The 15th Annual Workshop on Supply Chain and Logistics

Operations Research for Sustainability

June 3, 2022 (in-person)
June 6, 2022 (online)

Bilkent University
Department of Industrial Engineering
Ankara, Turkey

In-Person Program Schedule, June 3, 2022, Friday

Place: Mithat Çoruh Auditorium (EB Building). Please register through the following link: https://www.eventbrite.com/e/fifteenth-annual-workshop-on-supply-chain-and-logistics-tickets-347991862027

14:00 - 14:15: Opening remarks

14:15 - 15:15: "Input Material Reduction Incentives vs. Scrap Recycling for Closed Loop Supply Chains"
Tolga Aydınlıyım, The City University of New York

15:15 - 15:45: Coffee break

15:45 - 16:45: "Wastewater Recycling Capacity Investment in Urban Water Systems"
Onur Boyabatlı, Singapore Management University

Online Program Schedule, June 6, 2022, Monday (Ankara, GMT +3 hours)

Zoom Link: Please send an email to workshop@ie.bilkent.edu.tr for the link.

10:00 - 11:00: Keynote session: "Sustainable Operations: The Key to Clean and Inclusive Growth"
Beril Toktay, Georgia Institute of Technology

11:00 - 11:15: Break

11:15 - 12:15: "Strategic and Operational Decisions in One-Way (Electric) Carsharing Systems"
Burak Boyacı, Lancaster University

12:15 - 14:00: Lunch break

14:00 - 15:00: "OR in Low and Middle-Income Countries: A Chance to Advance OR Research and Tangible Sustainable Development"
Philipp Trotter, University of Wuppertal, University of Oxford

15:00 - 15:15: Break

15:15 - 16:15: Practice session: "How Energy Crisis of 2022 Affected Hydrocarbon Flows"
Barış Sanlı, Bilkent Energy Policy Research Center

16:15 - 16:30: Break

16:30 - 17:30: "Understanding the Effects of Ride-Hailing Platforms on the Auto Industry, Society, and Environment"
Gökçe Esenduran, Purdue University

Input Material Reduction Incentives vs. Scrap Recycling for Closed Loop Supply Chains

Tolga Aydınlıyım, The City University of New York

Abstract: Motivated by interactions with a major player in the aerospace industry, we consider the relationship between a supplier of specialty material forgings and a buyer that manufactures airplane components by extensively machining down these forgings as per component design specifications. Due to high material removal costs, the buyer prefers these forgings to be as similar in geometry and size to the component as possible, i.e., near-net-shape. The supplier, by default, is unable to deliver such near-net-shape forgings as per technological constraints, but can utilize costly effort and/or invest in the required technologies to achieve such capabilities. By taking into account uncertainty regarding the correspondence between supplier's effort and resulting forging size, we assess the implications of two innovative approaches for improving supply chain performance: (i) Input material reduction incentives via contracting, and (ii) scrap material recycling. We characterize the optimal decisions with respect to final component geometry, costs of implementing the two approaches under consideration, and which party in the supply chain controls the strategic recycling decision. We find that the supply chain should utilize both approaches in a complementary way for components with complex geometry, yet deliberately limit recycling and eliminate contracting for components with simple geometry—a strategy the buyer always implements when controlling the recycling decision. Furthermore, we show these contracting and recycling strategies to be robust by considering linear, cost-sharing, and non-linear contract alternatives. Finally, we study supply chain inefficiencies that result from decentralizing the recycling and/or contracting decisions, and highlight whether cost-sharing and non-linear contracts can outperform linear contracts.

Tolga Aydınlıyım is an Associate Professor of Operations Management at the Zicklin School of Business, Baruch College, The City University of New York. He also serves as the Operations and Decision Analytics Area Coordinator of the Zicklin PhD program in Business. He earned a PhD in Operations Research from Case Western Reserve University, and a BS in Industrial Engineering from the Middle East Technical University, Turkey. Tolga's research interests are broadly in operations and supply chain management, with particular interest in operations-marketing-economics interface, retail operations, revenue management and pricing, closed-loop supply chain management, and scheduling and capacity allocation in supply chains and healthcare. His research papers have appeared in *Management Science*, *Manufacturing & Service Operations Management*, *Production and Operations Management*, *Decision Sciences*, and

European Journal of Operational Research. He serves as an associate editor of *Decision Sciences*.

Wastewater Recycling Capacity Investment in Urban Water Systems
Onur Boyabatlı, Singapore Management University

Abstract: Recycled wastewater plays a pivotal role in water sustainability by closing the urban water cycle to make the water a renewable resource. Wastewater recycling requires an upfront capacity investment and this investment decision is influenced by the important characteristics of an integrated urban water management system including the availability of other water sources (e.g., freshwater from reservoirs and desalinated seawater), the relative cost, flexibility, supply availability and uncertainty of these water sources, and the existence of different demand streams (potable and non-potable water demand). Considering these characteristics, this paper studies the wastewater recycling capacity investment decision of a water utility using a two-stage stochastic cost-minimization model under rainfall and recycling cost uncertainties. We characterize the optimal wastewater recycling capacity investment and the subsequent optimal water (freshwater, recycled wastewater and desalinated seawater) allocation decisions. We then use this optimal model to analyze several practically relevant research questions. First, we investigate the impact of reservoir capacity on the optimal wastewater recycling capacity investment. Because freshwater and recycled wastewater can be both used to satisfy non-potable demand, common intuition may suggest that optimal wastewater recycling capacity and reservoir capacity are substitutes. Interestingly, we demonstrate that these two capacities can be substitutes or complements (and characterize specific conditions for these behaviors). Using a model calibration based on real data, we find that these two capacities are more likely to be complements in practical situations. Second, we analyze how the rainfall and recycling cost variabilities affect the optimal wastewater recycling capacity and the optimal expected cost. We find that the optimal expected cost increases in rainfall variability. This result confirms the common understanding in practice that climate change, which is associated with increasing rainfall variability, has a detrimental impact on the management of urban water system. We find that higher rainfall variability incents the utility to decrease the optimal wastewater recycling capacity. This result is contrary to common belief that increasing reliance on wastewater recycling is the right strategy to counteract against changes in rainfall pattern due to climate change. We also find that high recycling cost variability not only decreases the optimal expected cost but also incents the utility to increase the wastewater recycling capacity investment level. In practice, the variability of recycling cost is associated with the energy-intensity of the process. Our results have important implications for the water

utility's choice between renewable (e.g., wind, solar) and fossil fuel energy sources. This is because renewable sources reportedly have higher cost variability due to intermittency problems in comparison with the fossil fuel sources.

Onur Boyabatlı is an Associate Professor of Operations Management at the Lee Kong Chian School of Business, Singapore Management University. He holds a Ph.D. in Technology and Operations Management from INSEAD, France, M.S. and B.S. degrees in Industrial Engineering from Bilkent University, Turkey. His main research interests are in the areas of integrated risk management in global supply chains, operational decision making in commoditized industries with a special focus on agribusiness, technology and capacity management under financing frictions, supply chain finance and sustainable operations. His research papers have been published in *Management Science* and *Manufacturing & Services Operations Management* (*M&SOM*) journals. He is the co-editor of "Agricultural Supply Chain Management Research – Operations and Analytics in Planting, Selling, and Government Interventions" and "Handbook of Integrated Risk Management in Global Supply Chains." He is currently serving as the Chair for iFORM (Interface of Finance, Operations and Risk Management) Special Interest Group. He has served as an Associate Editor for the *M&SOM* journal between 2019 and 2021. He was awarded the *M&SOM* journal's Meritorious Service Award in 2016, 2017 and 2018; *Management Science* journal's Distinguished Service Award in 2012 and Meritorious Service Award in 2014. He was selected for "Most Influential Business Professors under 40" by Singapore Business Review in 2016.

Keynote Session: Sustainable Operations: The Key to Clean and Inclusive Growth

Beril Toktay, Georgia Institute of Technology

Abstract: A focus on sustainability gives us the opportunity to engage with the big issues of our day, to research important questions on environmental and social impact, and to draw in and connect with a diverse set of students, scholars, and communities. This talk will provide a framework for research and education to achieve these goals.

Beril Toktay is Professor of Operations Management and Brady Family Chairholder. Her primary research areas are sustainable operations and supply chain management. Professor Toktay's research has been funded by several National Science Foundation grants and has received distinctions such as the MSOM Society's 2015 Management Science Best Paper in Operations Management Award, the M&SOM 2019 Responsible Research Award and the

2021 M&SOM Best Paper Award. She is Department Co-Editor for the "Health, Environment and Society" department at *M&SOM* and Special Issue Co-Editor on "Business and Climate Change" for *Management Science*. She currently serves as VP of Marketing, Communications and Outreach at INFORMS. She is the founding Faculty Director of the Ray C. Anderson Center for Sustainable Business and the co-architect and Executive Co-Director of Georgia Tech's Office of Serve-Learn-Sustain. Professor Toktay became a Distinguished Fellow of the MSOM Society in 2017 and received the MSOM Distinguished Service Award in 2018. The Metro Atlanta Chamber of Commerce selected her as a 2019 E3 Impact Award Finalist, an award that recognizes "visionary individuals advancing sustainability in Atlanta."

Strategic and Operational Decisions in One-Way (Electric) Carsharing Systems

Burak Boyacı, Lancaster University

Abstract: Carsharing is an advanced car rental system that allows its users to access and hire fleets of vehicles in different locations for short time intervals without owning one. Recently, these systems receive increasing attention not only because of the affordable and flexible mobility they provide to their users, but also because of their environmental and societal benefits. Carsharing systems are classified according to the flexibility they offer to their users. In round-trip systems, each vehicle has a dedicated parking spot and users have to pick up and return vehicles to these spots, whereas one-way systems allow their users to return vehicles to any spot in the system. In this talk, I will talk about problems we worked on related to one-way electric carsharing systems. First, I will describe the methodology we used in planning the locations of new stations in an already operating carsharing system. Second, I will summarize our work on the operational decisions, such as accepting/rejecting demand and assigning personnel to relocate vehicles. This part will cover optimization frameworks we propose for different systems with different reservation policies. Third, I will briefly cover our recent article on upgrading chargers in existing electric carsharing systems. I will conclude my talk with the interesting open research questions from the carsharing literature.

Burak Boyacı is a Senior Lecturer (Associate Professor) in the Management Science Department and has affiliations with the Centre for Transport and Logistics (CENTRAL), Centre for Doctoral Training on Statistics and Operational Research in Partnership with Industry (STOR-i), and Data Science Institute (DSI) at Lancaster University. He has joined Lancaster University Management School in September 2013. He received his BSc and MSci degrees from the Industrial Engineering Department of Boğaziçi University. He received

his PhD degree from Ecole Polytechnique Fédéral de Lausanne in 2014. His research and teaching interests include large-scale optimization problems, specifically discrete optimization and column generation applications. He has a particular interest in problems from transportation and logistics, more specifically city logistics, emergency response planning and operations, public and shared-use transport planning, air and freight transportation operations. His current work is focused on carsharing systems, mobility-as-a-service applications, airline maintenance scheduling, operations and maintenance in offshore wind farms, resource constraint project scheduling, and waste routing. He has published in various OR journals and presented in many conferences. In 2017, the article he has co-authored, that is published in the *European Journal of Operational Research*, received the best paper (in Innovative Applications of OR) award.

OR in Low and Middle-Income Countries: A Chance to Advance OR Research and Tangible Sustainable Development

Philipp Trotter, University of Wuppertal, University of Oxford

Abstract: The last decades have seen significant advancements of OR approaches across fields such as logistics, mobility, energy, production planning. Yet arguably, contexts with the greatest problems in logistics, mobility, energy access and manufacturing efficiency, namely low and middle-income countries (LMICs), have received the least attention from the global OR community. Using a set of different examples, this talk argues that the OR community focusing more strongly on LMICs can yield a profound synergy: First, it can help address some of the most pressing global gaps to the UN's Sustainable Development Goals (SDGs). OR is capable of finding creative optimal solutions where resources, budgets, time and infrastructure are constrained, and is one of the most potent resources to simultaneously study multiple objectives such as the SDGs. Second, it simultaneously opens myriad new routes to generalize OR approaches and advance OR theory. This talk argues that placing the vast majority of existing logistics, mobility, energy or scheduling problems from their established Westernised conceptualisations into an LMICs context quickly yields new constraints, model structures and required approaches which have not been discussed before in the literature.

Philipp Trotter is an Assistant Professor at the Schumpeter School of Business and Economics at the University of Wuppertal and an Honorary Research Associate at the Smith School of Enterprise and the Environment at the University of Oxford. His research is strongly interdisciplinary and addresses the nexus of energy and sustainable development in Africa, covering technical aspects of energy planning and supply chain optimisation as well as quantitative

and qualitative policy analyses and design. He holds a PhD from the Department of Mechanical Engineering at the University of Bath, an Energy Engineering Diplom degree from RWTH Aachen University, as well as an MSc in Politics of the Developing World from LSE. He has received several prizes and scholarships for his academic achievements, including the Springorum Memorial Medal from RWTH Aachen University, the Comparative Politics Prize from LSE, an EU Marie Curie Fellowship, a Studienstiftung des deutschen Volks scholarship and membership of the Young College of the North Rhine-Westphalian Academy of Sciences and Arts. His research has been published in leading scientific journals worldwide (*Nature*, *Nature Energy*, *Nature Sustainability*, *Research Policy*) and has been featured in the BBC, New York Times, TIME Magazine, Forbes, Reuters, Bloomberg and AllAfrica, among others. He worked as a strategy consultant with McKinsey and Company for three years, is a Globalizer Advisor for Ashoka International, and has consulted the World Bank, GIZ, DFID, AfDB, ADB, IRENA, the Uganda, Zambian, Kenyan and UK government.

Practice Session: How Energy Crisis of 2022 Affected Hydrocarbon Flows
Barış Sanlı, Bilkent Energy Policy Research Center

Abstract: Before Russian invasion of Ukraine, hydrocarbon flows were already tight. The war has resulted with new sanction policies which eventually shifted oil and gas flows. In this study, a chronology of the recent events from energy supply-demand dynamics will be reviewed.

Barış Sanlı graduated from the University of Manchester Institute of Science and Technology (UMIST) after attending first year at Boğaziçi University Electrical and Electronics Engineering. He worked as a research assistant at Middle East Technical University and advisor, deputy director general, head of department in the Turkish energy market regulator EPDK and Ministry of Energy and Natural Resources.

Understanding the Effects of Ride-Hailing Platforms on the Auto Industry, Society, and Environment
Gökçe Esenduran, Purdue University

Abstract: Ride-hailing industry has grown at a rapid rate in the last decade, reaching a global worth of approximately $61 billion. More than 540 million people use such platforms worldwide, and both the auto industry and customers feel the effects of the change ride-hailing platforms have brought. Customers may benefit from the presence of ride-hailing platforms because some rely on

using the platform instead of buying/renting a car, while some others who buy a new or used car may choose to provide rides on the platform and gain additional income. In addition, there may be environmental benefits as one of the main premises of these platforms is to make people move with fewer cars and thus reduce the overall environmental impact of transportation. On the other hand, ride-hailing platforms may cannibalize dealer and rental agency sales and hurt the auto industry. Nevertheless, understanding the true implications of a platform's presence on the auto industry, consumer welfare, and the environment requires a comprehensive model that considers not only the manufacturer's but also the dealer's and rental agency's decisions. To the best of our knowledge, we are the first to consider all three firms while also constructing a detailed consumer utility model. Our results show that when the manufacturing cost is high, the number of rental cars decreases while the number of cars sold increases leading to an increase in the overall ownership and thus in the environmental impact. We also observe that the platform's presence always hurts the rental agency but benefits the manufacturer as well as the consumer welfare. It benefits the dealer profits only when the manufacturing cost is sufficiently high.

Gökçe Esenduran is an Associate Professor of Management at Krannert School of Management, Purdue University. She received her Ph.D. from Kenan-Flagler Business School, the University of North Carolina at Chapel Hill. Before joining Purdue, she was an associate professor at The Ohio State University. Gökçe's current research primarily focuses on sustainable operations. She has published in journals such as *Management Science*, *M&SOM*, *Production and Operations Management*, and *Journal of Operations Management*. She received the Krannert Young Faculty Scholar Award in 2019. She is serving as a senior editor for *Production and Operations Management* and as an associate editor for *Decision Sciences*. She was the treasurer of Women in OR/MS between 2014-2015. She served on the POMS College of Sustainable Operations board between 2016-2020, first as the secretary and then as the president/past-president. Currently, she is serving as the chair of MSOM Sustainable Operations SIG and a member of the INFORMS Magazine Editorial Advisory Board.

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