Overtime and adding options led to auto recalls costing $167 million over seven years

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A study of North American auto production over a seven-year period finds that using overtime and increasing the number of factory-installed options are positively associated with manufacturing-related recalls.

The study, accepted for publication in the journal *Management Science*, found that the economic cost of extremely high factory utilization—operating near or at overtime levels—translates into a recall cost of $167 million over seven years.

The research by faculty at Indiana University's Kelley School of Business, University of Minnesota's Carlson School of Management and Insead business school is timely in light of the fact that U.S. automakers are using overtime and adding shifts to meet increasing demand, rather than expanding plant capacity.

Five of the top 10 largest auto recalls in U.S. history have taken place in the past decade.

According to the National Highway Traffic and Safety Administration, the average number of auto recalls per million registered U.S. vehicles has risen steadily from 3.10 in the 1980s to 11.79 from 2000 to 2010. Each auto recall has a potential economic consequence of more than $20 million.

"While previous studies had focused on linking product recalls to financial costs and loss of market share, our intent was to identify

operational characteristics of an assembly line such as overtime and variety and link them to future recalls," said Rachna Shah, associate professor of supply chair and operations at the Carlson School and the paper's lead author.

"In designing the study, our objective was to fill a huge gap in existing research on one hand, and to provide actionable guidance to practicing managers, which could help reduce future recalls, on the other hand. Overtime and variety provide such managerial levers," she said.

"If managers run an auto factory on consistent overtime, recalls stemming from manufacturing errors increase by more than 300 percent," added George Ball, assistant professor of operations and decision technologies at Kelley. "Such errors become even more prevalent when overtime is combined with high levels of variety."

Ball and Shah are co-authors of the paper, "Plant Operations and Product Recalls in the Automotive Industry: An Empirical Investigation," with Serguei Netessine, professor of technology and operations management and the Timken Chair at Insead.

The authors found that in an overtime situation, either the plant is working its current staff extra hours or it temporarily hires an extra shift to increase capacity.

"Either case is fraught with challenges which are difficult for manufacturers to overcome," they wrote. "Personnel fatigue may prevent high quality assembly and inspection at high rates of utilization, and when in use, temporary staff may be less equipped to perform appropriate processes accurately."

Shah, Ball and Netessine also found that when as few as four extra options are added on the production line, it can lead to two extra

recalls—the equivalent of $46.2 million in additional costs to automakers over the same seven-year period. They base this on average recall cost of $200 per car and an average of 10,000 cars per recall.

Manufacturers usually assemble one model at a time. But within each model, many options are offered and can be installed on each car. Switching between different tasks to install options within a short period of time adds complexity to workers' job tasks. It also affects quality inspectors, who, under increased pressure, miss mistakes.

The same study found that moving to different models on an assembly line within a longer period of time does not affect the quality of the cars produced.

Shah, Ball and Netessine studied occurrences of recalls of all autos made in North America by Chrysler, Ford, General Motors, Honda, Mazda, Mitsubishi and Toyota from 2000 to 2006, using three sources: The Harbour Report, Ward's Automotive and the National Highway Traffic and Safety Administration.

The data set included information about production at 32 plants, 80 unique models and a sample size of 232 car model years.

The paper's findings have important implications for managers, who frequently are required to provide variety in their products but are rewarded for efficiency, which would motivate them to run at high levels of utilization.

"Our results suggest that managers should be careful in using its employees on sustained overtime over long periods of time," the authors wrote. "The bottom line is that complexity causing variety on an assembly line requires commensurate levels of excess capacity to manufacture good quality products and there are significant risks of

working a production plant on sustained overtime over long periods of time."

Three former GM executives have read the paper and attested to the veracity of its findings.

Shah, Ball and Netessine believe this is the first study to link operational variables to product recalls, particularly in the automotive industry. In a series of papers, Shah and Ball are examining several different leading causes of recalls, with an overall goal of reducing future recalls.

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