

Measuring the impact of supply chain performance



A step-by-step guide to using the
Supply Chain Council's SCOR Model

by Peter Bolstorff

During a recent industry conference, I had the opportunity to participate in an end-of-day spontaneous discussion on the topic of supply chain continuous improvement with a group of logistics executives. The companies these executives worked for can be grouped into one of three categories:

- The first were companies who had invested heavily (and well) three to five years ago in a formal Six Sigma (or Lean) program to drive improvement; the results were amazing but their project well was drying up. They were ready to take aim at their supply chains, but most of the black belts had been assigned to plants, not logistics.
- The second were companies who had been financially very successful, and consequently never saw a real burning need for change. However, they now were facing shrinking margins, and all the corporate functions — including logistics — had to find a way to chip in and help maintain operating income.
- The third were companies who were chartered with establishing supply chain strategy in support of a strategic business plan to carry them forward for the next three years. Part of that involves identifying the right practices to drive the changes.

While each of these companies seem to be at

What is SCOR?

The **Supply Chain Operations Reference** model, developed by the *Supply Chain Council* (www.supply-chain.org), provides a standard methodology for managing supply chain projects centered on five areas: **Plan, Source, Make, Deliver** and **Return**.



the furthest ends of a three-dimensional pyramid, each logistics manager agreed that they had three fundamental challenges to solve:

- 1) How to measure supply chain performance and logistics impact.
- 2) How to identify the priority of the right change (project) and get the right resources to get the job done, when supply chain processes are by their very nature cross-functional.
- 3) How to implement the necessary changes, knowing that most supply chain improvements fail because of organizational change management issues, not because the ideas were bad.

This article will address the first question, specifically how the *Supply Chain Council's SCOR* Model measures both business and supply chain performance from a process point of view.

Delivery Performance

Delivery Performance is a discrete measure defined as the percentage of customer orders delivered “on time and in full” to customer request date and/or to customer commit date. The third option is Perfect Order Delivery, which adds to “on time and in full” other essential components making a perfect match to your customer’s purchase order, including perfect invoice (price, quantity, item number) and perfect receipt (bill of lading and packing slip).

Level Two Logic. The Level One delivery metrics do not cascade like cost metrics. You cannot “add up” the Level Two metrics to get the Level One metrics. But it is possible to decompose them using inference instead. In line with the SCOR Level Two focus on material flow, the Delivery Performance Level Two metrics take the “on time and in full” concept and apply them to each physical location based on the process role in the chain.

Suggested Level Two Metrics:

- Source** Purchase Order (Supplier) On Time and Complete to Commit
- Make** Work Order (Schedule Attainment) On Time and Complete to Commit
- Make** Transfer Order On Time and Complete to Commit
- Deliver** Customer Order Ship On Time and Complete to Commit
- Deliver** Customer Order Receipt On Time and Complete to Commit
- Return** Return Authorization On Time and Complete RECEIPT to Commit

Level Three Logic. There does not seem to be a set of consistent metrics across industries that can be standardized. The benchmark source above provides a healthy list as does the SCOR Level Three suggestions in the SCOR Model dictionary.

Delivery Performance

	Level One Metric		Calculation Components		
	Description	Data	Data	Description	Query Assumptions
Delivery Reliability	On Time and in Full to Customer Request	11.3%	1000	Total Number of Customer Orders	
			150	Total Number of Orders Delivered on Time to Customer Request Date	
			125	Total Number of Orders Delivered in Full to Customer Request Date	
			113	Total Number of Orders Delivered on Time and in Full to Customer Request Date	
	On Time and in Full to Customer Commit	78.9%	850	Total Number of Orders Delivered on Time to Customer Commit Date	
			799	Total Number of Orders Delivered in Full to Customer Commit Date	
			789	Total Number of Orders Delivered on Time and in Full to Customer Commit Date	
	Perfect Order Delivery to Commit-Approximation	56.4%	564	Total Number of Orders Delivered on Time and in Full without Credit Adjustments	

Frequently Used Query Samples for Level One Metrics:

- Total Number of Customer Orders – A
- Total Number of Customer Orders Delivered On Time and In Full to Request – B
- Total Number of Customer Orders Delivered On Time and In Full to Commit – C
- Total Number of Customer Orders with Credit Adjustments – D

Calculations:

- Delivery Performance to Request = B / A
- Delivery Performance to Commit = C / A
- Perfect Order Delivery (Approximation) = (C - D) / D

Unit – Defect – Defect Opportunities:

- Customer Order – Customer Order not Delivered On Time and In Full – Total Number of Customer Orders

Order Fulfillment Lead Time

Order Fulfillment Lead Time is a continuous measurement defined as the amount of time from customer authorization of a sales order to the customer receipt of product. The major chunks of time include stops in order entry, manufacturing, distribution and transportation. Back Order Duration is another perceived high level metric that focuses on the Order Fulfillment Lead Time of Customer Orders not filled in Full.

Level Two Logic. The Level Two Order Fulfillment Lead Time metrics attempt to segment the time buckets that a customer order goes through from origination to receipt and/or installation complete. It is helpful to stratify the data by Product Family, Customer Channel, and/or supply chain strategy, i.e., to-order, stocked, engineered, etc.

Suggested Level Two Metrics:

- Customer Authorization to Order Entry Complete
- Order Entry Complete to Start Manufacture
- Start Manufacture to Manufacturing Ship
- Manufacturing Ship to Order Received at Warehouse
- Order Received at Warehouse to Order Shipped to Customer
- Order Shipped to Customer to Customer Receipt of Order
- Order Received at Customer to Installation Complete

Level Three Logic. In the spirit of a continuous measurement, each of the Level Two Metrics can be broken down to Level Three metrics. Yet, there does not seem to be a set of consistent categories that cut across all industries. The benchmark sources above provide a healthy list as does the SCOR Level Three suggestions in the SCOR Model dictionary.

Frequently Used Query Samples for Level One Metrics:

- Order Receipt Date — A
- Order Entry Date — B
- Manufacturing Start Date — C
- Manufacturing Ship Date — D
- Warehouse Receipt Date — E
- Warehouse Ship Date — F
- Customer Receipt Date — G
- Installation Complete Date — H

Calculations:

Order Fulfillment Lead Time for an Order = G - A

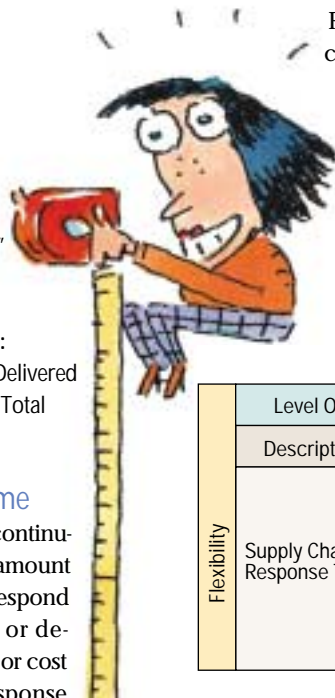
Order Fulfillment Lead Time for all "n" Orders = average (G - A) "n"

Unit – Defect – Defect Opportunities:

Customer Order – Customer Orders Delivered greater than contracted Lead Time – Total Number of Customer Orders

Supply Chain Response Time

Supply Chain Response Time is a continuous measurement defined as the amount of time it takes a supply chain to respond to an unplanned 20% increase or decrease in demand without service or cost penalty. The major sources of response



Order Fulfillment Lead Time

	Level One Metric		Calculation Components		
	Description	Data	Data	Description	Query Assumptions
Responsiveness	Order Fulfillment Lead Time	16.0	4	Customer Authorization to Order Entry Complete	
			5	Order Entry Complete to Start Manufacture	
			2	Start Manufacture to Manufacturing Ship	
			2	Manufacturing Ship to Order Received at Warehouse	
			1	Order Received at Warehouse to Order Shipped to Customer	
			1	Order Shipped to Customer to Customer Receipt of Order	
			1	Order Received at Customer to Installation Complete	

time line up with the SCOR Level One processes including Source, Make, Deliver and Plan (Re-Plan). The overall calculation should be based on the constraint resource, which could be machine, people, or material.

Level Two Logic. The Supply Chain Response Time metrics attempt to segment the time buckets unplanned demand must go through to fulfill customer requirements. Generally, this can be calculated by role in the supply chain and material type, i.e., Supplier Response Time for Raw Materials and/or Purchased Finished Goods. For Make Response Time use the constrained resource (machine or people) for the basis of calculation.

Re-Plan is the number of days from recognition of a change in demand until the process/system is updated to respond. This generally is additive to Source, Make and Deliver Response Times.

Suggested Level Two Metrics:

- Re-Plan Response Time
- Source Response Time
- Make Response Time
- Deliver Response Time

Supply Chain Response Time

	Level One Metric		Calculation Components		
	Description	Data	Data	Description	Query Assumptions
Flexibility	Supply Chain Response Time	113.0	30	Re-Plan Response Time	
			33	Source Response Time	
			45	Make Response Time	
			5	Deliver Response Time	

Level Three Logic. At this point each of the Level Two metrics can be decomposed to three further defined time buckets, including order processing (i.e., purchase order, work order, sales order), material processing and transit. The benchmark sources above provide a healthy list, as do the SCOR Level Three suggestions in the SCOR Model.

Frequently Used Query Samples for Level One Metrics:

- Re-Plan Response Time — A
- Source Response Time — B
- Make Response Time — C
- Deliver Response Time — D

Calculations:

Supply Chain Response Time = A + B + C + D

Unit – Defect – Defect Opportunities

Customer Order — Customer Orders Delivered greater than contracted Lead Time — Total Number of Customer Orders

Total Supply Chain Management Cost

Total Supply Chain Management Cost is a discrete measure defined as the fixed and operational costs associated with the Plan, Source, Make and Deliver supply chain processes. This “activity based lite” view of supply chain costs takes into account order management (Deliver), material acquisition (Source), inventory carrying (Indirect Plan), planning/finance (Plan), and information technology costs (Indirect Enable).

Levels Two and Three Logic. Total Supply Chain Management Costs metrics attempt to segment the cost centers into process based activity. Start with mapping your cost centers from SG&A (selling, general and administrative expenses) and COGS (cost of goods sold) should map to one of the Level Three metrics, and they add up to get both the sub-totals and totals.

Suggested Level Two and Three Metrics:

Order Management Cost

Customer Service Cost — Cost centers that have to do with entering customer orders, reserving inventory, credit check, consolidating orders, processing inquiries and quotes.

Finished Goods Warehouse Cost — Cost centers that have to do with the storage, receiving, picking and shipment of finished goods products.

Outbound Transportation Cost — Cost centers that have to do with the transportation (all modes, including export) of finished goods products.

Contract and Program Management Cost — Cost centers that have to do with the initiation and ongoing management of customer contracts, including master agreements, compliance to vol-

ume-based incentives and other special incentives.

Installation Planning and Execution Costs — Cost centers that have to do with the planning and execution of product installation

Total Supply Chain Management Cost

Level One Metric	Calculation Components				
	Description	Data	Data	Description	Query Assumptions
	Revenue	\$1,000,000	NA	NA	
COGS	55.4%	\$389,000	Direct Material Cost		
		\$110,000	Direct Labor Cost		
		\$55,000	Indirect Cost		
Total Supply Chain Management Cost	21.9%	\$98,011	Order Management Cost		
		\$35,098	Customer Service Cost		
		\$23,908	Finished Goods Warehouse Cost		
		\$21,098	Outbound Transportation Cost		
		\$9,000	Contract and Program Management Cost		
		\$-	Installation Planning and Execution Cost		
		\$8,907	Accounts Receivable Cost		
		\$61,638	Material (Product) Acquisition Cost		
		\$18,997	Purchasing Cost		
		\$5,987	Raw Material Warehouse Cost		
		\$1,099	Supplier Quality Cost		
		\$2,987	Component Engineering and Tooling Cost		
		\$24,678	Inbound Transportation Cost		
		\$7,890	Accounts Payable Cost		
		\$8,092	Planning and Finance Cost		
		\$2,349	Demand Planning Cost		
		\$4,509	Supply Planning Cost		
		\$1,234	Supply Chain Finance Control Cost		
		\$30,806	Inventory Carrying Cost		
		\$25,609	Opportunity Cost		
		\$3,452	Obsolescence Cost		
		\$1,245	Shrinkage Cost		
		\$500	Taxes and Insurance Cost		
\$20,000	IT Cost for Supply Chain				
\$10,000	Supply Chain Application Cost				
\$10,000	IT Operational Cost for Supply Chain				
SG&A Cost	18.1%	\$180,965	SG&A Costs		

at customer-designated locations.

Accounts Receivable Cost — Cost centers that have to do with the processing and closure of customer invoices, including collection.

Material Acquisition Cost

Purchasing Cost — The cost centers associated with the strategic as well as the tactical parts of the purchasing process.

Raw Material Warehouse Cost — The cost centers associated with the receiving, storage and transfer of raw material product.

Supplier Quality Cost — The cost centers associated with supplier qualification, product verification and ongoing quality systems for raw materials.

Component Engineering and Tooling Cost — The cost centers associated with the engineering (design and specification) and tooling costs for raw materials, i.e., packaging.

Inbound Transportation Cost — Cost centers that have to do with the transportation (all modes including import) of raw material and/or purchased finished goods products.

Accounts Payable Cost — Cost centers that have to do with the processing and closure of supplier invoices, including credit and disputes.

Planning Cost

Demand Planning Cost — The cost centers allocated to unit forecasting and overall demand management.

Supply Planning Cost — The cost centers allocated to supply planning, including overall supply planning, distribution requirements planning, master production planning and production scheduling.

Supply Chain Finance Control Cost — The cost centers in finance allocated to reconcile unit plans with financial plans, account for and control supply chain cost centers, and report financial performance of the supply chain SCORcard.

Inventory Carrying Cost

Opportunity Cost — The value of inventory times the cost of money for your company.

Obsolescence Cost — The additional cost of obsolescence in the form of accruals and/or write-offs.

Shrinkage Cost — The additional cost of shrinkage in the form of accruals and/or write-offs.

Taxes and Insurance Cost — The cost centers allocated to the payment of taxes and insurance for inventory assets.

IT Cost for Supply Chain

Supply Chain Application Cost — The cost centers summarizing the fixed costs associated with supply IT application costs to Plan, Source, Make, Deliver and Return.

IT Operational Cost for Supply Chain — The cost centers summarizing the ongoing expenses associated with maintenance, upgrade and development of IT costs to support Plan, Source, Make, Deliver and Return.

Frequently Used Query Samples for Level One Metrics:

- Order Management Cost — A
- Material Acquisition Cost — B
- Planning Cost — C
- Inventory Carrying Cost — D
- IT Cost for Supply Chain — E

Calculations:

Total Supply Chain Management Cost = A + B + C + D + E

Unit – Defect – Defect Opportunities

Cost as % Sales — Cost as % Sales over Objective — Total Cost

Total Returns Management - Warranty Cost

Total Returns Management - Warranty Costs is a discrete measure that attempts to segment the cost centers associated with defective product returns, planned and unplanned returns of maintenance, repair and overhaul products (MRO), and returns associated with excess customer inventory. As with Total Supply Chain Management Cost, Total Returns Management is not additive to Cost of Goods. Usually it is a subset of indirect costs in COGS and/or SG&A. Total Returns Management - Warranty Cost is additive to Total Supply Chain Management Cost.

Level Two Logic. The Level Two logic attempts to segment the process of initiating and closing the return authorization, including customer service, warehouse and transportation from the cost of the returned material itself.



Total Returns Management-Warranty Cost

	Level One Metric		Calculation Components		
	Description	Data	Data	Description	Query Assumptions
	Revenue	\$100,000	NA	NA	
Supply Chain Cost	Total Returns Management-Warranty Costs	3.6%	\$134	Returns Authorization Processing Costs	
			\$2,222	Returned Product Warehouse Cost	
			\$222	Returned Product Transportation Costs	
			\$1,000	Warranty Costs	

Cash-to-Cash Cycle Time

Suggested Level Two Metrics:

Return Authorization Processing Cost Cost centers that have to do with entering return authorizations, scheduling receipts and processing replacement or credit.

Returned Product Warehouse Cost Cost centers that have to do with labor and space for receipt and storage of return products.

Returned Product Transportation Cost Cost centers that have to do with the transportation cost of returned products.

Warranty Cost Cost centers that have to do with the material, labor and problem diagnosis for verification and disposition of returned product.

Frequently Used Query Samples for Level One Metrics:

Returns Authorization Processing Cost — A

Returned Product Warehouse Cost — B

Returned Product Transportation Cost — C

Warranty Cost — D

Calculations:

Total Returns Management - Warranty Cost = A + B + C + D

Unit — Defect — Defect Opportunities

Cost as % Sales – Cost as % Sales over Objective – Total Cost

Cash-to-Cash Cycle Time

Cash-to-Cash Cycle Time is a continuous measure that is calculated by adding the number of days of inventory to the number of days of receivables outstanding and then subtracting the number of days of payables outstanding. The result is the number of days of working capital your organization has tied up in managing your supply chain.

Level Two Logic. Cash-to-Cash Cycle Time is like one of those multiple-step word problems; first, you need to calculate Inventory Days of Supply, then Days Sales Outstanding, and lastly Days Payable Outstanding.

Suggested Level Two Metrics:

Inventory Days of Supply

$(\text{Inventory } \$) / (\text{Annualized COGS } \$ / 365) =$
Inventory Days of Supply

Days Sales Outstanding

$(\text{Receivables } \$) / (\text{Annualized Revenue } \$ / 365) =$
Days Sales Outstanding

Days Payables Outstanding

$(\text{Payables } \$) / (\text{Annualized Material Costs } \$ / 365) =$
Days Payables Outstanding

Level Three Logic. Level Three metrics for Cash-to-Cash Cycle Time look to stratify each Level Two metric by type of

	Level One Metric		Calculation Components		
	Description	Data	Data	Description	Query Assumptions
Asset Management Efficiency	Material Cost	\$250,000	NA	NA	
	COGS	\$500,000	NA	NA	
	Revenue	\$1,000,000	NA	NA	
	Cash-to-Cash Cycle Time	127.8	146.0	Inventory Days of Supply	
			\$200,000	Total Inventory	
			\$100,000	Finished Goods Inventory	
			\$25,000	Work in Process Inventory	
			\$75,000	Raw Material Inventory	
			54.8	Days Sales Outstanding	
			\$150,000	Total Receivables	
73.0			Days Payables Outstanding		
\$50,000	Total Payables				

inventory, receivable and payable. For example, inventory is classified by whether it is a raw material, semi-finished (WIP) good, purchased finished good, returned good, finished good, consigned finished good, or non-working. Non-working can further be classified by dead, excess, slow moving, etc. A similar type of classification can be applied to receivables and payables by looking at the reason codes for customer delinquent payments.

Frequently Used Query Samples for Level One Metrics:

Inventory Days of Supply — A

Days Sales Outstanding — B

Days Payables Outstanding — C

Calculations:

Cash-to-Cash Cycle Time = A + B - C

Unit – Defect – Defect Opportunities:

1 Day of Working Capital — Days of Working Capital Over Target — Total Number of Days of Working Capital

In the next issue, we will look at how to identify the priority of the right change, and just as importantly, how to get the right resources to get the job done. **CLO**

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