## The Hierarchy of Supply Chain Metrics: Diagnosing Your Supply Chain Health

**Wednesday, February 18, 2004**

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**The Bottom Line: Companies can assess their supply chain health using just three key metrics: demand forecast accuracy, Perfect Order fulfillment, and supply chain cost**

### Effective performance measurement remains a challenge

One of the critical ingredients for effecting renewable, strategic business change is ongoing performance measurement. Measuring supply chain performance is not a new practice. Most companies today measure at least some aspect of their supply chain and understand the need for a more comprehensive measurement program. Yet measuring performance effectively remains a major challenge for them. Why?

● **An abundance of possibilities**—One of the major challenges is to figure out what to measure that will yield the most information and benefit for the least investment of resources. The problem is not a lack of possible metrics, but an overwhelming abundance of choices.

● **Enablers add to the complexity**—While traditional measurement focuses solely on operational performance indicators such as cycle times and inventory levels, companies also need to bring into the equation what AMR Research refers to as *enablers*: the application technologies and best practices that enable performance. Benchmarking these enablers is critical to having actionable information by going beyond the question of *how are we doing?* to *why?* Why are we at our current performance levels; what impact are our technologies and best practices having on our performance; and what are the best-in-class companies doing differently than we are?
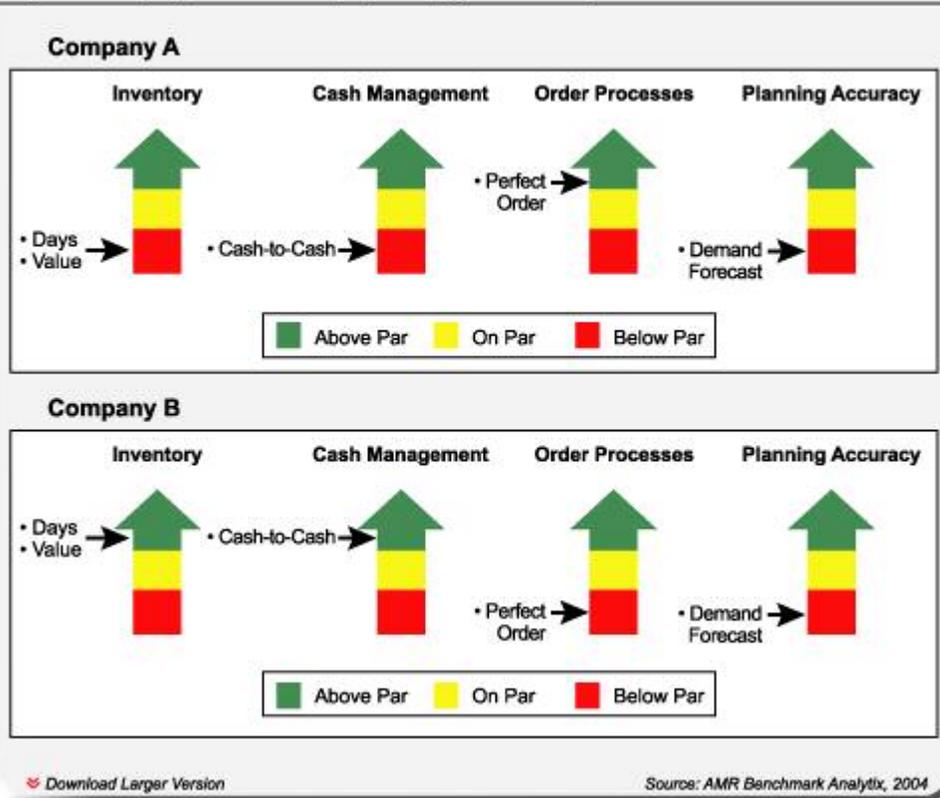
### Interdependencies among metrics

The key is to focus on the few critical metrics that really matter—the ones that provide the most balanced view of end-to-end supply chain performance, allowing companies to see clearly how they're doing and why, and where they're making tradeoffs. Before identifying the few key metrics on which to focus, it's important to understand how all the possible supply chain metrics interrelate. The metrics reflect the underlying realities of the supply chain they measure, and as such, none exist in a vacuum, although this is often how they're treated.

Consider the following typical interdependencies we see in our benchmarking studies (see Figure 1):

● **Trading off high inventories for good order quality**—Compared to its peer companies, Company A has high inventories, long cash-to-cash cycle time, good order quality (as evidenced by the Perfect Order metric), and low Demand Forecast Accuracy (DFA—see Table 1). What's going on? Low DFA indicates that Company A has poor visibility into demand. But the company still wants to be able to give its customers what they want when they want it. So what does it do? It makes extra finished goods, keeping an inventory buffer to avoid stockouts. High inventories in turn drive a longer end-to-end cash cycle time and at the same time enable good Perfect Order performance. Company A is willing to pay the price of high inventory holding costs so it can maintain good customer responsiveness levels.

● **Sacrificing customer responsiveness for low costs**—Company B, on the other hand, has low inventories, short cash-to-cash cycle time, poor order quality, and low DFA. This company is clearly more focused on maintaining margins than on customer responsiveness. It, too, has low DFA, but it's keeping inventories lean and cash cycle times short. The result: high stockouts leading to poor Perfect Order performance. The tradeoff: It's sacrificing customer responsiveness for a strong cost structure.

Note the pattern here: demand visibility affecting inventories, cash cycle times, and Perfect Order fulfillment. While there are clearly more interdependencies and scenarios, this pattern of interaction holds in every company, albeit with different specifics.

**Figure 1: Company A versus Company B supply chain interdependencies**

## Company A

| Inventory | Cash Management | Order Processes | Planning Accuracy |
|---|---|---|---|

- Days
- Value → [Inventory arrow]
- Cash-to-Cash → [Cash Management arrow]
- Perfect Order → [Order Processes arrow]
- Demand Forecast → [Planning Accuracy arrow]

■ Above Par   ■ On Par   ■ Below Par

## Company B

| Inventory | Cash Management | Order Processes | Planning Accuracy |
|---|---|---|---|

- Days
- Value → [Inventory arrow]
- Cash-to-Cash → [Cash Management arrow]
- Perfect Order → [Order Processes arrow]
- Demand Forecast → [Planning Accuracy arrow]

■ Above Par   ■ On Par   ■ Below Par

Source: AMR Benchmark Analytix, 2004

**Table 1: Supply chain metric definitions**

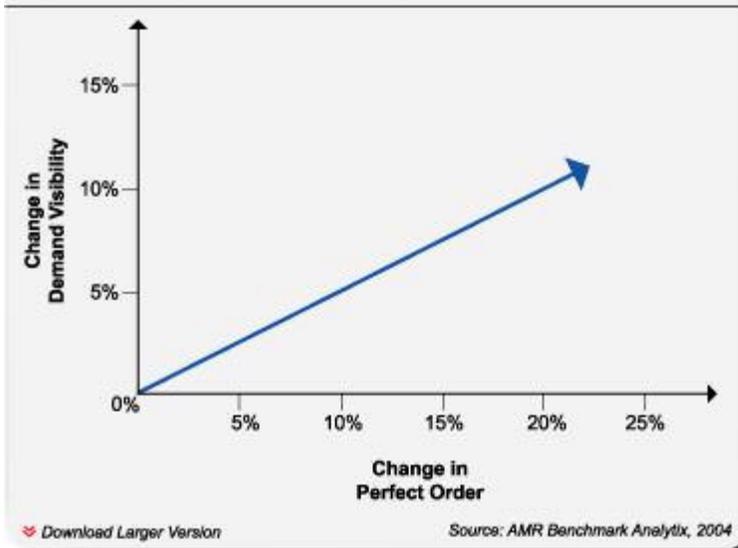| Metric | Definition |
|---|---|
| Perfect Order | An order that is complete, accurate, on time, and in perfect condition<br><br>The conditions that prevent a Perfect Order include:<br><br>Orders Not Delivered On Time<br>  Due to stockout/manufacturing delay<br>  Due to late shipment<br>  Due to in-transit/delivery delays<br><br>Order Not Meeting Customer Requirements<br>  Due to inaccurate shipment<br>  Due to poor quality of finished goods<br>  Due to damage to finished goods in transit |
| Demand Forecast Accuracy (DFA) | The difference between forecasted and actual demand<br><br>Specifically, this is the inverse of the mean absolute percent error (sometimes referred to as MAPE) between forecasted and actual demand |
| Cash-to-Cash Cycle Time | The length of time between when a company spends cash to buy raw materials to the time cash flows back into the company from its customers<br><br>Includes the following metrics:<br><br>Ship to Customer Delivery—Time taken from shipment of finished goods to delivery at customer's address<br><br>Raw Material Receipt to Payment—Time from receipt of raw materials to payment; also called Days Payables Outstanding (DPO)<br><br>Inventory Days—Average days of inventory on hand<br><br>Days Sales Outstanding (DSO)—Measurement of the average collection period from invoicing to cash receipt |
| Supply Chain Management Cost | SCM Cost includes the following components:<br><br>Direct purchasing operating cost<br>Manufacturing operating cost<br>Transportation cost<br>Warehouse/distribution center operating cost<br>Inventory holding cost<br>Customer service operating cost |

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### The importance of demand visibility

The driver in both these companies' situations is demand visibility. This is supported by analysis of our benchmark data, which shows a strong correlation between DFA and Perfect Order fulfillment across industry. Companies with good demand visibility have better Perfect Order performance, and companies with poor demand visibility have worse Perfect Order performance (see Figure 2). At best, poor demand visibility forces companies to make tradeoffs between cost and customer responsiveness; at worst, it drives poor performance on *both* cost and responsiveness.

**Figure 2: The impact of demand visibility**



*Y-axis: Change in Demand Visibility (0%, 5%, 10%, 15%)*
*X-axis: Change in Perfect Order (5%, 10%, 15%, 20%, 25%)*

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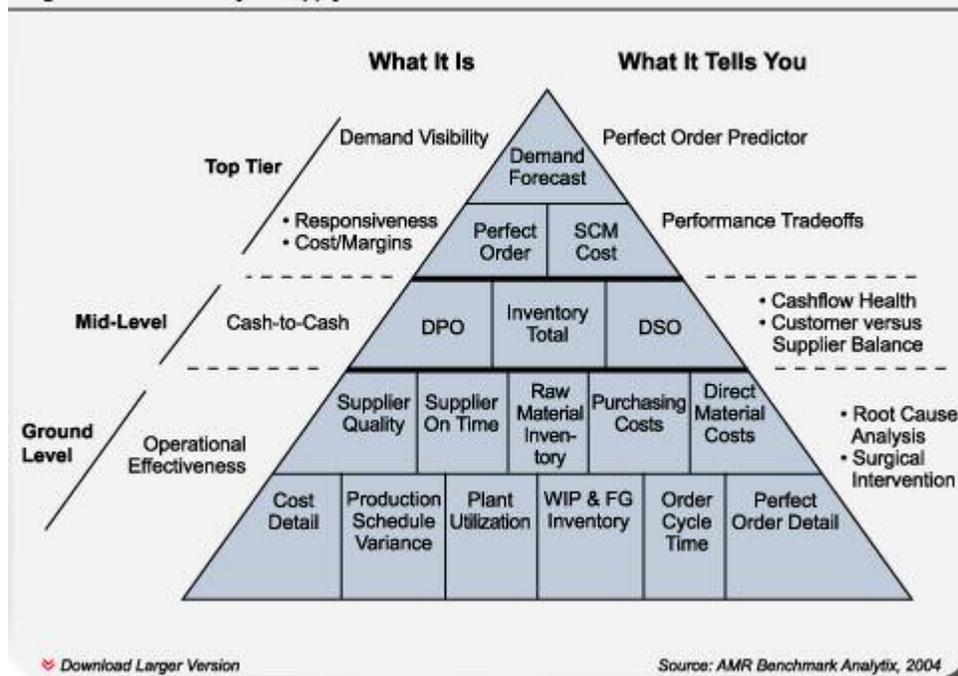## Introducing the Hierarchy of Supply Chain Metrics

While demand forecast, costs, and order quality are clearly important indicators of overall performance, additional metrics are required to take effective action. However, simply indiscriminately adding metrics into the pot is not the answer. A multilevel approach that allows increasing granularity of focus is needed. AMR Research's solution is the **Hierarchy of Supply Chain Metrics**, which we define as:

> *A tiered system of metrics to improve supply chain effectiveness—the top tier assesses a company's supply chain health, while the two successive tiers diagnose the root cause of performance gaps and provide insight for corrective action.*

The hierarchy has three levels, each serving a different purpose and aimed at a different goal (see Figure 3):

- **Top tier: Supply chain health assessment**—This is the 50,000-foot level, at which an executive can assess, with just three metrics, the overall health of the supply chain and the high-level tradeoffs a company might be making.

- **Mid-level: Supply chain diagnostic**—The next level of detail is the 25,000-foot view. This level uses a composite cashflow metric to provide an initial diagnostic tool.

- **Ground level: Supply chain effectiveness**—The bottom level uses a variety of metrics that support effective root cause analysis and allow surgical, highly efficient corrective action.

**Figure 3: The Hierarchy of Supply Chain Metrics**

| What It Is | | What It Tells You |
|---|---|---|

Top Tier — Demand Visibility — Demand Forecast — Perfect Order Predictor
• Responsiveness • Cost/Margins — Perfect Order — SCM Cost — Performance Tradeoffs

Mid-Level — Cash-to-Cash — DPO — Inventory Total — DSO — • Cashflow Health • Customer versus Supplier Balance

Ground Level — Operational Effectiveness — Supplier Quality — Supplier On Time — Raw Material Inventory — Purchasing Costs — Direct Material Costs — • Root Cause Analysis • Surgical Intervention
Cost Detail — Production Schedule Variance — Plant Utilization — WIP & FG Inventory — Order Cycle Time — Perfect Order Detail

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Source: AMR Benchmark Analytix, 2004

### Top tier: Supply chain health assessment

At the highest level of the hierarchy are three key metrics: DFA, Perfect Order Fulfillment, and Supply Chain Management (SCM) total cost (see Table 1). As demonstrated earlier, DFA has predictive power: the extent of a company's demand visibility can predict the responsiveness of its supply chain, as evidenced by its Perfect Order rating. Of course, responsiveness by itself does not guarantee a healthy supply chain. Companies have gone out of business while they're being responsive because they lost sight of costs. Therefore, it is essential to look at the balance between Perfect Order fulfillment and SCM cost. Most companies we see make a tradeoff between these two performance areas: customer responsiveness, as captured in their Perfect Order fulfillment rating, and costs.

### Mid-level: Supply chain diagnostic

The next level of the Hierarchy of Supply Chain Metrics looks beyond overall customer responsiveness and cost to the cash-to-cash metric—how well is your company managing its cashflow? Are there immediate opportunities to take some cash off the table? The cash-to-cash metric is a composite that includes customer and supplier payment times and total inventories. It allows a company to see whether the time it takes to pay its suppliers and the time it takes a company's customers to pay are in balance. This metric determines whether the bellwether inventory metric, which can contribute to high cost and/or a low Perfect Order, deserves further analysis. High inventories might be a result of excess in any of the components of raw materials, work in process, or finished goods, and each is a symptom of a different underlying problem.

### Ground level: Supply chain effectiveness

Analysis of the detailed metrics on the ground level of the hierarchy allows a company to identify and implement the specific interventions that address the root cause of issues identified at the first two levels with the most efficient and targeted use of resources. In our benchmarking research, we have a portfolio of approximately 45 operational metrics, some of which are listed in Figure 3.

Metrics at the ground level include supplier effectiveness indicators such as the percentage of supplier receipts that passed quality and on-time standards and the raw material inventories, purchasing operating costs, and direct material costs that are often affected by and interact with supplier performance. Also included here are metrics that indicate a company's level of operational effectiveness, including further SCM cost details, production schedule variance, plant utilization, work in process and finished goods inventories, order cycle time, and details about the Perfect Order fulfillment total.

## Using the Hierarchy of Supply Chain Metrics—a case example

Consider the example of ConsumerCo, a $1B manufacturer of household products. It has done a good job keeping its costs low to support its overall business strategy, which is to be a lower cost provider than its competitors while keeping product quality on par with the market. However, it has some specific opportunities to shore up its external relationships—with suppliers, logistics providers, and customers—in very targeted ways. By doing so, ConsumerCo can continue to keep costs down while improving its customer responsiveness.

Figure 4: ConsumerCo case example—using the Hierarchy of Supply Chain Metrics
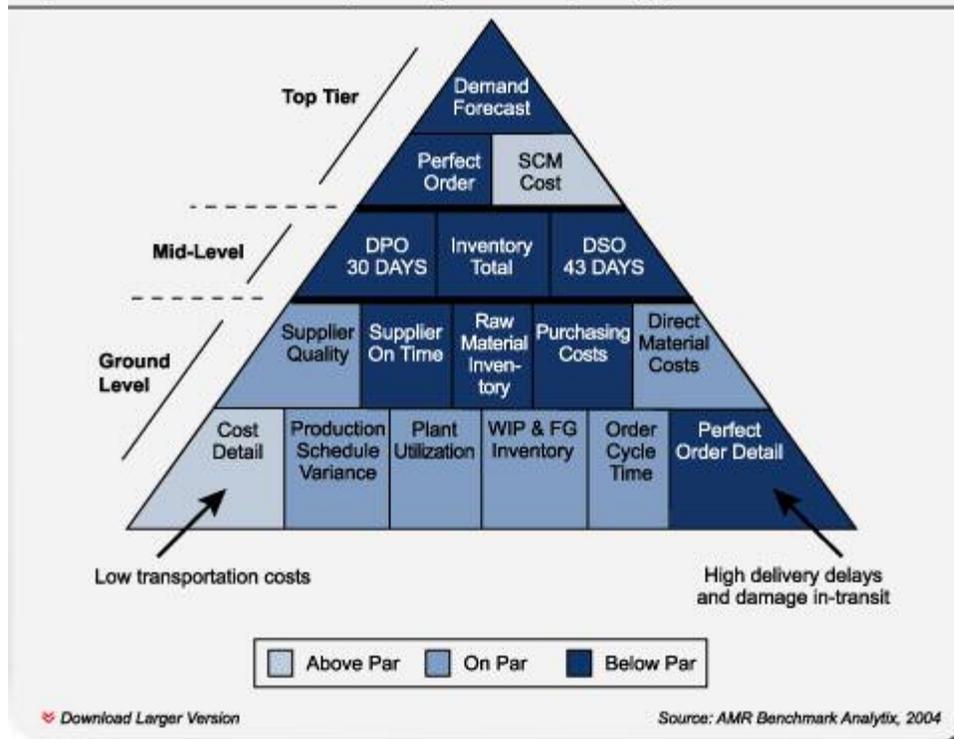
## Top tier: trading off customer responsiveness for cost

At the top tier of the Hierarchy of Supply Chain Metrics, ConsumerCo's demand forecast accuracy is low, its Perfect Order rating is on the low side at 5% below the average, and its SCM total costs are good. Consistent with its strategy, this company is focused on reining in costs, but is doing so at the expense of customer responsiveness.

## Mid-level: high inventories and a cash management opportunity

At the mid-level, ConsumerCo's overall cash cycle time is slightly longer than the average, but not worrisome. However, the component metrics are more interesting.

• **High inventories**—Given that its Perfect Order rating is low (though it's not yet apparent why), it's likely that the problem with the Perfect Order is not a lack of inventory. However, it might still be the case that ConsumerCo has the wrong inventory or lacks visibility into its inventory.

• **Cash management opportunities**—ConsumerCo pays its suppliers in 30 days on average, but its customers take an average of 43 days to pay it. This points to some immediate cash flow opportunities. In addition, the long Days Sales Outstanding (DSO) might be related to poor Perfect Order performance, reflecting customer dissatisfaction with order quality.

## Ground level: supplier performance, logistics execution, and customer payment times

We then arrive at the ground-level metrics, where a deeper root cause analysis uncovers specific supplier, logistics provider, and customer areas in which to focus corrective action:

• **Supplier relationships**—While finished goods inventories are slightly high, the real culprit is 20% higher than average raw material inventory. At the same time, the supplier on-time rating (the rate at which suppliers meet on-time commitments of raw material) is 5% lower than the average, a likely contributor to higher raw materials that serve as a buffer. An examination of the costs that relate to suppliers reveals slightly high purchasing operating costs and on par direct material costs. In a nutshell, ConsumerCo is paying its suppliers well and, as exposed in the cash-to-cash metric, is paying them relatively quickly, but is not receiving the service levels it requires from its suppliers.

• **Logistics provider relationships**—The components of the Perfect Order uncover the source of the low Perfect Order rating. Rather than stockouts or inaccurate shipments (which would point to inventory problems), it's delivery delays and damage in transit that are the culprits here, each 10% higher than average. Since both of these relate to a transportation theme, we look at the related cost details. Consistent with its low total SCM costs, ConsumerCo's transportation costs are very good, at 4% below the average. One possibility is that it might be paying its logistics providers so far below industry standards that service levels suffer. ConsumerCo should reconsider pricing and service-level agreements with its logistics providers.

• **Customer relationships**—Corrective action that improves the Perfect Order might also help improve

customer payment times, thus improving overall cash cycle time. In addition, as with DFA at the top tier, ConsumerCo has an opportunity to work more closely with its customers to improve demand visibility.

## Enabler information provides basis for corrective action

Once you've assessed and diagnosed the health of your supply chain using our Hierarchy of Supply Chain Metrics, specific corrective actions can be identified. This is where a solid understanding of where you stand with regard to application technology and best practice enablers becomes critical, since these serve as important levers to help adjust performance.

In the case of ConsumerCo, for example, in addition to possibly revisiting the agreements it has with its suppliers and logistics providers, it can examine its supplier and logistics provider-related enablers. To what extent is it sharing forecasts with its suppliers and logistics providers? Is it using electronic connections to speed up purchase orders to suppliers and tenders to logistics providers? Similarly with its customer relationships, are customers sharing forecasts with ConsumerCo to the extent possible to help demand visibility? How does ConsumerCo's use of these enablers compare to that of its peers and, in particular, to the best-performing companies?

## Recommendations

Measuring performance is a critical underpinning of a well-run business. The Hierarchy of Supply Chain Metrics contains the right level of the right metrics and provides a structured approach to continuous, effective, and efficient performance measurement and improvement. The operational performance metrics contained in the hierarchy should be supplemented by an accurate measure of a company's enabler usage to help determine the most effective corrective action to take.

Companies should use the Hierarchy of Supply Chain Metrics to do the following:

● **Track performance on an ongoing basis**—Measure at regular intervals (e.g., annually) so you can track performance changes. It's particularly useful to have baselined your performance prior to a major market or organizational change (e.g., implementation of a new system) to get a clear picture of the effect of the change on performance.

● **Put a structured evaluation program in place**—Implement a structured process to evaluate, analyze, and act on the results of the measurement. Many companies have Key Performance Indicators (KPIs) in place that they measure, but the results sit on a shelf collecting dust.

● **Work with trading partners**—Rather than simply shifting costs and responsibilities around the supply network, work with trading partners—customers, suppliers, and logistics providers—to drive costs out of the supply chain and improve end customer responsiveness across the network.

## Acronyms

DFA—Demand Forecast Accuracy

DPO—Days Payables Outstanding

DSO—Days Sales Outstanding

FG—Finished Goods

KPI—Key Performance Indicator

MAPE—Mean Average Percent Error

SCM—Supply Chain Management

WIP—Work in Process