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Optimizing material flow and warehouse use at BorgWarner

BorgWarner Inc., a $10.5 billion company headquartered in Auburn Hills, MI, is a global automotive industry components and parts supplier with sales of $9.07 billion in 2016. A leading supplier in the transmission and powertrain segment, BorgWarner has an international presence, with more than 27,000 employees at 62 manufacturing facilities in 17 countries.

It is primarily known for its powertrain products, which include manual and automatic transmissions and transmission components, such as electro-hydraulic control components, transmission control units, friction materials and one-way clutches, along with turbochargers, engine valve timing system components and four-wheel drive system components. The company is divided into two groups, Engine and Drivetrain.

BorgWarner Emissions Systems, whose products deal with air management and emissions control for passenger cars, light trucks and commercial vehicles, is part of the Engine Group, which is responsible for research and development of the company's internal combustion engine-related components, along with operational efficiency, including fuel consumption, emissions and performance.

Emissions Systems products are engineered to reduce emissions, improve fuel economy and enhance vehicle performance. Itsadvanced technologies include exhaust gas recirculation (EGR) modules, which consist of the valve, cooler, tubes and by-pass valve; as well as secondary air systems, tubular products, advanced actuators, thermostats, integrated systems solutions and related products.

The only Emissions Systems plant in the U.S., located in Dixon, IL, currently operates 20 different product lines. This highly diverse product mix presents material flow and warehousing challenges. With recent business expansions and further growth expected, BorgWarner foresaw challenges in daily operations due to the lack of floor space and standardization in its material flow and warehousing processes.

To deal with these material flow and warehouse optimization issues, BorgWarner Emissions Systems brought in a student team from the Tauber Institute for Global Operations at the University of Michigan, consisting of Bevin Mathew, working on a Master of Science in Engineering degree in Industrial & Operations Engineering under the Engineering Graduate Program (EGP), as well as Satwik Pattanayak and Zhi (Rambo) Xie, both pursuing Master of Supply Chain Management degrees.

Above, right: Bevin Mathew, Satwik Pattanayak and Zhi (Rambo) Xie onsite at BorgWarner Inc.

To deal with these material flow and warehouse optimization issues, BorgWarner Emissions Systems brought in a student team from the Tauber Institute for Global Operations.

During this 14-week project, the Tauber team assessed current operations at the Dixon facility and proposed recommendations aimed at standardizing processes to reduce line-side inventory and material handler labor utilization, while improving warehouse use.

Brian Love
Professor of Materials Science and Engineering
College of Engineering

Sanjeev Kumar
Lecturer of Technology and Operations
Ross School of Business

Optimizing material flow and warehouse use at BorgWarner (continued)

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"The project focused on improving material flow on the shop floor and warehousing operations," said Mathew. "In spite of the presence of a global and extensive supply chain, the intention was to deliver results by initiating operational changes only at the Dixon plant. The key problems addressed were high line-side inventory, high labor utilization and warehousing inefficiencies. An integrated in-plant milk-run system, along with a new warehouse slotting strategy, was proposed to resolve these problems."

The team initially studied the plant's current state and identified product line-specific constraints that would have to be taken into account during the solution development process. Warehousing efficiency was analyzed and compared with industry benchmarks.

"The material flow situation at the Dixon plant was unique and more challenging because of its more complicated product mix," said Mathew. "The high level of variety (over 1,200 raw-material component parts) made standardization a challenge. The large number of production lines with non-synchronized changeovers further made for a challenging problem. Separating the different components into categories based on their velocity (rate of consumption of packaged units) helped place these into different buckets and tailored strategies could be developed to deal with each category."

However, the lack of a common database with pertinent data for each component part hindered the current state analysis. Because such a database would be needed to deliver a robust and sustainable solution, the Tauber team began building a Plan for Every Part (PFEP) for over 1,000 component parts. The team also built into the PFEP the ability to automate key strategic decisions relating to material flow and warehousing.

"As part of the project, 'pick-cards' were used to carry critical information related to the milk-run system to make the process self-sustaining," said Mathew. "Most of the parameters were auto-calculated on a newly developed PFEP file. A Warehouse Mapping Visualization system was also developed to see what the real-time warehouse occupancy was like on any given day."

From left to right: Sanjeev Kumar–Ross School of Business, Christopher Lanker–Vice President and General Manager Asia, Zhi (Rambo) Xie–Master of Supply Chain Management, Bevin Mathew–MSE in Industrial & Operations Engineering, Satwik Pattanayak–Master of Supply Chain Management, David Peek–Supply Chain Manager

In order to optimize material flow and warehousing, a solution concept for an in-plant milk-run system that facilitates consumption-based periodic line-side replenishment was devised. A pilot was implemented on one of the departments to assess its potential impact and any unforeseen challenges.

"A pilot implementation was conducted on the line with the highest level of product mix complexity for one shift with the new proposed system," said Mathew. "The results showed a reduction of line-side inventory from six hours to roughly 30 minutes. The pilot also demonstrated how easily the material flow handler could adapt to the new system without external help and the effectiveness of the 'pick-cards.'"

A scaled up solution was subsequently developed for the Dixon plant. The warehouse was reconfigured into separate supermarket and reserve storage zones with freshly introduced slotting strategies aimed at enhancing picking efficiency. Structural modifications in the warehouse created additional capacity of over 100 skid spaces, leading to higher storage density. The Tauber team also proposed visual enhancements to the shop floor to aid in the smooth functioning of the proposed material flow and warehousing systems.

As a result of Tauber team recommendations, line-side inventory could be reduced by 75 percent. The team was also able to generate 1,800 square feet of additional floor space for potential new business and to improve labor utilization by 15 percent, leading to possible financial benefits of $500,000 a year. Furthermore, the creation of standardized work for material handlers provides BorgWarner Emissions the flexibility to easily adapt its material flow and warehousing plan to changes in its existing business.

Optimizing material flow and warehouse use at BorgWarner (continued)

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"The dunnage aisles have been streamlined with the implementation of our new outside warehouse facility, with overflow of all types catalogued and tracked," said Mathew. "This facility took priority for Dixon Operations which needed the additional space for a product launch. 1,100 units of finished good dunnage are now on hand in Dixon at all times, which was not planned prior to this launch. Currently the Dixon plant is working on a cost savings measure by expanding the outside warehouse to be used for consignment."

BorgWarner Project Team

Students
Bevin Mathew–EGP (MSE in Industrial & Operations Engineering)

Satwik Pattanayak–Master of Supply Chain Management

Zhi (Rambo) Xie–Master of Supply Chain Management

Project Sponsors
Ron Muskat–Warehouse Supervisor

David Peek–Supply Chain Manager

Faculty Advisors
Brian Love–Professor of Materials Science and Engineering, College of Engineering

Sanjeev Kumar–Lecturer of Technology and Operations, Ross School of Business

About Tauber Team Projects

The 2016 Tauber Team Projects resulted in $460 million in savings according to sponsoring company calculations, an average of $14.4 million per project over 3 years.

Each two to three person Tauber Team consists of graduate engineering, MBA, and/or MSCM students. Along with receiving high-level corporate support from the sponsoring company, each team is advised by a College of Engineering and a Ross School of Business faculty member and overseen by a Tauber Institute Co-Director. The projects begin on-site in May and continue for 14 weeks. Students present the results of their projects and compete for over $40,000 in scholarships at the U-M Tauber Institute's annual *Spotlight!* event, held each September in Ann Arbor, Michigan. *Spotlight!* provides outstanding opportunities for students and corporate partners to establish relationships while exploring innovations in operations and manufacturing.

To learn more about the Tauber Institute for Global Operations, visit tauber.umich.edu or contact us at 734-647-1333.