

The Supernetwork Sentinel

Summer 2016

Welcome to the Summer 2016 edition of ***The Supernetwork Sentinel***, the newsletter of the Virtual Center for Supernetworks at the Isenberg School of Management, UMass Amherst. ***The Supernetwork Sentinel*** is published in Fall, Winter, and Summer editions. The newsletter's purpose is to keep you informed of events, activities, and successes of the Virtual Center for Supernetworks, the Center Associates, and the Supernetworks Laboratory for Computation and Visualization. In this newsletter, we report on conferences, a new book, and the Center Director's Visiting Fellowship experience at Oxford University. As always, we also include a list of our recent Center publications.

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The Center Director speaking at Carnegie Mellon University on April 4, 2016



(L-r) Professors Nu, Sider, and Nagurney as Visiting Fellows at All Souls College at Oxford University during the Trinity Term 2016



POMS Conference, Orlando, Florida, May 3-6, 2016

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Center Associates Shine at EURO Conference in Poland

The 28th European Conference on Operational Research, which took place July 3-6, 2016, in Poznan, Poland, served as a great venue for a reunion of several Center Associates. Center Associate Professor Patrizia Daniele of the University of Catania organized two invited sessions for this conference: **Recent Advances in Dynamics of Variational Inequalities and Equilibrium Problems 1 and 2**, in which she also presented a fascinating paper on a network model for organ transplants.



Professor Daniele before her presentation

The Center Director presented two papers in Professor Daniele's sessions, one co-authored with her and Doctoral Student Center Associate Shivani Shukla on cybersecurity investments under nonlinear budget constraints and network vulnerability and the other on freight service provision for disaster relief.

Center Associate Professor Tina Wakolbinger of the Vienna University of Economics and Business also organized an invited session for this conference on **Humanitarian Operations**. Not only did she present a paper but she also brought two of her doctoral students with her and one presented a paper.

Center Associate Professor Ladimer S. Nagurney of the University of Hartford presented the paper: **Physical Proof of the Occurrence of the Braess Paradox in Electrical Circuits** that was co-authored with the Center Director.

Also, the Center Director presented the paper: **Competitive Food Supply Chain Networks with Application to Fresh Produce**, Min Yu and Anna Nagurney, *European Journal of Operational Research* (2013), **224(2)**, 273-282, which was selected as one of two papers by the Editors of the *European Journal of Operational Research*, for presentation in a special session with the Editors of this journal at

EURO in Poznan. Congratulations to Center Associate Professor Min Yu from the University of Portland for this distinct honor! This paper has received a lot of citations and is impactful.

Center Associate Professor Dmytro Matsypura of the University of Sydney presented the paper: **Wildfire Fuel Management: Optimisation of Prescribed Burning**, which was co-authored with Professor Oleg Prokopyev of the University of Pittsburgh.



(l-r) Professors Wakolbinger, Matsypura, and Daniele at the conference

Also, at the conference, the new book, *Competing on Supply Chain Quality: A Network Economics Perspective*, co-authored by the Center Director and Center Associate Professor Dong "Michelle" Li, was displayed at the Springer booth. The book was just published in June 2016.



Professor Anna Nagurney with Matt Amboy of Springer and her new book with Dong "Michelle" Li



Center Associates at EURO with doctoral students and colleagues from Italy after dinner

We thank the organizers of this conference for an outstanding experience!

Center Director Keynotes Analytics Day in Canada

On April 15, 2016, The Center Director, Professor Anna Nagurney, delivered the plenary talk: [Predictive and Prescriptive Models of Cybercrime and Cybersecurity Investments Under Network Vulnerability](#) at Analytics Day, which took place at the University of Waterloo in Canada.



The Center Director giving her plenary talk

[The conference was well-advertised](#) and attracted practitioners as well as academics from numerous universities in the Toronto area. Professor Nagurney had been invited to speak by Dr. Fatma Gzara. Dr. Gzara runs the [Waterloo Analytics and Optimization Lab](#).

Her presentation attracted attention from the media and she was interviewed by Jeff Outhit for an article in the *Waterloo Region Recorder* on ransomware since both universities and hospitals have experienced such cyber attacks recently.

[The article can be accessed here.](#)



(l-r) Professor Anna Nagurney and Professor Fatma Gzara

Competing on Supply Chain Quality Book is Published

We are delighted to report that the new book, consisting of 400 pages: [Competing on Supply Chain Quality: A Network Economics Perspective](#), co-authored by Professor Anna Nagurney and Center Associate Professor Dong Li of Arkansas State University, was published in June 2016 by Springer International Publishing Switzerland.



This book consists of over half a decade of research and spans numerous topics from information asymmetry, supplier selection and quality, identification of the most important firms in supply chain networks, and also competition in freight service quality. To-date, supply chain management and quality management have been studied separately with a focus on centralized decision-making. This book, in contrast, presents a unified framework for the subject matter and tackles the more complex and realistic decentralized decision-making behavior and impacts on quality. The book was inspired by numerous product quality failures with the goal of providing insights to assist in enhanced decision-making. It also explores the impacts of policy interventions in the form of minimum quality standards.

This book is the second in a series on Supply Chain Management, edited by Distinguished Professor Chris Tang of UCLA's Anderson School of Management.

Center Director Enjoys Visiting Fellowship at Oxford University

Professor Anna Nagurney spent the Trinity term, from late April until mid July, as a Visiting Fellow at All Souls College at Oxford University in England. This is a very prestigious fellowship. While on this fellowship she had an office and an apartment provided by Oxford University.



The Center Director at Oxford University with other Visiting Fellows, the Warden, and the Dean of Visiting Fellows

The theme of the research that she conducted was *supply chain networks*. She completed the co-editing of the book, *Dynamics of Disasters: Key Concepts, Models, Algorithms, and Insights*, with Professors Ilias Kotsireas and Panos M. Pardalos, and the writing of its Introduction. The book is now in production with Springer, the publisher, and consists of 18 chapters, all rigorously refereed. The contributions are by both academics and practitioners, including two chapters from representatives from the United Nations, and address key concepts, models, algorithms, and insights associated with some of the most challenging problems in disasters from risk mitigation and preparedness to response and recovery. Two chapters that she wrote: one on a mean-variance disaster relief model with stochastic link costs and time targets, co-authored with Professor Ladimer S. Nagurney, and the other on freight service provision with supplier selection, are included in the volume. The support of the Visiting Fellowship is acknowledged in the book's Introduction. It was very meaningful to hear former Secretary-General of the United Nations, Kofi Annan speak at Oxford during her term here. Also, she enjoyed conversations with Fellow Ed Mortimer, who used to write speeches for Annan.

In addition, the book, *Competing on Supply Chain Quality: A Network Economics Perspective*, with Dong Li, was finalized and

published. All Souls College and Oxford University are acknowledged in it for the opportunities provided. She presented a copy of this book in July to Gaye Morgan for the Codrington Library with an inscription.



The Center Director at All Souls College at Oxford University

Also, while at All Souls College, the paper, **A Generalized Nash Equilibrium Network Model for Post-Disaster Humanitarian Relief**, co-authored with Emilio Alvarez-Flores and Professor Ceren Soylu, was considerably expanded to include a case study on Hurricane Katrina, the most costly natural disaster to hit the United States. In this paper, the authors develop a Generalized Nash Equilibrium network model for post-disaster humanitarian relief by nongovernmental organizations (NGOs). NGOs derive utility from providing relief supplies to the victims of the disasters at multiple demand points in a supply chain context while competing with each other for financial funds provided by donations. The shared constraints consist of the lower and upper bounds for demand for relief items at the demand points and can be imposed by the regulatory body or higher level coordinating NGO to reduce materiel convergence or even congestion. The authors demonstrate that this game theory problem, because of its special structure, can be reformulated as an optimization problem, for which existence of a solution is guaranteed. Conditions for uniqueness are also given. We provide an effective computational scheme, which resolves the problem at each iteration to closed form expressions in the relief item flows and the Lagrange multipliers associated with the supply and demand constraints. We also provide numerical examples illustrating the Generalized Nash Equilibrium network framework, and compare their solutions to those obtained under the Nash Equilibrium counterpart without shared constraints. This paper is now under review in a journal. Emilio Alvarez Flores was a student of Professor Nagurney's at the Isenberg School and she chaired his Commonwealth Honors College dissertation. Emilio received a Dean's Award for his research. He had also been a student in

Professor Nagurney's Humanitarian Logistics and Healthcare class at the Isenberg School of Management in Spring 2016.



The view from Professor Nagurney's office at Oxford

In addition, she worked on the paper, **Quality in Competitive Fresh Produce Supply Chains with Application to Farmers' Markets**, with Doctoral Student Center Associate Deniz Besik, and which will be submitted to a journal in late July 2016. The paper develops a game theory model for farmers competing at farmer's markets in which the demand price functions explicitly capture quality based on the fresh produce and associated network economic activities of harvesting, storage, and transportation. Also, she examined the market that takes place in downtown Oxford.

She also served on a dissertation viva assessment committee for a doctoral student at Oxford University, Ellen Knebel.



Professor Ladimer S. Nagurney with former Visiting Fellow and Dr. Constantin Teleman at All Souls College

Kudos and News

Congratulations to Center Associate Dong "Michelle" Li. She took part in UMass Amherst graduate graduation ceremonies on May 6, 2016. She successfully defended her dissertation in 2015.



(l-r) Professor Christian Rojas, Dr. Li, and Doctoral Student Center Associate Deniz Besik

Doctoral Student Center Associate Sara Saberi will be defending her dissertation: **Network Game Theory Models of Services and Quality Competition with Applications to Future Internet Architectures and Supply Chains**, on August 12, 2016, in Management Science at the Isenberg School of Management. Professor Anna Nagurney is the chair of her dissertation committee. She will then begin her appointment as an Assistant Professor at the Foisie School of Business at Worcester Polytechnic Institute in Massachusetts.

Doctoral Student Center Associate Shivani Shukla delivered the talk, **Multifirm Models of Cybersecurity Investment Competition and Network Vulnerability**, at the highly selective conference, New England Security Day, which took place at Harvard University on April 28, 2016, in Cambridge, Massachusetts.



Shivani Shukla speaking at Harvard University

The Center Associates were very prominent at the POMS Conference, May 3-6, 2016, in Orlando, Florida.



Center Associates Professors Min Yu, Amir H. Masoumi, with Dr. Fuminori Toyasaki, and Center Associate Professor Tina Wakolbinger with her doctoral student Christian Burkhardt at POMS

Center Associate Professor Ladimer S. Nagurney is on sabbatical in the Department of Electrical and Computer Engineering at UMass Amherst and will be returning to the University of Hartford in the Fall. Along with the Center Director he spent time in Oxford, England and co-wrote the OpEd with her: [Why We Are Stronger Together](#), which was published in the [Daily Hampshire Gazette on June 27, 2016](#). The OpEd comments on Britain exiting the European Union.

Congratulations to Center Associate Professor Patrizia Daniele on the following publications: (with S. Giuffrè and M. Lorino): **Functional Inequalities, Regularity and Computation of the Deficit and Surplus Variables in the Financial Equilibrium Problem**, *Journal of Global Optimization*, in press, and (with C. Ciarcia): **New Existence Theorems for Quasi-variational Inequalities and Applications to Financial Models**, *European Journal of Operational Research*, in press.

Congratulations to Center Associate Professor Ding Zhang on the publication of his paper: **A Dynamic Allocation Model for Medical Resources in the Control of Influenza Diffusion**, co-authored with M. Liu and Z. Zhang, which was published in the *Journal of Systems Science and Systems Engineering*, (2015), **24(3)**, 276-292. Also, congratulations to Professor Zhang on the publication of his paper: **Modelling Inter-Supply Chain Competition with Resource Limitation and Demand Disruption**, with Z. Che, C. Teng, and J. Sun, published in the *International Journal of Systems Science* (2016), **47(7)**.

On June 9, 2016, the Center Director delivered an invited seminar, **Supply Chain Networks Against Time: From Food to Pharma** at the Centre for Transport Studies at Imperial College in London, England. Her host was Professor Panagiotis Angeloudis.



(L-r) Professor Angeloudis, the Center Director, and Professor Ben Heydecker of UC London

She was delighted to have Professor Ben Heydecker, renowned for his research in transportation, who is at the University College London, come to her presentation.

Afterwards, Professor Anna Nagurney was treated with her family to dinner at the Royal Automobile Club in London by Center Associate Dr. Stavros Siokos, who is a financier in London.

Dr. Siokos and Professor Nagurney are the co-authors of the book: *Financial Networks: Statics and Dynamics*.



Dr. Stavros Siokos with the Nagurneys in London

On June 29, 2016, the Center Director had the pleasure of speaking at the Management Science Department at Lancaster University in England. The title of her seminar presentation was: **Disaster Relief Supply Chains: Network**

Models, Algorithm, and Case Studies. Her hosts were Professors Graham Rand, Konstantinos Zografos, and Matthias Ehrgott. She thanks her hosts for the wonderful hospitality.



The Center Director with Professors Rand and Ehrgott

Center Associate Professor Tina Wakolbinger is an active member of [the EURO Working Group on Humanitarian Operations](#). She is a Senior Editor in Disaster Management of the premier journal [Production and Operations Management](#).

Congratulations to Center Associate Professor Amir H. Masoumi of Manhattan College for the success of the [Business Analytics Competition & Conference](#), which took place at his college, May 24-27, 2016. Professor Masoumi introduced Dr. Anne Robinson, the keynote speaker, who is a former President of INFORMS. Plus, Manhattan College received first place in the competition!

Congratulations to Center Associate Professor Jose M. Cruz of the School of Business at the University of Connecticut for his publication with S. Bhattacharjee, **Economic Sustainability of Closed Loop Supply Chains: A Holistic Decision and Policy Analysis Framework**, *Decision Support Systems*, (2015), **77**, 67-86.

Center Associate Professor Patrick Qiang of Penn State University Malvern is on sabbatical for a year and will be spending a greater part of his sabbatical conducting research in China.

Recent Center Publications

Please see our center articles at:
<http://supernet.isenberg.umass.edu/dart.html>

Cybersecurity Investments with Nonlinear Budget Constraints: Analysis of the Marginal Expected Utilities, P. Daniele, A. Maugeri, and A. Nagurney (2016). invited paper for *Operations Research, Engineering, and Cyber Security: Trends in Applied Mathematics and Technology*, Th.-M. Rassias and N.J. Daras. Eds., Springer.

Freight Service Provision for Disaster Relief: A Competitive Network Model with Computations, A. Nagurney (2016), in press in *Dynamics of Disasters: Key Concepts, Models, Algorithms, and Insights*, I.S. Kotsireas, A. Nagurney, and P.M. Pardalos, Eds., Springer International Publishing Switzerland.

A Layered Protocol Architecture for Scalable Innovation and Identification of Network Economic Synergies in the Internet of Things, T. Wolf and A. Nagurney, , *Proceedings of the 2016 IEEE First International Conference on Internet-of-Things Design and Implementation (IoTDI)*, pp 141 – 151.

A Supply Chain Network Game Theory Model of Cybersecurity Investments with Nonlinear Budget Constraints, A. Nagurney, P. Daniele, and S. Shukla, in press in *Annals of Operations Research* (2016).

A Mean-Variance Disaster Relief Supply Chain Network Model for Risk Reduction with Stochastic Link Costs, Time Targets, and Demand Uncertainty, A. Nagurney and L.S. Nagurney (2015), in press in *Dynamics of Disasters: Key Concepts, Models, Algorithms, and Insights*, I.S. Kotsireas, A. Nagurney, and P.M. Pardalos, Eds., Springer International Publishing Switzerland.

Towards Pricing Mechanisms for delay Tolerant Services, L. Marentes, T. Wolf, A. Nagurney, and Y. Donoso, *International Journal of Computers Communications & Control* (2016), **11(1)**, 77-89.

A General Multitiered Supply Chain Network Model of Quality Competition with Suppliers, D. Li and A. Nagurney, *International Journal of Production Economics* (2015), **170**, 336-356.

Supply Chain Performance Assessment and Supplier and Component Importance Identification in a General Competitive Multitiered Supply Chain Network Model, D. Li and A. Nagurney (2015), in press in the *Journal of Global Optimization*.

A Game Theory Model of Cybersecurity Investments with Information Asymmetry, A. Nagurney and L.S. Nagurney, *Netnomics* (2015), **16(1-2)**, 127-148.

A Supply Chain Game Theory Framework for Cybersecurity Investments Under Network Vulnerability, A. Nagurney, L.S. Nagurney, and S. Shukla, in *Computation, Cryptography, and Network Security*, N.J. Daras and M.T. Rassias, Editors, Springer International Publishing (2015), 381-298.

Supply Chain Network Competition in Price and Quality with Multiple Manufacturers and freight Service Providers, A. Nagurney, S. Saberi, S. Shukla, and J. Floden, *Transportation Research E* (2015), **77**, 248-267.

A Multiproduct Network Economic Model in Financial Services, A. Nagurney, *Service Science* (2015), **7(1)**, 70-81.
Design of Sustainable Supply Chains for Sustainable Cities, A. Nagurney, *Environment & Planning B* (2015), **42(1)**, 40-57.

A Supply Chain Network Game Theory Model with Product Differentiation, Outsourcing of Production and Distribution, and Quality and Price Competition, A. Nagurney and D. Li, *Annals of Operations Research* (2015), **228(1)**, 479-503.

An Integrated Disaster Relief Supply Chain Network Model with Time Targets and Demand Uncertainty, A. Nagurney, A.H. Masoumi, and M. Yu, in *Regional Science Matters: Studies Dedicated to Walter Isard*, edited by P. Nijkamp, A. Rose, and K. Kourtit, Springer International Publishing Switzerland (2015), 287-318.

Fashion Supply Chain Network Competition with Ecolabelling, A. Nagurney, M. Yu, and J. Floden, in *Sustainable Fashion Supply Chain Management: From Sourcing to Retailing*, T.-M. Choi and T.C.E. Cheng, Editors, Springer (2015), 61-84.

A Game Theory Model for a Differentiated Service-Oriented Internet with Duration-Based Contracts, A. Nagurney, S. Saberi, T. Wolf, and L.S. Nagurney, in *Proceedings of ICS 2015: Operations Research and Computing: Algorithms and Software for Analytics*, B. Borchers, J. P. Brooks, and L. McLay, Editors, INFORMS (2015), 15-29.

Securing the Sustainability of Global Medical Nuclear Supply Chains Through Economic Cost Recovery, Risk Assessment, and Optimization, Anna Nagurney, Ladimer S. Nagurney, and Dong Li, *International Journal of Sustainable Transportation* (2015), **9(6)**, 405-418.

A Mean-Variance Disaster Relief Supply Chain Network Model for Risk Reduction with Stochastic Link Costs, Time Targets, and Demand Uncertainty, A. Nagurney and L.S. Nagurney (2015), presented at the Dynamics of Disasters conference, June 29-July 2, 2015, Kalamata, Greece.

A Network Economic Game Theory Model of a Service-Oriented Internet with Price and Quality Competition in Both Content and

Network Provision, S. Saberi, A. Nagurney, and T. Wolf, *Service Science* (2014), **6(4)**, 229-250.

Supply Chain Network Competition in Time-Sensitive Markets, A. Nagurney, M. Yu, J. Floden, and L. S. Nagurney, *Transportation Research E* (2014), **70**, 112-127.

A Cournot-Nash-Bertrand Game Theory Model of a Service-Oriented Internet with Price and Quality Competition Among Network Transport Providers, A. Nagurney and T. Wolf, *Computational Management Science* (2014), **11(4)**, 475-502.

Spatial Price Equilibrium with Information Asymmetry in Quality and Minimum Quality Standards, A. Nagurney, D. Li, and L.S. Nagurney, *International Journal of Production Economics* (2014), **158**, 300-313.

The Center Director and Center Associates thanks you for your support!

The Center Director

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