O.R. DRIVES INNOVATION, VALUE AT GENERAL MOTORS

Auto giant uses OR/MS and analytics to meet automotive industry challenges and provide value to customers and the company.

BY PEILING WU-SMITH AND MICHAEL HARBAUGH

THE AUTOMOTIVE INDUSTRY IS FACING unprecedented challenges. Increasing globalization imposes increased complexity and risk. New disruptive business models continually challenge the status quo. Greater consumer demand for connected technologies and smarter service experiences requires automakers to constantly innovate while remaining efficient and profitable. Considering the complexity of the challenges in the auto business and the speed at which change is occurring in every arena – technology, business, materials and resources, governmental policies and regulations – it is critical to employ a data-driven, science-based approach to understand problems and implement viable solutions.

At General Motors (GM), operations research provides that framework, particularly for complex issues and systems that involve multiple objectives, many alternatives, trade-offs between competing effects, large amounts of data and situations involving uncertainty or risk. Today, no area of GM is untouched by analytical methods.

The O.R. Team

The O.R. team at GM is composed of Ph.D. and master’s-level technical experts, along with subject matter experts with hands-on and executive leadership experience in key areas of the business. The mission is to identify and analyze strategic opportunities to improve GM’s profitability, increase operational efficiency and provide customer insights across the enterprise including customer analytics, finance, marketing, product development, revenue management, quality, safety, and supply chain and logistics. Projects are aligned with top company priorities, which are based on a combination of business performance drivers and senior leadership input. The team’s implementation model comprises a mix of analyses by internal experts to understand the issue, develop capabilities including analytical principles, math models and tools, and early partnership with stakeholders and decision-makers to scope and maximize the potential impact of implemented solutions.

In the fall of 2017, GM Chairman and CEO Mary Barra announced GM’s vision of a future world with “Zero Crashes, Zero Emissions and Zero Congestion.” GM has been working on the technologies that will enable this future as the automotive industry transforms from traditional manufacturing to transportation services. GM believes the future of personal mobility will be driven by the convergence of electrification, autonomous vehicles, connectivity and shared mobility services, for safer, better and more sustainable transportation solutions.

The O.R. team aligns with this corporate vision and contributes to GM’s success with operations research and analytics. We continue building core expertise, while strengthening our analytical capabilities in critical functions across the enterprise.

Operations research has a long and influential presence in GM. As early as the 1960s and 1970s, GM employed analytical techniques for transportation science and traffic flow analyses. In the 1980s, GM used mathematical optimization methods to reduce logistics costs and improve assembly line job sequencing. In the 1990s, it patterned warranty cost reduction analyses after epidemiology studies from the healthcare field. Near the turn of the century, GM applied decision analysis to determine the best business model for its OnStarTM technology and service.

One notable long-term analytics effort was GM’s work on production throughput analysis and optimization. Even when overall industry production
capacity is above demand, it is usually the case that demand for certain “hot” vehicles exceeds planned plant capacities. In such cases, an increase in production capacity will generate larger profits via more sales revenue and/or overtime cost avoidance.

GM’s operations research team analyzed production throughput using math models and simulation, identified cost drivers and bottlenecks, and developed a throughput improvement process to increase productivity and reduce costs. The resulting software has been enhanced over a 20-year period to extend GM’s capabilities, enabling it to accommodate product and manufacturing flexibility, variable control policies and more complex routing. The software is used globally in GM plants, as well as to design new production systems and processes, and has contributed over $2.1 billion to GM’s bottom line. These and other operations research applications are now standard processes in our manufacturing facilities.

Optimizing Vehicle Inventory
Another high-impact initiative involved the optimization of GM’s new-vehicle inventory. This effort focused on answering two complementary questions: (1) What is the optimal number of vehicles to build? and (2) What are the optimal vehicle configurations? In collaboration with GM’s Order Fulfillment and Sales Forecasting teams, the Operations Research team developed decision support tools to optimize the inventory that maximizes profit less inventory carrying costs, and help dealers order the best variations for each vehicle model. The tools have significantly improved GM’s sales. The 800+ dealer franchises who participated in the initial pilot study averaged a 3 to 5 percent lift in sales and revenue compared to a control group of more than 7,000 franchises. The analyses have also helped GM reduce its aggregate retail inventory, contributing to significant financial gains.

Achievements of GM’s OR/MS and analytics initiatives have been recognized by INFORMS on many occasions. GM has been an Edelman finalist on three occasions, including winner of the 2005 competition, and it has twice been selected as a finalist for the Wagner Prize (including one winning entry). In 2016, GM was awarded the INFORMS Prize for its “sustained track record of innovative and impactful applied operations research and advanced analytics.”
With the exponential growth in data and computing power, the increasing demand for OR/MS and analytics, the expanding digital connection to customers and the introduction of advanced vehicle technologies in autonomous driving and connectivity, this is an exciting time for operations research at GM. With so many research-rich opportunities, the team is positioned to have a profound impact on the organization, help the company rise above the competition, and most importantly provide increased value to customers. As evidence of the value and promise that GM places on OR/MS and analytics, GM named its first chief data and analytics officer in 2017, thereby amplifying the influence and application of data-driven, science-based analysis across the company.

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REFERENCES

ALL ABOUT THE ROUNDTABLE
The Roundtable consists of the institutional members of INFORMS with member company representatives typically the overall leader of O.R. activity. The Roundtable is composed of about 50 organizations that have demonstrated leadership in the application of O.R. and advanced analytics. The Roundtable culture is peer-to-peer, encouraging networking and sharing lessons learned among members.

The Roundtable meets three times a year. Roundtable goals are to improve member organizations’ OR/MS practice, help Roundtable representatives grow professionally and help the OR/MS profession to thrive. Further information is available at http://roundtable.informs.org.

The Roundtable also has an advisory responsibility to INFORMS leadership. According to its bylaws, “The Roundtable shall regularly share with INFORMS leadership and advise the INFORMS Board on its views, its suggested initiatives and its implementation plans on the important problems and opportunities facing operations research and the management sciences as a profession and on the ways in which INFORMS can deal proactively with those problems and opportunities.” The Roundtable Board meets with the INFORMS Board each spring to discuss topics of mutual concern. This series of articles aims to share with the INFORMS membership at large some information and insights into how O.R. is carried on in practice today.