



R & D: From the College Campus to the Cutting Edge

With Industry Cutting R and D, Tomorrow's Technology May Be As Close as Your Local University



Tomorrow's hot new breakthrough in nanotechnology, MEMS, silicon carbide, 3D packaging, lead-free or some other leading edge electronics manufacturing technology, may be under development today at your local university.



By Bernard Levine

ACADEMIC RESEARCHERS EYE SUPPLY CHAIN MANAGEMENT

Electronics companies are turning to academia to help optimize the supply chain. The scientific approach a university can take towards business and engineering management issues can be of enormous help to industry in deciding what products to offer, how to run factories efficiently, when to increase capacity and buy new equipment and other crucial decisions.

Measuring electronic product demand, developing statistical models to track order rates and inventory levels, and other supply chain management research efforts are receiving growing attention at educational facilities. Lehigh University in Bethlehem, Pennsylvania is doing extensive supply chain work through its Center for Value Chain Research, a joint operation between its engineering and business colleges. The center partners with a half-dozen companies, including Agere Systems, headquartered in nearby Allentown, Pennsylvania.

Research carried out at Lehigh helped convince Agere it could speed up the factory planning cycle for its semiconductor assembly and test facilities, according to Chris Armbruster, supply chain strategy director for Agere. Simulations at Lehigh indicated the firm could move to daily planning for its factory operations, which utilize Oracle ERP plus an advanced planning system.

The IC maker has kept most assembly and test in-house, and accelerating the facility re-planning enterprise from a weekly to a daily basis "has helped us leverage our back-end speed advantage" over companies that outsource most or all back-end operations, he claimed. Agere does assembly and test in 48 hours and probe in 36 hours, for a total of three and a half days.

"We do 80 to 90 percent of assembly and test internally, so this gives us a huge advantage of speed, allowing us to postpone assembly and test operations until they are absolutely required," Armbruster said.

The university research, which was more of a case study, he said, "provided the simulation, saying it is possible. The research helped us get over the hump of whether it can be done."

The Center for Value Chain Research has a group working on these types of problems, said David Wu, the leader of the center, which is funded by the National Science Foundation. Wu is also professor and chairman of Lehigh's Department of Industrial and Systems Engineering.

"The way plans are refreshed has significant impact on how capacity is managed in the plant," Wu said. "We come in with a small team, a couple of faculty and graduate students typically, and

come in with a fresh perspective. In this case, we first built a simulation model. We ran simulations, what are the pros and cons? We built the study and Agere would provide real data. Then we present the results of our findings, creating software prototypes, and hand over the tools we developed. Chris and his people would take over the next step of making it operational." Agere's data remains proprietary, but the general intellectual content is publishable by the center, he added.

Lehigh is currently working with Agere on another project to predict future product category demand by identifying and following specific groups of parts that tend to be leading indicators of broader, coming growth.

"The current leading indicator project started with a hunch that there are indicator products that can predict what will happen with demand," said Armbruster. "We believe you can model on current demand with an indication where demand is going on a specific process technology so you can ensure sufficient capacity going forward, whether we need more capital equipment or reserve capacity with foundries. We all have to make decisions on capacity. With statistical modeling, you follow that indicator product, that suggests two or three months later, the rest of the herd will follow. If your business model says, go buy a big piece of capital equipment, and the leading indicator says yes, it is going up, you feel more comfortable. If the indicator is going down, it's a red flag."

An early demand signal can be used to adjust capacity levels, agreed Wu. "We found you can take a particular group of products and cluster them into sub-groups. Certain products demonstrate demand patterns ahead of the herd, a couple of months ahead of everything else. Monitoring the indicator product provides an important data point, especially for products with volatile demand patterns over time. If you know certain products are ahead of the herd, you can predict the impact in the next couple of months." Such predictions, of course, are vital for the electronics industry, where volatile product demand patterns are often a way of life.

Modeling can also help companies decide what products to make, Wu said. The center has developed optimization software to analyze five or six sources of future risk a new product must face. "At any one time, there might be 200 or 300 products a company could include in its portfolio.

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David Wu, leader of The Center for Value Chain Research and professor and chairman, Department of Industrial and Systems Engineering, Lehigh and Chris Armbruster, supply chain strategy director, Agere.

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What are the 50 you should choose? What are the best 50 you can pick that are most sustainable? Modeling can come up with computer software to evaluate millions of scenarios that may occur in the future. It allows companies to make more informed decisions. Looking into, say, wireless products, what are the products that Agere should consider developing? What subset would be the most promising? You analyze risk from the market, customers, the product development itself. Analyzing these sources of risk allows you to make better decisions on the portfolio."

Although product life cycles are short, Wu said, the development cycle isn't, "so it is really challenging not to be locked out of the market. Product development has to be done much earlier. For cell phone products, you need a reasonable assessment of what the market will be like two to three years down the road, what are the technologies, who are the main customers and competition. There are a lot of factors. Software is not a crystal ball. Software allows you to put data into facts. You can base your decision on facts, not just intuition. Executives use these things as tools,

helping them to decide."

The Lehigh center uses engineering tools including statistics and mathematical modeling to examine supply-chain demand, Wu said. "We focus on operations research, using some of these engineering tools to work on business-related problems. We focus on demand forecasting for products with relatively short life cycles. Most forecasting tools on the market today are for stable products with longer life."

Projects between companies and the center generally last two years. "In the first year, we build a team and establish the research process. In the second year, we try to leverage our findings into our process," said Armbruster, with everyone benefiting. "It really brings the academic view into the business culture, an academic view to a problem: what is the best approach and is it better than what we are doing."

Meanwhile, "students are shocked to learn how much uncertainty, how many unknowns we have to deal with in business," Armbruster said. Students, added Wu, "Get a good sense of how business really works." — B.L.