Study: Demand information can help adjust capacity

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Adjusting a firm's capacity can be expensive and difficult for a production manager.

A new UT Dallas study derived optimal policies and data-driven, problem-solving techniques for firms to learn about demand so that they can decide when and by how much they should adjust their capacity level.

"The structure of the optimal policy tells you, based on current information, whether or not you should change your capacity," said Dr. Anyan Qi, assistant professor of operations management in the Naveen Jindal School of Management and one of the paper's authors. "It's a mapping from what you know and what you have to what your decision should be—whether you should continue to observe the demand, increase the capacity or decrease the capacity."

The study was published in the January-February issue of *Operations Research*.

Qi said it's important for researchers to investigate capacity—an indicator of a firm's capability to satisfy the demand and, therefore, to earn revenue. Increasing the capacity can be costly because it requires an investment, such as buying additional equipment or hiring more workers. Downsizing capacity, which may require layoffs or equipment disinvestment, also can be expensive.

"If you do not have enough capacity, and you have a lot of demand, you are losing potential revenue," Qi said. "If you have a lot of capacity, but not enough demand, you suffer from the redundant capacity you have. We would like to see the demand match the supply."

To demonstrate that their method can be implemented with actual demand data, the researchers developed a numerical study using production and financial data related to the Ford Focus. Using the data from the first two generations of the Focus in the North American market, the numerical study illustrates how one could use the paper's approach in deciding how to adjust capacity for the third generation.

Qi said it's difficult for firms to make decisions about capacity investment because of demand uncertainties. Production managers typically need to observe the demand for a while and then adjust the capacity level based on what they learn about it.

Capacity adjustment can be costly and often is subject to managerial hurdles, which can make it difficult to adjust the capacity level multiple times. The study's main finding is that when this is the case, the production manager will need to maintain a careful balance between observing the demand and changing the capacity.

The manager should take time to gather more information, especially if the demand can grow higher, Qi said. Because of the limited opportunity to change the capacity, the manager wants to learn more information about the demand so he or she can make the best decision.

Qi said the study—one of the first papers that combines capacity with demand learning—also speaks to today's focus on machine learning.

"It's important to know how to learn about your demand," Qi said. "How do you analyze big data to learn about the demand and support your

operational decision?"

Dr. Hyun-Soo Ahn and Dr. Amitabh Sinha, both of the University of Michigan, are co-authors on the paper. In 2015, the same trio of researchers published a study on investing in a shared supplier in a competitive market.

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