New Tool For Inventory Management: Component Safety Stock Reduction

A top priority for inventory managers is the control and reduction of safety stock. However, determining just what that correct level and investment is, especially for component or raw materials, remains a challenge for many. That is, until now.

Taking a lesson from determining finished goods safety stock. John A. Estep, CFPIM, president, E/Step Software Inc. (Yakima, WA; www.EstepSoftware.com) believes the solution lies in considering the approach used for finished goods. It involves calculating each item's safety stock individually using the item's service target, forecast error, error distribution, lead time and replenishment frequency. "Only then will the safety stock achieve the service goal for each item," he explains.

In this exclusive to *IRR*, Estep notes that while many companies have learned this lesson for finished goods, they fall back on old habits when it comes to setting component or raw material safety stock. They return to a fixed time supply and set the safety stock for all items at an artificial two weeks, or two months supply.

The question of the error factor. "The problem is that the error at the component level is not known, while it is at the finished goods level," asserts Estep, who develops finished goods/service parts forecasting and inventory planning software. While there may be independent demand for some components, and this demand has its own error, it applies only to the independent demand for the component, not to the dependent demand from its parents, he explains. "With no error available for dependent demand at the component levels, companies often resort to using a fixed time supply to establish component safety stocks," he maintains. "This is the worst possible solution because it results in both high inventory and low service."

Creating dependent error for any component at any level of the bill of materials. Estep, after much investigation at several diverse companies, has devised a methodology to create a dependent error for any component.

"Think of it as similar to a bill of materials explosion," he offers. "There you compute dependent demand for any component which represents the accumulated demand from its parents, all their parents, and so on." What is done is to translate the error from each finished goods part down through the bill to all of its components, all their components, and so on.

The result, according to Estep, is a number for each component that quantifies the accumulated error. This number can be used to compute a safety stock for any desired component, in conjunction with service target, lead time, and so forth, just like at the

Table 1. The Conventional Approach

Description	Level	Lead Time	Safety Stock	Working Stock	Total Stock
Finished goods	0	15	2,174,761	241,730	2,416,491
Components	1	13	0	223,180	223,180
Raw materials	2	11	0	142,633	142,633
Total			2,174,761	607,543	2,782,304

Table 2. The Component Safety Stock Approach

Description	Level	Lead Time	Safety Stock	Working Stock	Total Stock
Finished goods	0	2	793,686	241,730	1,035,416
Components	1	2	336,020	223,180	559,200
Raw materials	2	11	52,628	142,633	195,261
Total			1,182,334	607,543	1,789,877

finished goods level. "If a parent part has both dependent and independent demand, the errors from both are combined for their components, he adds.

There are limitations. Essentially, Estep has applied independent demand techniques to items with dependent demand. But there are limitations. The technique works as long as two conditions exist:

- Several finished goods are made from the same component; and
- It takes a relatively short time (compared to the component lead time) to make the finished good once the components are in stock.

Estep quickly points out that many have discounted the practice of using independent demand techniques on products with dependent demand—and with good reason, he adds.

To illustrate the failings of this technique, as applied in the past, Estep describes the example of manufacturing a lamp. If a lamp is made from one component and that component is in stock 90% of the time, the probability of being able to meet demand on lamps is 90%. However, if it takes two components to make the lamp, and each has a 90% chance of being in stock, the probability of having both in stock is 81% (.9x.9=.81). Using the same formula, if the lamp requires 20 components, each set to 90%, the service level for the finished item is only 12% ($.9^{20}=.12$).

The Estep variation of this technique does hold promise as a viable solution. "That's why people stopped using independent demand techniques on dependent demand and started using MRP," he comments. Instead, Estep's solution is a "constrained variation" of this technique that reduces inventory without sacrificing service.

For example, manufacturing a bicycle takes 50 components. Once all of the 50 components are on-site, the bicycle takes only three days to assemble. The frame comes from overseas and takes 10 weeks to arrive. The gearshift from Europe takes 12 weeks. All the other parts are obtained locally within one week.

Therefore, the total time to make the bicycle is 12.5 weeks. If all parts were stocked at a 90% level, the probability of being able to assemble the bicycle on time is .9 to the 50th power, or 0.005%—essentially zero.

Instead, Estep suggests identifying the components with long lead times and stock them at very high levels of service, such as 99.9%, even 99.99%, and not to worry about the components with short times. Stocking the frames and gearshifts at 99.9%, the combined service is 99.8%. At 99.99 percent, the combined availability is 99.98%.

"Even if you have to order some of the other components, the maximum time to produce a bicycle would be one week plus three days for assembly," he explains.

The Estep methodology in actual operation: inventory slashed more than 35%. Estep described this technique (which is also an option within E/Step Software's Finished Goods Series) as applied at a customer's manufacturing facility. According to his analysis, the finished goods (level 0) produced by the company are assembled from a number of components (level 1) that are created by processing various raw materials (level 2). The lead time for each step in the process includes: 11 weeks to get raw materials; 2 weeks to make the components; and 2 weeks to assemble the finished goods.

Total lead time for the finished goods was 15 weeks, but if the company had the components ready, it took only two weeks for assembly. Lead time on the components was 13 weeks: 11 weeks to get the raw materials and two weeks to process them.

Using the conventional approach, which includes all safety stock at the finished goods level, none at the component levels, service was set to a 99% target, but covered forecast errors over the 15 week total lead time to replenish. (Table 1, page 1) shows the inventory required.

"Using the component safety stock approach, we created a reserve at the component and raw material levels, which allowed us to uncouple their lead times from each other and from the finished goods," Estep explains. "We essentially are guaranteeing that we will never run out of parts at levels 1 or 2. We did this by setting their lot fill service to 99.9 percent." In this case, it meant about one stock-out every two years, or one expedite every two years to insure perfect service.

With this policy in place, the component lead time dropped from 13 weeks to two weeks, and the finished goods lead time fell from 15 weeks to two weeks (see Table 2, page 1).

The actual benefits defined. While safety stock dropped more than 45%, a better measure of performance, according to Estep, is the total stock (safety stock plus working stock), which dropped over 35%. Adding just over $388,600 worth of component and raw material safety stock eliminated the need for more than $1.38-million worth of safety stock at the finished goods level. This provided the manufacturer a net savings of $992,400.

"Evidently, one dollar of reserve inventory at the lower levels is far more powerful than one dollar of finished goods inventory," Estep relates. He also notes that while the top-level service is theoretically the same for both scenarios, the second has a decided advantage in the event of unexpectedly high demand. "In the case of a stock-out, it will take only two weeks, rather than 15 weeks, to resupply," he adds.

To *IRR* readers, Estep suggests they "figure out their critical items and take them out of the lead time picture." What would your lead time be without considering those items? "By keeping a moderate amount of inventory on a small number of components, most companies can reduce their finished goods lead times, and thus their inventory, considerably," Estep asserts.