A structural equation model assessment of logistics strategy

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Abstract

Purpose – The purpose of this paper is to assess relevance of the three dimensions (process strategy, market strategy, and information strategy) of the Bowersox and Daugherty typology to logistics strategy and organizational competitive outcomes.

Design/methodology/approach – Empirical data gathered from US logistics managers were analyzed using second-order factor analysis to examine the Bowersox/Daugherty typology's relevance to logistics strategy and organizational competitive responsiveness.

Findings – The findings identify overall logistics strategy and its effect on logistics coordination effectiveness, customer service effectiveness and organizational competitive responsiveness. Implications for teachers and practitioners of logistics and supply chain management are discussed.

Practical implications – The paper's findings expand the understanding of logistics strategy's role in organizational competitive responsiveness. In addition, the findings of this paper provide a foundation for future research into comparative studies of business logistics management and supply chain management.

Originality/value – The paper provides empirical insights that could facilitate the development of logistics management/supply chain management theory.

Keywords Logistics management, Supply chain management, Logistics strategy, Competitive responsiveness, Customer service, Structural equation model

Paper type Research paper

Introduction

Logistics' role as part of strategy has been apparent since at least the 1970s (Heskett, 1977). During the 1980s strategy considerations had become a theme in the Council of Logistics Management's (CLM's) (now the Council of Supply Chain Management Professionals (CSCMP)) supplement to bibliography on logistics management (Kohn and McGinnis, 1997b). As part of ongoing research during the 1980s Bowersox and Daugherty (1987) presented a typology which postulated three dimensions of logistics strategy; namely, process, market, and information. This is considered the first known business logistics strategy classification. During the last two decades, their typology has been used as a conceptual framework for conducting empirical research for studying dimensions of logistics strategy. Although Bowersox and Daugherty (1987) typology has generated a rich stream of literature, these studies have produced varying results.

Although previous research did not provide consistent evidence to validate the Bowersox and Daugherty (1987) original typology, Autry *et al.* (2008) stated that these inconsistencies could stem from various methodological approaches used

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in different studies. Furthermore, very few studies in the literature have examined the basic structure of the typology in the context of overall organizational strategy.

Logistics strategy is a competitive tool that consists of multitude of factors that contribute to the organizational "competitive responsiveness" (Heskett, 1977). As used in this manuscript "competitive responsiveness" refers to the organization's ability to respond more quickly and effectively than competitors:

- to changing customer and supplier needs;
- to changing competitor strategies; and
- in developing and marketing new products.

If process, market, and information concerns are coordinated within the overall logistics strategy (OLS) and there is a clear focus on customer service (as perceived by the customer), then "logistics" will contribute to overall organizational competitive responsiveness. However, a number of other dimensions should also affect organizational competitive responsiveness including competitive products, effective marketing campaigns, efficient procurement and production activities, and adequate financial resources.

This current research adopts a perspective that the Bowersox and Daugherty typology provides a strong conceptual basis consistent over time with regards to salient dimensions of logistic strategy. These dimensions should be coordinated at many levels of the organization to achieve competitive responsiveness. Through this research we hope to unravel the complexities of logistics management strategy and understand the role logistics management strategy plays in maintaining and enhancing competitive advantage responsiveness. Using a confirmatory factor analysis (CFA) and a structural model, we assess the validity of three dimensions of Bowersox and Daugherty typology and their simultaneous relationship to logistics coordination, customer service effectiveness (CSE), and overall organizational competitive responsiveness. The model developed in this study uses a second-order factor, called overall logistic strategy, to represent the three dimensions of Bowersox and Daugherty typology.

This paper is organized into seven sections. The first two sections are the introduction and literature review. The fourth, fifth, and sixth sections discuss the research model and study hypotheses, methodology, and analysis and results. The final section discusses the relevance and implications for logistics/supply chain management practitioners, educators, and researchers.

Literature review

Using a qualitative study, Bowersox and Daugherty (1987) identified three dimensions of logistics strategic orientation, which may be used individually or in combination to respond to organizational business requirements. They are summarized as:

(1) Process strategy – management of traditional logistics activities with a primary goal of controlling costs.

(2) Market strategy – management of selected traditional logistics activities across business units with the goal of reducing complexity faced by customers.

(3) Information strategy (also referred to as "channel strategy" by some researchers) – a diverse group of traditional logistics activities and other activities managed as a system with the goal of achieving inter-organizational coordination and collaboration through the channel.

Subsequent research has concluded that the Bowersox and Daugherty typology was worthy of further research (McGinnis and Kohn, 1993); that the typology is "promising" (Clinton and Closs, 1997); that multiple strategies are present in all organizations to varying degrees and process strategy explains more variance in logistics coordination effectiveness (LCE) than do market and information strategies (Kohn and McGinnis, 1997a); and that the Bowersox and Daugherty typology can be used for examining logistics strategy in US manufacturing firms (McGinnis and Kohn, 2002).

More recently, Autry *et al.* (2008) surveyed 254 logistics managers from multiple industries. Their research identified two logistics strategy dimensions, functional logistics (FL) strategy and externally oriented logistics (EOL) strategy. The former was described as similar to Bowersox and Daugherty's process strategy. The latter was described as somewhat resembling channel (information) strategy. Logistics activities associated with the two strategies were as follows:

- Functional logistics (FL): inventory and order management, order processing, procurement, and storage.
- Externally oriented logistics (EOL): coordination and collaboration activities, logistics social responsibility, strategic distribution planning, and technology and information systems.
- Three logistics activities that did not vary significantly between FL and EOL strategies were customer service, operational controls, and transportation management.

Finally, McGinnis *et al.* (2010) compared logistics strategy evolution from 1990 to 2008 using the Bowersox and Daugherty dimensions (Process Strategy, Market Strategy, and Information Strategy) as independent variables and three dependent variables (Logistics Coordination Effectiveness, Customer Service Effectiveness, and Company/Division Competitive Responsiveness) to identify and evaluate the changes, if any, that occurred in logistics strategy over that period. The authors concluded that:

- the Bowersox and Daugherty typology provided an excellent framework over the period;
- cost efficiency (process strategy) is important in both "intense" and "passive" logistics strategies but that reducing complexity faced by customers (market strategy) and inter- and intra-organizational coordination (information strategy) decline in importance in "passive logistics strategies";
- inter- and intra-organizational coordination (information strategy) facilitates process strategy and market strategy in firms with "intense logistics strategies"; and
- LCE and CSE better assess logistics strategy outcomes than company/division competitive responsiveness.

While providing a wealth of insight into the relevance of the Bowersox and Daugherty typology, the literature has not empirically examined:

- the psychometric properties and construct validity of the measurement scales (process strategy, market strategy, LCE, CSE, and company/division competiveness);

- the relationships existing between the six constructs; and
- the relationship of the six constructs to OLS.

Further analysis of available data could provide greater insight into the dimensions of the Bowersox and Daugherty typology and logistics strategy outcomes. The findings of this investigation are expected to contribute to the logistics literature by validating and testing the multidimensional conceptualization of underlying dimensions of overall logistic strategy and its role on competitive response. Conceptualizing overall logistic strategy at a higher order construct provides managers with an opportunity to examine the strategy outcomes at a higher level of abstraction beyond individual dimensions and allows decision makers to see these dimensions as a set of interrelated dimensions that require strategy formulations collectively. Furthermore, testing and validating the relationships between logistic strategy competitive response in different time periods provide additional insights into the robustness of the conceptualized relationships among constructs over time.

Research model and study hypotheses

SEM is a methodology which is uses empirical evidence to confirm a set of hypotheses representing a widely accepted theory. The structural model we propose for this research can be found within the framework of strategic management theory described in almost any modern day textbook in strategic management such as Wheelen and Hunger (2010). The ensuing discussion describes the justification of our SEM model.

In their original discussion of process, market, and information strategies, Bowersox and Daugherty (1987) recognized that classification of organizations based on strategic orientation was not absolute and that organizational forms (strategic orientation) overlap. Further, they recognized that many firms combine more than one type of orientation and that no single type of orientation dominates within an industry. According to Wheelen and Hunger (2010), the basis for this theoretical structure lies within the framework of strategic management theory. The process of classical strategic management begins with environmental scanning (identifying strategic factors), followed by strategy formulation (creating mission statement, objectives, strategies, and policies). The next stage is strategy implementation (developing programs, budgets, procedures) and finally evaluation and control (monitoring objectives). These activities proceed in a sequential, yet interactive, progression where previous steps may be modified due to feedback from subsequent steps. For example, challenges in strategy implementation may cause an organization to rethink portions of strategy formation. Once in place, changes ripple through the organization as it evolves over time. The overall objective of strategic management is to insure that an organization remains healthy in a business sense and can continue to advance its competitive advantage in the market place.

The strategy formulation phase also takes place at the functional level (Wheelen and Hunger, 2010). Here each business unit such as marketing, finance, R&D, operations, purchasing, logistics, human resource management, and information technology in turn must formulate their individual strategies. The alignment of functional strategies with the overall corporate strategy is needed to achieve a unified effort working towards the common goal. A great deal of research in strategic management and related fields addresses how policies and objectives develop and are implemented within organization. Articles cited here are used to address how a theoretical model can be developed to support our research. Hult *et al.* (2007) used theories of organizational learning and information processing to investigate how the culture of competitive responsiveness and knowledge base helped shape supply chain management strategy to meet the challenges of competing within a volatile market. The implication of this research is that maintaining competitive advantage is often driven by successful strategic management policies at the functional level as well at the corporate level.

Defee and Stank (2005) studied how strategic management principles and processes impacted supply chain structural development and performance. The authors found an iterative relationship within the framework of strategy, structure and performance processes which suggested that supply chain management strategies needed to be aligned with their partners. Heskett (1977) emphasized that logistics considerations can play an important role in achieving strategic objectives, such as increased market share or increased profits. In traditional corporate structures, successful logistics strategy should result in increased effectiveness of business operations. Among the many functional areas affected, customer service is recognized as an area of primary concern for many organizations. Therefore, effective logistics can result in enhanced customer service operation.

The impact of a successful customer service operation results in a competitive advantage for the organization. Tseng (2009) proposed a conceptual framework to use a knowledge chain based on customer, supplier, and competitor information to support and improve the organization's competitive advantage. Donaldson (1995) examined manufacturing companies and concluded that organizations which were more responsive to customer needs would be better able to improve their competitive responsiveness.

An examination of several selected articles shown in Table I, indicates that logistics strategy, the blend of Bowersox and Daugherty's process, market, and information strategies referred to in this manuscript as OLS affects LCE, CSE, and company/division competitive responsiveness (COMP). However, the structural relationships between OLS, LCE, CSE, and COMP have not been examined. Specifically, linkages among OLS, LCE, CSE, and COMP have not been quantified to ascertain their roles relative to each other. A clearer understanding of these roles could provide insights to practitioners and researchers of logistics strategy's role in helping the firm achieve its objectives.

If we consider overall logistic strategy as a higher order construct incorporating the Bowersox and Daugherty dimensions, then a conceptual model can be developed to validate this structure and investigate the linkages between logistic strategy and organizational outcomes. Bowersox and Daugherty (1987) suggested that process, market, and information strategy (PROCSTR, MKTGSTR, and INFOSTR, respectively) have a common objective of managing the logistics process and that there is a strong need to examine the inter-actions among PROCSTR, MKTGSTR, and INFOSTR and how they further organizational strategies.

The structural model shown in Figure 1 depicts OLS is linked to process, market, and information strategy as conceptualized by Bowersox and Daugherty (1987). Also, this model shows the link between OLS and company/division competitive responsiveness. In this conceptualization, we emphasize that the hypothesized effect on competitive responsiveness is through logistic coordination and CSE. Therefore, we offer the following hypotheses:

Table I. Comparison of selected logistics strategy studies

Authors	Background	Methodology	Findings
McGinnis and Kohn (1990)	Authors began a review of alternate perspectives of logistics organization and logistics strategy	Mail questionnaire to 523 logistics managers of USA manufacturing firms: 222 (42.4 percent) usable returns	Logistics Coordination Effectiveness, Customer Service Effectiveness, and Competitive Responsiveness, among other variables, that varied $p < 0.05$ among identified strategies. No attempt to identify paths among significant variables
McGinnis and Kohn (1993)	Builds on previous research to develop additional insights into logistics as a part of strategy	Mail questionnaire to 146 subjects who had responded to a previous questionnaire: 59 (43.7 percent) usable returns	Three logistics strategy clusters identified based on process and market strategies. LCE, customer service effectiveness, and company/division competitive responsiveness varied $p < 0.05$ among strategies. The need to explore linkages of logistics strategy was recognized
Clinton and Closs (1997)	Assess whether underlying factors could be identified for the Bowersox and Daugherty typology	Used survey data from 375 USA manufacturers and 103 Canadian Association of Logistics Management members	Identified six of ten commonalities of advanced logistics organizations. Concluded process, market, and channel (information) strategies have a common objective of managing the logistics process. Process emphasizes internal integration; market emphasizes external integration; and channel (information) focuses on integrated planning and operations. Further concluded that the richness of logistics strategy variables is not exhausted and that further research is warranted

(continued)

Authors	Background	Methodology	Findings
McGinnis and Kohn (2002)	Tested relationship of Bowersox and Daugherty variables with LCE	Mail questionnaire to 714 logistics managers in USA manufacturing firms: 172 (24.1 percent) usable returns. Multiple regression analysis was used to assess independent variables that explain variance in LCE	Factor analysis identified two independent variables, one comprised of Process and Information strategies (P&IS) the other consisting of Market Strategy (MS). Both independent variables were significant and explained 46.5 percent of the variance in LCE. The authors concluded that process, market, and information strategies contribute to LCE. Recommended further research to identify interactions among process, market, and information strategies and how these strategies blend to further organizational objectives
Autry *et al.* (2008)	Empirically developed logistics strategy taxonomy	Mail questionnaire to logistics managers from multiple industries: 254 (38.0 percent) usable surveys were received from 668 subjects	Cluster analysis was used to identify two logistics strategies: FL and EOL. Recommended that further research investigate logistics strategy
McGinnis *et al.* (2010)	Studied logistics strategy from 1990 to 2008	Compared empirical data gathered in 1990, 1994, 1999, and 2008	Identified logistics strategy clusters (intense and passive) and their relationships to logistics strategy outcomes. Concluded that cost efficiency is common to both strategy clusters, that reducing complexity faced by customers and inter- and intra-organizational coordination is less important in passive logistics strategies. Also concluded that LCE and customer service effectiveness better measure logistics strategy outcomes

Note: See notes for complete citations

Table I.

H1. OLS positively influences LCE.

H2. LCE positively influences CSE.

H3. CSE positively influences company/division competitive responsiveness (COMP).

If the hypothesized relationships are supported then it would suggest that OLS, LCE, and CSE are necessary for COMP. This would require organizational commitment to OLS, LCE, and CSE in order to achieve COMP.

Methodology

Measurement scales used in the study

Each construct in this study was modeled as a latent variable and measured by several items on a five-point Likert scale, as shown in Table II. Six constructs identified in Table II were used for the purposes of evaluating logistics strategy and its effect on organization competitive responsiveness in US manufacturing firms. Each dimensions identified consisted of multi-items scales that were used to measure constructs identified in Bowersox and Daugherty typology, namely process, market, and information strategy (PROCSTR, MKTGSTR, and INFOSTR, respectively). These scale items have been used in several studies reported in the literature, have sufficient content validity (Kohn and McGinnis, 1997a) and possess adequate levels of reliability (George and Mallery, 2003). We also selected three other constructs to represent the outcomes of logistics strategy, namely LCE, CSE, and company/division competitive responsiveness (COMP). The scale items had been previously developed using factor analysis, have been replicated, appear to fit the construct name, and have relevant levels of reliability (Kohn and McGinnis, 1997a). All six constructs are previously described and discussed by Keller *et al.* (2002). After considering issues of validity and reliability, occurrence of scale replication, consistency of sampling and data collection methodologies, and the lack of relevant multi-year data on logistics strategy, we concluded that these six constructs selected for this research would provide a useful basis for validation of relationships among logistics strategies and their implications.

Data collection

Data for the study had been collected at four different time periods in time (1990, 1994, 1999, and 2008). Identically worded questions were used to collect data for each of the six constructs. The subjects were logistics managers in US manufacturing firms who:

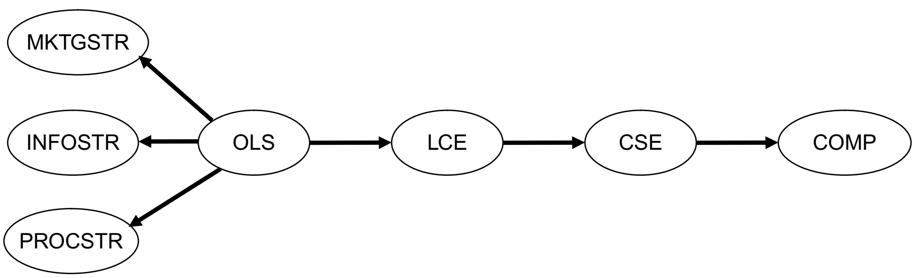


Figure 1. Conceptualized structural model

Scales/items	Reliability coefficients (α) 1990	1994	1999	2008
Scale 1: process strategy (PROCSTR) – average $\alpha = 0.651$	0.626	0.710	0.579	0.609
1.1 In my company/division, management emphasizes achieving maximum efficiency from purchasing, manufacturing, and distribution				
1.2 A primary objective of logistics in my company/division is to gain control over activities that result in purchasing, manufacturing, and distribution costs				
1.3 In my company/division, logistics facilitates the implementation of cost and inventory reducing concepts such as focused manufacturing and just-in-time materials procurement				
Scale 2: market strategy (MKTGSTR) – average $\alpha = 0.741$	0.811	0.642	0.737	0.772
2.1 In my company/division, management emphasizes achieving coordinated physical distribution to customers served by several business units				
2.2 A primary objective of logistics in my company/division is to reduce the complexity our customers face in doing business with us				
2.3 In my company/division, logistics facilitates the coordination of several business units in order to provide competitive customer service				
Scale 3: information strategy (INFOSTR) – average $\alpha = 0.629$	0.520	0.727	0.568	0.699
3.1 In my company/division, management emphasizes coordination and control of channel members (distributors, wholesalers, dealers, retailers) activities				
3.2 A primary objective of logistics in my company/division is to manage information flows and inventory levels throughout the channel of distribution				
3.3 In my company/division, logistics facilitates the management of information flows among channel members (distributors, wholesalers, dealers, retailers)				
Logistics coordination effectiveness (LCE) – average $\alpha = 0.609$	0.539	0.649	0.708	0.538
4.1 The need for closer coordination with suppliers, vendors, and other channel members has fostered better working relationships among departments within my company				
4.2 In my company logistics planning is well coordinated with the overall strategic planning process				
4.3 In my company/division logistics activities are coordinated effectively with customers, suppliers, and other channel members				
Customer service effectiveness (CSE) – average $\alpha = 0.695$	0.723	0.729	0.673	0.653
5.1 Achieving increased levels of customer service has resulted in increased emphasis on employee development and training				
5.2 The customer service program in my company/division is effectively coordinated with other logistics activities				
5.3 The customer service program in my company/division gives us a competitive edge relative to our competition				
Company/division competitive responsiveness (COMP) – average $\alpha = 0.733$	0.684	0.862	0.675	0.701
6.1 My company/division responds quickly and effectively to changing customer or supplier needs compared to our competitors				
6.2 My company/division responds quickly and effectively to changing competitor strategies compared to our competitors				
6.3 My company/division develops and markets new products quickly and effectively compared to our competitors				
6.4 In most of its markets my company/division is a (1 – very strong competitor, 5 – very weak competitor)				

Table II.
Scale items retained

- were members of the CSCMP – previously the CLM;
- were employed by manufacturing firms; and
- held job titles of manager or higher.

Collection of the 1990 data is described in McGinnis and Kohn (1993), collection of the 1994 data is described in Kohn and McGinnis (1997a, b), collection of the 1999 data is described in McGinnis and Kohn (2002), and 2008 data collection is described in McGinnis *et al.* (2010). After examining the means, standard deviations, and reliability coefficients of the variables during the four time periods the authors concluded that the data were satisfactory for inclusion in the following analysis. Using data from the four previous studies allows us to assess the roles of factors driving logistics strategy during this time period. The intent here is to identify broad changes in the makeup and behavior of logistics strategy. The data collected is of sufficient sample size and reliability for this purpose.

Analysis and results

The first step of this process was to factor analyze the variables Process Strategy, Market Strategy, and Information Strategy to ascertain whether they were associated with one or more logistics strategy factors. The factor analysis was conducted on all four sets of data, 1990, 1994, 1999, and 2008. As shown in Table III, they loaded on one factor, OLS. Contributions to the average percentage of variance in the factor across all four data sets were, in descending order, process strategy (an average of 60.3 percent), market strategy (23.7 percent) and information strategy (16.1 percent). Note that the some totals do not add to 100.0 percent due to rounding. Because all four sets of data were consistent in ordering of process, market, and information strategies, total variance explained, and high alphas the authors concluded that there was a theoretical basis for constructing a model which explained how OLS relates to LCE, CSE, and company/division competitive responsiveness.

In the next step, correlations among structural variables in Figure 1, OLS, LCE, CSE, and company/division competitive responsiveness (COMP), were calculated for all four data sets. Ten of the 12 correlations shown as Table IV were significant at $\alpha < 0.01$ and two were significant at $\alpha < 0.05$. Inspection of the correlations revealed similarities in all data sets and are described as follows. For OLS, the average correlations with the other variables in descending order were LCE: 0.595, CSE: 0.505, and COMP: 0.347. Next, average correlations for the four data sets of LCE in descending order were CSE: 0.588 and COMP: 0.395. Finally the average correlation of CSE and COMP was 0.424.

Table IV presents the reliability coefficients for the six constructs for all four data sets, 1990, 1994, 1999, and 2008. Moreover, to be able to compare these data sets

	Factor loading/percent explained variance				
Variables	1990 ($n = 59$)	1994 ($n = 91$)	1999 ($n = 172$)	2008 ($n = 49$)	Average
Process Strategy	0.774/54.9%	0.773/65.0%	0.793/61.1%	0.859/60.3%	60.3%
Market Strategy	0.832/27.7%	0.841/19.9%	0.738/21.7%	0.783/25.3%	23.7%
Information Strategy	0.932/17.5%	0.804/15.1%	0.812/17.2%	0.677/14.4%	16.1%
Total Variance Explained	100.1%[a]	100.0%	100.0%	100.0%	100.1%[a]
Reliability Coefficient (α)	0.893	0.926	0.915	0.912	0.912

Note: [a]Totals do not add to 100 percent due to rounding

Table III. Factor loadings on OLS for process strategy, market strategy, and information strategy

Table IV.
Correlations of variables

	1990 ($n = 59$) LCE	1990 CSE	1990 COMP	1994 ($n = 83$) LCE	1994 CSE	1994 COMP	1999 ($n = 172$) LCE	1999 CSE	1999 COMP	2008 ($n = 49$) LCE	2008 CSE	2008 COMP
1990												
OLS	0.514**	0.479**	0.313*									
LCE		0.615**	0.490**									
CSE			0.511**									
1994												
OLS				0.601**	0.512**	0.407**						
LCE					0.551**	0.434**						
CSE						0.431**						
1999												
OLS							0.687**	0.489**	0.239*			
LCE								0.560**	0.337**			
CSE									0.362**			
2008												
OLS										0.578**	0.538**	0.428**
LCE											0.626**	0.317*
CSE												0.393**

Note: Correlation is significant at: *0.05 and **0.01 levels (two-tailed) in different time periods, we needed to test if these data sets were fundamentally different from each other with respect to subjects' evaluations of scale items. Therefore, we performed ANOVA to test if the means of scale scores different from one another for the constructs used in this study. Table V shows the results of comparisons among four different data sets and ANOVA results indicate that mean scores of scales were not statistically different from each other.

Table V also presents the results for KMO tests for sampling adequacy and Bartlett's test for sphericity for the four data sets, 1990, 1994, 1999, and 2008. These measures are used to determine the suitability of the data for factor analysis. The four KMO measures are 0.689, 0.679, 0.824, 0.694, respectively, and all levels of significance are less than 0.000. All KMO results are above 0.5 which is the minimum cut off for factor analysis. KMO results along with the Bartlett results indicate the data are suitable for factor analysis.

Exploratory factor analysis of Bowersox and Daugherty typology

Using the 1999 data, exploratory factor analysis (EFA) was conducted on nine logistics strategic orientations scores using principle component analysis with varimax rotation

Scales	Years of data collection[b]				ANOVA mean differences*
	1990	1994	1999	2008	
Process strategy (PROCSTR)					
n	59	91	172	50	
μ	2.186	2.337	2.330	2.187	Not significant
σ	0.736	0.817	0.706	0.660	
Market strategy (MKTGSTR)					
n	59	91	172	50	
μ	2.254	2.535	2.543	2.186	Not significant
σ	0.796	0.789	0.484	0.660	
Information strategy (INFOSTR)					
n	59	91	172	50	
μ	2.582	2.718	2.770	2.580	Not significant
σ	0.668	0.740	0.717	0.609	
Logistics coordination effectiveness (LCE)					
n	59	91	172	50	
μ	2.554	2.685	2.582	2.580	Not significant
σ	0.774	0.707	0.730	0.609	
Customer service effectiveness (CSE)					
n	59	83	172	50	
μ	2.271	2.528	2.518	2.633	Not significant
σ	0.838	0.823	0.743	0.772	
Company/division competitive responsiveness (COMP)					
n	59	91	172	48	
μ	2.284	2.500	2.102	2.422	Not significant
σ	0.629	0.703	0.589	0.659	
KMO measure of sampling adequacy	0.689	0.679	0.824	0.694	
Bartlett's test of sphericity – significance level	0.000	0.000	0.000	0.000	

Notes: Significance at: $^{*}p < 0.05$ level; [a]scale scores = (sum of item scores of items in that scale)/(number of items); [b]a five-point scale was used (1 – strongly agree, 5 – strongly disagree)

Table V. Comparison of means of scale scores and measures of factor analysis adequacy: 1990 through 2008[a] to extract the factors. The 1999 data were used as a choice of data set because the sample size ($n = 172$) was the largest of the four data sets. This would reduce the likelihood that further analysis would be compromised in the smaller data sets due to chance variation. A three-factor solution revealed reasonable loadings on three factors as conceptualized by Bowersox and Daugherty typology. As can be seen in Table VI, market strategy (MKTGSTR) accounted for 22.2 percent of variance, process strategy (PROCSTR) accounted for 21.5 percent, and two items from information strategy (INFSTR) accounted for 15.8 percent of variance for a total of 59.5 percent of variance.

Although EFA provided reasonable loadings for the underlying factor structure of logistic strategic orientations, we would have preferred to see clearer factor loadings on each factor. Therefore, to confirm the underlying structure presented by Bowersox and Daugherty and test whether the logistic strategic orientation is comprised of one second-order general factor with three first-order factors – PROCSTR, MKTGSTR, and INFSTR, second-order CFA was used.

Confirmatory factor analysis

For complex models of logistics strategies, as described earlier in this paper, SEM is not only the ideal analytical technique but perhaps the only technique that can provide a sound theoretical basic for analysis. To confirm the underlying structure, the authors conducted CFA on the 1999 data using AMOS. A number of fit indices such as χ^2, root mean square error of approximation (RMSEA) goodness of fit index (GFI), and comparative fit index (CFI) are used to assess the model fit of the hypothesized structure. The two-step approach suggested by Anderson and Gerbing (1988) was used to first examine the measurement model and then the structural model. In the measurement model, the hypothesized relationship between the nine logistic strategic orientations and the three first-order factors were examined to understand how well the relationships fit the data. In the structural model, we examined the relationship between the three first-order factors (PROCSTR, MKTGSTR, and INFSTR).

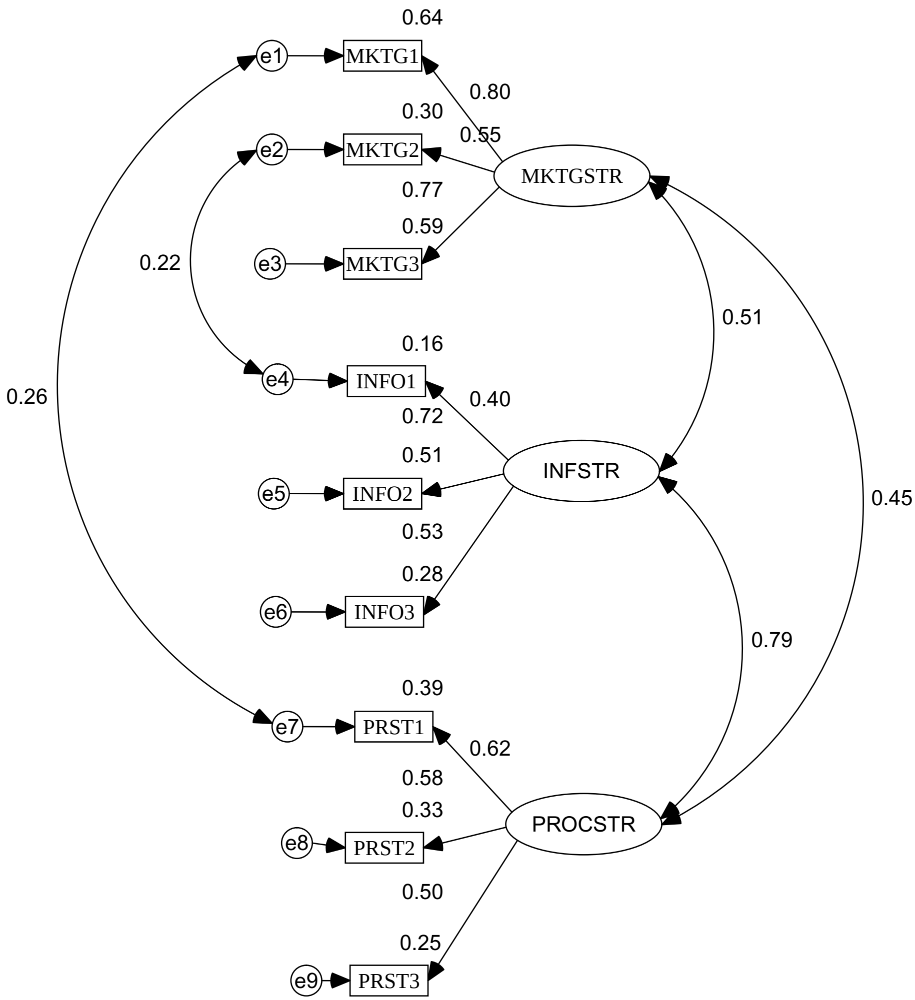
The results of the initial estimation of the first-order factor model did not reveal a satisfactory results with a χ^2 of 43.559 (df = 24) significant at $p < 0.009$ level. Other fit indices provided a moderate level of fit (RMSEA = 0.069; GFI = 0.948; CFI = 0.936). After analyzing the modification indices, we learned that we would achieve

Scale items	PROCSTR	MKTGSTR	INFOSTR
1-1	0.743		
1-2	0.771		
1-3	0.522		
2-1		0.866	
2-2		0.601	
2-3		0.855	
3-1	0.522		0.292
3-2			0.649
3-3			0.900
Eigenvalue	1.935	2.002	1.428
% variance	21.501	22.247	15.863

Note: $n = 172$

Table VI.
EFA 1999 data

a significantly better fit if we were to allow two of the error terms to be correlated. Based on this information, we allowed the correlations between the errors of indicator variables e2 ← → e4 and e1 ← → e7. Inspection of the Table IV shows the scales that were used in the measurement model. The scales that needed to co-vary were 2.2 for marketing strategy (e2) and 3.1 for information strategy (e4), respectively. These scales correspond to "reduce complexity" and "coordination/control of channels". Similarly, scales 2.1 for marketing strategy (e1) and 1.1 for process strategy (e7) were correlated. These scales correspond to "coordination of distribution" and "maximum efficiency", respectively. As shown in Figure 2, this resulted in significantly improved model fit ($\chi^2 = 31.058$; $p = 0.095$; RMSEA = 0.049; GFI = 0.962; CFI = 0.970). Non-significant χ^2 as well other fit indices indicated a good fit between the model and the data. Furthermore, the results



Notes: $n = 172$; $\chi^2 = 31.058$; $p = 0.095$; CFI = 0.970; GFI = 0.962; RMSEA = 0.049

Figure 2.
First-order CFA for overall logistics of logistics strategy 1999 data

showed that all loadings in the model were significant, leading us to conclude that the relationships between the items and latent factors were confirmed by the data.

Fornell and Larcker (1981) suggested a formula to calculate the internal consistency of the latent factors. They suggest a threshold value of 0.70 be used for acceptable reliability. The construct reliabilities for the three first-order factors are listed in Table VII. All three reliabilities exceeded the recommended level of 0.70 indicating a good internal consistency. The last step in the process to confirm the underlying structure of the model was to evaluate the relationship between the three first-order factors and a second-order factor named "overall logistic strategy". The purpose here is to understand how the three factors contributed to an overall construct. The results of the structural model displayed in Table VII resulted in a non-significant χ^2 value and very good fit indices.

Structural model and hypotheses testing

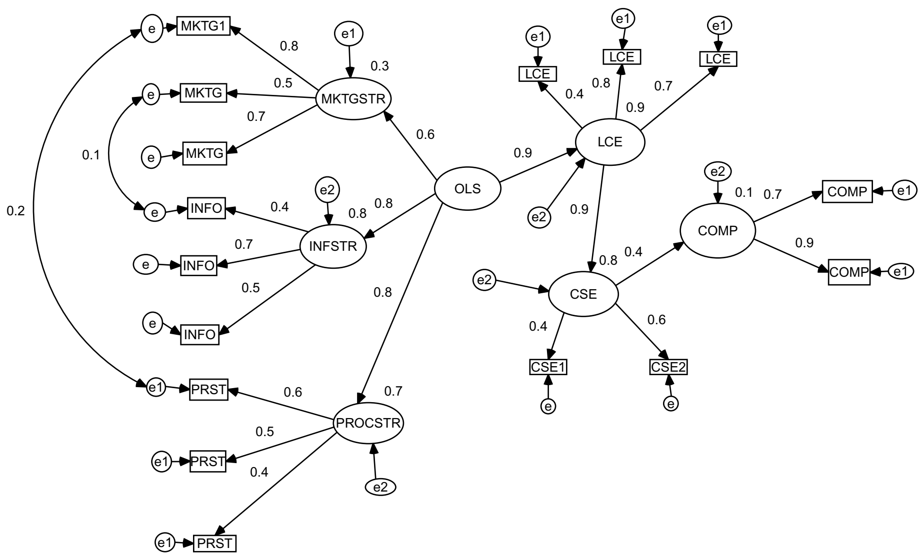
The structural model was used to test the hypotheses of all six factors tested in the measurement model. The hypothesized structural model for 1999 data is shown in Figure 3. Inspection of Figure 3 revealed that the all linkages were significant and the directions of relationships were as hypothesized. Figure 3 also shows standardized coefficients for the linkages, R^2 values for the variables, as well as correlation coefficients between two sets of measurement variables. Finally, the values for χ^2 (125.97), p-value (0.022), GFI (0.916), CFI (0.960), and RMSEA (0.043) indicate a good fit.

As we discussed earlier, the OLS construct is a second-order construct and its three dimensions (MKTGSTR, INFOSTR, and PROCSTR) are first-order factors measured by their respective indicators. Before estimating the path coefficients of the hypothesized structural model, we conducted a CFA on all six latent factors (MKTGSTR, INFOSTR,

Indicators	Standardized loadings (t-values)	Construct/indicator reliability	Error variance
MKTGSTR		0.85	0.12
2-1	0.80 (7.413)	0.64	0.10
2-2	0.55 (6.301)	0.30	0.09
2-3	0.77 (n/a)	0.59	0.08
INFORSTR		0.77	0.09
3-1	0.40 (3.830)	0.16	0.09
3-2	0.72 (4.989)	0.52	0.10
3-3	0.53 (n/a)	0.28	0.09
PROCSTR		0.78	0.08
1-1	0.62 (4.593)	0.41	0.08
1-2	0.58 (4.458)	0.34	0.10
1-3	0.50 (n/a)	0.25	0.09
Fit statistics			
$\chi^2 = 31.058$ (df = 22, $p = 0.095$)			
$p = 0.095$			
CFI = 0.970			
GFI = 0.962			
RMSEA = 0.049			

Note: $n = 172$

Table VII.
Results of measurement model 1999 data



Notes: n = 172; χ^2 = 125.971; p-value = 0.022; GFI = 0.916; CFI = 0.960; RMSEA = 0.043

Figure 3. SEM for OLS and competitive responsiveness 1999 data

PROCSTR, LCE, CSE, and COMP). Table VIII shows the correlations between the constructs hypothesized to have significant relationships. Therefore, we concluded that the measurement model possessed good overall fit with the data.

Additional analysis of the data from 1990 ($n = 59$), 1994 ($n = 91$), and 2008 ($n = 49$) to assess whether the results shown as Figures 2 and 3 were robust in terms of:

- direction of relationships; and
- strength of relationships among variables.

Inspection of the first-order CFA and the SEM for OLS and competitive responsiveness showed that the direction of relations were as hypothesized. Further inspection of the strength of relationships among variables provided limited results. As shown in Table IX, the first-order CFA for 1990, 1994, and 2008 were poor, good, and poor, respectively. As shown in Table X the SEM for OLS and competitive responsiveness were poor for 1990 and 2008 but fair/good for 1994.

	MKTGSTR	INFOSTR	PROCSTR	LCE	CSE
INFOSTR	0.53				
PROCSTR	0.45	0.79			
LCE	0.60	0.84	0.86		
CSE	0.52	0.80	0.56	0.88	
COMP	*0.14*	0.30	0.32	0.44	0.36

Notes: $n = 172$; all correlations are significant at: $p < 0.05$, except for values italicised

Table VIII. Correlations among constructs 1999

Overall, the 1999 data supported the hypothesized relationship directions and strength of the hypothesized relationships. The other three data sets (1990, 1994, and 2008) supported the directions of the hypothesized relationship directions and provided faint to modest support of the strength of the model's relationships. While this may be due to the smaller sample sizes (1990 = 59, 1994 = 91 and 2008 = 49) or fundamental changes in the relationships is a matter for speculation. However, the authors conclude that the agreement on the consistency of direction of the relationships in all four data sets provides encouragement regarding the relationship of logistics strategy and organization competitive responsiveness. The following section discusses relevance and implications of these results.

Discussion of results

Model fit indices obtained for the data sets collected in different years were not consistent across all time periods examined. Satisfactory to good fit indices are obtained for the 1994 ($n = 91$) and 1999 ($n = 172$) data sets. Although the model fits for the 1990 ($n = 59$) and 2008 ($n = 49$) data sets were not compelling, directions of the relationships identified among the constructs were identical in all data sets. However, these results show adequate fit in terms of testing the hypothesized model. Accordingly, we concluded that OLS affects company/division competitive responsiveness through two intervening (or moderating) variables (Tabachnick and Fidell, 2007), LCE and CSE. In other words, OLS is a necessary, but not sufficient, condition for it to lead to increased organizational competitive responsiveness. If the OLS is accompanied by:

- effective logistics coordination; and
- CSE then the organization competitive responsiveness is likely to be greater.

However, in the absence of effective logistics coordination and/or CSE a well thought out logistics strategy that balances its three components (control and efficiency, coordination to provide customer service, channel coordination and control

Statistic	1990/$n = 59$	1994/$n = 91$	2008/$n = 49$	Desired outcome
χ^2	48.05	25.39	32.28	Small number desired
p-value	0.002	0.385	0.094	$p > 0.05$
CFI	0.775	0.993	0.993	CGE > 0.900
GFI	0.849	0.944	0.875	GFI > 0.900
RMSEA	0.131	0.025	0.091	RMSEA < 0.05
Model's fit	Poor	Good	Poor	

Table IX. Summary of first-order CFA for overall strategy: 1990, 1994, 2008

Statistic	1990/$n = 59$	1994/$n = 91$	2008/$n = 49$	Desired outcome
χ^2	149.96	118.89	126.60	Small number desired
p-value	0.001	0.074	0.023	$p > 0.05$
CFI	0.795	0.951	0.874	CGE > 0.900
GFI	0.791	0.865	0.766	GFI > 0.900
RMSEA	0.096	0.049	0.079	RMSEA < 0.05
Model's fit	Poor	Good	Poor	

Table X. Summary of SEM for OLS and competitive responsiveness: 1990, 1994, 2008 through information) will not increase organizational competitive responsiveness. Whether competitive responsiveness can be achieved through a weak logistics strategy that is well coordinated (perhaps a contradiction) with a high level of CSE is unlikely, given the direction of relations of the model developed in this manuscript.

Inspecting the table of path coefficients (Table XI) reveals all are significant at $p < 0.01$ except the coefficients associated with OLS → PROSTAT. Over the past 20 years it was not significant in the 1990 data set but became highly significant ($p \leq 0.000$) for the 1994 and 1999 studies. In the 2008 study its level of significant rose to $p < 0.05$. A likely explanation is that information systems were in their infancy during the 1980s and therefore played much less of a role in logistics strategy. Managers had not yet begun to appreciate the competitive advantage that might be gained from incorporating this technology in their management of logistics operations. By the next decade, it was clear that first class information systems were vital to any logistics operation and the high significance of this path in those studies reflects this widespread attitude. By the end of the first decade of the new century, it is clear that information systems and complex cyber networks have evolved sufficiently to become the backbone of all logistics and supply chain operations. As a result of this maturation, managers may have achieved the majority of benefits from the information systems strategy. In a sense, this component, while still important, no longer plays the role it once did as strategy initiatives have moved on. An alternative explanation for the lower level of significance is that the sample size for the 2008 data set is much smaller and this has substantially influenced its level of significance.

An additional unanswered question is "where does the foundation for an effective logistics strategy originate?" While the results of this research do not provide a specific insight, they do provide a starting point for thought. For example, if an organization's management feels that strong CSE is a source of competitive advantage, how is it possible without a well-coordinated logistics strategy? Or, does the need for a high level of customer service provide the motivation to develop a well thought out and coordinated OLS that optimizes efficiency, customer focus, and coordinated information flows throughout the channel? In another example, management may decide that a key to overall organization competitive responsiveness is control of total costs. In this scenario, the need to gain control of system wide costs would result in an emphasis on efficiency which might only be achieved by including coordination with customers and internal business units, sharing information with other channel members, insuring that logistics activities are coordinated with overall strategy, and integrating customer services with logistics processes. These two examples provide possible insights into the origins of effective logistics strategies.

	1990	1994	1999	2008
OLS → MKSTR	0.599***	0.613***	0.451***	0.611***
OLS → INFSTR	0.067ns	0.590***	0.432***	0.333*
OLS → PROSTR	0.443**	0.419***	0.363***	0.705***
OLS → LCE	0.201**	0.261***	0.370***	0.185**
LCE → CSE	2.478**	2.090***	1.669***	2.865**
CSE → COMP	0.537***	0.624***	0.371***	0.571**

Notes: Significant at: *$p < 0.05$, **$p < 0.01$, ***$p < 0.000$; ns – not significant

Table XI. Standardized regression estimates for paths for all data

Relevance and implications

An essential finding of the model presented in this manuscript is the dynamics of logistics strategy as a competitive tool. By themselves, neither a well thought out logistics strategy, nor an emphasis on coordination, nor customer service, will provide organizational competitive responsiveness. If process, market, and information concerns are coordinated within the OLS to the extent that logistics coordination is effective, and there is and a clear focus on customer service (as perceived by the customer), then "logistics" will contribute to overall organizational competitive responsiveness. However, the organization must also consider other dimensions that affect competitive responsiveness including competitive products, effective marketing campaigns, efficient procurement and production activities, and adequate financial resources. Without these other dimensions then organizational competitive responsiveness will not occur. Whether these insights apply to "supply chain management", "supply management", or some other concept is beyond the scope of this manuscript.

However, there are implications for practitioners, educators, and researchers. First, the components of effective logistics strategy include efficiency, customer responsiveness, and coordination and control in the channel. This is consistent with the framework proposed by Bowersox and Daugherty (1987). Second, effective logistics strategy does not occur in isolation. The results presented in this manuscript highlight the importance of extensive integration if logistics strategy if it is to make a positive contribution to organizational competitive responsiveness. Next, the fundamentals of logistics' strategy do not appear to have significantly changed between 1990 and 2008. This evidence of intellectual stability supports the conclusion that logistics and supply chain management have evolved into genuine disciplines. Finally, there does not appear to be any specific genesis of effective logistics strategies. While an OLS, LCE, and CSE are necessary for logistics' contribution to organizational effectiveness, the symptoms of logistics' dysfunction could appear at any point of the model shown as Table IV. For example, a lack of competitive responsiveness (COMP) might result from unsatisfactory customer service (CSE). However, this lack of customer service could be the result of:

- poor logistics execution due to inadequate coordination (LCE) within the organization and/or between the organization and other channel members;
- inefficiencies (PROCSTR) due to a lack of cost management;
- an inability to effectively coordinate internally (MKTGSTR) to meet customer needs; and
- inadequate information flows for coordination and control (INFOSTR) among channel members.

If an organization is starting with a blank sheet of paper, it appears that logistics strategy should start with the competitive goals of the organization and work back to customer service objectives, logistics coordination objectives, and to the appropriate blend of logistics efficiency (PROCSTR), logistics responsiveness (MKTGSTR), and logistics information management (INFOSTR).

For practitioners, the implication is that logistics' contributions to organizational success cannot be achieved in isolation. In many organizations, functional "silos" and program "sewers" preclude the cooperation that optimizes overall organizational success. As suggested in the results "OLS", "LCE", and "CSE" imply broad coordination at many levels of the organization. This broad and deep coordination is shown by the work of Porter (1985). Here, inbound and outbound logistics, as part of the value chain, are horizontally integrated with operation, marketing and sales, and service; and vertically integrated with procurement, technology, human resource management, and the firm' infrastructure. However, successful logistics (and the authors suspect supply chain management) strategies have three requirements: a balance of efficiency, customer responsiveness, and coordination throughout the value chain. Attempts to insulate (or isolate) logistics (and probably supply chain management) from other of the organization's activities will likely result in reduced competitive responsiveness.

For teachers of undergraduate courses, this research provides a framework for presenting logistics in context of other activities within the organization. Here selected chapters and cases can be used to help students understand that logistics, and logistics' components, do not occur in a vacuum. In advanced courses comprehensive cases, field projects, facility visits, and guest speakers can reinforce student understanding of logistics and supply chain management within the context of the organization.

Teachers of graduate courses and thesis/dissertation advisors can first emphasize the importance of integrating logistics/supply chain management research with other activities of the organization. This can help enrich research in the field and reduce the amount of narrow "tunnel vision" that can occur when graduate students and researchers focus on narrow aspects of logistics and supply chain management without providing adequate recognition of the need to integrate logistics with other activities within the firm. Second, graduate-level teachers can facilitate student interest in areas of logistics/supply chain management that:

- tend to be stable over time, such as research into Bowersox and Daugherty typology and the work of Porter as opposed to; and
- areas that come into favor and then fade in short periods of time.

As described in the above paragraphs, this research provides insights for practitioners, teachers, and researchers into the origins of effective logistics strategy and the importance of the role this strategy plays within the overall framework of successful corporate strategic management.

For researchers, future logistics/supply chain management research would benefit from the replication of earlier studies to examine which concepts are stable over time and which concepts emerge and the fade. In particular, additional empirical research outside the USA could provide further insights into the cross-cultural relevance of the Bowersox and Daugherty typology.

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