A Northeast Commuter Railroad Struggles to Optimize Its Spare Parts Inventory

By Robert J. Bowman

Metro-North Railroad, the nation's second-largest commuter rail operation, looks for a way to predict the unpredictable: the need for parts in response to equipment breakdowns.

Figuring out which replacement parts to stock for a busy commuter railroad seems an impossible task. Retailers base their inventory levels on intelligent predictions about what consumers will buy. But how do you forecast demand when you're dealing with equipment failure—the kind of thing that is, by its very nature, unpredictable?

The challenge is especially daunting for Metro-North Railroad, the nation's second-largest commuter railroad. Serving the New York City metropolitan area, MNR carries 275,000 passengers a day, running 1,193 engines and railcars over 765 miles of track. To support that operation, it stocks some 40,000 active service and spare parts, worth nearly $100m.

As might be expected in a big operation like MNR's, a good number of those parts are slow-moving, with intermittent demand. It's not every day that a wheel or axle fails, but when it does, the consequences are severe. Entire trains can be forced out of service, with ripple effects throughout the system. So railroads frequently pile up too much stock as a buffer against the unexpected.

Richard Price had logged more than 30 years in the commuter rail business when he retired from New Jersey Transit, one of the Conrail spinoffs. Actually, "retired" isn't the most accurate word, since he soon took a job with MNR. He was hired to perform the same task he'd been doing at NJ Transit —trying to figure out the best way to forecast inventory levels for service and replacement parts.

When Price left NJ Transit, the carrier was on the verge of implementing a new inventory planning and optimization system from Belmont, Mass.-based Smart Software Inc. Both railroads faced the identical challenge of forecasting intermittent demand. MNR's previous solution was a homegrown product which smoothed out parts usage and gave an average number for future buys—hardly reflective of the realities of that operation. The railroad needed a way to apply sophisticated analytics to transactional history, in order to come up with accurate stocking levels at two central distribution centers, 13 manned physical storerooms, and 66 virtual inventory sites.

A Shift in Focus

As with most commuter operations, MNR's focus had been on providing the best possible service to customers. Suddenly, with the economy in crisis and public transportation facing a shortfall in funding, the railroad needed to find ways to slash overhead.

"With the bend in the economy, we were told we had to cut material costs," says

Price. "We couldn't cut the demand stream, so the only way was to cut our safety stock margin—[to acquire] tools that would allow us to see things as they're happening." Drawing on his experience with NJ Transit, he turned to Smart Software.

Despite Price's familiarity with the vendor, Smart was no shoo-in. MNR scrutinized proposals from seven providers, narrowing the field to three finalists. Each was asked to forecast the railroad's critical parts consumption over a 34-month period, in addition to predicting for two more months that Price held back from the initial calculation. One candidate achieved none of the fill rates that Price had designated. The second scored on two out of 10 opportunities. Smart's score was seven out of 10. "When we compared the cost of inventory purchase to the forecast, they came out with the best ability to meet fill with the lowest cost," Price says.

MNR is still in the process of implementing the new SmartForecasts system, but it has already begun to show results. Charles N. Smart, chief executive officer of Smart Software, says just seven or eight items in MNR's inventory can account for "multimillion-dollar savings." According to Price, the railroad has achieved a 97-percent fill rate on those items, and he expects that number to climb to just shy of 99 percent as the application fully kicks in.

Roughly 80 percent of the first 10,000 items that MNR tested are subject to intermittent demand. (For all of the railroad's spare parts, the number is closer to 60 percent.) Only a small percentage are on a regular replacement cycle, with the rest experiencing huge and infrequent spikes in use, followed by no activity at all. As Price puts it: "You see randomness all over the place."

History Plus Math

Nevertheless, says Smart, the system is able to adopt a historical perspective in order to devise correct inventory levels. "The classic approach is to look at the breakdown record on individual machines. That requires a tremendous amount of data collection and management.

"All we require is for them to have tracked consumption and demand for the part in the same way a CPG [consumer packaged goods] company would have tracked demand for its product," Smart says. Still, there's the issue of intermittent demand to be addressed. To the historical data, the system applies a set of empirically based algorithms, employing such techniques as probabilistic modeling and statistical "bootstrapping."

The calculations aren't set in stone; they change in accordance with ongoing operations. "The client doesn't stop gathering information on the day we implement," says Smart. "It's constantly updating demand information.... If they so choose, for every reporting period we can readjust consumption levels and safety stock. You add those together and you get the reorder point for the minimum amount of inventory necessary to satisfy demand over the lead time."

Smart was expecting the training and implementation phase to be completed by the end of April, and the system to become fully live within 30 to 60 days after that.

MNR is just one of seven independent agencies within New York's Metropolitan Transportation Authority. Price says SmartForecasts will likely be adopted by other operating units of MTA in the coming months, beginning with the Long Island Railroad toward the end of this year. In all, MTA serves 14.6 million people in New York, Connecticut and New Jersey.

"We've got good confidence [in the application]," Price says. "The numbers so far show us able to accurately forecast some very difficult items, while we have the luxury of stocking less."

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