Designing Resilient Global Supply Chains

Until recently, the topic of global supply chains rarely captured public or media attention. But the COVID-19 pandemic, coupled with geopolitical conflicts, has had an unprecedented impact on global supply chains and pushed the subject into the national spotlight. The intensity, durability and range of recent and ongoing supply chain disruptions have prompted enterprises to re-examine the premises of traditional supply chains.

If there is one thing firms have learned from their recent experiences, it is the need for resiliency in their supply chains. The grim situation experienced by global supply chains was different from past disruptions. Historically, supply chain shocks included natural disasters, terrorist attacks, information system downtime, labor disputes, hacker attacks and political and social movements. Such conventional shocks were often regional in scale and could be handled in isolation.

The latest shocks on global supply chains have several new features: the length of the disruption is long and unpredictable; the shock simultaneously impacts various geographical areas around the globe; and the shock disrupts both supply and demand, with the resulting bullwhip effect triggering even larger shocks in the upstream supply chains. Many problems remain in global supply chains, including shortages of raw materials and labor, clogged ports, transportation delays, government interventions, etc.

Clearly, resiliency does not just happen. It involves investing in people, processes and technology, as well as designing strategic redundancies in the supply chain. Post-pandemic reviews indicate that firms that handled disruptions better were those that invested in designing resiliency before the pandemic.

Our interdisciplinary supply chain management program covers critical topics to help today’s professionals successfully navigate future challenges. In this issue of Linkages, you will read about our program and faculty’s latest achievements and research, including: two new faculty who are using modeling to improve large-scale food distribution supply chains (p. 2-3) and optimize peer-to-peer transportation platforms (p. 6); how students experience the challenges of strategic decision-making through simulations (p. 7); the appointment of global supply chain leader Jennifer de Souza, vice president, The Raymond Corporation, to the David D. Reh School of Business Leadership Council (p. 7); and more.

We hope you enjoy this issue and welcome your feedback (mahmoodi@clarkson.edu).

— Professor Farzad Mahmoodi
Joel Goldschein ’57 Endowed Chair in Supply Chain Management & Director of Clarkson’s GSCM Program

TOP 25 Supply Chain Management Programs in the Nation for 18 years
U.S. News & World Report, 2023
Solving Logistical Challenges in Large-Scale Supply Chains

India's public distribution system (PDS) program is the largest food distribution network in the world. Initially aimed at reducing food insecurity for those living below the poverty line, the goal today of the PDS program has expanded, providing food for up to 75% of the country's population. That means procuring, storing and transporting millions of tons of grains grown by India's farmers, as well as other essential commodities, and distributing the food through the 500,000+ government-owned Fair Price Shops throughout the country.

At the same time, another food and grocery delivery network known as quick commerce — or q-commerce — is taking shape in cities around the world. In the U.S., for example, companies like Gopuff and Gorillas guarantee customers a speedy 30-minute grocery delivery. In a country like India, where the competition is fiercer, businesses promise to make deliveries within 10 minutes. To achieve this, these companies must procure and store "fast and fresh" foods in strategically placed warehouses (known as dark stores) to ensure product availability, fast delivery and customer satisfaction.

While their objectives and customer base differ, both food distribution systems present serious logistical challenges related to procurement, transportation, storage and delivery.

Both also offer examples of supply chain problems that Ajinkya Tanksale is working to solve. Professor Tanksale holds a PhD in industrial and systems engineering from the Indian Institute of Technology Kharagpur. Last fall, he joined the faculty of the Reh School of Business as an assistant professor of operations & information systems, and of engineering & management.

Prof. Tanksale's research interests center around finding solutions to complex real-life problems using operations research methods and mathematical modeling. "As an industrial engineer, I am fascinated by multivariable logistics challenges, like location problems, which involve developing models to help businesses strategically plan where to locate facilities along a supply chain. Site location decisions have a big impact on costs, supply chain operations and the delivery of products and services."

His interest in food distribution supply chains began with his dissertation research on procurement and logistics planning for India's PDS network. But he also explores logistics related to other large-scale operations, such as railroad systems, healthcare services and humanitarian efforts.

Prof. Tanksale's research has been published in the European Journal of Operational Research, the Journal of the Operational Research Society, the International Journal of Production Economics, Computers & Industrial Engineering, Socio-Economic

87% of Clarkson students complete at least one co-op or internship before graduation

In his Strategic Sourcing and Quality Management classes at Clarkson, students benefit from the real-life research examples he shares in the classroom. “Teaching is about explaining a topic in the simplest and clearest way possible,” he says. “Many supply chain management and operations topics are best explored through case studies and even educational games. For example,

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I have explained the Greenfield analysis and supply chain network design with the help of any Logistix simulation software.

“While teaching Strategic Sourcing at Clarkson this past fall, I engaged students with a dual-sourcing game, The Mexico-China Sourcing Game, to explain the trade-off between risk, lead time and efficiency in sourcing.”

Prof. Tanksale’s commitment to the teaching profession runs deep. The son of a teacher, he attended a high school co-founded by his grandfather in a small town in Maharashtra, a prosperous state in Western India that is also famous for being the home of India’s Bollywood film industry.

Prof. Tanksale studied mechanical engineering as an undergraduate at Shivaji University. “But it wasn’t the right fit for me,” he recalls. “I was never into machines. But I was good at logical thinking and computer coding. In my junior and senior years, I took electives in quality management and operations research — those two classes opened up a whole new career path for me.”

Prior to his position at Clarkson, Prof. Tanksale taught at the Indian Institute of Technology Varanasi, where he worked as an assistant professor. “Engineering students are more interested in how problems are solved, while the business and engineering & management students at Clarkson are more interested in why.”

Clarkson students, he says, are also “very open.”

“They ask questions, they come to office hours, they share feedback. They are very passionate about learning.”

That openness extends to the faculty and the culture of the Reh School as well. “It is a very congenial atmosphere but also very professional,” he says. Prof. Tanksale is already collaborating with his colleague, Professor Santosh Mahapatra, on research related to q-commerce logistics.

100% placement rate for 2022 GSCM graduates (89% reporting)
$70,125 average starting salary

TOP 25 E&M Programs in the Nation
GreatBusinessSchools.org
Faculty Research, News and Awards

Professor Bebonchu Atems, associate dean of faculty affairs & research, co-authored (with Visiting Assistant Professor Jehu Mette, Assistant Professor Guoyu Lin and Associate Professor Golshan Madraki) "Estimating and Forecasting the Impact of Nonrenewable Energy Prices on U.S. Renewable Energy Consumption," which has been published in Energy Policy.

Assistant Professor Rohan Crichton’s research focuses on green operations and human resource management, which affect the sustainability of supply chains. He co-authored "Improving Executive Compensation in the Fossil Fuel Sector to Influence Green Behaviors," which appeared in a recent issue of the German Journal of Human Resource Management. The authors provide a reexamination of executive compensation as a key lever in bringing about sustainable supply chain management practices within the fossil fuel sector.


Prof. Madraki was recently named associate director of Clarkson’s Honors Program and was chosen by the Clarkson University Students Association to give the Last Lecture for the Class of 2022.

Professor Farzad Mahmoodi, Joel Goldschein ’57 Endowed Chair in Supply Chain Management, was the recipient of the 2022 Clarkson's Lifetime Achievement in Research and Scholarship Award. This award is granted annually to a tenured faculty member who is recognized internationally for a body of work that exemplifies the highest level of research accomplishment and has made a significant impact on their chosen field of study.

In addition to establishing and leading one of the top supply chain management programs in the United States, Prof. Mahmoodi is recognized as one of the most prolific individual researchers in the field.

Prof. Mahmoodi recently co-authored "Multi-Echelon Inventory Optimization Under Disruption Risk," in Operations and Supply Chain Management: An International Journal; "Suppliers Portfolio and Returner Incentive Decisions in Closed-Loop Remanufacturing Systems Under Multiple Stochastic Scenarios," in the International Journal of Sustainable Engineering; "The Role of Supply Chain Analytics Capability and Adaptation in Unlocking Value From Supply Chain Relationships," in Production Planning & Control; and "Designing Global Supply Chains for Resiliency and Resourcefulness," in Management Insight. Prof. Mahmoodi also was invited to present "Coping With Challenges Facing Global Supply Chains and Recommended Mitigation Strategies" at the International Research Conference for the Management Disciplines, Reims, France, and "Designing Resilient Supply Chains" at Fudan University, Shanghai, China.

Prof. Milne received the 2022 Faculty Research Excellence Award, which is awarded annually to a David D. Reh School of Business faculty member.

Associate Professor Amir Mousavian is co-author of “A Robust Controller Design Based on Kharitonov’s Theorem for Frequency Control in an Interconnected Power System,” published in the European Journal of Electrical Engineering & Computer Science. Prof. Mousavian was also recently named the David M. Spatz ’68 Director of Engineering & Management Endowed Chair.

Last December, Assistant Professor Ajinkya Tanksale delivered a talk, “Benders Decomposition — Theory and Application,” at the Indian Institute of Technology (IIT) Kharagpur, India. In his presentation, Prof. Tanksale explained the theoretical foundation of Benders decomposition and its application to the complex, large-scale optimization problems arising in logistics and supplychain. The event was organized by the Institute of Industrial & Systems Engineers Student Chapter of IIT Kharagpur.

Assistant Professors Wentao Wu and Zhilu Lin co-authored “The Impact of Demonetization on Microfinance Institutions,” recently published in the Journal of Business Research. The article sheds light on the unintended consequences of demonetization on microfinance institutions (MFIs) and provides policy implications for MFIs, using the 2016 demonetization in India as a quasi-experiment. MFIs in India play an important role in shaping the supply chain, particularly for small businesses and entrepreneurs seeking financing.

Assistant Professor Chester Xiang received the Reh Teaching Award in May 2022. This is the highest annual award for teaching excellence in the David D. Reh School of Business. Prof. Xiang pioneered the use of management simulations, core content in the capstone Advanced Topics courses for both undergraduate- and master’s-level programs.

Associate Professor Dennis Yu is co-author of “Multi-Objective Optimization for Multimodal Transportation Routing Problem With Stochastic Transportation Time Based on Data-Driven Approaches,” which has been accepted for publication in RAIRO-Operations Research.
A Wider Perspective on Supply Chains

Last fall, Rosemonde Ausseil arrived in Potsdam to join the Reh School of Business faculty as an assistant professor of engineering and management after completing her PhD in Decision Science and Engineering Systems at Rensselaer Polytechnic Institute.

“I love the location,” she says. “All the opportunities to be outdoors and enjoy nature—it’s a very good fit for me.”

But it was more than the promise of a scenic view that attracted her to Clarkson. “The global supply chain program is nationally ranked, and Clarkson’s E&M program is unique in the U.S. It’s one of only two programs in the nation with dual accreditation by both business and engineering accrediting agencies. That appealed to me.

“Engineers get caught up in the details. Incorporating a management viewpoint can help you see things more broadly. My research in supply chain management is applied rather than theoretical, so I benefit from a wider perspective.”


“Currently, the system sends one request, and a supplier (driver) can accept or reject the request; this creates uncertainty in the matching process,” she says. “I wondered what would happen if drivers could pick from multiple ride request options. This would give drivers more autonomy and control over their services and more riders would be served.”

To mitigate selection uncertainty, Professor Ausseil used modeling and optimization techniques to create a personal menu of two or three requests that a supplier could choose from. By making the system more dynamic, data based on the suppliers’ acceptance thresholds for requests from previous supplier interactions with the platform could be used to improve matching decisions.

An article based on her research, “Supplier Menus for Dynamic Matching in Peer-to-Peer Transportation Platforms,” was published last year in Transportation Science. She currently has a related article considering the analysis of data patterns from suppliers’ choices under peer review at another journal.

Last fall, Prof. Ausseil taught Operations & Supply Chain Management and Quality Management & Lean Enterprise.

“The students here are very engaged and have a real hunger to succeed, which is great because my classes are very interactive.”

This spring, she is teaching Operations & Supply Chain Management again and is already working to improve the learning experience for her students. “This semester, I plan to bring in more case studies and coding to help them with data analysis and forecasting.”

“It is important to me to make a connection with my students. Not so long ago, I was a student, so I know how important that is. I want them to know that I want each of them to succeed.”

TOP 20 Best Alumni Networks (Private Schools)
The Princeton Review – The Best 388 Colleges: 2023
Supply Chain Leader Joins Reh School Leadership Council

The world’s transition to a clean energy economy is underway, and large corporations have a vital role to play.

As vice president of energy solutions, procurement and leasing for The Raymond Corporation, a Toyota Industries company, Jennifer de Souza is leading the global manufacturers’ transformation to the low-carbon future by investing in renewable energy systems and storage solutions.

But her influence extends well beyond The Raymond Corporation. De Souza has emerged as an industry thought leader, championing game-changing energy solutions like lithium-ion batteries, while advocating for investments in robotics and automation.

All of this, she says, will transform business processes and improve manufacturing and supply chain efficiencies, while increasing productivity and reducing costs. “With the transition to electrification and the reshoring of manufacturing to the United States, we have a once-in-a-generation opportunity to remake our economy and build domestic capacity for high-tech, high-volume manufacturing.

“To do that, we need to prepare our future leaders and workforce for this paradigm shift.”

Last year, de Souza joined the Reh School of Business Leadership Council. The Leadership Council is composed of industry leaders who provide perspectives on the relevance of the curriculum, the educational experience and the future direction of the School.

Her relationship with Clarkson first began more than 10 years ago, when she attended Clarkson’s Supply Chain Management Executive Seminar.

“Clarkson is one of the leaders in supply chain and engineering & management education,” she says. “Raymond, as well as Toyota, is invested in Clarkson and the success of its graduates. Many of our associates were recruited from Clarkson, and we continue to turn to Clarkson for new talent.”

From Students to Strategic Decision Makers

In a Reh School classroom, students engaged in intense negotiations that included pricing, forecasting, contracting and product mixing. The students were global supply chain management majors, and the class was SB441: Advanced Topics in Global Supply Chain Management.

“The capstone course is designed for students to experience the real-life challenges of strategic decision-making within a global supply chain,” says Dennis Yu, associate professor of operations & information systems.

Last fall, Professor Yu led students through a 10-week simulation exercise called Floral-Park. The computer-assisted, live-action game challenged students to assume the roles of importers (wholesalers) and florists (retailers) operating within complex global supply chains involving perishable products — fresh-cut flowers.

“Multiple factors had to be considered in their decision-making. For example, teams needed to be as precise as possible in their demand forecasting; if they ordered too few or too many flowers, they would lose money.”

There were other variables to consider, too. “Retailers needed the flowers for Valentine’s Day. The flowers were imported from different countries, prices varied by flower type, and lead time from grower to market could be as long as two weeks or as short as two days.”

The experience was enhanced through lectures and discussions on topics such as matching supply and demand through pricing optimization, product differentiation and capacity allocation. Students learned firsthand the importance of risk management and supply chain integration. “The most successful teams integrated all the factors into their decision-making. They also learned that cooperating with business partners can improve the outcomes for both parties.”
Why Clarkson Continues to be Recognized as a Leader in GSCM Education

U.S. News & World Report’s 2023 rankings place Clarkson’s supply chain management program among the top 25 in the nation for the 18th year and first in New York state. “Being recognized as the No. 1 program in New York and in the top 25 nationally is no small feat,” says Professor Diego Nocetti, dean of the Reh School of Business. “The U.S. News ranking is a strong endorsement of the relevance of our curriculum, our vast industry connections and alumni networks, and the international reputation of our faculty.”

Professor Farzad Mahmoodi, the Joel Goldschein ’57 Endowed Chair in Supply Chain Management and the director of the GSCM program, agrees. “For two decades, our program has benefited from a specialized approach to supply chain education and our ongoing ability to attract top faculty-scholars in the field.”

Students majoring in GSCM learn through a collaborative, systems-based approach that promotes integration and “big picture” thinking. Through coursework and hands-on learning opportunities, they get a thorough grounding in operations, sourcing and logistics, information systems, economics and organizational behavior.

As with all students in the Reh School, they benefit from an environment that emphasizes globalization and innovation.

The result? Graduates who are sought after by highly respected global companies to not only navigate today’s challenges but serve as tomorrow’s leaders.

“In today’s global economy, what works one year may not work the next,” says Prof. Mahmoodi. “There are always unforeseen challenges, such as the global pandemic, which caused enormous disruptions to global supply chains and required new thinking and innovative approaches.

“Supply chain professionals must be able to work successfully within their areas but also be able to take a broader view. The achievement of our alumni in the field is the strongest endorsement of the success of our educational approach.”

Clarkson’s GSCM major is not the only program in the Reh School recognized for excellence by U.S. News & World Report. In 2023, the innovation & entrepreneurship program was ranked among the top 40 in the nation.

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