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Editor's Note: Much of the content that APICS provides its members and markets focuses on operational improvement using tools such as lean, six sigma, Just-in-Time, and so on. Despite widespread acceptance and implementation of these kinds of tools, achieving improved performance with them has remained elusive for many organizations. We want to learn more about the reasons for this disconnect, so we're pleased to support the work being done by our colleagues at Michigan State University as they explore the factors that contribute to achieving operational excellence.

If you're an operations manager, we'd like to invite you to participate in Michigan State's online survey. It takes about 20 minutes (or less) to complete, and all participants submitting completed surveys will receive an executive summary of the results. Michigan State's Steve Melnyk (who is the author of the Back to Basics department in *APICS* magazine) also tells us that all submitters of completed surveys will be entered into a grand prize drawing for a $75 VISA gift card.

To take the survey, please click on http://www.msu.edu/~wujinhui/. Thank you for your participation, and we look forward to together learning more about this important area of business performance.

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COMMUNITIES OF PRACTICE
Focus on Lean: Simulation Technology

Practice Makes Perfect
Simulation technology has come a long way and is a key element in lean implementation. Lean improvement teams now have the ability to analyze manufacturing and supply chain operations, and simulation capabilities provide the next step in the traditional lean improvement toolkit.

Simulation adds the dynamic representation that shows a process over time and the impact of changes on that process. It is visually powerful to actually see material flowing through a process and metrics calculated that mirror the real operation. Product mix is typically a key driver of performance in an operation, and simulation is unique in its ability to model mix impacts.

Material, information, and financial flows may all be modeled as an interdependent system. For instance, how much will the consignment inventory for a customer really affect the cash-to-cash cycle if the payment terms don't change? What is the impact of information delay when importing raw materials?

Simulation has been used successfully in factory floor improvement, inventory management, capacity analyses, and process design. Benefits such as the following are not unusual.

- Postponing final packaging results in 30 percent inventory reduction with substantial service improvement to more than 97 percent.
- Shift/work center change allows reduction of staff from 7 to 6 days per week.
- Adding staff to a bottleneck work center reduces overall number of workers by 10 percent
- Synchronized operations reduce cycle time from 18 to 13 weeks.

A traditional tool such as value stream mapping is a good first step in a lean process analysis. However, it is a static representation and typically not completed for the lower volume products that cause many problems. Because simulation models are dynamic, managers can see the impacts of variability in demand patterns, production processes, and downtime. It is also possible to test schedules, kanbans, and placement of inventory buffers before employing them in the actual operation.

Variability and product mix have significant impacts on throughput and capacity investments. Statistical distributions derived from historical records may be used to represent operations, which is important to develop sound confidence intervals for the results. Many real-world parameters have skewed distributions resulting in maximum backlogs, process times, wait times, outages, and so forth, which are much longer than the average. Things do not even out over time when it comes to the impact of variability in a process.

Lean analysts have used simulation to test process improvements including

- Kanbans and constant work-in-process replenishment
- Every-part-every intervals for continuous flow
- Batch and campaign sizes vs. one-piece flow
- Line balancing
- Setup reduction
- Routing changes
- Shared resources
- Postponement
- Downtime
- Yield and scrap
- Material lead times
- Work cell design and distances traveled

- Cross-trained workers to perform multiple tasks.

For any change being tested, analysts may view results graphically or in a spreadsheet. Traditional and lean metrics such as takt times/rates, overall equipment effectiveness, and end-to-end cycle times may all be incorporated.

The technology has broad applicability in process and discrete industries, multilocation supply chains, job or flow shops, make-to-order and make-to-stock environments, and engineering design activities.

A credible model is essential; a baseline model is normally tested against current operational metrics using actual historical data. After that, the model is validated for demand and supply processes against those metrics and only then is it ready to be used to test changes in processes, capacities, lead times, and so forth.

With the software advantages of Excel spreadsheets and graphic user interface/database technologies, models may be fed with actual data from enterprise resources planning systems, advanced planning and scheduling systems, and manufacturing execution systems. It also makes it possible to keep them up-to-date for use by planners, engineers, research and development staff, and process excellence teams.

Achieving a fully demand-driven pull process remains a challenge for lean programs. Simulation is a powerful iterative tool that can have an important impact today in implementing the pull process, but it is not the silver bullet. The next breakthrough will be integrating optimization algorithms to test solutions by simulating them for a period of time with all of the real-world variability applied.

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