customers organized into networks. The strength of interorganizational systems has been particularly important with respect to enabling the process transformation needed to create effective networks (Drew and Smith, 1995; Greis and Kasarda, 1997; Teng et al., 1996; Kumar and van Dissel, 1996; Venkatraman, 1994).

In this paper, we associate each channel governance configuration with combinations of vertical integration and supply chain linkage attributes. In a market configuration, links between suppliers and customers are weak, and vertical integration is low. In a network, there are strong links between suppliers and customers, but the level of vertical integration is low. Finally, in a hierarchy, both vertical integration and the strength of supply chain linkages are high. These combinations are summarized graphically in Fig. 2. Note that the combination of weak linkages and high vertical integration (shown as the darkly shaded quadrant) is not considered in our conceptualization of channel governance configurations. We have restricted our examination of channel

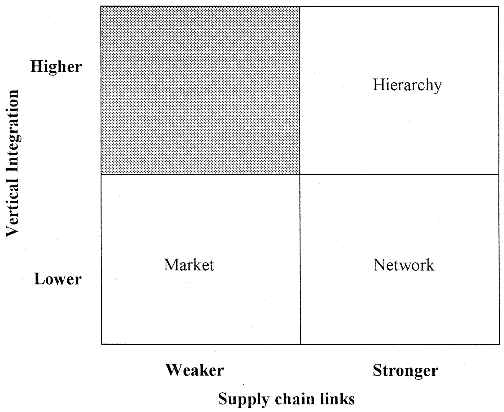

Fig. 2. Proposed configurations of channel governance.

governance types to the three classifications generally considered in the literature on networks (Jarillo and Ricart, 1987; Jarillo, 1988; Thorelli, 1986; Powell, 1990).

2.1.2. Logistics integration

Logistics has traditionally been defined as the process of planning, implementing, and controlling the efficient flow and storage of goods, services, and related information as they travel from point of origin to point of consumption (Council of Logistics Management, 1998). Within this model, the locus of logistics control has been the individual firm. Moreover, as in many other areas of management, logistics activities have traditionally been divided along functional boundaries. Lately, there is a recognition that logistics activities should be integrated more within the entire domain of the business, not simply relegated to a narrow functional role (Greis and Kasarda, 1997; Fawcett and Clinton, 1996). Logistics integration can be described by two dimensions — internal and external — depending on the nexus of integrative activities. Note that logistics integration is different from the supply chain links characterizing channel governance. Logistics integration refers to specific logistics practices — operational activities that coordinate the flow of materials from suppliers to customers throughout the value stream; supply chain links refer to the relationships between suppliers and customers comprising the supply and distribution channel.

2.1.2.1. Internal integration. We refer to logistics integration across functional boundaries within a firm as ''internal integration.'' What we refer to as internal integration was formally termed ''integrated logistics'' and recognized by an A.T. Kearny study that introduced three stages of logistics development, each reflecting increasing integration of logistics activities within the firm (Bowersox and Daugherty, 1987). Implicit in the recognition of the stages of integrated logistics is the notion that benefits, especially cost benefits, will be realized by companies that operate their logistics processes as an integrated system rather than by optimizing functional subsystems.

This systems approach *within the firm* has been the underlying premise of much of logistics management, thought, and practice (Kent and Flint, 1997). The extent of internal integration would be reflected by the extent to which logistics activities interact with other functional areas, as well as the extent to which logistics is or is not a separate functional unit. For example, indications of higher levels of internal integration would include increased coordination of logistics activities with other departments in the firm, increased communication (electronic and interpersonal) between logistics and other departments, increased importance of logistics in the overall business strategy, and a blurring of the formal distinction between logistics and other areas of the firm (McGinnis and Kohn, 1990).

2.1.2.2. External integration. A second dimension of logistics integration, which we refer to as ''external integration,'' is the integration of logistics activities across firm boundaries. External integration is a relatively new concept and reflects a transformation of the manufacturing enterprise to encompass the entire supply chain, not an individual company, as the competitive unit (Greis and Kasarda, 1997). To compete effectively, supply chains must act as a cohesive entity, in effect changing from a collection of unrelated firms to a set of firms that form a productive enterprise. This form of manufacturing organization would necessarily require a greater number of inter-firm operational interactions, as well as changes in the nature of these interactions.

Logistics activities are significant elements of these inter-firm operational interactions. External integration would be reflected by the extent to which the logistics activities of a firm are integrated with the logistics activities of its suppliers and customers. For example, many companies have created dedicated ''inter-firm'' logistics approaches, such as electronic data interchange, that link their manufacturing functions with particular suppliers of components. Indications of higher levels of external integration would include: (1) increased logistics-related communication (both computer and interpersonal) with suppliers and customers; (2) greater coordination of the firm's logistics activities with those of its suppliers and customers; and (3) more blurred organizational distinctions between the logistics activities of the firm and those of its suppliers and customers. Various inter-organizational logistics interactions have been examined extensively in prior research (Bozarth et al., 1998; Cooper et al., 1997; Ellram, 1992; Marcussen, 1996; Miller and Kelle, 1998; Srinivasan et al., 1994; Stump and Sriram, 1997; Vonderembse et al., 1995; Walton, 1994; Walton and Marucheck, 1997).

These two dimensions of logistics integration determine four configurations of logistics integration as shown in the 2 × 2 matrix in Fig. 3. Low levels of integration of logistics activities either within the firm or external to the firm would be categorized as ''functional logistics.'' High levels of internal integration accompanied by low levels of external integration is classified as the ''integrated logistics,'' as described above. Conversely, high level of external integration accompanied by low levels of internal integration is classified as ''inter-firm logistics.'' Such a firm might make extensive use of EDI to coordinate logistics activities with suppliers but would not utilize electronic communications extensively with the walls of their own organization. Finally, the fourth configuration, and the one on which we focus, is ''enterprise logistics.'' Enterprise logistics integration is characterized by high levels of both internal and external integration.

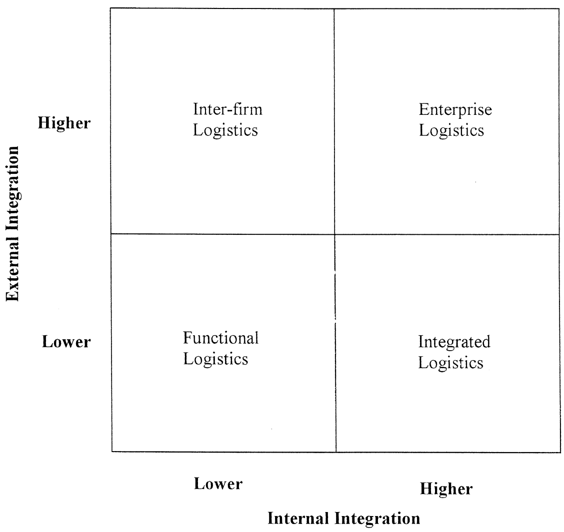

Fig. 3. Configuration of logistics integration.

2.1.3. Performance

We consider two types of performance in our framework — operational and financial. Operational measures of performance relate to the efficiency and effectiveness of the internal manufacturing and logistics processes within the firm. These categories of performance reflect competencies in specific areas of manufacturing and logistics, including cost, delivery speed and reliability, quality, and flexibility. These four categories reflect the two arguably most important dimensions of performance-efficiency, or the ability to provide a service at a lowest possible cost, and customer service, or the ability to accommodate customers' special requests (Fawcett and Clinton, 1996). Operational performance measures provide a relatively direct indication of the effects of the relationship between supply chain structure and logistics.

Financial performance measures are more likely to reflect the assessment of a firm by factors outside of the firm's boundaries. These measures would include conventional indicators of business performance, such as market share, return on investment, and sales growth. While these measures are less under the direct control of manufacturing and logistics functions within a firm, it is important to consider whether they are affected by the relationships between supply chain structure and logistics implied by our framework.

2.2. Linking the elements

The underlying conceptual theme of our framework is the idea of fit. ''Fit'' has generally been invoked with respect to the relationship between strategy and structure (Galbraith, 1977; Galbraith and Kazanjian, 1986; Miles and Snow, 1984). The basic idea is that strategy and structure should be consistent — that certain combinations of strategy or structure variables that are more ''appropriate'' in some sense. We can extend this idea of fit to consider logistics integration and supply chain structure — that certain configurations of supply chain structure and logistics integration are in some sense ''better.'' Therefore, a firm that exhibits a fit between its logistics integration and supply chain structure can be expected to perform better than a firm that does not exhibit such a fit. Recall that supply chain structure is composed of two elements — geographic dispersion and channel governance. Examining fit between logistics integration and supply chain structure thus requires the consideration of the fit between logistics integration and geographic dispersion as well as the fit between logistics integration and channel governance.

We first explore the fit between supply chain structure and geographic dispersion of the supply chain. Distance and time increase the difficulty of establishing and maintaining effective interactions between suppliers, production facilities, distributors, and customers. The coordination mechanisms, both internal and external to the firm, that are characteristic of enterprise integration enable more effective management of this added complexity. Therefore, we expect enterprise logistics integration to enable higher levels of performance in geographically dispersed supply chains. Similarly we would expect that enterprise logistics in a less geographically dispersed supply chain might be unnecessary and wasteful and would be likely to result in lower performance. Fit between logistics integration and geographic dispersion would be achieved for two combinations. The first would be the case in which both enterprise logistics and geographic dispersion are present; the second would be the case in which there is neither enterprise logistics nor geographic dispersion. H1 follows:

H1. *Performance will be higher in firms achieving a fit between logistics integration and geographic dispersion.*

Next, we explore the fit between logistics integration and channel governance. It is becoming more common for networks of firms to band together to produce and distribute products in response to new competitive pressures. Enterprise logistics integration provides a coordination infrastructure that allows the logistics function to become the repository of the operational intelligence shared by the network elements. Network firms are characterized by strong linkages between supply chain members but with low levels of vertical integration. In contrast to a hierarchy, where legal ownership arrangements maintain these links, our expectation would be that enterprise logistics integration would provide the operational mechanisms that support these inter-organizational interactions in a network. Therefore, we would expect that the performance of a firm that is part of a network structure would be higher if it also employs an enterprise integration approach to logistics. Similarly, we would expect a firm that is not part of a network structure to achieve better performance if it does not employ enterprise logistics. The coordination and communications mechanisms inherent in enterprise logistics would be unnecessary where links between supply chain elements are weak. On the other hand, the coordination and communication mechanisms of enterprise logistics may conflict with the control-oriented links between elements in a hierarchical supply chain. Logistics integration–channel governance fit would therefore be achieved for two combinations. The first would occur when both enterprise logistics and network structure are present; the second would occur when neither enterprise logistics nor network structure is present. The second hypothesis is therefore:

H2. *Performance will be higher in firms achieving a fit between logistics integration and channel governance.*

3. Methodology

3.1. Population

The population for this exploratory analysis was the North Carolina membership of the World Trade Center of North Carolina. This non-profit and non-political North Carolina-based organization engages in a range of promotional activities to provide trade access to its members in international markets. The organization is comprised of more than 3000 private and public sector organizations. In order to assure that the respondents included only private sector firms, academic institutions and non-profit organizations were excluded from the sample using the appropriate codes of the membership database.

The final population represents a comprehensive group of North Carolina companies that display the following three criteria: (1) global market focus, (2) broad industry representation, and (3) range of organizational size. With respect to global focus, all firms engage in some form of export activity beyond North America. With respect to the second criteria, firms represent a broad spectrum of industries with products that can be sold in a variety of global markets thereby ensuring a variety of organizational structures and supply chain arrangements depending on market requirements. Finally, with respect to the last criteria, World Trade Center organizations include Fortune 500 companies as well as smaller and mid-size companies. A broad range of company size was desired to assure an expanded set of organizational structures and strategic orientations. Table 1 summarizes respondent characteristics, including employees, sales, SIC, and the position of the responding individual. Of the responding individuals, most were in the upper levels of management (president, CEO, COO, CFO, general manager, director, or vice-president). The remainder represented a variety of areas that could be expected to be knowledgeable about the firm's logistics activities, including production, logistics, purchasing, export management, and sales.

3.2. Survey instrument

A questionnaire was sent to each World Trade Center member company identified in the sample. Distinct sections of the questionnaire address a range of topics including: (1) supplier relationships, (2) customer relationships, (3) logistics activities, (4) supply chain activities, (5) ownership of suppliers, production facilities, and distributors, and (6) business unit performance.

The questionnaire was based on constructs taken from the literature in logistics and organizational theory. For most sections, questionnaire items were adapted from scales published in prior research (McGinnis and Kohn, 1990; Heide and John, 1992). Other items were constructed from constructs and

Table 1
Respondent characteristics (number responding in each category)

Employees

< 25	25–100	101–500	501–1000	> 1000	No response
21	16	22	4	8	4

Sales ($ millions)

< 1.0	1.1–10	11–50	51–100	> 100	No response
11	14	13	7	14	16

SIC

10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	No response
2	26	25	2	11	0	0	3	7

Respondent position

Top management[a]	Vice-president	Finance[b]	Other management[c]	No response
39	16	4	15	1

[a] President, CEO, Director, COO, General Manager.
[b] CFO, Assistant Comptroller, Assistant Treasurer.
[c] Production, Logistics, Purchasing, Export, Sales.

concepts found in the literature, but for which specific measures have not been developed. For example, geographic dispersion of the supply chain is a relatively new concept, so a new measure was developed specifically for this study. The questionnaire was not pre-tested formally, but colleagues knowledgeable in logistics were consulted in its development to better ensure its validity and reliability.

Each section contained a set of scaled items corresponding to the section topic. In some sections, respondents were asked to rate their agreement with a set of statements characterizing supply chain relationships and logistics practices in their firms. These responses were measured on a five-point Likert scale. In other sections, respondents were asked to provide simple percentages. For example, respondents were asked to indicate the percentage of the business unit's production facilities, suppliers, distributors and customers located in major geographic regions. Respondents were also asked to rate business unit performance relative to the respondent's industry on a three-point scale (below average, average, or above average).

The questionnaire was mailed with a self-addressed pre-paid postage return envelope to the individual designated as the representative to the World Trade Center. Of a total of 1000 questionnaires mailed, 75 fully usable responses were obtained from the original mailing and follow-up phone calls.[2] The relatively low response rate could potentially be a concern and could possibly limit the study's generalizability. To check for differences between respondents and non-respondents, we compared the size of the firms (as measured by number of employees) in our sample to that of 101 non-respondent firms randomly chosen from our original mailing list. The firm size for non-respondents was obtained from the *North Carolina Manufacturers Directory* (North Carolina Department of Commerce, 1997). A t-test showed no significant difference between firm size in our sample and that of the non-respondents ($T = 1.35$, $p > 0.10$).

3.3. Variables

Before proceeding to data analysis, we first constructed a set of variables corresponding to the three constructs in our conceptual framework: supply chain structure, logistics integration, and organizational performance. In general, the approach we employed was to first reduce the raw questionnaire data to a smaller group of intermediate variables. We then used the configurations approach to identify classifications, or taxonomies, of geographic dispersion, channel governance and logistics integration. Using cluster analysis, which has been commonly employed in prior configuration research (Dess et al., 1993), we were able to identify a set of final variables as sets of distinct configurations categorizing each respondent firm. The first step was to standardize the intermediate variables so that all variables have a mean of 0 and a standard deviation of 1, which removes scale dependency from the analysis, and aids in the interpretation of cluster analysis results because it makes the identification of ''high'' and ''low'' values of cluster means much clearer. We then employed the K-means cluster analysis method to identify clusters. In the K-means approach, it is assumed that the number of clusters in known (Dillon and Goldstein, 1984). Since for the most part we are classifying groups of data based on a known set conceptually developed configurations (e.g., hierarchies, markets, and networks for channel governance), this approach is appropriate.

3.3.1. Geographic dispersion variables

Geographic dispersion (GEODISP) was computed directly from the raw questionnaire data. Respondents were asked to specify the percentage of suppliers, production facilities, distributors, and customers located in each of the following regions: North

[2] A possible explanation for the relatively low response rate emerged during the follow-up telephone calls. Approximately 100 of the original non-respondents were telephoned. In this group, approximately 50% of the contact names telephoned in the follow-up phase either no longer worked for the respondent firm or were not the proper individual to respond to the questionnaire. Of those who were eventually contacted subsequently, 20 additional surveys were returned. It seems likely therefore that the ''effective'' size of the original mailing list was much smaller than 1000. If we extrapolate from the experience of the follow-up calls, where approximately 50% of the contact names from the mailing list were not valid respondents, we would estimate that the ''effective'' size of the mailing list to be at closer to 500. Although this would be only an approximate estimate, it would result in a larger effective response rate, something on the order of 15–16%.

America, Europe, Asia, and others. The objective underlying the computation of the geographic dispersion variable was to assess how to indicate how ''evenly'' each of these supply chain elements was spread geographically. For example, a respondent with one-half its suppliers located in two regions would have a lower geographic dispersion rating than a company with one-quarter of its suppliers in each of the four regions.

Overall measures of geographic dispersion were assessed for each supply chain element — supplier dispersion (SUPPDISP), production dispersion (PRODDISP), distributor dispersion (DISTDISP), and customer dispersion (CUSTDISP). The variables were computed so that they would range from 0 (concentrated completely within one region) to 1 (spread evenly over all four regions). If all regions were equally represented, then the value for each region would be 25%; if only one region were represented, the value for one region would be 100% and the values for the others would be 0%. The variable is then calculated by the formula below.[3]

$$\mathrm{DISP} = 1 - \frac{\left[|\mathrm{Europe\%} - 25| + |\mathrm{Asia\%} - 25| + |\mathrm{N.\,America\%} - 25| + |\mathrm{Other\%} - 25|\right]}{150}$$

Cluster analysis of these dispersion variables revealed two clusters consistent with a dispersed and concentrated supply chain. The first cluster showed high values for all four individual dispersion variables; the second cluster showed low values for all four individual dispersion variables. The results of this cluster analysis are shown in Table 2.

3.3.2. Channel governance variables

We use the configuration approach to classify each firm as a network, hierarchy or market based on a characterization of the firm along two dimensions: (1) the firm's relationships between its suppliers and customers; and (2) the extent of vertical integration present in the firm's supply chain. Twelve questionnaire items, listed in Table 2, addressed a range of attributes that describe the nature of supplier and customer linkages. The average of these 12 items was used to construct a single composite variable, SUPPCUST, characterizing the strength of supplier and customer links. The Cronbach's alpha for these 12 items is 0.72, which indicates an acceptable level of reliability (Nunnally, 1967).

In order to assess vertical integration of the supply chain, respondents were asked to specify the percentage of each of the following stages of the supply chain — raw materials, components, subassemblies, final product assembly, and final product distribution — owned by the firm. The vertical integration variable, VERTINT, was computed by taking the average of the ownership measures for all stages of the supply chain. Cluster analysis was then employed to identify distinct structural supply chain configurations exhibited by respondents. The results, shown in Table 3, confirm the existence of three clusters corresponding to network, hierarchy and market. For each cluster, the entry in the table shows the mean value for that particular variable. Therefore, cluster 1, which has high values for both vertical integration and the strength of supply chain links, is characterized as a hierarchy. Cluster 2, which has low values for both supply chain links and vertical integration, is categorized as a market. Finally, cluster 3, which has a low value for vertical integration

Table 2
Configurations of geographic dispersion

Variable	Cluster means (standardized values)	
	1	2
CUSTDISP	1.040	−0.473
DISTDISP	1.007	−0.458
PRODDISP	0.832	−0.378
SUPPDISP	0.648	−0.294
Dispersion type	dispersion	concentration
Number in cluster	25	55

[3] Note that in this formula, if all four regions are equally represented at 25%, the numerator would equal $|25-25|+|25-25|+|25-25|+|25-25|=|0$, and the quotient would be zero. The dispersion score would equal 1 in this case. If only one region is represented at 100%, the numerator would equal $|100-25|+|25-0|+|25-0|+|25-0|=150$, and the quotient would equal 1. The dispersion score would be 0 in this case.

Table 3
Configurations of channel governance

Variable	Cluster means (standardized values)		
	1	2	3
SUPPCUST[a]	1.504	−1.536	2.577
VERTINT	2.282	−1.280	−1.280
Channel governance type	hierarchy	market	network
Number in cluster	28	43	9

[a]SUPPCUST is computed as the average of the following questionnaire items: (1) Cooperation with customers; (2) interdependence with customers; (3) flexibility with customers; (4) informal relationship with customers; (5) ongoing relationship with customers; (6) information sharing with customers; (7) cooperation with suppliers; (8) interdependence with suppliers; (9) flexibility with suppliers; (10) informal relationship with suppliers; (11) ongoing relationship with suppliers; (12) information sharing with suppliers.

but a high value for supply chain links, is categorized as a network. The results of the cluster analysis are consistent with what would be expected from the conceptual classification shown in Fig. 2.

3.3.3. Logistics integration variables

Logistics integration is described conceptually by four configurations — functional logistics, integrated logistics, inter-firm logistics and enterprise logistics — that correspond to various combinations of internal and external integration of logistics activities within the organization. A cluster analysis based on six logistics integration survey items confirmed these four configurations of logistics integration as shown in Table 4. Consistent with our earlier discussion and what is shown in Fig. 3, we expected to find four clusters corresponding to functional, integrated, inter-firm, and enterprise logistics. Of the six logistics questionnaire items, the first three assessed internal integration activities, and the second three assessed external integration activities. Therefore, a cluster characteristic of enterprise integration should have high values for all six items. A cluster characteristic of integrated logistics should have high values on the first three items and low values on the second three items. A cluster characteristic of inter-firm integration should have low values on the first three items and high value on the second three items. Finally, a cluster characteristic of functional logistics should have low values on all items. Based on these criteria, the first cluster corresponds clearly to integrated logistics, scoring high on internal logistics items 1 through 3 and low on external logistics items 4 through 6. The second cluster corresponds to enterprise logistics with relatively high ratings on all six items. The third cluster shows low values on all but one item, so it would reasonable to classify this cluster as functional logistics. The fourth cluster presents a mixed picture. It has high values on items characteristic of both internal and external integration. However, two of the three internal items have low values and two of the three external items have high values. The argument could be made that this cluster reflects inter-firm logistics integration, to some extent.

Table 4
Configurations of logistics integration

Variable[a]	Cluster means (standardized values)			
	1	2	3	4
LOGISTICS1	0.442	0.516	−1.343	−1.290
LOGISTICS2	0.221	0.284	−2.123	0.368
LOGISTICS3	0.520	0.016	0.196	−0.921
LOGISTICS4	−0.956	0.448	−0.935	0.685
LOGISTICS5	−0.804	0.239	−0.450	0.605
LOGISTICS6	−0.588	0.550	−0.536	−0.610
Logistics integration type	integrated logistics	enterprise logistics	functional logistics	inter-firm logistics
Number in cluster	17	38	9	12

[a]Variable descriptions: LOGISTICS1: logistics computer communication between departments within the firm; LOGISTICS2: coordination of logistics across functional boundaries within the firm; LOGISTICS3: clear organizational boundaries between logistics and other functions within the firm (reverse-scored); LOGISTICS4: coordination of logistics with suppliers and customers; LOGISTICS5: seamless integration of logistics across supply chain; LOGISTICS6: logistics computer communication with suppliers and customers.

3.3.4. Performance

Business performance is described by two dimensions: operational performance and financial performance. Seven questionnaire items probed the organization's performance on these dimensions relative to other firms in the respondent's industry. Principal components analysis was employed to reduce these seven questionnaire items to a smaller set of variables. The resulting loading matrix is shown in Table 5. The left-most column labeled ''item'' lists the questionnaire items. Three components were found corresponding to cost performance (COSTPERF), service performance including delivery, flexibility and quality performance (SERVPERF) and financial performance (FINPERF). To determine significance, we followed the approach of Stevens (1996), which explicitly takes sample size into account. For a sample size of 80, the minimum value of a loading significant at the 0.01 level would be approximately 0.57. Variables were then constructed from the results of principal components analysis by taking the mean of the significant items in each component (Dunteman, 1989). For COSTPERF, the single questionnaire item was used. The Cronbach's alpha values are 0.53 for SERVPERF and 0.65 for FINPERF, which indicate an acceptable level of reliability (Nunnally, 1967).

3.3.5. Fit variables

The results of the cluster analyses described above were then used to construct a set of variables assessing the fit between enterprise logistics, channel governance, and geographic dispersion. The first step was to define dichotomous variables corresponding to clusters for each construct. These variables are listed in Table 6. It should be noted that only variables corresponding to those configurations directly related to hypothesized relationships were defined. For example, only one logistics variable was defined, namely ENTERPRISE. The value of this variable was defined to be 1 for a cluster value of 2 and 0 for all other clusters. Table 6 provides detailed specifications for the other dichotomous configuration variables.

Once these configuration variables were constructed, two variables characterizing ''fit'' were defined. The first variable assesses the fit between enterprise logistics and geographic dispersion. In particular, fit results when the firm exhibits an ''appropriate'' consistency between logistics and geographic dispersion. The hypothesized fit between logistics and geographic dispersion will result from one of two combinations. The first is one in which the firm exhibits both enterprise logistics and a dispersed supply chain; the second is one in which the first employs neither enterprise logistics nor a dispersed supply chain. Therefore, the logistics-dispersion fit variable, ENT_DISP, equals 1 when the two dichotomous configuration variables ENTERPRISE and DISP are the same and 0 when they are not the same. The second fit variable, ENT_NET, which specifies logistics–channel governance fit, is defined in exactly the same manner. Table 6 provides the detailed definitions for each of the configuration and fit variables.

Table 5
Principal components loading matrix (Varimax rotation)
Significant loadings are shown in bold type.

Item	Component		
	1	2	3
Cost performance	0.076	0.106	**0.885**
Delivery performance	0.167	**0.691**	−0.442
Flexibility performance	−0.067	**0.620**	0.311
Quality performance	0.146	**0.798**	0.069
Sales growth	**0.810**	−0.055	0.022
ROI	**0.809**	0.060	−0.092
Market share	**0.641**	0.326	0.171
% Variance explained	25.45	23.19	15.98
Cumulative % variance explained	25.45	48.64	64.62
Component name	FINPERF	SERVPERF	COSTPERF

Table 6
Definitions of configuration and ''fit'' variables

Variable	Definition	
DISP	1	if in dispersion cluster
	0	otherwise
NETWORK	1	if in network cluster
	0	otherwise
ENTERPRISE	1	if in enterprise logistics cluster
	0	otherwise
ENT_DISP	1	if ENTERPRISE = DISP
	0	otherwise
ENT_NET	1	if ENTERPRISE = NETWORK
	0	otherwise

4. Results

The variables described in the previous section were defined in such a way that our hypotheses could be tested using an approach similar to that Safizadeh et al. (1996) used to test the performance implications of the product–process matrix. Each of the ‘‘fit’’ variables is equal to 1 when there is a fit and 0 when there is not a fit. The analysis therefore is a relatively straightforward examination of whether firms in the ‘‘fit’’ classification exhibit significantly higher performance than firms that are not in the ‘‘fit’’ classification. A *t*-test is used to test this relationship for each of the three performance variables defined above. Table 7 shows the results of this analysis.

H1 predicted that performance would be higher for firms exhibiting a fit between logistics integration and geographic dispersion. The results did in fact show that a fit between enterprise logistics and geographic dispersion was associated with higher performance on both operational performance measures (cost and service). There was no significant difference in financial performance. In those firms whose supply chains are dispersed across wide geographic areas, enterprise logistics as hypothesized provides operational advantages in both cost and in service performance. Similarly, for firms whose supply chains are not dispersed, employing a logistics integration approach other than enterprise logistics also resulted in higher performance. Therefore, H1 is supported for operational performance.

The results relating to the fit between logistics integration and channel governance were surprising. There was no significant difference in cost performance, but there were significant differences in the service and financial performance measures. H2 predicted that performance would be higher for firms exhibiting a fit between logistics integration and channel governance. What was surprising was that the firms *not* achieving fit had significantly higher performance. Therefore, H2 was not supported and, in fact, was contradicted to a large extent. We will consider this unexpected result below.

5. Discussion and conclusions

In this paper, we have argued that a new and expanded role for logistics will be required in the new extended manufacturing enterprise. As competition shifts from head-to-head battles between firms to competition between supply chains, a firm’s success will increasingly depend on its ability to coordinate and integrate the production activities at geographically dispersed and organizationally distinct locations with its logistics operations. This ‘‘new’’ enterprise logistics will place a high priority on both inter-firm and intra-firm integration of logistics activities for sustainable commercial success. The results of this study provide a number of important implications and suggest several areas for future research.

Table 7
Data analysis results

Fit between enterprise logistics and	Performance measure		
	Cost (COSTPERF)	Service (SERVPERF)	Financial (FINPERF)
Geographic dispersion (ENT_DISP)			
Fit ($n = 40$)	3.65	4.35	3.30
No fit ($n = 35$)	3.06	3.99	3.46
T	2.10**	1.88*	0.58
Network structure (ENT_NET)			
Fit ($n = 35$)	3.17	3.99	3.13
No fit ($n = 40$)	3.55	4.35	3.58
T	1.30	1.86*	1.68*

*$p < 0.10$.
**$p < 0.05$.

The notion of fit suggests a contingency effect for the benefits of enterprise logistics. We would expect enterprise logistics to provide a positive impact in situations where its strengths can be exploited; we would expect its greater complexity to hinder performance in those cases that do not require its capabilities. Our results supported this expectation in the case of geographic dispersion. There was a clear positive relationship between operational performance and fit between logistics integration and geographic dispersion of the firm's supply chain. The results also suggest that while organizations have been able to translate this fit into improved operational performance, they have not yet done so for financial performance. In sum, enterprise logistics can play an important role in allowing a geographically dispersed supply chain to operate as a ''virtual'' supply chain.

The results related to the fit between logistics and channel governance are more complicated. In fact, the results of the analysis were opposite of the hypothesized relationship for financial and service performance. Firms achieving fit between logistics integration and channel governance showed lower performance than firms that did not achieve fit. Therefore, firms that employed either enterprise logistics *or* a network structure, but not both, had higher financial and service performance than firms characterized by both enterprise logistics and network structure or neither enterprise logistics nor network structure.

A definitive explanation for these results must be left for future research and validation across a more broadly defined sample, but we can provide one interpretation here. It may very well be that enterprise logistics and network structure are similar in nature, but opposite in tactics, and therefore may be redundant and inefficient. The coordination mechanisms provided by enterprise logistics may conflict with those in a firm whose supply chain is organized as a network, possibly because interpersonal cooperative links between supply chain members are already in place, and are deteriorated by an impersonal IT relationship. This conflict is suggested by the fact that the scaled item measuring ''non-technical'' logistics coordination with suppliers and customers and the item measuring computer-based communications with suppliers and customers were both rated high while, at the same time, effective seamless integration of logistics across the supply chain was rated lower (see Table 4, under the ''Enterprise'' cluster). This redundancy in communication and coordination mechanisms may create a confounding organizational burden that results in poorer performance. Rather than reinforcing one another, the mechanisms inherent in networks and enterprise integration may actually conflict with one another.

However, the results do not imply that enterprise logistics *necessarily* penalizes performance. The implication is that performance is lower when both enterprise logistics and network structure are present or when neither enterprise logistics nor network structure is present. Both approaches attempt to provide coordination among elements in the supply chain. Better performance was achieved when the supply chain–logistics integration combination included one or the other, but not both approaches. Performance was also higher than if neither approach was present.

Therefore, possibly the best approach to this logistics and supply chain decision is to include enterprise logistics in a geographically dispersed supply chain, but not in a pure network — either the supplier/customer links need to be controlled through hierarchical ownership, *or* logistics integration should assume the role of linking suppliers and customers. In a supply chain that is geographically concentrated, enterprise integration is unnecessary, would be inefficient, and likely result in lower operational performance. The flip side is that if there is no enterprise integration, then a network can assume the role of linking suppliers and customers — hierarchical control is not necessary. The implication is that coordinating strong links between suppliers and customers requires some type of control — either through logistics mechanisms within and between firms, or through a more formal vertical integration arrangement.

Thus, the results support the notion of a contingency effect. Enterprise logistics does not necessarily provide a benefit for performance in all cases. Its benefit arises in combination with other dimensions of a firm's supply chain structure. The paper provides strong support for the need for enterprise logistics for large global companies whose suppliers and customers span the globe. Future research might address whether the benefits of enterprise logistics can be more closely linked with specific network architectures, for example decentralized or centralized architectures. Certain industries might achieve more effective performance by focusing enterprise logistics activities on the distribution of finished goods directly to the customers rather than on the inbound supply of parts and raw materials, or vice versa.

At the same time, the results suggest that our understanding of how supply chain structures and logistics interact may be more complex that simply replacing or supplementing more traditional elements of customer–supplier interaction with information technology. This area will prove a very fertile and important area for future research. It is essential to understand how the new ‘‘digital’’ environment will affect current business practices. Some aspects of logistics communications may be enhanced by new digital and Internet-based technologies. However, creating a ‘‘virtual’’ supply chain in which all members of the globally dispersed extended enterprise are linked into an effective entity as if distances, national borders, and cultural differences did not exist is a tremendous challenge today. The answers to many of these questions and issues will require a coordinated research approach that integrates survey-based studies with case-based studies that can address many of the psychological aspects of inter-organizational relationships and communications.

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