Developing Effective Metrics for Supply Management

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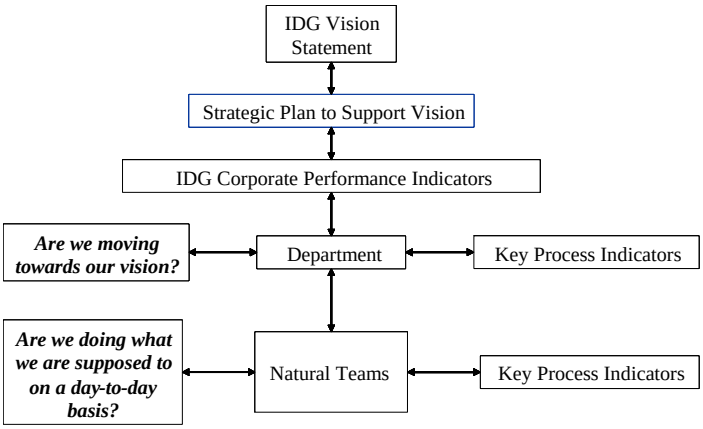
Abstract. Metrics are used to know where you are, where you have been and where you are going. This paper examines a process for selecting metrics based on the organization's vision. The best way to know if a metric is changing is to examine the data over time using time-series charts. A ten-step process to implement metrics is also presented.

Selecting Metrics. Metrics are used to determine how your processes are performing. Is service level staying the same? Is it increasing or decreasing? Appropriate metrics provide focus on what is important to an organization. At the Industrial Distribution Group, metrics are linked from the top of the organization down. Figure 1 shows how this process works. It starts with the vision statement for the organization. IDG's vision statement is given below.

Figure 1: Linking Measurements



> *IDG will create exceptional value for our stakeholders (Customers, shareholders, suppliers, and our associates) by providing a broad range of products and our Flexible Procurement Solutions™ (FPS) to the industrial MROP market. The documented cost savings of these solutions will provide a competitive advantage to our Customers and a competitive differentiation for IDG.*

Leadership develops the strategic plan to support this vision as well develops the Corporate Performance Indicators (CPIs). These are five to six metrics that reflect whether the organization is moving toward the visions. There are other metrics that are followed but these CPIs provide the focus for the organization. Examples of possible CPIs include sales, %SG&A, and customer cost savings.

From here, each department develops their mission statements. This is usually done by the purchasing manager's natural team (the manager and his/her direct reports). These mission statements must support the company vision statement. In addition, each department develops Key Process Indicators (KPIs) that are directly related the vision, the CPIs, and their own mission statement. The mission statement for IDG purchasing is given below.

Purchasing will effectively manage supply of product and related data through the implementation of processes designed to reduce cost and improve Customer satisfaction. We will do this by maximizing service levels, inventory turns, and overall supplier performance.

The following metrics were selected as KPIs for purchasing: service level, stock turns, inventory turns, and GMROI. Within each department, there are natural teams that meet on a regular basis, usually monthly. These teams consist of the supervisor and his/her direct reports. These natural teams also develop metrics that related back to the KPIs, departmental mission statement, the CPIs and the company vision statement. This provides the linkage of measures from the top of the organization down. Focusing the organization in this manner provides the opportunity to greatly improve results. But, to do this, the metrics must be displayed and interpreted correctly. This is done with time-series (control) charts.

Time Series Charts: You simply cannot have effective metrics if you do not truly understand one basic underlying concept. If you can grasp the profound implications of this concept, it can revolutionize how you look at your business. This concept is called variation. And variation provides the foundation for understanding time series charts.

What is variation? Variation is simply differences that occur in results, most often in measurements. For example, in manufacturing, it could be the difference in a dimension on two "identical parts." One part has an outer diameter of 2.001"; the next part made has an outer diameter of 1.999". This is variation. Differences. Variation applies to service as well. The on-time delivery performance for one month is 98.5%. The next month it is 99.2%. The previous month, it was 95.9%. Each month has a different result. This is variation. Differences. Leaders see variation in the numbers they use to manage the business. Sales vary each month. Days Sales Outstanding is up one month; down the next. SG&A varies from report to report. This is variation. Differences. So things vary.

Suppose one of the key metrics for your group is service level. Leadership wants a 97% service level. You have to report on your monthly service level at the monthly leadership staff meeting. Sometimes, the service level is above 97%; other times it is below 97%. Each month, the service level result is compared to the goal. You are happy when it is above 97%; not so happy when it is below 97. The data for 2004 is given in the table below.

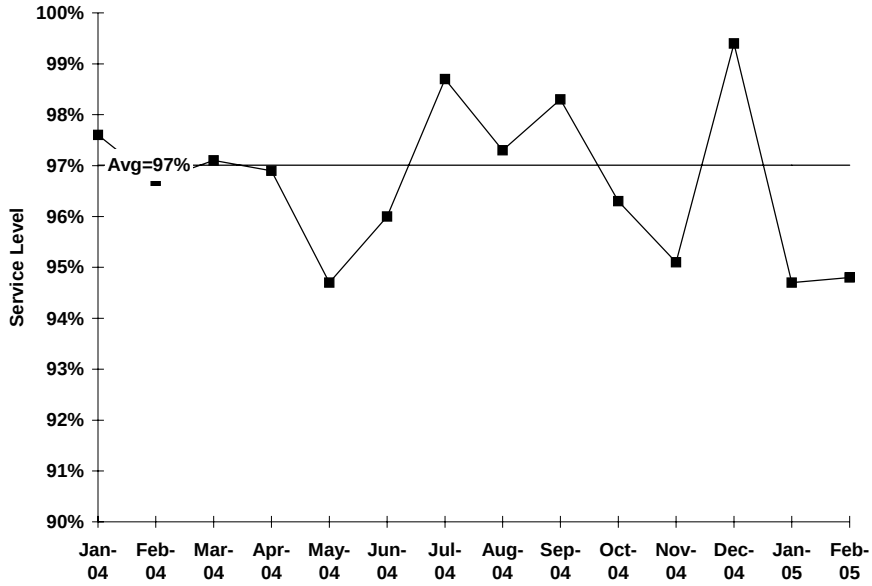
Month	Service Level	Month	Service Level
Jan-04	97.6%	Jul-04	98.7%
Feb-04	96.7%	Aug-04	97.3%
Mar-04	97.1%	Sep-04	98.3%
Apr-04	96.9%	Oct-04	96.3%
May-04	94.7%	Nov-04	95.1%
Jun-04	96.0%	Dec-04	99.4%

The average for the year was 97% - right on the goal. So, you are happy about that. But during the year, you were happy for 6 months and not happy for 6 months. Now the results for the first two months of 2005 are in. January 2005 service level was 94.7. February was about the same, 94.8. Your boss is not happy with the result and wants to know what happened these two months. Things definitely look like they have gotten worse!

It is easy to compare a result to a goal. Either you made it or you didn't. Limited comparisons of one number against another are no help in determining what is really occurring. To find out what is really happening with the process, the data must be examined over time.

Figure 2 is a plot of the data over time. An average line (based on the 2004 data) has been added. What does the chart show you? Yes, the first two months of 2005 are a little low, but not really that much different from 2004. So, is there really a problem with service level? Has it gotten worse? To answer that question, the time series chart can be further enhanced by the addition of the control limits. These limits mathematically define the range to expect in service level.

Figure 2: Service Level Over Time



To understand what the control limits mean, one must understand common cause variation and special cause variation. Common cause variation is the variation that exists because of the way the process was designed and is managed. It refers to the many sources of variation that are normally present within a process. For example, consider how long it takes you to drive to work (assuming your process for doing so is the same from day to day). Suppose, on average, it takes 20 minutes to get to work. It does not take, however, 20 minutes each day. Suppose you know that, in general, it will take between 15 minutes and 25 minutes to get to work. Some days it may take 22 minutes; other days 18 minutes; others 24 minutes, etc. The difference between each day's time and the average, most of the time, will not be alarming to you. You realize that the differences are due to the traffic, speed you drive, red lights caught, etc. All of these sources of variation are called common cause variation. They represent the "normal" variation in your process of getting to work. All processes have common causes of variation. Common causes of variation are predictable. This means you can predict what will happen, at least within some range. This is as true for sales as it is for driving to work.

Special causes of variation are not part of the way the process is managed, and are considered abnormalities. "Special cause" simply means that something which normally does not occur has happened. If you get a flat tire on the way to work, you will not arrive at work in the "normal" span of 15 to 25 minutes. This is a special cause of variation, and its effect on the process is measurable. For example, if you have a flat tire, it might take 60 minutes to get to work. This is definitely out of the normal range of 15 to 25 minutes, and this deviation from the norm is directly attributable to the special cause; having a flat tire. Other possible special causes of variation in your driving to work process would include adverse weather conditions

and traffic congestion due to an accident. Special causes are sporadic in nature and cannot be predicted.

Why do we need to know if the variation is due to common or special causes? The reason is that it determines what needs to be done to improve a process. If special causes are present, the process is not consistent and predictable. Special causes need to be identified and permanently removed from the process. The reasons for special cause can usually be traced to one event. To reduce common causes of variation, the process must be fundamentally changed. The only way to separate common from special causes of variation is to use a time series chart with the control limits.

The calculations to determine the control limits are given in many books so we don't give them here. There are two limits. One is the upper control limit (UCL). This is defined as the largest value to expect from the process as long as there are no special causes of variation present. The lower control limit (LCL) is the smallest number to expect if only common cause of variation is present.

Figure 3: Service Level with Control Limits

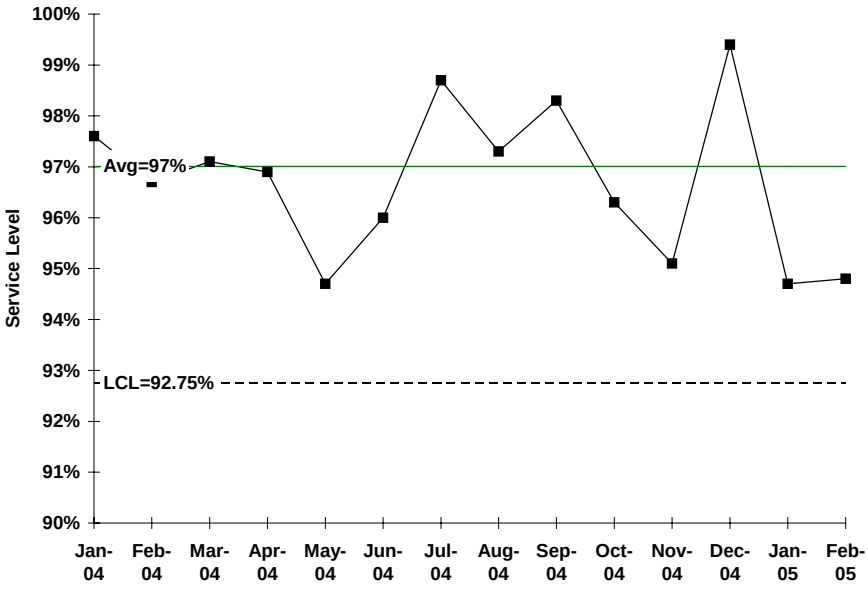


Figure 3 adds the control limits to the chart. There is no upper control limit in this case (maximum service level is 100%). The time series chart now can be interpreted. As long as there are no points beyond the natural process limits and there are no patterns (such as a long run of points above or below the average), the process is "in control" – it is consistent and predictable. We can predict what will happen in the future. Each month, the service level will be between 92.75 and 100 with an average of 97. To improve service level, the process must be fundamentally changes. This usually involves putting a team together. The team follows a structured problem solving process to fundamentally change the process. The time series charts provide an excellent method of determining when the process has improved. The procedure outlined below describes how to set up the data collection process.

Data Collection Process. The ten steps in the data collection process are described below. Follow these steps to be sure that you have developed effective measurements.

Step 1: Write down what you want to measure. This sounds fairly trivial, but it provides a good starting point to develop a measure. Simply put down, in writing, what you want to measure.

Example: I want to measure the service level.

Step 2: Define the purpose of the data collection. There should always be a reason why we are collecting the data. It could be that we want to monitor performance over time and take actions on special causes of variation. It may be that we want to use the data in a team environment to work on process improvement. Write down the purpose of the data collection.

Example: I want to provide weekly feedback to each individual buyer on his/her service level so the buyer can work on improving his/her service level. Also, I want to provide leadership with an overall service level for purchasing.

Step 3: Determine if other measures are appropriate for the processes involved. This step helps ensure that you consider the processes involved. There may be other items to consider when setting up the measurement process. Usually, it is good to look at a process from four dimensions: quality, quantity, timeliness, and cost. Sometimes, with a minimum amount of extra effort, you can collect additional good data.

Example: You could also measure inventory turns as well as expediting.

Step 4: Develop the operational definitions for the measure. An operational definition is a clear, concise detailed definition of a measure. What is meant by service level and how is it defined? How is the measure developed?

Example: Service level is defined as the ratio of lines filled complete the first time to the lines ordered.

Step 5: Determine if the measurement is currently being taken and if there is historical data available. If the measurement is currently being taken, the process becomes easier since people are already taking the data. In this case, you will need to check to see if the data is being taken correctly. In some cases, there will be historical data available. This data can be used to determine how the process has worked in the past.

Example: The service level for each buyer is each Monday in a computer report based on the past week's data. The buyers have not been keeping past data.

Step 6: Determine who will collect the data. A decision must be made about who should collect the data. It is usually best if the person closest to the process collect the data. This could be anyone at any level in the organization. For example, it could be the Controller if the data being collected involve monthly profits.

Example: Each buyer will collect his/her own data. The purchasing manager will collect the summary data for all buyers.

Step 7: Determine how the data will be collected and how it will be displayed. This is a crucial step. If the process for defining how the data will be collected is not correct, a lot of time and effort can be wasted. Questions to consider include:

- Can the data be automatically collected?
- Can the data be downloaded from the system?
- Will the data have to be manually collected?
- Can the data be collected from reports?
- Should the data be displayed as a control chart or a Pareto diagram?
- What steps do I expect the data collectors to go through to collect the data?

Part of determining how the data will be collected includes writing down the procedure (either as a process flow diagram or a step-by-step procedure). This is definitely required for new data collection processes. It lets the data collectors know what they need to do. A decision must be made on how frequently to collect the data. The more frequent the data collection the better. Daily is best, followed by weekly and then monthly. Data collection longer than a month is not very useful for process improvement. Tools, such as a data collection form, that are needed are designed at this point. Data collection forms should always include the name of the person collecting the data, the date, as well as a place for comments. It is best to display the data as a time series (control chart) whenever possible. Set up the measurement as a positive, for example, percent on-time instead of percent late.

Example: There is no method to automatically collect the data for service level by buyer. Each buyer will have to record his/her own data from the weekly computer report.

Step 8: Determine how to ensure the data collection process takes place. Data collection usually includes a change of behavior. You are asking associates to do something different and new. Change is never simple. This is particularly true for new data collection systems. Even with existing data collection processes, associates may be wondering about the sudden interest in the data. Some things to consider in implementing the data collection process include:

- Explain the reason for the data collection to the associates doing the data collection.
- Let the associates know what the goal is and what will be done with the data.
- Always follow-up after implementation to ensure that the data collection process is taking place.

Example: It is explained to the buyers that the objective of the data collection is to increase service level. The point is made that most of the reasons for variation in service level are due to the way the process was put together. The goal for the service level is an average of 97%. It is explained that the data will be used by each buyer and their natural team to improve service level. To ensure the data collection is being done correctly each week, the purchasing manager will review the data collection each use and use all the buyers' data to measure the total service level for purchasing.

Step 9: Determine who will review the data and how often. We collect data too often for the sake of collecting data. We don't review the data and no action is taken on it. Remember, the purpose of collecting data is to take some action; to improve a process.

Example: The buyers will review their own results weekly and share their results at their monthly natural team meeting.

Step 10: Implement the process. You have planned it. Now go do it. Often you will need to make revisions to the process once it has been implemented to help improve the quality of the data collection.

REFERENCES

Wheeler, Donald J., *Understanding Variation, The Key to Managing Chaos*, SPC Press, Knoxville, TN, 1993