Supply Chain Metrics

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Most discussions and articles about supply chain metrics are, in actuality, about internal logistics performance measures. The lack of a widely accepted definition for supply chain management and the complexity associated with overlapping supply chains make the development of supply chain metrics difficult. Despite these problems, managers continue to pursue supply chain metrics as a means to increase their "line of sight" over areas they do not directly control, but have a direct impact on their company's performance. We provide a framework for developing supply chain metrics that translates performance into shareholder value. The framework focuses on managing the interfacing customer relationship management and supplier relationship management processes at each link in the supply chain. The translation of process improvements into supplier and customer profitability provides a method for developing metrics that identify opportunities for improved profitability and align objectives across all of the firms in the supply chain.

It is generally believed that a well-crafted system of supply chain metrics can increase the chances for success by aligning processes across multiple firms, targeting the most profitable market segments, and obtaining a competitive advantage through differentiated services and lower costs. The lack of proper metrics for a supply chain will result in failure to meet consumer/end user expectations, suboptimization of departmental or company performance, missed opportunities to outperform the competition, and conflict within the supply chain. However, there is no evidence that meaningful performance measures that span the supply chain actually exist. Many factors may contribute to this situation including: the lack of a supply chain orientation, the complexity of capturing metrics across multiple companies, the unwillingness to share information among companies, and the inability to capture performance by customer, product or supply chain. A major contributor to the lack of meaningful supply chain performance measures is the absence of an approach for developing and designing such measures.

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In most companies, the metrics that management refers to as supply chain metrics are primarily internally focused logistics measures such as lead time, fill rate, or on-time performance. In many instances, these measures are financial (inventory turns and overall profitability), but they do not provide insight regarding how well key business processes have been performed or how effectively the supply chain has met customer needs. In a growing number of firms management is beginning to measure performance outside the firm, but these efforts have been limited to evaluating the performance of tier one suppliers, customers, or third-party providers. These metrics do not capture how the overall supply chain has performed and fail to identify where opportunities exist to increase competitiveness, customer value, and shareholder value for each firm in the supply chain.

In this paper, we present a framework for developing metrics that measure the performance of key supply chain processes, identify how each firm affects overall supply chain performance, and can be translated into

shareholder value. In the first section, we describe the problem with current metrics and the need for supply chain performance measures. In the second section, the relevant literature is reviewed and its application to supply chain management evaluated. The paper concludes with a framework for developing supply chain metrics.

Problems with Existing Metrics

The performance measures used in most companies have several problems that prevent them from effectively measuring supply chain performance. Many measures identified as supply chain metrics are actually measures of internal logistics operations as opposed to measures of supply chain management. The majority are single firm logistics measures such as fill rate, lead time, on-time performance, damage and responsiveness [1] and are not the multi-firm measures that are necessary to measure the performance of the supply chain [2]. Similar measures were obtained in seminar programs held at multiple locations in the United States and abroad, when we asked executives to identify examples of supply chain metrics. Typically, the executives identified inventory turns as one of the measures of supply chain performance, a view shared by several authors [3]. However, as a supply chain metric, inventory turns is not an effective measure and provides a useful example of why new metrics are needed for managing the supply chain.

An inventory turns measurement fails to capture key differences in product cost, form, and risk within the supply chain. Figure 1, which illustrates inventory positions and flows across a supply chain, helps make this point. As inventory moves closer to the point of consumption, it increases in value. That is, the out-of-pocket cash investment in the inventory increases.

Consequently, if the opportunity cost of money and the inventory turns are similar, inventory carrying costs are much higher at the retail level, and an inventory turn improvement by the retailer has a much greater effect on overall supply chain performance than a turn improvement by the supplier, or manufacturer, and a greater impact than a turn improvement by the wholesaler. Referring to Table 1, if the

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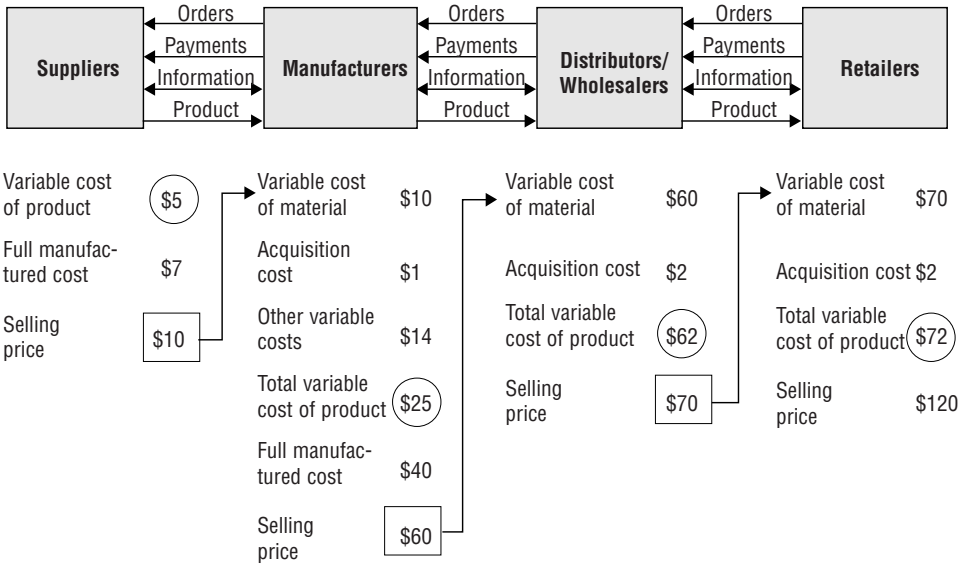
Figure 1
Inventory Flows Within the Supply Chain



Source: Adapted from Douglas M. Lambert and Mark L. Bennion, "New Channel Strategies for the 1980s," in *Marketing Channels: Domestics and International Perspectives,* ed. Michael G. Harvey and Robert F. Lusch, Norman: Center for Economic Management Research, School of Business Administration, University of Oklahoma, 1982, p. 127.

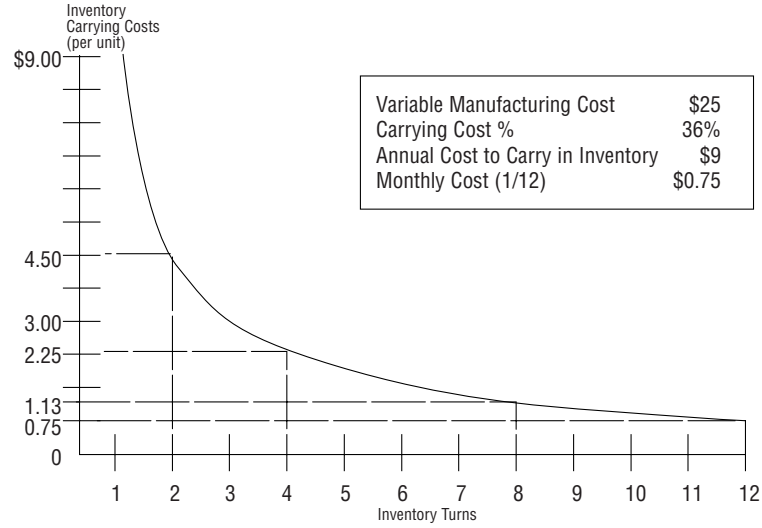
supplier, manufacturer, wholesaler and retailer are all achieving six turns and have a similar inventory carrying cost of 36 percent, an improvement to seven turns would be worth $0.04, $0.21, $0.53, and $0.62 per unit sold for each of the parties, respectively. This example illustrates that the common practice of pushing inventory forward in the supply chain may reduce overall supply chain performance. Current inventory turns at each level within the supply chain also must be considered. Figure 2 shows how the inventory carrying cost per unit changes with the number of inventory turns. While Figure 2 reflects the manufacturer data from Table 1, the shape of the curve is identical for the supplier, distributor/wholesaler and retailer. Now, let's reconsider how existing inventory turns at various tiers in the supply chain will affect the general rule that inventory, or inventory ownership, should be moved backward in the supply chain. If the

Table 1
How Supply Chain Position Affects Inventory Carrying Cost

		Supplier	Manufacturer	Distributor/ Wholesaler	Retailer
Cash value of inventory:*		$5	$25	$62	$72
Inventory carrying cost %:		36%	36%	36%	36%
ICC/unit with:	1 turn	$1.80	$9.00	$22.32	$25.92
	2 turns	$0.90	$4.50	$11.16	$12.96
	3 turns	$0.60	$3.00	$7.44	$8.64
	4 turns	$0.45	$2.25	$5.58	$6.48
	5 turns	$0.36	$1.80	$4.46	$5.18
	6 turns	$0.30	$1.50	$3.72	$4.32
	7 turns	$0.26	$1.29	$3.19	$3.70
	8 turns	$0.23	$1.13	$2.79	$3.24
	9 turns	$0.20	$1.00	$2.48	$2.88
	10 turns	$0.18	$0.90	$2.23	$2.59
	11 turns	$0.16	$0.82	$2.03	$2.36
	12 turns	$0.15	$0.75	$1.86	$2.16

*Based on data provided in Figure 1

Figure 2
Annual Inventory Carrying Costs Compared to Inventory Turns



Source: Adapted from Jay U. Sterling and Douglas M. Lambert as referenced in Douglas M. Lambert and James R. Stock, *Strategic Logistics Management*, Burr Ridge, IL: Irwin McGraw-Hill, 1993, p. 390.

manufacturer is only achieving five turns and wholesaler has eleven turns, a one turn improvement equates to $0.30 per unit sold for the manufacturer and $0.17 per unit sold for the wholesaler. In this case, the general rule is broken.

In addition, an inventory turn rate does not recognize the different forms or the risk of holding inventory. Raw materials held by the supplier may be used for multiple products or customers. This situation makes it difficult to determine how downstream changes would affect the amount of inventory held by the supplier. An inventory turns metric does not consider risk. The further downstream the inventory, the greater risk that it does not exactly meet consumers' requirements. Pushing the inventory backwards and postponing its final form permits the supply chain to avoid higher obsolescence costs and the cost of repositioning inventory when it has been deployed to the wrong location.

A single inventory turn metric for the supply chain cannot capture the differences that an improvement in turns will have at each level or for the total supply chain. Performance, as measured by total inventory carrying costs, would be a better measure since it considers both the cash value of the inventory at various positions in the supply chain as well as varying opportunity costs for inventory investments for various supply chain members [4]. Total inventory carrying cost is improved by pushing inventory backwards in the supply chain toward the point of origin. The further back, the lower the overall inventory carrying costs for the entire supply chain. In summary, inventory turns and other commonly used logistics measures are inadequate for evaluating and aligning performance across multiple companies in the supply chain.

Another problem with metrics stems from the lack of a widely accepted definition for supply chain management. Until recently, many logistics practitioners, academics, and consultants viewed supply chain management as an extension of logistics outside the firm to include customers and suppliers [5]. However, the Council of Logistics Management revised its definition of logistics in 1998 to reflect that logistics is only a part of supply chain management:

> Logistics is that part of the supply chain process that plans, implements and controls the efficient, effective flow and storage of goods, services, and related information from point-of-origin to the point-of-consumption in order to meet customer requirements [6].

Supply chain management has a much broader scope and considers the effect of functions other than logistics on business processes spanning multiple companies:

> Supply chain management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders [7].

Figure 3 shows the eight processes that must be implemented within the firm and then across key members of the supply chain. The supplier relationship management process was originally termed procurement, but unfortunately procurement is confused in the logistics literature and in practice with the functional silo purchasing and for this reason we have decided to rename it supplier relationship management. The use of supply chain management as another name for logistics has led to observations that most companies have been using logistics metrics instead of measures that capture supply chain performance [8].

Literature Review

The techniques and measures described in the literature focus on developing performance measures for an organization and do not capture the performance of the supply chain in total or how each organization affects overall performance. Some authors recognize the need to measure performance across the supply chain but do not provide a method for developing the metrics and fail to recognize the supply chain processes that drive performance.

More research is needed to develop supply chain metrics and to overcome the implementation barriers [9]. Most of the literature has focused on analyzing and categorizing performance measurement systems but little research has been devoted to supply chain performance measures [10].

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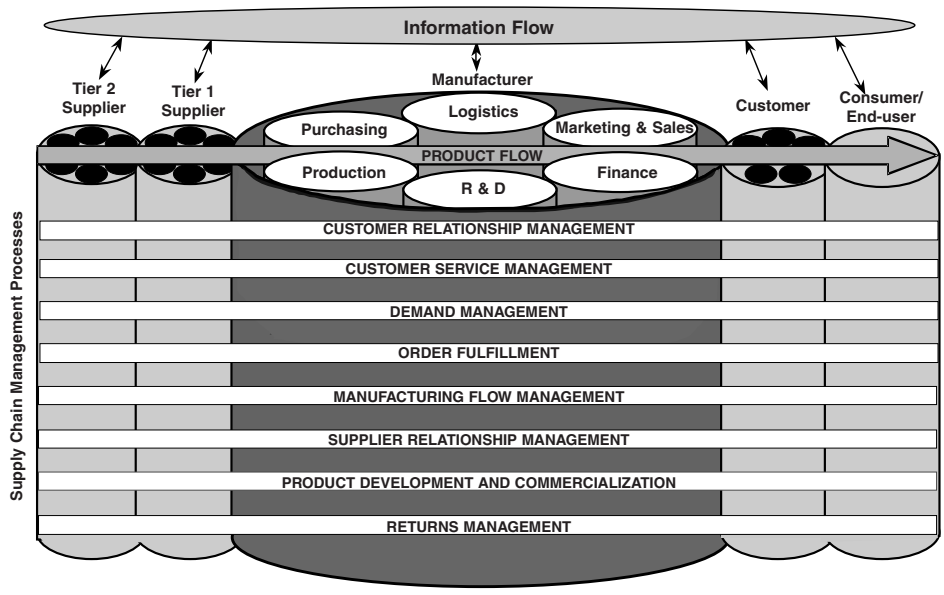
Figure 3
Supply Chain Management:
Integrating and Managing Processes Across the Supply Chain



Source: Adapted from Douglas M. Lambert, Martha C. Cooper, and Janus D. Pagh, "Supply Chain Management: Implementation Issues and Research Opportunities," *The International Journal of Logistics Management,* Vol. 9, No. 2 (1998), p. 2.

Research is needed to determine what should be measured, when and why. The supply chain must be viewed as one entity and any measurement system should span the entire supply chain [11]. The challenge is to develop a measurement system that enables managers to see the areas where supply chain performance can be improved, so they can focus their attention, and obtain higher levels of performance [12].

Why Supply Chain Metrics?

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Several factors are contributing to management's need for new types of measures for managing the supply chain including:

- The lack of measures that capture performance across the entire supply chain.
- The requirement to go beyond internal metrics and take a supply chain perspective.
- The need to determine the interrelationship between corporate and supply chain performance.
- The complexity of supply chain management.
- The requirement to align activities and share joint performance measurement information to implement strategy that achieves supply chain objectives.
- The desire to expand the "line of sight" within the supply chain.
- The requirement to allocate benefits and burdens resulting from functional shifts within the supply chain.
- The need to differentiate the supply chain to obtain a competitive advantage.
- The goal of encouraging cooperative behavior across corporate functions and across firms in the supply chain.

Measures spanning the entire supply chain do not exist [13], and logistics or other functional measures do not adequately reflect scope of supply chain management [14]. Managers can only determine whether they have met their corporate goals after the fact, by diagnosing poor financial results or when they lose a key customer [15]. The measures used have little to do with supply chain strategy and objectives and may actually conflict resulting in inefficiencies for the overall supply chain [16]. Metrics integrating performance across multiple companies are just emerging [17], but they are only in their

early stages and generally focus on measuring the performance of adjacent channel members: suppliers, carriers, and immediate customers.

The adoption of a supply chain approach holds numerous consequences for the measurement and control of individual business activities [18] and the performance measures used. The shift from a functional to a process focus will require the development of new types of measures, financial as well as operational [19]. Supply chains, rather than the functional operations within a single company, will become the new focus [20]. Supply chain members will become accountable for the joint performance of these key business processes, and they will require an integrated information system to enable multiple members of the supply chain to gain access to performance measures [21]. Management will need to understand the activities and costs of upstream and downstream supply chain members [22].

Linking Corporate and Supply Chain Performance

In order for management to understand the interrelationship between corporate and supply chain performance, more holistic measures are required. These measures must integrate corporate financial and non-financial performance [23]. The translation of these measures into shareholder value is critical for resolving conflicting objectives and supporting cost trade-offs across the supply chain especially in areas where cost or asset increases are required by some member(s). Existing measurement systems provide little assistance or insight regarding the question "What's in it for me?" [24]. Future supply chain management innovations will come under increasing scrutiny to determine if and when they yield a positive impact on corporate performance.

The complexity of the supply chain requires a different approach for designing metrics and measuring performance. In the case of a manufacturer, a supply chain can be represented as an uprooted tree, where the roots are the suppliers and the branches are the customers (see Figure 4). Managers require an understanding of what each branch or root adds to the value of the supply chain. The complexity of most supply chains makes it difficult to understand how activities at multiple tiers are related and influence each other. Performance measures must reflect this complexity and consider cross-company operations from original suppliers to the end customer [25].

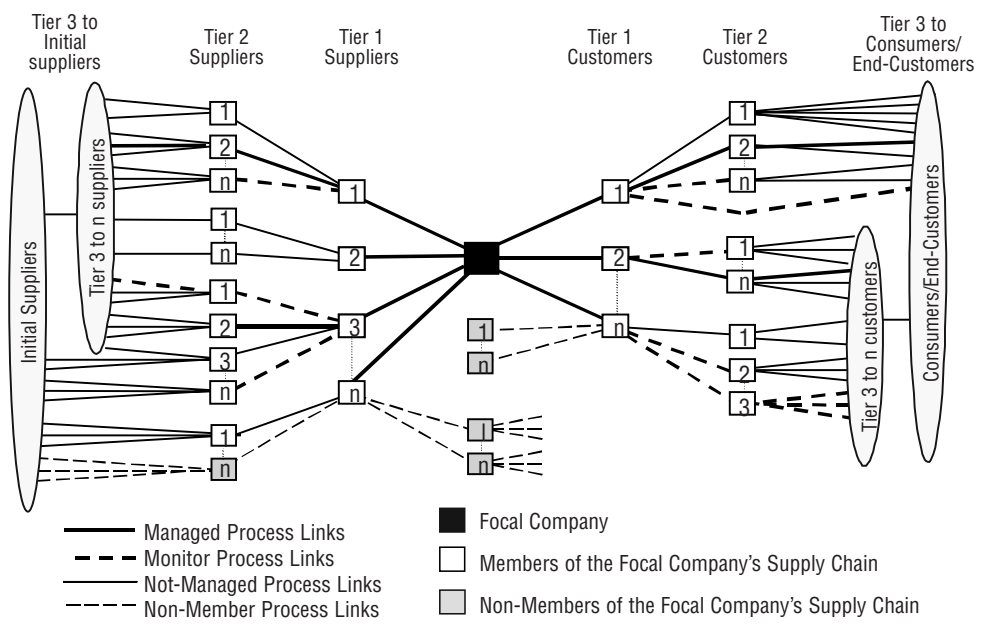
Relationship Between Supply Chain Metrics and Strategy

Implementing a supply chain strategy requires metrics that align performance with the objectives of other members of the supply chain [26]. Managers can no longer focus on optimizing their own firm's operations. Instead, they need to work collaboratively to generate the greatest mutual gains and savings [27]. Aligned metrics can assist in shifting managers' focus to attaining the operational goals of the enterprise-wide supply chain [28]. The alignment of metrics enables managers to identify and institutionalize the organizational, operational, and behavioral changes [29] needed to manage the key business processes spanning their network. Aligned metrics can direct management attention and effort to the areas requiring improvement leading to higher levels of performance for the supply chain [30]. By establishing metrics throughout the supply chain, managers will be more likely to reach overall corporate goals and business strategies [31]. Integrating the key business processes across the supply chain is difficult because of the many constituencies, each with their own metrics and individual objectives [32]. Their objectives may have little in common resulting in potential conflict and inefficiencies for the supply chain [33]. Conflicting objectives preclude managers from effectively managing trade-offs across functions [34] as well as across companies.

Implementing a supply chain strategy requires metrics that align performance with the objectives of other members of the supply chain.

Managers need to extend their "line of sight" across the supply chain by measuring the performance of activities and companies they do not directly control [35]. Management of a single company rarely controls the total supply chain and cannot see areas for improvement across the entire supply chain [36]. Increased visibility and shared metrics assist management with the integration, synchronization, and optimization of these inter-enterprise processes. The visibility makes the supply chain more transparent and can lead the way

Figure 4
Types of Inter-company Business Process Links



Source: Douglas M. Lambert, Martha C. Cooper and Janus D. Pagh, "Supply Chain Management: Implementation Issues and Research Opportunities", *The International Journal of Logistics Management*, Vol. 9, No. 2 (1998), p. 7.

for performance improvements. Managers can determine how well the supply chain performed against the expectations of their customers [37] and use the information to determine where performance improvements need to occur. The identification of deficiencies outside a company's span of control can lead to programs aimed at improving performance or taking some level of control of upstream or downstream supply chain activities. Managers rarely have face-to-face contact with the end users, and supply chain metrics enable all the linked members to better respond to changes in consumer demand [38].

Integrated metrics allow management to assess the overall competitiveness of the supply chain and to determine which internal improvement efforts produce the greatest impact on overall competitiveness.

Functional shifts and cost trade-offs made across multiple firms require metrics capable of measuring the resulting benefits and burdens. Individual companies may have to sacrifice internal efficiencies or perform additional functions to reduce or optimize total supply chain costs [39]. Consequently, some firms will benefit from the realignment of activities of functions while others will incur additional burdens or costs. Management needs the capability to measure where any benefits or burdens have occurred and a mechanism for negotiating an equitable redistribution of the benefits among firms [40].

Supply chain metrics are needed to sustain competitiveness and to differentiate product and service offerings. The commoditization of products and the number of competitive product offerings are forcing management to differentiate the firm's offerings through increased performance. As a result, managers must examine the supply chain to determine additional revenue opportunities and where they can obtain the greatest leverage to differentiate the brand and/or to eliminate costs [41]. Integrated metrics allow management to assess the overall competitiveness of the supply chain and to determine which internal improvement efforts produce the greatest impact on overall competitiveness [42].

Supply chain metrics are also necessary to encourage the desired changes in behavior. Rewards and incentives are usually based on performance measurements that are focused internally rather than on the consumer or the supply chain [43]. The metrics used influence the behavior of individuals and determine supply chain performance [44]. The metrics

provide the means for management to determine whether the performance of the firm's supply chain members has improved or degraded and what factors have contributed to the situation. Behavior of managers in individual firms can be modified and controlled through measurements such as increases in value or competitiveness, or through the use of rewards and sanctions [45].

The focus on internal logistics metrics results in performance measures and activities not being aligned with supply chain strategy. The operational objectives of the companies frequently conflict with one another leading to inefficiencies in the supply chain [46]. Many of the measurements used within firms are developed in isolation and are linked to local rewards rather than strategy. The missing connection between strategy and measurements promotes an internal focus that becomes an obstacle to developing supply chain metrics [47]. The disconnect between strategy and performance measures contributes to many of the strategic level measures appearing unrelated or not actionable at lower levels in the corporate hierarchy. For example, companies do not have metrics that measure customer service from the consumer's perspective despite having strategic goals of satisfying customer requirements. Many critical customer service measures are not tracked by existing performance measurement systems despite their effect on supply chain performance [48]. As a result, the relationship between the performance of supply chain activities and what creates value for the consumer is not clearly understood [49].

Framework for Developing Supply Chain Metrics

Complexity makes the development of supply chain performance metrics very difficult (see Figure 5). For example, consumer goods manufacturers such as Colgate-Palmolive, Procter & Gamble and Unilever sell to the same customers and purchase from the same suppliers. Competing supply chains appear more like interconnected or overlapping networks than a mutually exclusive "supply chain versus supply chain" form of competition. The overlap results in many instances of shared inventories, shared services, and shared assets between supply chains [50]. Managers cannot easily determine how business practices within specific companies drive total supply chain performance. As was pointed out earlier, you cannot simply add up inventory turns for participating firms and arrive at a total for the supply chain.

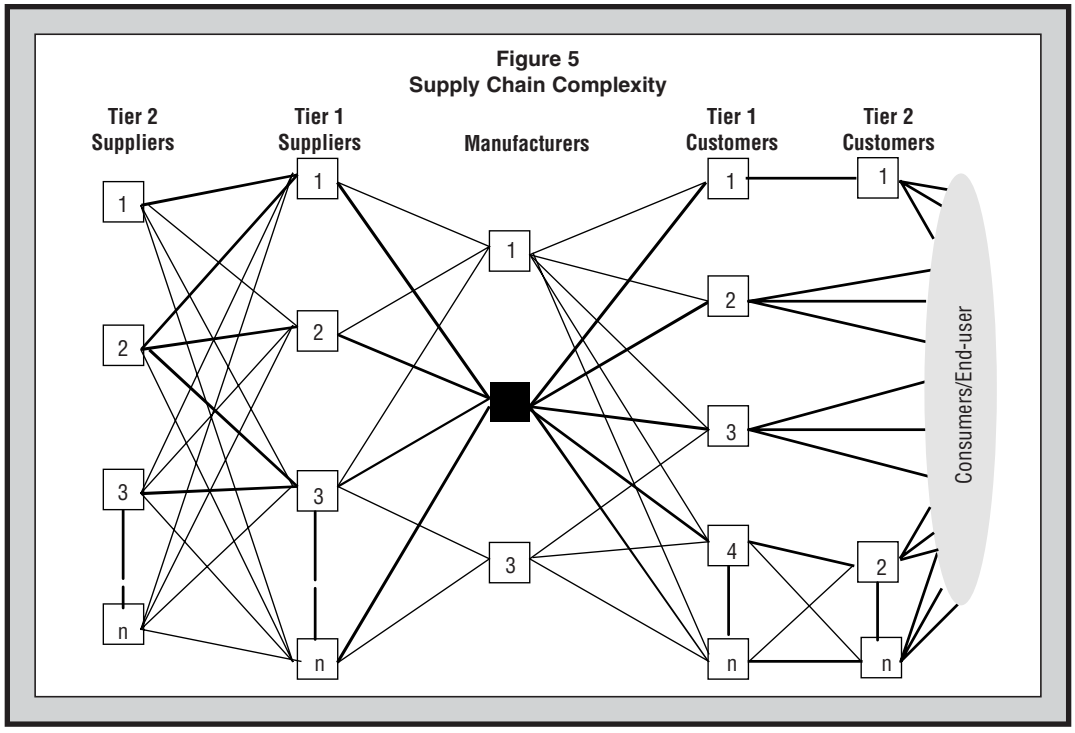
Despite the complexity and overlap existing in most supply chains, managers can develop metrics to align the performance of key business processes across multiple companies. We propose a framework that aligns performance at each link (supplier-customer pair) within the supply chain. The framework begins with the linkages at the focal company and moves outward a link at a time. The link-by-link approach provides a means for aligning performance from point-of-origin to point-of-consumption with the overall objective of maximizing shareholder value for the total supply chain as well as for each company. The framework consists of seven steps:

We propose a framework that aligns performance at each link (supplier-customer pair) within the supply chain.

- Map the supply chain from point-of-origin to point-of-consumption to identify where key linkages exist.
- Use the customer relationship management and supplier relationship management processes to analyze each link (customer-supplier pair) and determine where additional value can be created for the supply chain.
- Develop customer and supplier profit and loss (P&L) statements to assess the effect of the relationship on profitability and shareholder value of the two firms.
- Realign supply chain processes and activities to achieve performance objectives.
- Establish non-financial performance measures that align individual behavior with supply chain process objectives and financial goals.
- Compare shareholder value and market capitalization across firms with supply chain objectives and revise process and performance measures as necessary.
- Replicate steps at each link in the supply chain.

Map the Supply Chain

The framework begins with the mapping of the supply chain from point-of-origin to



point-of-consumption. The map identifies the various paths materials and information flows may take from source to the final consumer (see Figure 4). Managers can use the map to identify the different companies and linkages comprising the supply chain. The key supply chain linkages are those that are most critical to success. The initial focus should be on managing those dyads with the greatest potential for increasing profitability and developing a sustainable competitive advantage. Customer relationship management (CRM) and supplier relationship management (SRM) are the two major processes that capture the overall performance of a supplier-customer relationship and can be used to link up the entire supply chain.

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Analyze Each Link

The supplier applies the CRM process to define how it will manage relationships with customers. Key customers are identified and the supplier's CRM teams work with these accounts to tailor product and service agreements that meet their requirements and specify the level of performance [51]. The CRM process creates value by working with the customer to improve performance (see Figure 6). For example, the CRM team may negotiate with the customer's team to implement supplier managed inventory (SMI). Successful SMI implementation may lead to increased revenues as the customer allocates a larger proportion of the business to that supplier. If the relationship reduces costs and can yield a price reduction for the consumer, revenues may increase as total sales for the supply chain increase. Revenues may increase as a result of better in-stock availability at the end of the supply chain. The cost of goods sold may decrease through better scheduling of material requirements and more efficient utilization of plant capacity and labor. The supplier experiences a one-time decrease in sales when SMI is implemented and the customer uses up existing inventory. The supplier's expenses may increase as the company assumes ownership of, and responsibility for, the customer's inventory; however, other expenses may decrease due to reduced order processing and forecasting costs. Inventory carrying costs decrease as point-of-sale data are used to schedule shipments instead of forecasting requirements and maintaining safety stock. Better capacity utilization and collaborative planning and forecasting of requirements may reduce the need for customer specific assets. If these cost reductions in total do not more than offset the increased costs, then some other method of sharing benefits must occur. For example, the customer could write the supplier a check. The

process improvements obtained through CRM can be translated into increased shareholder value through the use of an economic value-added (EVA) model as illustrated in Figure 6.

On the opposite side of the dyad, the customer uses the SRM process to manage supplier relationships. The customer selects and develops relationships with suppliers based on their contribution and criticality. The SRM process is the mirror image of the CRM process. As with the CRM process, it is possible to identify how SRM affects EVA (see Figure 7). Referring to the previous example, the SRM process captures the value created through SMI implementation. The relationship may produce increased revenues through cost reductions, lower consumer prices, and improved quality obtained by working with a select group of suppliers. The cost-of-goods-sold (COGS) may be reduced through the leveraging of larger buys with a smaller number of suppliers. Expenses decrease as the supplier assumes responsibility for order placement and inventory management. Pushing the ownership of inventory backwards to the supplier reduces inventory carrying costs for the customer and for the total supply chain since the supplier owns the inventory at a lower cash value (see Figure 1). Together, the CRM and SRM processes capture the total value, adjusted for the cost of money, created by the supplier-customer relationship. Exhibits similar to Figures 6 and 7 can be developed for the other six supply chain processes.

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Develop Profit and Loss Statements

The development of customer and supplier P&L statements provides a complete picture of how the relationship affects profitability for both firms (see Figure 8). Initiatives undertaken by the two firms are reflected in these P&Ls, as are improvements in performance of the other six processes (see Figure 3). While performance metrics must be developed for all eight processes in order to motivate the desired behavior, the financial performance of all eight processes is captured in the customer P&Ls. When the customer P&Ls are aggregated for all customers and corporate joint costs deducted, the results represent overall firm performance.

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Figure 8 illustrates combined customer-

Figure 6
How Customer Relationship Management Affects Economic Value Added (EVA)

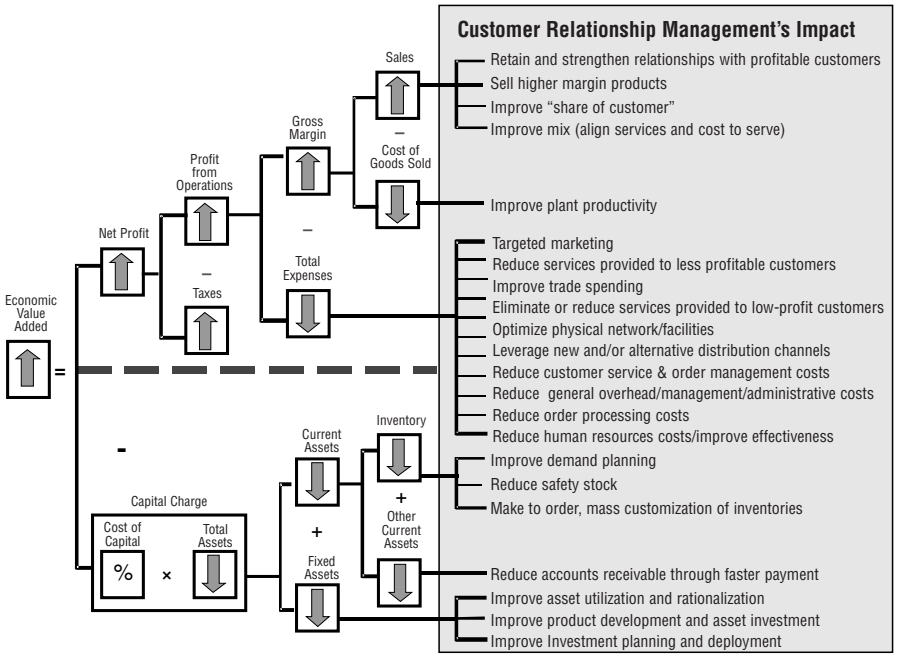
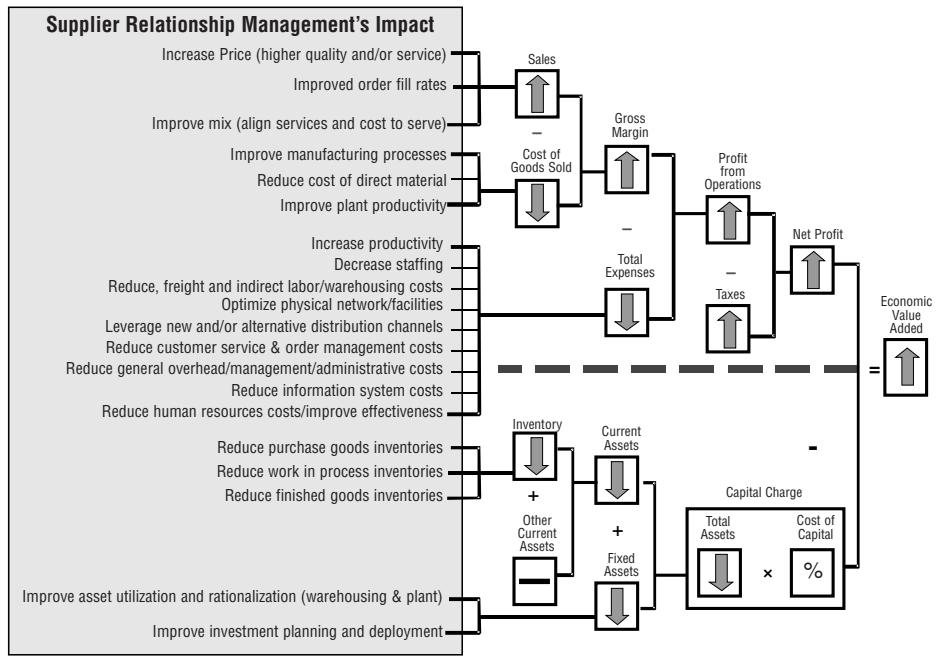


Figure 7
How Supplier Relationship Management Affects Economic Value Added (EVA)



supplier profitability analysis for a manufacturer selling to a wholesaler or retailer. In the case of the supplier (manufacturer), variable manufacturing costs are deducted from net sales to calculate a manufacturing contribution. Next, variable marketing and logistics costs are deducted to calculate a contribution margin. Assignable nonvariable costs, such as slotting allowances and inventory carrying costs, are subtracted to obtain a segment controllable margin. The net margin is obtained after deducting a charge for dedicated assets. In the case of the customer (wholesaler or retailer), product costs are deducted from sales to obtain a gross margin to which discounts and allowances are added to obtain the net margin. The remaining steps are similar to those taken by the supplier to obtain the net segment margin. These statements contain opportunity costs for investments in receivables and inventory and a charge for dedicated assets. Consequently, they are much closer to cash flow statements than a traditional P&L. They contain revenues minus the costs (avoidable costs) that disappear if the revenue disappears. If the supplier is selling an undifferentiated commodity to a customer that is another manufacturer, then the customer's report on the supplier is a total cost analysis unless revenue can be attributed to a source of supply (e.g., better quality or fewer returns). The customer compares the total cost for the current period to similar periods in the past or to comparable suppliers to determine the change in performance.

The P&Ls provide the best measure of supply chain performance and can be used to align performance across processes and between firms.

Realign Supply Chain Processes

The P&Ls provide the best measure of supply chain performance and can be used to align performance across processes and between firms. In our SMI example, the supply chain has the objective of increasing availability while simultaneously reducing costs. SMI implementation may cause the supplier to incur additional costs in some areas while obtaining cost reductions in others. The supplier's P&L reflects the resulting total cost as well as changes in assets (because of charges for assets employed), revenue, and profitability. Similarly, the customer's P&L reflects any changes due to SMI implementation. A combined profitability analysis captures the

Figure 8
Combined Customer-Supplier Profitability Analysis:
A Contribution Approach With Charge for Assets Employed

Supplier	Customer A	Customer	Supplier A
Net Sales		Sales	
Cost of Goods Sold (Variable Mfg. Cost)		Cost of Goods Sold	
Manufacturing Contribution		Gross Margin	
		Plus: Discounts and Allowances	
Variable Marketing & Logistics Costs:		Market Development Funds	
Sales Commissions		Slotting Allowances	
Transportation		Co-Op Advertising	
Warehousing (Handling in and out)		Net Margin	
Special Packaging		Variable Marketing & Logistics Costs:	
Order Processing		Transportation	
Charge for Investment in Accts. Rec.		Receiving	
Contribution Margin		Order Processing	
		Contribution Margin	
Assignable Nonvariable Costs:		Assignable Nonvariable Costs:	
Salaries		Salaries	
Segment Related Advertising		Advertising	
Slotting Allowances		Inventory Carrying Costs Less:	
Inventory Carrying Costs		Charge for Accounts Payable	
Segment Controllable Margin		Segment Controllable Margin	
Charge for Dedicated Assets Used		Charge for Dedicated Assets Used	
Net Segment Margin		Net Segment Margin	

total effort and enables management to better understand how aligning their actions with supply chain objectives drives profitability in their firms. They can use this information as a basis for negotiating how to equitably split any benefits or burdens resulting from supply chain process improvements. In order to evaluate proposed programs, proforma P&Ls can be developed. This approach provides a much more accurate measure of supply chain performance than existing measures.

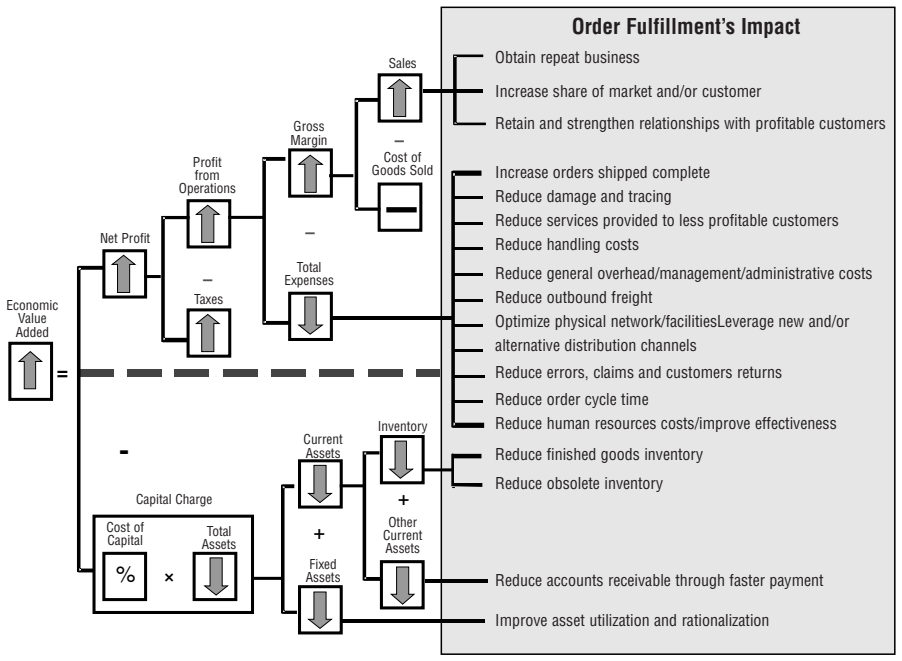
Functional or logistics measures, such as inventory turns, cannot capture the full extent of management cost trade-offs and can be easily "gamed." As previously described, inventory carrying cost is a better measure, but it does not capture the costs incurred to achieve the reduction in inventory. Increases in production setup costs, transportation costs, ordering costs and lost sales costs may more than offset any gains made in inventory carrying costs. Typically, inventory reductions have a greater impact on total supply chain performance if they occur at the retail level. Generally speaking, making to order, pushing inventory backwards or pushing inventory ownership backwards in the supply chain improves overall performance. A combined customer-supplier profitability analysis will capture how the repositioning of inventory improves total supply chain performance, whereas inventory turns does not reflect any of the cost trade-offs within a firm or in the supplier-customer link.

Align Non-financial Measures with P&Ls

P&Ls and EVA measures alone are not sufficient to effect improvements in supply chain performance or to align behavior. Supply chain and corporate metrics must be cascaded down to develop performance measures at the lowest level in the organization. For example, managers begin with the objectives identified in Figure 9 for developing performance measures for the order fulfillment process. A warehouseman or order fulfillment specialist supporting this process may not be able to relate how more efficient order picking and picking accuracy impact profitability or shareholder value, but they can focus on reducing order pick time and errors. Reducing order pick time while increasing productivity reduces the cost per order. Reducing order pick errors results in faster payment of customer invoices and reduces the cost of returned goods. By outperforming the competition, a faster order cycle time may lead to increased sales. Individual performance measures must be tied to the specific objectives required to

A combined customer-supplier profitability analysis will capture how the repositioning of inventory improves total supply chain performance whereas inventory turns does not reflect any of the cost trade-offs within a firm or in the supplier-customer link.

Figure 9
How Order Fulfillment Affects Economic Value Added (EVA)



improve profitability and shareholder value at each link in the supply chain. The relationship between improved non-financial performance and shareholder value can be accomplished by converting activities into costs through such means as activity-based costing, identifying any revenue or asset implications, and inserting this information into an EVA or profit analyses.

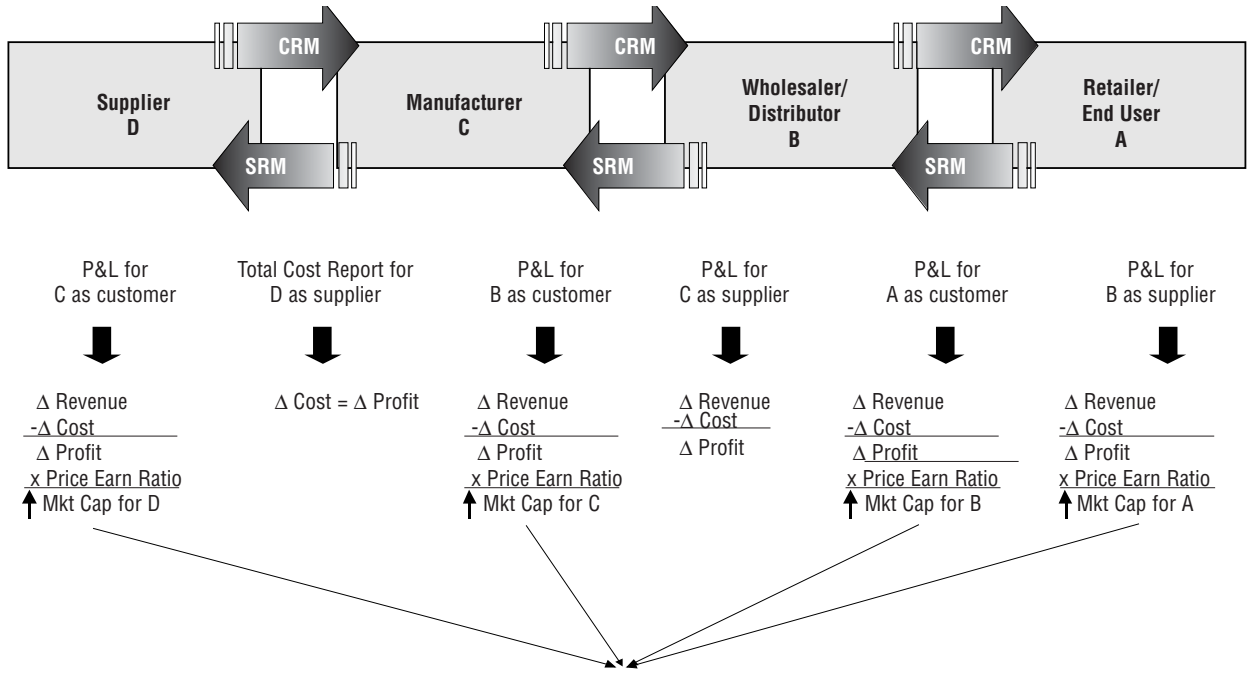
Compare Across Firms and Replicate

The final steps in the framework compare the resulting shareholder value and market capitalization across firms (see Figure 10) and replicate these steps at every link in the supply chain. Overall performance is determined by the increase in market capitalization for each firm in the supply chain. The wholesaler/distributor's P&L for C as a supplier and the manufacturer's cost saving for D as a supplier are not included in the market capitalization metric to avoid double counting as an increase in profit or expense reduction from a supplier is captured in the customer P&Ls. In the case of the retailer/end user, it would be unusual to have customer P&Ls so overall profitability is determined by summing supplier P&Ls and deducting corporate joint costs. While management's goal is to increase shareholder value, economic conditions or other events can lead to depressed price-earnings multiples in the short run. In these situations, it may be better to simply sum the changes in net profits. In Figure 10, all firms show an increase in profits because management uses the financial data to negotiate an equitable sharing of the costs and benefits.

Overall performance is determined by the increase in market capitalization for each firm in the supply chain.

Managers should assess whether the process changes and metrics employed have produced the targeted levels of profitability and shareholder value. They may need to refine the processes or make additional trade-offs to achieve the targets. In many instances, managers need to look further upstream or downstream in the supply chain to achieve their objectives. They may find second or third tier customers and suppliers provide additional opportunities to reduce cost, increase quality, and accelerate product development. The supply chain may eliminate some intermediaries that do not add value or may insert others that can increase the profitability of certain segments; for example, a distributor may be used to service

Figure 10
Profit and Market Capitalization Increases Measured Across Four Tiers of the Supply Chain



a large number of small accounts or to achieve distribution in a remote geographic region.

The customer-supplier profitability analysis should be applied at each link in the supply chain. By analyzing the processes at each link and understanding the value the link creates, managers can align the supply chain processes in order to provide the best value for consumers/end users and the highest profitability and shareholder value for each company. This framework increases management's understanding of how their firm contributes to the overall competitiveness and value created by the supply chain and provides the opportunity for a dynamic realignment of the supply chain. Management maximizes performance at each linkage and over time, the firms obtain the best performance. Eventually the processes become more efficient and effective and the supply chain naturally migrates to the point that maximizes profitability for each party and the whole. The process is on-going and requires continual adjustment. Managers can take proactive action within their firm as well as negotiate with other firms to further increase overall supply chain performance. Management must understand how value is created by each process at each link in the supply chain, take collaborative action to increase value, and replicate these steps across the entire supply chain. Ultimately, it is the value provided to retail customers or industrial end users (product and service quality relative to price) that determines the competitiveness of the supply chain and the profitability of its members.

Future Research

Future research is required to test the proposed framework in an actual business setting. Barriers to implementation and how they can be overcome need to be identified. Nonfinancial metrics must be developed for participating firms and tied to their financial performance. The goal should not be to identify specific metrics, but to provide the framework that allows managment to develop the best metrics for their situation. To the extent that similar metrics are identified in different supply chain settings, it may be possible to conclude that standard metrics

By analyzing the processes at each link and understanding the value the link creates, managers can align the supply chain processes in order to provide the best value for consumers/end users and the highest profitability and shareholder value for each company.

can be developed. Once the P&L statements described in this article are developed, management will still require a framework for negotiating an equitable distribution of costs and benefits. This promises to be another area with significant research potential. Finally, progress should be tracked over time to identify the costs associated with implementing the proposed framework and the long-term benefits that can derived from implementation.

Conclusions

Most of the performance measures called supply chain metrics are nothing more than logistics measures that have an internal focus and do not capture how the firm drives value or profitability in the supply chain. These measures may actually prove to be dysfunctional by attempting to optimize the firm's performance at the expense of the other firms in the supply chain, an approach that eventually decreases the value of the entire supply chain. The use of customer and supplier contribution reports avoids this situation. The customer-supplier P&Ls capture cost trade-offs as well as revenue implications, and any action taken by one firm is reflected in both firms' P&Ls. The combined P&Ls provide the necessary foundation for improving performance in the supply chain. Although one firm may incur additional costs, the combined analysis reflects whether the costs associated with a process improvement increased profitability through a larger share of the customer's business or increased supply chain competitiveness. By maximizing profitability at each link, supply chain performance migrates toward management's objectives and maximizes performance for the whole.

By maximizing profitability at each link, supply chain performance migrates toward management's objectives and maximizes performance for the whole.

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