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MSOM Society Student Paper Competition: Abstracts of 2015 Winners

The journal is pleased to publish the abstracts of the six finalists of the 2015 Manufacturing and Service Operations Management Society's student paper competition.

The 2015 prize committee was chaired by Goker Aydin (Kelley School of Business, Indiana University), Karan Girotra (INSEAD) and Sameer Hasija (INSEAD). The other committee members were: Philipp Afeche, Vishal Agrawal, Aydin Alptekinoglu, Atalay Atasu, Opher Baron, Bob Batt, Omar Besbes, Kostas Bimpikis, Robert Bray, Rene Caldentey, Andre Calmon, Carri Chan, Xin Chen, Ying-Ju Chen, Soo-Haeng Cho, So Yeon Chun, Florin Ciocan, Nicole DeHoratius, Sarang Deo, Lingxiu Dong, Pnina Feldman, Santiago Gallino, Srinagesh Gavirneni, Itai Gurvich, Jonathan Helm, Ming Hu, Dan Iancu, Foad Iravani, Srikanth Jagabathula, Fikri Karaesmen, Diwas Kc, Saravanan Kesavan, Bora Keskin, Sang Kim, Song-Hee Kim, Mirko Kremer, Harish Krishnan, Mumin Kurtulus, Guoming Lai, Cuihong Li, Jun Li, Ilan Lobel, Ruben Lobel, Lauren Lu, Alex Mills, Toni Moreno, Anton Ovchinnikov, Rodney Parker, Ali Parlakturk, Alfonso Pedraza Martinez, Ramandeep Randhawa, Paat Rusmevichientong, Soroush Saghafian, Ozge Sahin, Burhaneddin Sandikci, Nicola Secomandi, Melvyn Sim, Amitabh Sinha, Milind Sohoni, Greys Sosic, Brad Staats, Robert Swinney, Alireza Tahbaz-Salehi, Gustavo Vulcano, Gabriel Weintraub, Owen Wu, Wenqiang Xiao, Nan Yang, Zhibin Yang, Fuqiang Zhang, Jiawei Zhang, Yao Zhao, Karen Zheng, and Leon Zhu.

The 2015 prize winners are as follows:

First Prize:

Bike-Share Systems: Accessibility and Availability
Ashish Kbra, INSEAD

Second Prize:

Procurement Mechanisms for Differentiated Products
Daniela Saban, Stanford University

Finalists (in alphabetical order according to the author's last name):

Online and Offline Information for Omnichannel Retailing
Fei Gao, University of Pennsylvania

Optimal Purification Decisions for Engineer-to-Order Proteins
Tuğçe Martağan, Eindhoven University of Technology

*Public Relative Performance Feedback in Complex Service Systems:
Improving Productivity through the Adoption of Best Practices*
Hummy Song, Harvard University

*Impact of Electricity Pricing Policies on Renewable Energy Investments
and Carbon Emissions*
Şafak Yücel, Duke University

Bike-Share Systems: Accessibility and Availability

Ashish Kabra

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Advisors: Karan Girotra, INSEAD;

Elena Belavina, University of Chicago

The cities of Paris, London, Chicago, and New York (among others) have recently launched large-scale bike-share systems to facilitate the use of bicycles for urban commuting. This paper estimates the relationship between aspects of bike-share system design and ridership. Specifically, we estimate the effects on ridership of station accessibility (how far the commuter must walk to reach a station) and of bike availability (the likelihood of finding a bike at the station). Our analysis is based on a structural demand model that considers the random-utility maximizing choices of spatially distributed commuters, and it is estimated using high-frequency system-use data from the bike-share system in Paris. The role of station accessibility is identified using cross-sectional variation in station location and high-frequency changes in commuter choice sets; bike-availability effects are identified using longitudinal variation. Because the scale of our data, (in particular the high-frequency changes in choice sets) render traditional numerical estimation techniques infeasible, we develop a novel transformation of our estimation problem: from the time domain to the “station stockout state” domain. We find that a 10% reduction in distance traveled to access bike-share stations can increase system use by 6.7%, and that a 10% increase in bike availability can increase system use by nearly 12%. Finally, we use our estimates to develop a calibrated counterfactual simulation demonstrating that the bike-share system in central Paris would have 29.41% more ridership if its station network design had incorporated our estimates of commuter preferences—with no additional spending on bikes or docking points.

Procurement Mechanisms for Differentiated Products

Daniela Saban

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Advisor: Gabriel Y. Weintraub, Columbia
Business School

We consider the problem faced by a procurement agency that runs an auction-type mechanism to construct an assortment of differentiated products with posted prices, offered by strategic suppliers. Heterogeneous consumers then buy their most preferred

alternative from the assortment as needed. Framework agreements (FAs)—widely used in the public sector—take this form; the central government runs the initial auction and then the public organizations (hospitals, schools, etc.) buy from the selected assortment. This type of mechanism is also relevant in other contexts, including private procurement settings and the design of drug formularies. When evaluating the bids, the procurement agency must consider the optimal trade-off between offering a richer menu of products for consumers versus offering less variety, hoping to engage the suppliers in a more aggressive price competition.

We develop a mechanism design approach to study this problem. We characterize the optimal mechanism, which typically restricts the entry of close-substitute products to the assortment to induce more price competition among suppliers, without much damage to variety. We then use the optimal mechanism as a benchmark to evaluate the performance of the Chilean government procurement agency’s current implementation of FAs, used to acquire \$US2 billion worth of goods per year. Through a combination of theoretical and numerical results we show how the performance of such FAs can be considerably improved by introducing simple modifications to current practice which, similarly to the optimal mechanism, increase price competition among close substitutes.

Online and Offline Information for Omnichannel Retailing

Fei Gao

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Advisor: Xuanming Su, University of Pennsylvania

This paper studies how retailers can effectively deliver online and offline information to omnichannel consumers who strategically choose whether to gather information online/offline and whether to buy products online/offline. Information resolves two types of uncertainty: product value uncertainty (i.e., consumers realize valuations when they inspect the product in store, but may end up returning the product when they purchase online) and availability uncertainty (i.e., store visits are futile when consumers encounter stockouts). We consider three information mechanisms: *physical showrooms* allow consumers to learn valuations anytime they visit the store, even during stockouts; *virtual showrooms* give consumers online access to an imperfect signal of their valuations; *availability information* provides real-time information about whether the store is in stock. Our main

results follow. First, physical showrooms may prompt retailers to reduce store inventory, which increases availability risk and discourages store patronage. Second, virtual showrooms may increase online returns and hurt profits, if they induce excessive customer migration from store to online channels. Third, availability information may be redundant when availability risk is low, and may render physical showrooms ineffective when implemented jointly. Finally, these mechanisms do not exhibit significant complementarities and the optimal information structure often involves choosing one of the three.

Optimal Purification Decisions for Engineer-to-Order Proteins

Tuğçe Martağan

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Advisor: Ananth Krishnamurthy, University of Wisconsin-Madison

We investigate protein purification operations in pharmaceutical research and development. Each production order represents an engineer-to-order protein that needs to be purified using chromatographic separation. An order has a predetermined purity and yield requirement, and the biomanufacturing firm incurs high penalty costs when these production requirements are not achieved. However, achieving these requirements is often challenging since the starting material involves significant variability in terms of purity and yield, which also affects the outcome of subsequent chromatography operations. Furthermore, the biomanufacturer might have to compromise on the protein yield in order to achieve the desired purity level.

We model the protein purification problem as discrete-time Markov decision processes. First, we partition the state space into distinct, nonempty subsets called the *failure zone*, *risk zone*, and *target zone*. These zones provide an objective assessment of the starting material, manufacturing capabilities, and business risks at the beginning of each purification run. Next, we propose a *zone-based decision-making approach*, which is particularly useful in practice since it provides the optimal policy based on the condition of the starting material. Insights from the structural analysis are then used to develop a state aggregation and action-elimination scheme that leads to computational advantage in solving industry-size problems. Implementation insights at Aldevron, a contract biomanufacturing firm specialized in recombinant proteins, indicate an average of 25% reduction in lead times and 20% reduction in operating costs.

Public Relative Performance Feedback in Complex Service Systems: Improving Productivity through the Adoption of Best Practices¹

Hummy Song

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Advisor: Anita L. Tucker, Brandeis University

Managers of service organizations seek to improve productivity without eroding service quality. We explore whether privately versus publicly disclosing relative performance feedback (RPF) about individual workers' processing times can help achieve this goal. Using three years of patient encounter data from two emergency departments, one of which changed from privately to publicly disclosing RPF to physicians, we find an 8.6% decrease in physician processing time ($p < 0.01$), defined as the time from when the physician commences care to when the disposition order is signed. This change was associated with a lower likelihood of having at least one lab or radiology test ordered, but no statistically significant change in clinical quality or the level of patient satisfaction. The decrease in physician processing time was greater when physicians were seeing patients with symptoms of conditions for which there were not standardized protocols (e.g., abdominal pain) as opposed to ones for which there were standardized protocols (e.g., stroke). We conduct further analyses that suggest the benefit of public RPF may primarily stem from the identification and diffusion of best practices around workflow, rather than from the motivation to be top-ranked or the shame of being bottom-ranked. Thus, our results suggest public RPF may foster the sharing and adoption of strategies for improving the management of workflow.

Impact of Electricity Pricing Policies on Renewable Energy Investments and Carbon Emissions

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Advisors: A. Gürhan Kök, Koç University; Kevin Shang, Duke University

We investigate the impact of pricing policies (i.e., flat pricing versus peak pricing) on the investment levels of a utility firm in two competing energy sources (renewable and conventional), with a focus on the renewable investment level. We consider generation patterns and intermittency of solar and wind

¹ Former title: "Learning From the Best: The Effects of Public Relative Performance Feedback on Variability and Productivity"

energy in relation to the electricity demand throughout a day. Industry experts generally promote peak pricing policy as it smoothens the demand and reduces inefficiencies in the supply system. We find that the same pricing policy may lead to distinct outcomes for different renewable energy sources due to their generation patterns. Specifically, flat pricing leads to a higher investment level for solar energy and it can still lead to more investments in wind energy if considerable amounts of wind energy is generated throughout the day. We validate these results by using electricity generation and demand data of Texas. We

also show that flat pricing can lead to substantially lower carbon emissions and a higher consumer surplus. Finally, we explore the effect of direct (e.g., tax credit) and indirect (e.g., carbon tax) subsidies on the investment levels and carbon emissions. We show that both types of subsidies generally lead to a lower emission level but indirect subsidies may result in lower renewable energy investments. Our study suggests that reducing carbon emissions through increasing renewable energy investments requires a careful attention to the pricing policy and the market characteristics of each region.