THE INTERACTION OF INTERNAL AND DOWNSTREAM INTEGRATION AND ITS ASSOCIATION WITH PERFORMANCE

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INTRODUCTION

Do internal and external integration affect logistical and organizational performance? If so, then which type of integration affects performance and which type of performance is affected by integration? Recent papers in the *Journal of Business Logistics* and elsewhere address the link of integration with performance. As illustrated in Figure 1, three distinct theoretical approaches are identifiable: (1) the individual effects model; (2) the causal chain approach; and (3) the unified integration model. Panel 1 of Figure 1 illustrates that the individual effects model seeks the unique contributions of external and internal integration in predicting performance (Closs and Savitskie 2003). The second panel in Figure 1 illustrates that the causal chain approach models external integration, internal integration, and performance as a mediation chain. This model has been supported on a priori theory (Sanders and Premus 2005) and on a post hoc basis after the failure of data to support the individual effects model (Stank, Keller, and Daugherty 2001). Third, the unified integration model (Panel 3) treats integration as a single construct that predicts performance. Unlike the individual effects and causal chain models, internal and external integration are not latent constructs but observable measures of a lone integration construct. Rodrigues, Stank, and Lynch (2004) adopted this perspective on a post hoc basis after their failed effort to support the individual effects model. While these studies contribute to our understanding of the relationship between integration and performance and highlight its importance, it is evident that the individual effects, causal chain, and unified integration models are incompatible with one another. Internal integration, for example, cannot be a distinct latent construct that associates with performance and an indicator of a unified integration construct.

FIGURE 1

ILLUSTRATION OF COMPETING MODELS

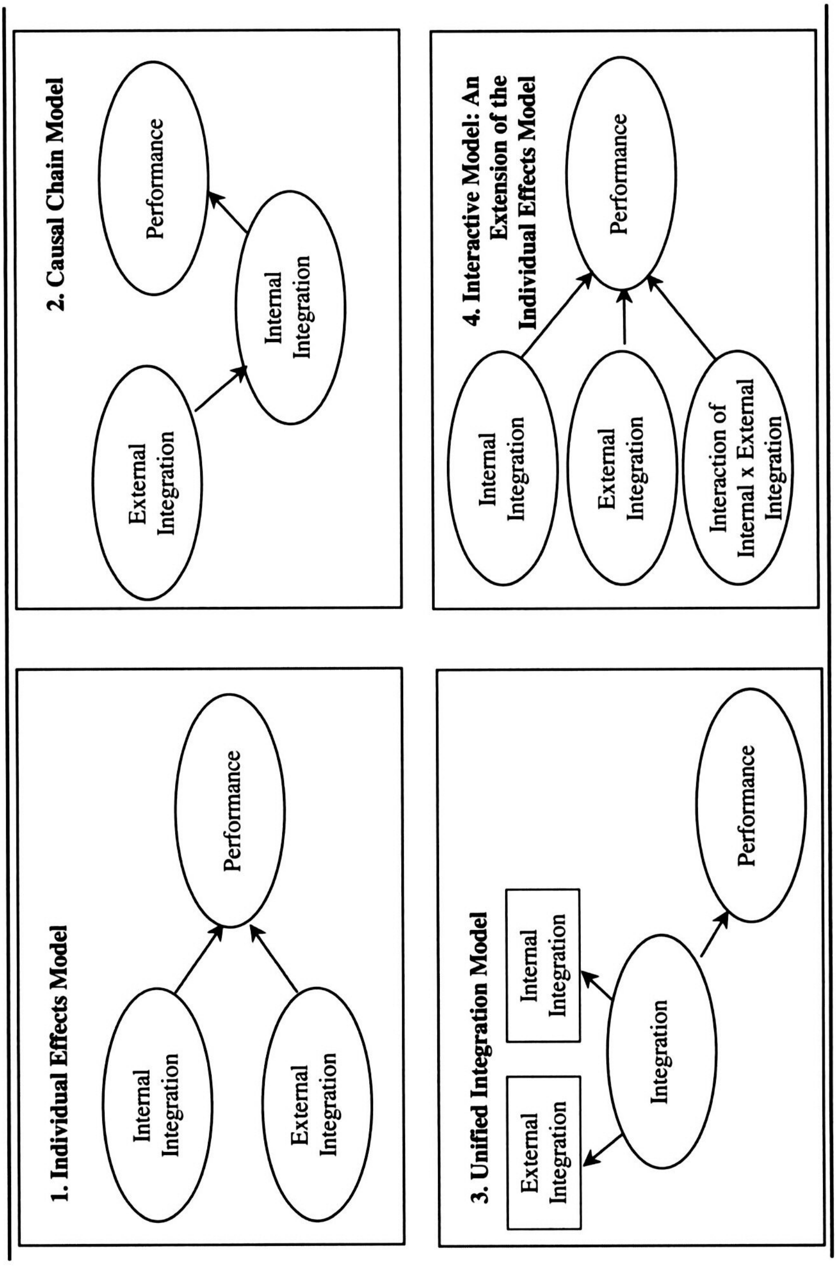
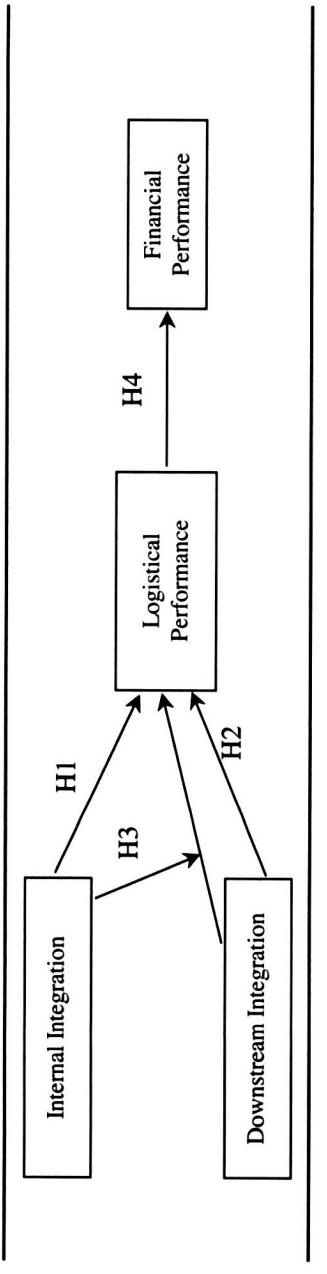


FIGURE 2

RESEARCH FRAMEWORK AND HYPOTHESES



The first contribution of this research lies in proposing and testing an interactive model that expands on the individual effects model. As shown in Panel 4 of Figure 1, we advocate that internal and external integration, while unique, interact in predicting performance. The logistics literature has not previously examined this interaction effect. With respect to the interaction effect, the firm that has not integrated internally (or one that does not "see across the firm" in terms of interfunctional relationships, trade-offs, and processes) may not translate an external or inter-firm integration effort (i.e., an attempt at "seeing across firms") into better performance as evidenced by improvements in lead times, lot sizes, inventory turns, or flexibility. The lack of internal integration may prevent external integration from fully impacting performance.

The second contribution of this research lies in the provision of a richer account of performance. We parcel out performance into two constructs: logistics performance (which includes lead times) and financial performance (which includes profitability). Figure 2 provides our theoretical framework. Specifically, we examine internal integration, downstream integration (as a type of external integration), and their interactive effect on logistical performance (H1-H3). The latter is hypothesized to predict financial performance (H4). Our model is not concerned with predicting integration itself. The study of potential drivers including integrative technologies, organizational size, and environmental uncertainty is left to others. In the next section, we briefly review the literature and present our hypotheses. In the Method section, we analyze prior scales, present our scales, and describe the sampling procedure we undertook. We then test the theory and present and discuss the results.

THEORY

Integration may be defined as "the unified control of a number of successive or similar economic or especially industrial processes formerly carried on independently" (*Webster's* 1966, p. 1175). This dictionary definition continues to form the basis of discussion and practice in logistics. In firms that are not integrated "logistics is a fragmented and often uncoordinated set of activities spread throughout various organizational functions with each individual function having its own budget and its own set of priorities and measurements" (Lambert and Stock 1993, p. 40). Recent thought iterates the connection of integration to process management and design (Lambert, Garcia-Dastugue, and Croxton 2005). Internal integration refers to unifying functions and processes inside the firm and includes those related to warehousing, transportation, inventory management, purchasing, demand planning, and production. External integration refers to unified control of functions and processes across trading partners. Upstream examples include the sharing of production plans and costs with suppliers, while downstream example includes the various shared information and processes associated with collaborative planning, forecasting, and replenishment (CPFR).

During the early 1960s, the National Council of Physical Distribution Management (NCPDM) centered the fledgling logistics field on the integration of physical distribution (or outbound) functions (Bowersox, Smykay, and LaLonde 1968). With advances in information technology, especially ERP systems, integration on a larger scale was possible and in 1985 the NCPDM changed its name to the Council of Logistics Management (CLM) and offered a definition of logistics that espoused

firm-wide integration of functions and processes from purchasing to outbound transportation management (Lambert and Stock 1993, p. 24. The scope of internal integration was expanded to encompass a firm-wide perspective. The rise of supply chain management (SCM) during the early 1990s correlates with further informational advances in Internet and Web-based technologies. In 2005, the CLM changed its name to include "supply chain" and defined SCM in part as integration throughout the supply chain. The scope of integration was now fully internal and external up and down the supply channel. That the concept of integration dates back to the business origins of logistics itself can be attributed to the growing realization by managers, consultants, and academics since the 1960s that coordinating activities initially across functions and later across firms creates a powerful framework and a tool for performance improvement. In this research, one of the types of performance we concentrate on is logistical performance, which may be defined as how well procedures are executed. The outputs of these procedures are normally of interest: e.g., fill rates, lead-time, and flexibility. The connection of integration with logistics performance is well documented (Closs and Savitskie 2003; Rodrigues, Stank, and Lynch 2004; Sanders and Premus 2005; Stank and Daugherty 2001) and is derived from the reduction of non-value added activities, better access to information, more streamlined operations, higher levels of coordination, the reduction of the bullwhip effect, and a more efficient matching of supply to demand. This discussion suggests the following two hypotheses.

H1: Internal integration and logistical performance associate positively.

H2: Downstream integration and logistical performance associate positively.

The third hypothesis concerns an expected positive interaction between internal and external integration in predicting logistical performance – the greater the level of internal integration, the stronger the effect of external integration on logistical performance (and vice versa). Let us consider a source firm that is high on internal integration. This suggests that appropriate internal trade-offs exist, processes are unified, and that managers see across the firm to leverage better, timelier information into, for example, better fill rates. Internal integration may be fostered by ERP systems (Sanders and Premus 2005) and other integrated software platforms (Rodrigues, Stank, and Lynch 2004), but its essence is inter-functional coordination and the creation of firm-wide standards and norms, which may be developed through cross-functional teams or ad hoc committees. If the source firm integrates with a customer, then the integration is both internal and external and may extend from the source firm's purchasing function potentially through to the customers' order processing unit. For example, a manufacturer that integrates processes with a retailer may be connected to the retail checkout counter POS system. Trade-offs are being made within the source firm and across firms and processes are being coordinated to reduce supply chain costs and surprises. However, if the source firm started with a low level of internal integration, then the external integration effort would hit a disintegrative wall near the interface between the two firms. For example, POS data might be shifted back to the source firm's finished goods warehouses. But the performance improvements that could be generated by coordinating such information with inventory planning, transportation, and production would be lost. The source firm may accrue a market share benefit from

external integration, but new transaction costs would be encountered and may be seen as a burden as there would be no operational or financial improvements within the source firm. We expect that the higher the level of internal integration, the stronger the effect of external integration on logistical performance. The following hypothesis is offered.

H3: The greater the internal integration, the stronger the relationship of downstream integration with logistical performance.

The last hypothesis states that logistical performance should predict financial performance such as profit. Operational improvements imply enhanced productivity and reduced costs (Schmenner and Swink 1998). Considerable increases in transportation and labor costs and lost sales may result from operational inefficiencies such as inability to deliver products on time. Poor operations such as low inventory turnover rates or lengthy delivery lead-times drive up inventory costs and thus negatively influence financial performance (Germain, Dröge, and Christensen 2001).

H4: Logistical performance and financial performance associate positively.

METHOD

Scaling

Tables 1 through 3 respectively present the internal integration, external integration, and performance scales in the key studies that were used to create the integration theory classification presented in Figure 1 (Closs and Savitskie 2003; Rodrigues, Stank, and Lynch 2004; Sanders and Premus 2005; Stank and Daugherty 2001). The right hand most column in the Tables present observations on face validity, which may be defined as whether items, on the face of it, measure what they purport to measure. Some of the items for scaling internal integration (Table 1) were deemed to possess low face validity. Specifically, Closs and Savitskie (2003) in items 3 and 4 assume that the exchange of information implies the use of information technology and Rodrigues, Stank, and Lynch (2004) in items 2 and 3 assume that process redesign implies a cross-functional or integrative approach. Neither is necessarily the case.

Several problems are noted with the scaling of external integration. Closs and Savitskie (2003) measured performance yet labeled the construct customer integration (Table 2). Item 2 (Table 2) of their logistics information technology integration (external) scale assumes that sharing strategic information is the result of information technology use. In addition, items from Rodrigues, Stank, and Lynch (2004) and Stank, Keller, and Daugherty (2001) measure the effect of integration on performance rather than integration itself. For example, "My firm has increased operational flexibility through supply chain collaboration" (Rodrigues, Stank, and Lynch 2004, item 2, Table 2) assesses flexibility as derived from collaboration and not collaboration. These scales skew subsequent correlations with measures of performance upward. Another problem apparent from Table 2, but more debatable, concerns the use of "and" statements. For example, item 2 from Closs and Savitskie's (2003) logistics information technology integration (external) scale refers to "suppliers and/or customers."

TABLE 1

SCALING OF INTERNAL INTEGRATION

Construct Label and Source	Items	Face Validity and Comments
Logistics Information Technology Integration (Internal): Closs and Savitskie (2003)	1. Logistics operating and planning databases are integrated across applications within my firm.	**High**
	2. My firm maintains an integrated database and access method to facilitate.	**High**
	3. The information available in my firm is accurate, timely, and formatted to facilitate use.	**Low:** Information technology not necessarily required to create accurate, timely, and formatted information
	4. My firm effectively shares operational information between departments.	**Low:** Information technology not necessary for sharing operational data
	5. My firm's logistics information systems capture and maintain real time data.	**High**
Integrated Internal Operations: Rodrigues, Stank, and Lynch (2004)	1. My firm extensively utilizes cross-functional work for managing day-to-day operations.	**High**
	2. My firm has extensively redesigned work routines and process over the past three years.	**Low:** Processes may have been redesigned, but not on a cross functional basis
	3. The orientation of my firm has shifted from managing functions to managing processes.	**Low:** Processes may still be managed solely within functional silos
	4. My firm effectively shares operational information between departments.	**High**

TABLE 1 (CONT.)

SCALING OF INTERNAL INTEGRATION

Construct Label and Source	Items	Face Validity and Comments
Internal Collaboration: Sanders and Premus (2005)	1. Uses cross-functional collaboration in strategic planning.	**High**
	2. Utilizes integrated database for information sharing.	**High**
	3. Shares operations information among departments.	**High**
Internal Collaboration: Stank, Keller, and Daugherty (2001)	1. My firm maintains an integrated database and access method to facilitate information sharing.	**High**
	2. My firm effectively shares operational information between departments.	**High**
	3. My firm has adequate ability to share both standardized and customized information internally.	**High**
	4. My firm provides objective feedback to employees regarding integrated logistics performance.	**High**
	5. My firm's compensation, incentive, and reward systems encourage integration.	**High**

TABLE 2

SCALING OF EXTERNAL INTEGRATION

Construct Label And Source	Items	Face Validity and Comments
Customer Integration: Closs and Savitskie (2003)	1. My firm is able to accommodate a wide range of unique customer requests by implementing preplanned solutions.	**Low:** Item measure performance to accommodate unique requests
	2. My firm has different, unique logistics service strategies for different customers.	**Low:** Item measures reliance on segmentation
	3. My firm has established a program to integrate and facilitate individual customer requirements across our strategic business units.	**High**
Logistics Information Technology Integration (External): Closs and Savitskie (2003)	1. My firm obtains information directly from customers to facilitate operational plans and reduce reliance on forecasting.	**High**
	2. My firm is willing to share strategic information with selected suppliers and/or customers.	**Low:** Strategic information often shared in paper document form
Integrated External Operations: Rodrigues, Stank, and Lynch (2004)	1.My firm effectively shares operational information externally with selected suppliers and/or customers.	**High:** Contains "and" statement
	2. My firm has increased operational flexibility through supply chain collaboration.	**Low:** Items measure operational flexibility through collaboration
	3. My firm successfully integrates operations with customers and/or suppliers by developing interlocking programs and activities.	**Low:** Item measures success; contains "and" statement
	4. My firm is actively involved in initiatives to standardize supply chain practices and operations.	**Moderate:** Supply chain standardization may be wholly internal to the firm; e.g., purchasing across geographic locations within the same SBU

TABLE 2 (CONT.)

SCALING OF EXTERNAL INTEGRATION

Construct Label And Source	Items	Face Validity and Comments
External Collaboration: Sanders and Premus (2005)	1. Shares operations information with suppliers.	**High**
	2. Shares cross-functional processes with suppliers.	**High**
	3. Engages in collaborative planning with suppliers.	**High**
	4. Shares cost information with suppliers.	**High**
External Collaboration: Stank, Keller, and Daugherty (2001)	1. My firm effectively shares operational information externally with selected suppliers and/or customers.	**Low:** Item measures effectiveness of sharing; contains "and" statement
	2. My firm has developed performance measures that extend across supply chain relationships.	**High**
	3. My firm experiences improved performance by integrating operations with supply chain partners.	**Low:** Item measures improved performance through integration
	4. My firm has supply chain arrangements with suppliers and customers that operate under principles of shared risks and rewards.	**High:** Contains "and" statement
	5. My firm has increased operational flexibility through supply chain collaboration.	**Low:** Item measures operational flexibility due to collaboration
	6. My firm benchmarks best practices/process and shares results with suppliers.	**High**

TABLE 3

SCALING OF PERFORMANCE

Construct Label and Source	Items	Face Validity and Comments
Customer Service: Closs and Savitskie (2003)	1. Delivery speed	**High**
	2. Responsiveness to key customers	**High**
	3. Order fill capacity	**High**
	4. Delivery time flexibility	**High**
	5. Customer satisfaction	**High**
Logistics Performance: Rodrigues, Stank, and Lynch (2004)	1. Low logistics cost	**High**
	2. Delivery speed	**High**
	3. Delivery dependability	**High**
	4. Order fill capacity	**High**
	5. Inventory turns	**High**
	6. Customer satisfaction	**High**
Firm Performance: Sanders and Premus (2005)	1. Cost improvement relative to performance goals	**High**
	2. Product quality goals relative to performance goals	**High**
	3. New product introduction time relative to performance goals	**High**
	4. Delivery speed relative to performance goals	**High**

Note: Items from Closs and Savitskie (2003) and Rodrigues, Stank, and Lynch (2004) were accompanied by definitions.

TABLE 3 (CONT.)

SCALING OF PERFORMANCE

Construct Label and Source	Items	Face Validity and Comments
Logistical Service Performance: Stank, Keller, and Daugherty (2001)	1. The ability to reduce the time between order receipt and customer delivery to as close to zero as possible	**High**
	2. The ability to accommodate delivery times for specific customers	**High**
	3. The ability to respond the needs and wants of key customerss	**High**
	4. The ability to provide desired quantities on a consistent basiss	**High**
	5. The ability to modify order size, volume or composition during logistics operationss	**High**
	6. The ability to meet quoted or anticipated delivery dates and quantities on a consistent basiss	**High**
	7. The global judgment regarding the extent to which perceived logistics performance matches customer expectations	**High**

Note: Items from Closs and Savitskie (2003) and Rodrigues, Stank, and Lynch (2004) were accompanied by definitions.

This creates a problem for respondents when integration is high with suppliers but low with customers. It also raises the question of whether external integration should be thought of as a single construct consisting of two components – upstream and downstream integration – or as two distinct constructs that impact different types of performance. The logistics literature is not clear on this issue. The external collaboration scale of Sanders and Premus (2005) did not fall into the "and statement" trap, but their items focus exclusively on integration with suppliers. Finally, the logistics literature has done an excellent job on scaling performance. The face validity of the items shown in Table 3 is all rated high.

The scales used in this research, shown in Table 4, were selected or designed with the prior shortcomings and strengths in mind. Internal integration was measured using Miller's (1991) scale. Respondents were asked to rate their firm's reliance on interdepartmental committees, cross-functional teams, and inter-functional liaison personnel in assuring compatibility among decisions in one area (e.g., purchasing) with those in other areas (e.g., production). Seven-point scales with endpoints of "rarely used" and "frequently used" were utilized. Strengths of this scale include a long history of reliability in management research and a clear a focus on integration at the cross-functional decision-making level. The weakness of the scale is that it does not assess cross-functional process integration.

TABLE 4

SCALING AND CONFIRMATORY FACTOR ANALYSIS RESULTS

Scale		Loading	t-value
Internal Integration: $\rho = 0.86$. In assuring compatibility among decisions in one area (e.g., purchasing) with those on other areas (e.g., production), to what extent are the following integrative mechanisms used? 7-point scales with endpoints of "rarely used" and "frequently used."			
x1.	Interdepartmental committees, which are set up to allow departments to engage in decision-making on an ongoing basis	0.841	12.048
x2.	Cross-functional teams, which are temporary bodies set up to facilitate interdepartmental collaboration on a specific project	0.902	13.269
x3.	Liaison personnel whose specific job it is to coordinate the efforts of several departments for the purpose of a specific project	0.735	10.104
Downstream Integration: $\rho = 0.79$. Ratings on extent of each of the following. 7-point scales with endpoints of "rarely" and "frequently."			
x4.	We work with customers to develop a joint sales forecast that is used as the basis for replenishment	0.747	9.451
x5.	We exchange point of sale information with customers to drive both replenishment and billing activities from actual sales data	0.810	10.331
x6.	Customers notify us of planned promotions and exchange with us information on activities against a promotion	0.672	8.416

TABLE 4 (CONT.)

SCALING AND CONFIRMATORY FACTOR ANALYSIS RESULTS

Scale	Loading	t-value
Interaction of Internal x Downstream Integration:		
x7. Mean centering was undertaken prior to forming the interaction term	0.999	17.512
Logistical Performance: ρ = 0.68. Ratings on the change in firm performance over the past three years. 7-point scales with endpoints of "substantially worse" and "substantially better."		
y1. Delivery lead-times	0.561	5.912
y2. Inventory turnover rates	0.641	6.659
y3. On time deliveries to customers	0.468	4.919
Financial Performance: ρ = 0.93. Rating on firm performance over the past three years. 7-point scales with endpoints of "well below industry average" and "well above industry average."		
y4. Average return on investment	0.862	13.096
y5. Average profit	0.952	15.331
y6. Profit growth	0.845	12.719

CFA loadings are completely standardized estimates. All loadings are significant at $p<.01$.
$\chi^2 = 59.251$; $p = 0.358$; df = 56; RMSEA = 0.019; CFI = 0.992; GFI = 0.944; AGFI = 0.909.
ρ = scale composite reliability.

The measure of external integration was adapted from the work of Anthony (2000) and taps into reliance on cross-firm forecasting, exchange of point of sale information, and shared promotional planning. Industry experts in SCM refined the scale prior to data collection. We avoided the "and statement" problem by focusing on information exchange with downstream partners and accordingly we labeled the construct downstream integration. The weakness of a focus on integration at only one boundary of the firm is partially offset by clarity. Another weakness is inattention to integration through process standardization. However, information exchange of the sort measured often occurs when processes are integrated across firms (Cannon and Perreault 1999). A strength of the scale is that items capture the level of the phenomenon being scrutinized and not a trait assumed to be associated with the phenomenon (i.e., performance). The interaction of internal and external integration was formed from mean centered variables.

Logistical performance was measured in three areas: delivery lead-times, inventory turnover rates, and on time deliveries to customers. Seven-point scales were used to assess performance improvements over the past three years.. The items we use correspond well with those shown in Table 3 and those in other research (e.g., Fawcett and Clinton 1997; Stank and Lackey 1997).

Finally, we turned to the management literature for a measure of financial performance. The measure taps performance in three areas: average return on investment, average profit, and profit growth. Respondents rated performance over the prior three years in their primary industry (Miller 1991). Industry relative performance controls for inter-industry differences and the three-year horizon controls for random, one-time events that affect performance for a single quarter or year. Confidentiality issues and a demonstrated history of low response rates to requests for hard performance data such as actual ROI dictated the use of soft measures.

Sample

In the survey, the unit of analysis was a manufacturing firm or strategic business unit. The CSCMP's manufacturer member list was the sampling frame (n = 2,468 individuals). To control for multiple CSCMP members in a firm, the list was culled to 1,372 firms by retaining the member with the highest title level. Randomly selected members were screened by telephone to: (1) ensure sufficient knowledge; and (2) employment by a manufacturer. Participating members were faxed or e-mailed the survey. In the end, 914 potential respondents (representing two-thirds of the sample frame) were contacted and of these, 538 received questionnaires. Reminders were faxed to respondents who did not return a survey within two weeks after receiving the original. A total of 152 surveys were returned, for a 28% response rate.

The sample represents a wide range of firms: food and kindred products (SIC 20), 13%; chemicals and pharmaceuticals (SIC 28), 26%; industrial machinery (SIC 35), 10%; and electronic products (SIC 36), 15%. The majority of the respondents were managers (45%), followed by directors (28%) and vice presidents (15%). The majority indicated that logistics was their primary functional area (51%), followed by distribution (22%), supply chain management (12%), operations (3.9%), information systems, materials management, and purchasing (each with 2.6%), manufacturing (1.3%), and other functional areas such as forecasting (1.9%). Average sales for firms in the sample are $5.4 billion and the average age is 55 years.

Late respondents were defined as those completing the survey only after receiving a follow up fax two weeks after initial receipt (n = 31). They were compared to the remaining respondents (n = 121) (Armstrong and Overton 1977). Using t-tests, no differences were found in any of the variables. Following the advice of Mentzer and Flint (1997), 300 randomly selected non-respondents were faxed a set of ten items from the survey. A comparison of these responses (n = 28) to the sample (n = 152) using t-tests revealed no significant differences. Both assessments indicate no evidence of non-response bias.

Reliability and Validity

The correlation matrix along with means and standard deviations of the variables are provided in Table 5. To assess the measurement scheme, a confirmatory factor analysis (CFA) was applied to the covariance matrix (Jöreskog and Sörbom, 1993). The model fit statistics are: $\chi^2 = 59.251$; $p = 0.358$; df = 56; RMSEA = 0.019; CFI = 0.992; GFI = 0.944; AGFI = 0.909. The CFI, GFI, and AGFI all exceed the minimum limit of 0.900, the model p-value exceeds 0.10, and the RMSEA is well within acceptable bounds. The standardized loadings shown in Table 4 all exceed 0.400 and respective t-values are significant at the 0.01 level. The standard test for examining divergent validity was undertaken: that is, setting the correlation between pairs of constructs to unity and examining the $\Delta\chi^2$ against the hypothesized model. All tests were significant, providing evidence of divergent validity. To assess reliability, scale composite reliabilities (ρ) were examined. All exceeded 0.60. Thus the analysis demonstrated that the selected measurement system possesses adequate convergent and divergent validity and reliability.

TABLE 5

CORRELATION MATRIX AND SUMMARY STATISTICS

Var.	x1	x2	x3	x4	x5	x6	x7	y1	y2	y3	y4	y5	Mean	SD
x1.													4.71	1.66
x2.	0.76a												5.18	1.58
x3.	0.61a	0.66a											4.14	1.77
x4.	0.16	0.21a	0.18b										3.75	1.67
x5.	0.21b	0.18b	0.13	0.60a									3.20	1.93
x6.	0.06	0.11	0.06	0.50a	0.55a								3.71	1.78
x7.	0.03	-0.03	-0.04	0.11	0.14	0.05							0.42	2.14
y1.	0.20b	0.20b	0.09	0.15	0.17b	0.24a	0.06						5.15	1.02
y2.	0.26a	0.22a	0.20b	0.12	0.19b	0.19b	0.11	0.36a					5.04	0.99
y3.	0.26a	0.22a	0.23a	0.17b	0.16b	0.08	0.24a	0.54a	0.21a				5.46	0.98
y4.	0.09	0.10	0.03	0.16	0.15	0.07	0.05	0.13	0.20b	0.21b			4.76	1.31
y5.	0.13	0.09	-0.01	0.11	0.11	0.01	0.01	0.13	0.22a	0.18b	0.82a		4.63	1.35
y6.	0.15	0.11	0.07	0.12	0.21a	0.09	0.10	0.09	0.25a	0.15	0.73a	0.81a	4.52	1.34

x1-x3 = internal integration; x4-x6 = downstream integration; x7 = interaction of internal x downstream integration; y1-y3 = logistical performance; y4-y6 = financial performance.
a, $p < 0.01$; b, $p < 0.05$

RESULTS

The structural equations model presented in Figure 3 was tested on the covariance matrix. The fit statistics are adequate ($\chi^2 = 59.773$; $p = 0.447$; df = 59; RMSEA = 0.009; CFI = 0.995; GFI = 0.944; AGFI = 0.913). As seen in Table 6, the four hypotheses are supported. Logistical performance is predicted by internal integration (H1; $\gamma 1,1 = 0.349$; $t = 2.859$; $p < 0.01$), downstream integration (H2; $\gamma 1,2 = 0.276$; $t = 2.476$; $p < 0.01$), and the interaction of the two (H3 $\gamma 1,3 = 0.229$; $t = 2.258$; $p < 0.05$). Logistical performance predicts financial performance (H4; $\beta 2,1 = 0.340$; $t = 2.973$; $p < 0.01$). Adding direct paths from the integration constructs to financial performance did not improve overall model fit ($\Delta\chi^2 = 0.052$; $\Delta df = 3$; $p > 0.10$) as none of the paths were significant. The effect of integration on financial performance appears to be transmitted through logistical performance.

TABLE 6

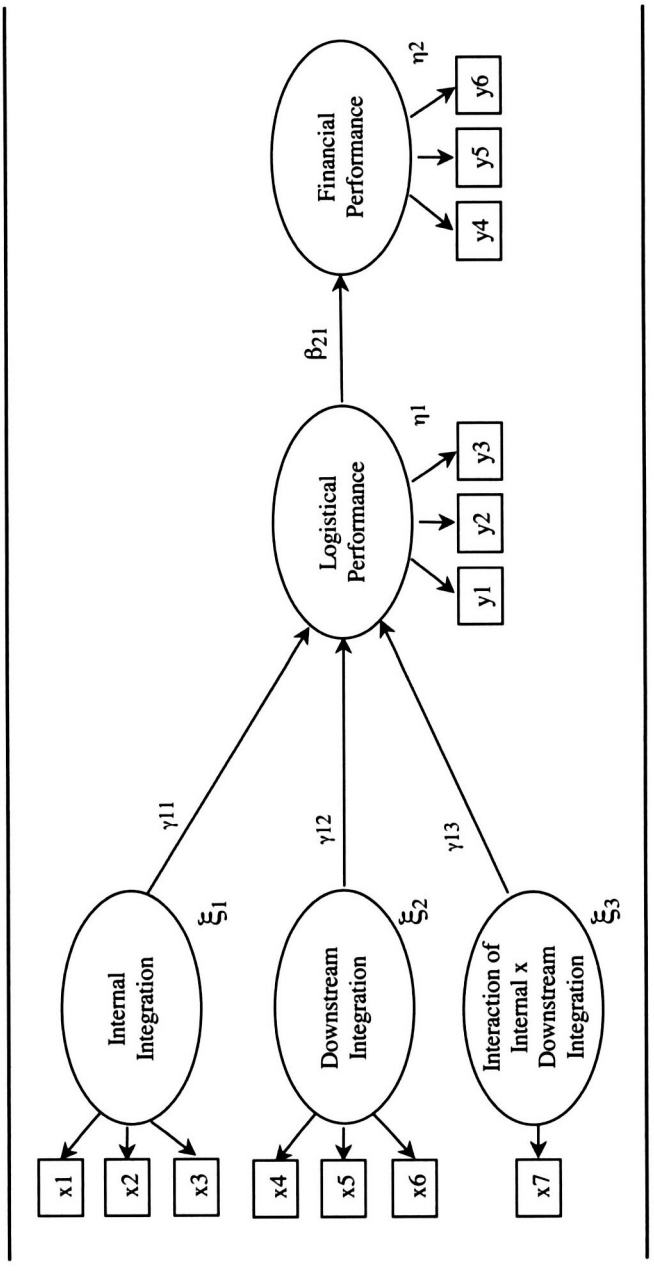
LISREL MODEL RESULTS

	Completely Standardized Estimate	t-value
H1: Internal integration ⟶ logistical performance ($\gamma 1,1$)	0.349	2.859a
H2: Downstream integration ⟶ logistical performance ($\gamma 1,2$)	0.276	2.476a
H3: Interaction of internal x downstream integration ⟶ logistical performance ($\gamma 1,3$)	0.229	2.258a
H4: Logistical performance ⟶ financial performance ($\beta 2,1$)	0.340	2.973a

$\chi^2 = 59.773$; $p = 0.447$; df = 59; RMSEA = 0.009; CFI = 0.995; GFI = 0.944; AGFI = 0.913.
a, $p < 0.01$.

FIGURE 3

EMPIRICAL MODEL



The positive sign of the interaction effect means that the greater the level of internal integration, the stronger the effect of downstream integration on logistical performance. To better understand the moderation, the sample was split on the median of the internal integration variable (4.70) into high and low groups (n = 74 in the low group; n = 78 in the high group). When internal integration is low, the correlation of downstream integration with logistical performance is null (0.067; *ns*). This compares to 0.459 ($p < 0.01$) when internal integration is high. The Fisher z, which assesses equality of correlations across two groups (Howell 1987), equals –2.564 ($p < 0.05$). Downstream integration predicts logistical performance only when internal integration is high. Figure 4 pictorially presents the interaction effect.

TABLE 7:

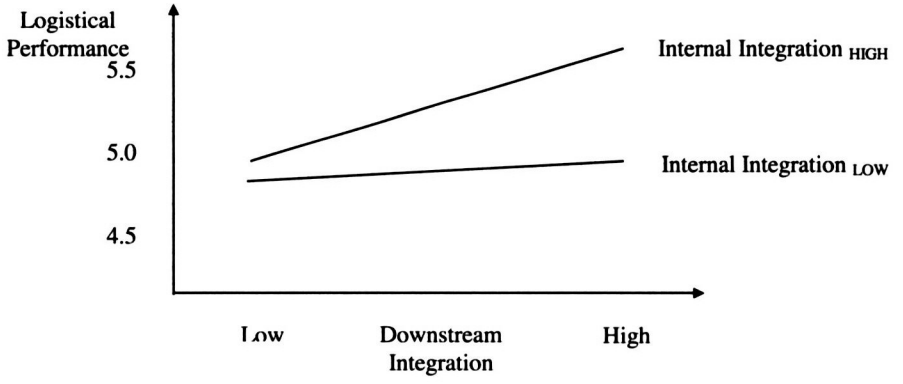
MODERATOR REGRESSION MODEL RESULTS PREDICTING FINANCIAL PERFORMANCE

	Standardized Estimate (β) (t-value)		
Predictor Variable	**Model 1**	**Model 2**	**Model 3**
Main Effects			
Logistical performance	.245 (2.831a)	.260 (2.934a)	.248 (2.905a)
Internal integration	.019 (.225)	–.001 (.364)	–.023 (–.259)
Downstream integration	.069 (.815)	.039 (.333)	–.015 (–.163)
Two-way Interactions			
Logistical performance x downstream integration	–	–.079 (–.870)	–.051 (–.550)
Logistical performance x downstream integration	–	.123 (1.454)	.116 (1.330)
Internal integration x downstream integration	–	.117 (1.313)	.081 (.878)
Three-way Interaction			
Logistical performance x internal integration x downstream integration	–	–	.142 (1.491)
Model F	4.136a	2.763b	2.706b
R^2	8%	11%	12%

a, $p<.01$; b, $p<.05$

FIGURE 4

IILLUSTRATION OF THE INTERACTION EFFECT: INTEGRATION ON LOGISTICAL PERFORMANCE



CONCLUSION

This research contributes to the literature by examining the interactive effect of internal and downstream integration on performance and by providing a richer account of performance by considering logistical and financial performance. A firm may possess, through culture, history, planning, or luck, a strong sense and vision of how functional interactions are important to performance. During the late 1980s, researchers at Michigan State University may have called these "leading edge" firms (Bowersox et al. 1992). This internal vision allowed the firm to more readily grasp the potential benefits of external integration as technological leaps during the 1990s paved the way toward modern SCM. The logistical and financial success of internal integration may thus have been a driver of the firm actively pursuing external integration opportunities. In contrast, other firms, low on logistics vision, survived on vertical silos and performance metrics that rewarded functional performance to the detriment of logistical and global financial performance. Dynamic markets or product-market combinations, coercive customers or suppliers, and senior management turnover may all contribute to integrating externally prior to internally. Internal integration may spur external integration and vice versa. Touting that external integration "affects" internal integration oversimplifies the situation. In addition, to conclude that integration is a single construct comprised of internal and external components on the basis of empiricism (e.g., Rodrigues, Stank, and Lynch 2004) discounts the historical trend of how logistics was transformed into SCM and undervalues the com-

plex effect that each may have on the other. We advocate that internal and external integration should be thought of as contemporaneous phenomena that feed upon one another across time.

Managerial Implications

Managers should understand that while downstream integration without internal integration will lead to operational improvements, the gains might be quite limited (see Figure 4). Managers in a firm that is high on downstream integration and low on internal integration may mistakenly perceive that downstream integration does not improve performance. Because of demanding customers, managers may view downstream integration as a margin squeezing cost of business. Our research suggests that firms in this position should consider the task half complete – the equally daunting work of integrating the firm internally should be undertaken. In contrast, the internally integrated firm that increases downstream integration will reap the fullest logistical rewards in terms of fill rates and inventory turns, for example.

Managers should also understand that an improvement in logistical performance associates with better financial performance. Our modeling efforts demonstrated that financial performance is not directly predicted by integration: rather logistical performance transmits the effect of integration on financial performance. The significant interaction of internal and downstream integration on logistical performance suggests that a lack of integration in one or both of the two domains will not translate into meaningful financial performance gains. The results embedded in Figure 4 indicate the powerful advantage that integration can create. The key for managers is to understand that integration should be undertaken both internally and downstream. Firms high on both fronts accrue a multiplicative effect concerning logistical performance (e.g., inventory turns), which is then parlayed into superior financial performance. Regardless of how well a firm does in implementing internal or downstream integration, our research indicates that extreme failure in one area is sufficient to make null and void potential performance gains.

Limitations and Further Research

Of importance is the need for clarity on which of the causal chain, the unified integration, or the individual effects model with interactions is the most appropriate and best represents the underlying truth of the world. This theory driven need for clarity is clouded by an inability to directly compare results across studies, in part a function of different studies utilizing different scales. For example, external integration has been operationalized as downstream integration (as we have), as upstream integration (Sanders and Premus 2005) or as integration with either upstream or downstream exchange partners (Stank, Keller, and Daugherty 2001). The scales for internal integration have focused on a combination of information exchange, decision-making coordination across functions, and process serialization. As mentioned previously, our integration scales focused on the decision-making component – this is a notable limitation to our work. Further research is required to clarify whether our findings are a special case due to unique scaling traits or generalizeable due to our scales representing an adequate sample from the available universe of scales.

An issue worthy of iteration concerns whether external integration is a single construct versus multiple constructs. It may be that integration with suppliers is not equivalent to integration with customers. Both may ultimately affect financial performance but the routes or causal chains may be quite distinct. For example, integration with customers may result in higher turnover rates for finished goods, but not raw materials. The reverse may hold when integration with suppliers is high. Further research is required to tease out these potential effects.

Finally, our research demonstrated the importance of interactions in explaining variance in performance. Further research should concentrate on identifying additional moderator variables. A promising area would be to investigate the role of context. For example, integration may have a stronger effect in a dynamic demand environment. Predictable demand, especially when combined with the necessity to produce in large lots, may result in repetitive, stable operations that reduce the need for and impact of inter-functional coordination. Confirmation of such would start to provide a richer managerial understanding of when integration makes sense.

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