Supply chain by the NUMBERS

Learn how to develop action-oriented metrics that will help you measure the progress of your supply chain projects

at a glance

This article offers a step-by-step example of a typical SCOR supply chain implementation.

by Peter Bolstorff

A very sharp process improvement program manager — he was, admittedly, not a supply chain expert — recently asked me what seems like a simple question: "Is **SCOR** a noun or a verb?" Being a habitual SCOR user and proponent, I approached the answer in much the same way I would answer the question, "How do you put on your pants — right leg or left leg first?" In other words, I needed to mentally retrace some steps.

SCOR project steps

Step 1 First, pick and define your project's SCOR metrics; second, define a data collection plan including appropriate data sampling, data segmentation requirements and defect analysis for each of your chosen SCOR metrics; third, collect your benchmark comparative data; fourth, achieve consensus on your channel competitive requirements prioritizing delivery reliability, flexibility and responsiveness, supply chain management cost, and asset management efficiency using one superior, one advantage and two parity ratings; fifth, assemble your SCORcard and calculate your competitive parity, advantage and superior requirements opportunities.

Step 2 First, complete an AS IS Geographic map and SCOR process Thread Diagram; second, using the chosen SCOR metrics above, segment the data by phys-

ical location, including the defect analysis; third, conduct a disconnect analysis using the SCOR Level One Metrics as categories that includes disconnect brainstorming, affinity diagrams and fishbone analyses; fourth, identify leading practices that support your competitive requirements priority above; fifth, identify TO BE Material Flow changes (including eliminating disconnects and adding appropriate leading practices); sixth, conduct an opportunity analysis calculating savings opportunities for each TO BE change; seventh, prioritize changes using an effort-impact matrix and identify two to three quick hit changes; eighth, initiate detailed design, pilot and rollout phase of the quick hits.

Step 3 First, complete an AS IS Process Flow (a combination of transactional analysis and swim diagrams); second, using transactional productivity calculations, segment the data by business process (SCOR Level Three), including the defect analysis; third, map the leading practices (identified in Step 2) using SCOR Level Three process elements; fourth, identify TO BE Work and Information Flow changes using the SCOR TO BE process Blueprint (including eliminating disconnects and adding appropriate leading practices); fifth, conduct an opportunity analysis calculating savings opportunities for each TO BE change; sixth, aggregate work and information flow changes with material flow using the same effort-impact matrix.

Step 4 First, aggregate the supply chain changes identified in Steps 2 and 3 into a project approach; second, assemble the final opportunity calculation (using the defect analysis) for each project, essentially assembling an ROI; third, assemble a project charter based on the preferred implementation approach, i.e., Six Sigma, lean, software implementation, class A, etc.; fourth, initiate detailed design, pilot and rollout phase.

Supply chain delivery performance

Those who know me can accept the fact that my mind *does*, in fact, go through those mental steps — and those who've worked with me on a project know that I practice what I preach. After retracing the steps, I concluded that **SCOR is a noun**. I used one guideline in coming to that conclusion: improvement (savings) needed to be initiated to be considered a verb (Step 2-point 8 and Step 4-point 4). While SCOR metrics have a huge impact on identifying what to improve and estimating the impact, by themselves they will not save any money (point 2 of Steps 1 through 4).

The following is an example of a SCOR project team's journey of turning **Delivery Performance** data and analysis into real supply chain improvement. The team followed seven basic steps:

1. collect **raw data**;
2. derive **descriptive statistics** to characterize the sample;
3. assemble a **histogram** to isolate the defects;
4. conduct a **pareto analysis** of the defects to generate top causes (problem statements);
5. utilize **fishbone analysis** to identify root causes for top problem statements;
6. assemble action plan to **eliminate root causes**;
7. **execute action plan**.

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**.

Raw data

There are three questions to answer in gathering raw data. First, what is the operational definition that you will use to query the data? Second, what is an appropriate sampling plan, or how much data is enough? Third, what are appropriate ways to segment the data?

The project team chose one of the literal definitions of SCOR Delivery Performance — "On Time and In Full Delivery to Customer Commit Date." The challenge that most of the company's current delivery measures focused on line item fill rate at order shipment. Ideally, the team wanted to collect data for all sales orders in the last 12 months, but after some test queries concluded that all sales orders in January and February would be sufficient to represent known variability.

To expedite the data extraction, the team identified several different ways to segment the data (sorting and grouping): by sales order, customer number, customer ship to number, planned shipment date, actual ship date and internal shipping location (source of supply). **Table 1** is a sample of the result of the raw field data.

Table 2 is a sample of the calculations applied to measure On Time Shipment, On Time Delivery, In Full Delivery, and On Time & In Full Delivery to Customer Commit Date. In this case, a negative number means that either the delivery was late or the quantity was short, based on the customer commitment; an "N" means that a customer sales order was either late or short or both.

Chart 1 shows the project team's delivery performance for January and February was a dismal 24%.

Sales Order Number	Customer Number	Customer Ship To Number	Customer Expected Sales Order Quantity	Actual Shipped Sales Order Quantity	Customer Expected Sales Order Delivery Date	Actual Order Delivery Date	Planned Order Shipment Date	Actual Order Shipment Date	Internal Shipping Location Number (Source of Supply)
80265902	217761	50001739	908	891	5-Feb-04	10-Jan-04	31-Jan-04	8-Jan-04	1100
80265903	217881	50001739	368	368	26-Jan-04	1-Feb-04	21-Jan-04	28-Jan-04	1100
80268606	216320	50002143	746	740	31-Jan-04	4-Feb-04	26-Jan-04	1-Feb-04	1100
80277366	227106	50010716	497	492	13-Feb-04	13-Feb-04	8-Feb-04	9-Feb-04	1020
80277395	227601	50005415	412	412	23-Feb-04	23-Jan-04	18-Feb-04	20-Jan-04	1020
80261848	215385	80000242	776	696	18-Feb-04	7-Jan-04	13-Feb-04	5-Jan-04	1020
80263326	217499	80000726	632	632	5-Jan-04	1-Jan-04	31-Dec-03	30-Dec-03	1020
80263944	216738	60000001	782	782	3-Feb-04	22-Jan-04	29-Jan-04	20-Jan-04	1020
80291239	239553	60000015	907	789	13-Jan-04	6-Jan-04	8-Jan-04	3-Jan-04	1100
80276711	224263	50001123	564	439	1-Feb-04	6-Jan-04	27-Jan-04	4-Jan-04	1100

Table 1. Raw Field Level Data

Sales Order Number	On Time Shipment CALCULATION = (Planned Order Shipment Date – Actual Order Shipment Date)	On Time Delivery CALCULATION = (Customer Expected Sales Order Delivery Date – Actual Order Delivery Date)	In Full Delivery CALCULATION = (Actual Order Quantity Shipped – Customer Expected Sales Order Quantity)	On Time and In Full Delivery to Customer Commit Date CALCULATION = In Full Delivery CALCULATION >= 0 AND On Time Delivery CALCULATION >= 0\
80265902	23	26	-17	N
80265903	-7	-6	0	N
80268606	-6	-4	-6	N
80277366	-1	0	-5	N
80277395	29	31	0	Y
80261848	39	42	-80	N
80263326	1	4	0	Y
80263944	9	12	0	Y
80291239	5	7	-118	N
80276711	23	26	-125	N

Table 2. Calculations for different aspects of Delivery Performance

On Time Delivery CALCULATION = (Customer Expected Sales Order Delivery Date – Actual Order Delivery Date)		In Full Delivery CALCULATION = (Actual Order Quantity Shipped – Customer Expected Sales Order Quantity)	
Mean	0.9	Mean	-82.5
Standard Error	2.4	Standard Error	13.6
Median	0.5	Median	-0.5
Mode	-1.0	Mode	0.0
Standard Deviation	24.4	Standard Deviation	136.3
Range	104.0	Range	569.0
Minimum	-53.0	Minimum	-552.0
Maximum	51.0	Maximum	17.0
Sum	92.0	Sum	-8252.0
Count	100.0	Count	100.0
Largest (1)	51.0	Largest (1)	17.0
Smallest (1)	-53.0	Smallest (1)	-552.0
Confidence Level(95.0%)	4.8	Confidence Level (95.0%)	27.0

Table 3. Descriptive statistics for both On Time Delivery and In Full Delivery

Descriptive statistics — characterizing the data

While we have a number for the metric, we have little understanding. There are three questions to answer in assembling descriptive statistics: First, which segments require statistics? Second, what "average" should be used? Third, what is the standard deviation (variability) of the sample?

The project team chose to apply descriptive statistics independently to each facet of the On Time and In Full segments of the measure. **Table 3** shows the results as generated in Excel data analysis tools functionality.

In the case of On Time Delivery, the team concluded that the Mean was sufficient to represent the average and that the data was highly variable, ranging from 53 days late to 51 days early. For the In Full Delivery segment, the team concluded that the Median characterized the average better than the Mean, with this data segment ranging from 552 units short to 17 units over.

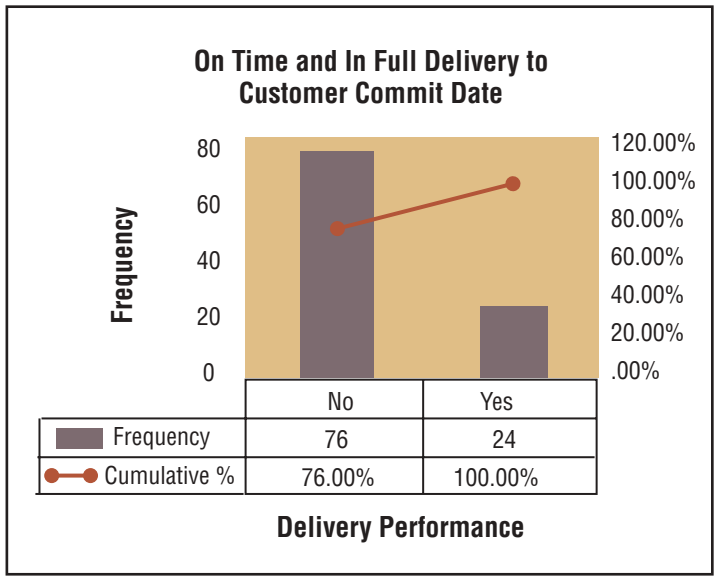

Chart 1. On Time and In Full Delivery to Customer Commit Date

Histogram

This step really initiates the "why" questioning process, and the focus changes from the entire data set to only those data points considered defective. There are two questions to answer at this step: First, what is considered a defective data point? Second, how should the defective data points be grouped and labeled to begin the problem-solving process?

The project team defined as defective any sales order that was either *not* on time or in full. Using the histograms for both On Time Delivery and In Full Delivery, the team was able to begin the problem-solving process. **Table 4** (p. 50) shows histograms in table format. In the case of On Time Delivery, the team focused the defect analysis on the orders delivered one to 53 days late. The focus for the In Full Delivery segment included all orders shipped short.

Pareto charts

While the histogram tells us what is defective, the pareto analysis starts to identify the "why." There are two questions this step attempts to answer: First, what are the primary categories of defects? Second, what are the biggest problem areas?

The project team started by analyzing and sorting the On Time Delivery defects (using an affinity diagram approach). They then completed the process on the orders delivered On Time but *not* In Full.

Chart 2 is a summary of their pareto analysis. The largest category, similar to many other projects, has to do with data settings; which is the subject of the fish-

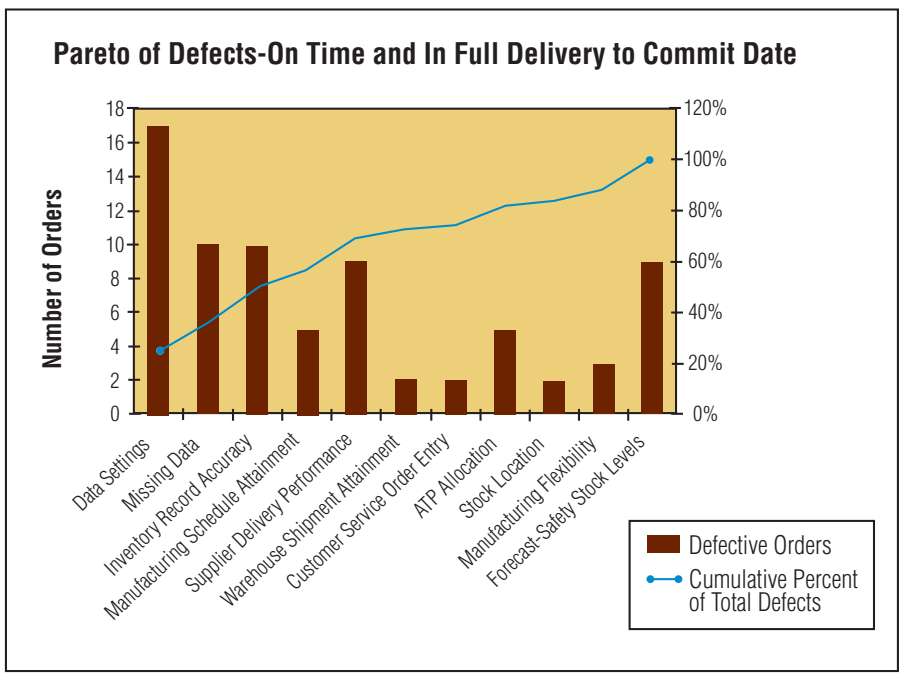

Chart 2. Pareto Chart of Defects for On Time and In Full to Commit Date

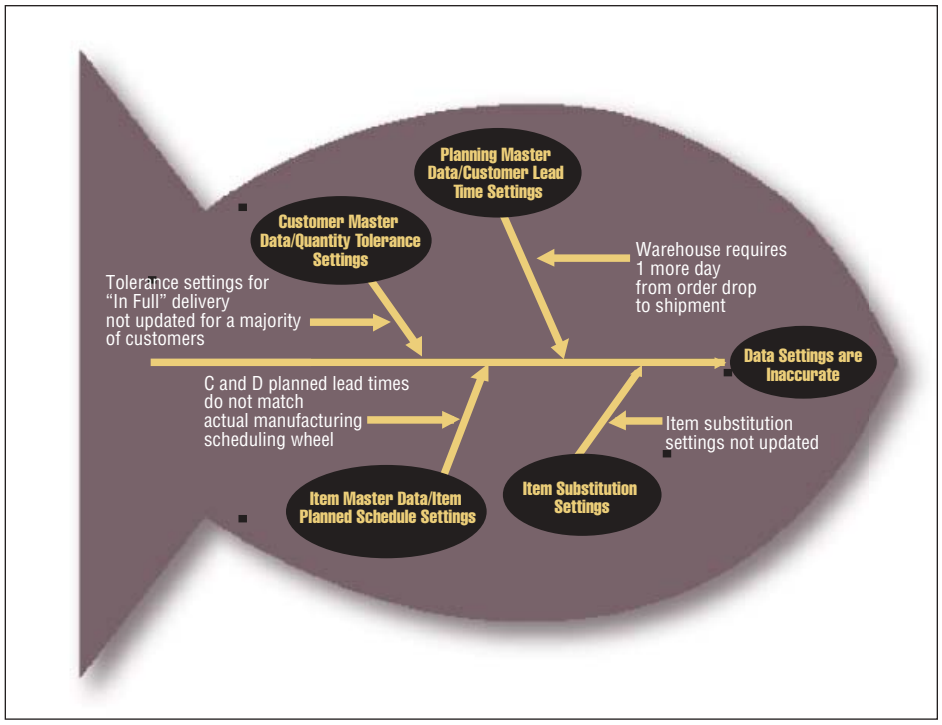

Chart 3. Fishbone analysis

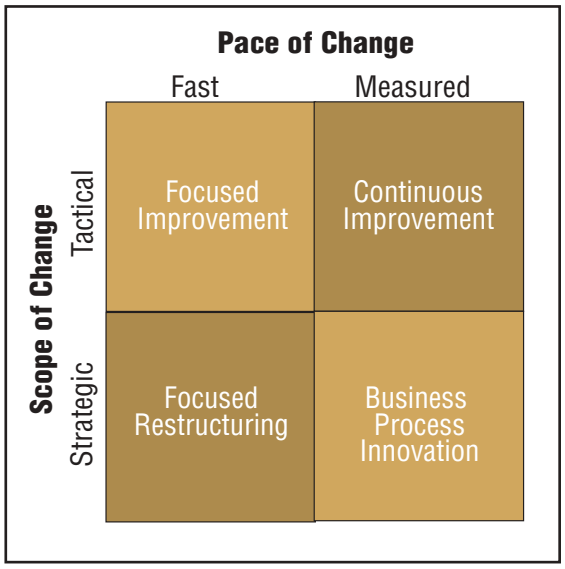

Chart 4. Implementation approach

bone analysis (see next section). In fact, the team realized that overall Data Integrity (Data Settings, Missing Data and Inventory Record Accuracy) accounted for about 60% of the total defects.

Fishbone analysis

The fishbone analysis focuses on generating a cause and effect summary for each bar on the pareto chart. The results will ultimately lead to the action-result step. There are two questions this step attempts to answer: First, what are the primary causes contributing to a specific defect category? Second, what are the secondary causes to a specific defect category?

The project team divided up the bars on the pareto chart and created 11 fishbone diagrams. **Chart 3** is an example of the Data Settings fishbone.

Each primary (and secondary) bone provided the focus for action planning and execution and ultimately performance improvement results. For example, the bone labeled Planning Master Data - Customer Lead Time Settings impacted five orders that were not delivered On Time. Resolution of this issue would have immediate positive impact on about 5% of all orders. Eliminating the Data Settings are Inaccurate bone would have immediate positive impact on 17% of the total orders.

Plan and execute improvements

This step focuses on an action plan required to eliminate the primary and secondary causes (and ultimately "kill" the whole fish). There are at least nine aspects to a good implementation plan:

- Issue and root cause analysis;
- Recommendation;
- Action plan;
- Responsibilities/timing;
- Payoffs;
- Implementation resources;
- Implementation leader;
- Implementation sponsor(s);
- Charter status.

The project team assembled project charter summaries for each fish (one for each bar on the pareto chart) and initiated immediate action on two. The implementation approach was based, in large part, on the complexity of the change.

Chart 4 helped the team sort the changes into a balanced project portfolio. The Pace of Change was based on a continuum from implementation timelines of weeks to months, while the scope of change was based on a continuum where individuals could drive improvement to large scale organization-sponsored initiatives.

The intent of this article has been to provide a summary roadmap of the basic steps of taking a metric through to implementation and results. While SCOR provides a world class cross-industry framework, it does not do the heavy-lifting analysis and problem-solving, nor does it make change happen — that part is up to you. **LT**

Would you like to see more SCOR articles like this one? Let us know at editor@logisticstoday.com.

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For a step-by-step guide to using the Supply Chain Council's SCOR Model, go to www.logisticstoday.com and click on **SCOR Reports: "Measuring the impact of supply chain performance**."

On Time Delivery (Days Late)	Frequency	Cumulative %	In Full Delivery (Quanty Short)	Frequency	Cumulative %
-53	1	1.00%	-552	1	1.00%
-51	1	2.00%	-518	1	2.00%
-50	1	3.00%	-517	1	3.00%
-49	1	4.00%	-455	1	4.00%
-48	1	5.00%	-408	1	5.00%
-39	1	6.00%	-399	1	6.00%
-38	2	8.00%	-367	1	7.00%
-35	1	9.00%	-320	1	8.00%
-33	3	12.00%	-319	1	9.00%
-32	1	13.00%	-305	1	10.00%
-31	1	14.00%	-304	1	11.00%
-28	1	15.00%	-259	1	12.00%
-27	1	16.00%	-254	1	13.00%
-22	1	17.00%	-244	1	14.00%
-19	2	19.00%	-240	1	15.00%
-18	2	21.00%	-237	1	16.00%
-16	1	22.00%	-214	1	17.00%
-13	2	24.00%	-174	1	18.00%
-12	1	25.00%	-168	1	19.00%
-11	3	28.00%	-154	1	20.00%
-10	2	30.00%	-148	1	21.00%
-9	4	34.00%	-144	1	22.00%
-8	2	36.00%	-137	1	23.00%
-6	2	38.00%	-133	1	24.00%
-5	1	39.00%	-127	1	25.00%
-4	1	40.00%	-125	1	26.00%
-3	1	41.00%	-118	1	27.00%
-2	2	43.00%	-107	1	28.00%
-1	4	47.00%	-90	1	29.00%
0	3	50.00%	-84	2	31.00%
1	2	52.00%	-80	1	32.00%
2	2	54.00%	-73	2	34.00%
3	1	55.00%	-65	1	35.00%
4	3	58.00%	-55	1	36.00%
5	2	60.00%	-39	1	37.00%
6	1	61.00%	-33	1	38.00%
7	2	63.00%	-30	1	39.00%
8	1	64.00%	-27	1	40.00%
9	1	65.00%	-25	1	41.00%
10	1	66.00%	-17	1	42.00%
11	1	67.00%	-16	1	43.00%
12	4	71.00%	-12	1	44.00%
14	3	74.00%	-10	1	45.00%
15	1	75.00%	-9	1	46.00%
17	1	76.00%	-6	2	48.00%
20	2	78.00%	-5	1	49.00%
22	1	79.00%	-1	1	50.00%
24	2	81.00%	0	46	96.00%
26	3	84.00%	1	1	97.00%
29	1	85.00%	5	1	98.00%
30	2	87.00%	12	1	99.00%
31	4	91.00%	17	1	100.00%
32	2	93.00%	More	0	100.00%
40	1	94.00%			
42	1	95.00%			
45	1	96.00%			
46	1	97.00%			
47	1	98.00%			
50	1	99.00%			
51	1	100.00%			
More	0	100.00%			

Table 4. Histograms of On Time Delivery and In Full Delivery