

Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World

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Pre-Conference Tutorial – Module III

SBP10

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Outline of Tutorial

- **Module I:** Network Fundamentals, Efficiency Measurement, and Vulnerability Analysis
- **Module II:** Applications and Extensions
- **Module III:** Mergers and Acquisitions, Network Integration, and Synergies

We have been focusing on network vulnerability and robustness analysis. We also have results in terms of *synergy* in the case of network integration as would occur in **mergers and acquisitions**.

In this framework we model the economic activities of each firm as a S-O problem on a network.

Relevant References

- A System-Optimization Perspective for Supply Chain Network Integration: The Horizontal Merger Case, Nagurney, *Transportation Research E* 45: (2009), pp 1-19.
- Multiproduct Supply Chain Horizontal Network Integration: Models, Theory, and Computational Results, Nagurney, Woolley, and Qiang, *International Transactions in Operational Research* (2009), in press.

Mergers and Acquisitions and Supply Chain Network Synergies

Today, supply chains are more extended and complex than ever before. At the same time, the current competitive economic environment requires that firms operate efficiently, which has spurred research to determine how to utilize supply chains more effectively.

There is also a pronounced amount of merger activity. According to Thomson Financial, in the first nine months of 2007 alone, worldwide merger activity hit \$3.6 trillion, surpassing the total from all of 2006 combined.

Notable examples: KMart and Sears in the retail industry in 2004 and Federated and May in 2005, Coors and Molson in the beverage industry in 2005, and the recently proposed merger between Anheuser Busch and InBev.

According to Kusstatscher and Cooper (2005) there were five major waves of of Merger & Acquisition (M &A) activity:

The First Wave: 1898-1902: an increase in horizontal mergers that resulted in many US industrial groups;

The Second Wave: 1926-1939: mainly public utilities;

The Third Wave: 1969-1973: diversification was the driving force;

The Fourth Wave: 1983-1986: the goal was efficiency;

The Fifth Wave: 1997 until the early years of the 21st century: globalization was the motto.

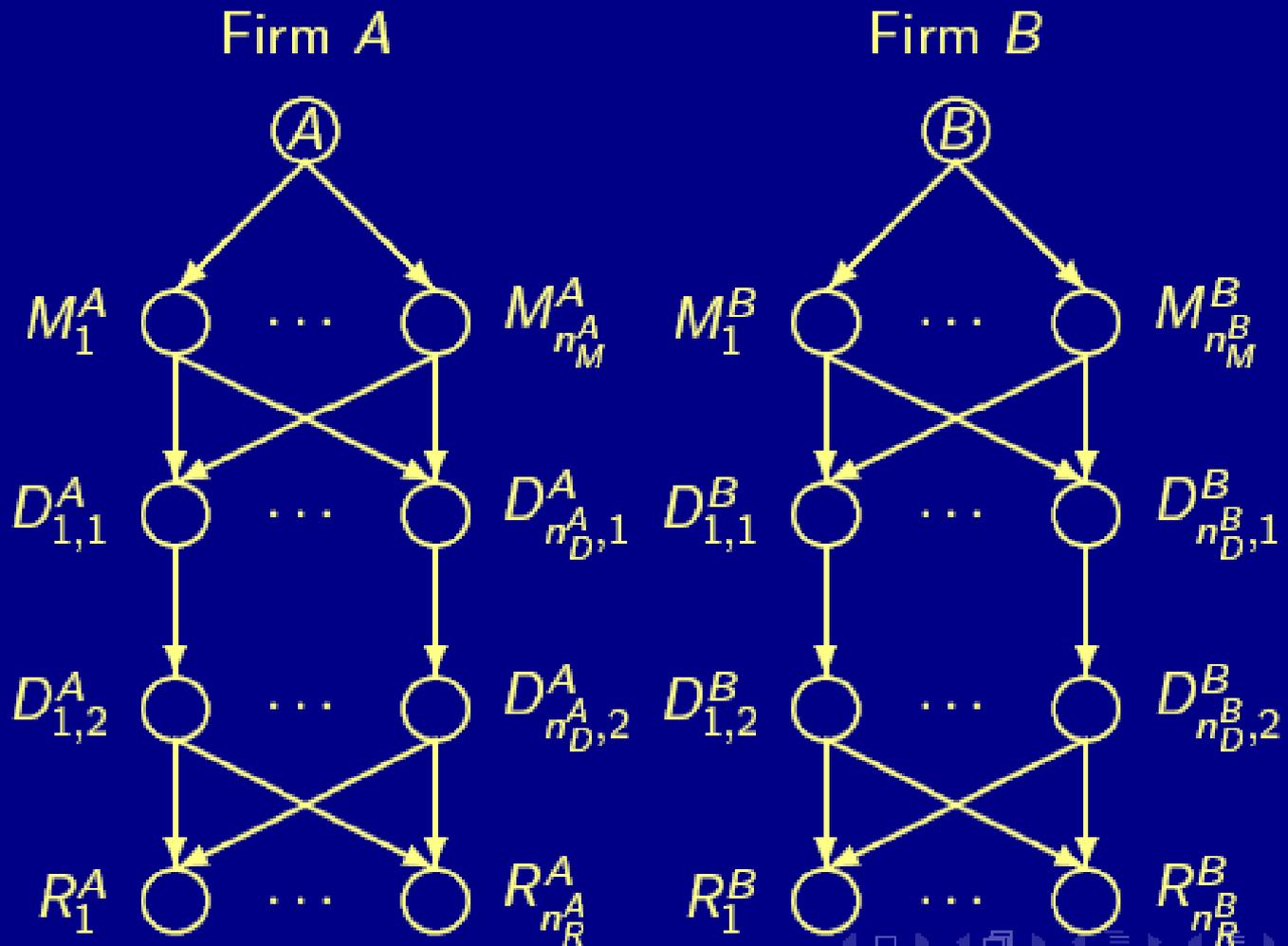
In 1998, M&As reached \$2.1 trillion worldwide; in 1999, the activity exceeded \$3.3 trillion, and in 2000, almost \$3.5 was reached.

A survey of 600 executives involved in their companies' mergers and acquisitions (M&A) conducted by Accenture and the Economist Unit (see Byrne (2007)) found that less than half (45%) achieved expected cost-saving synergies.

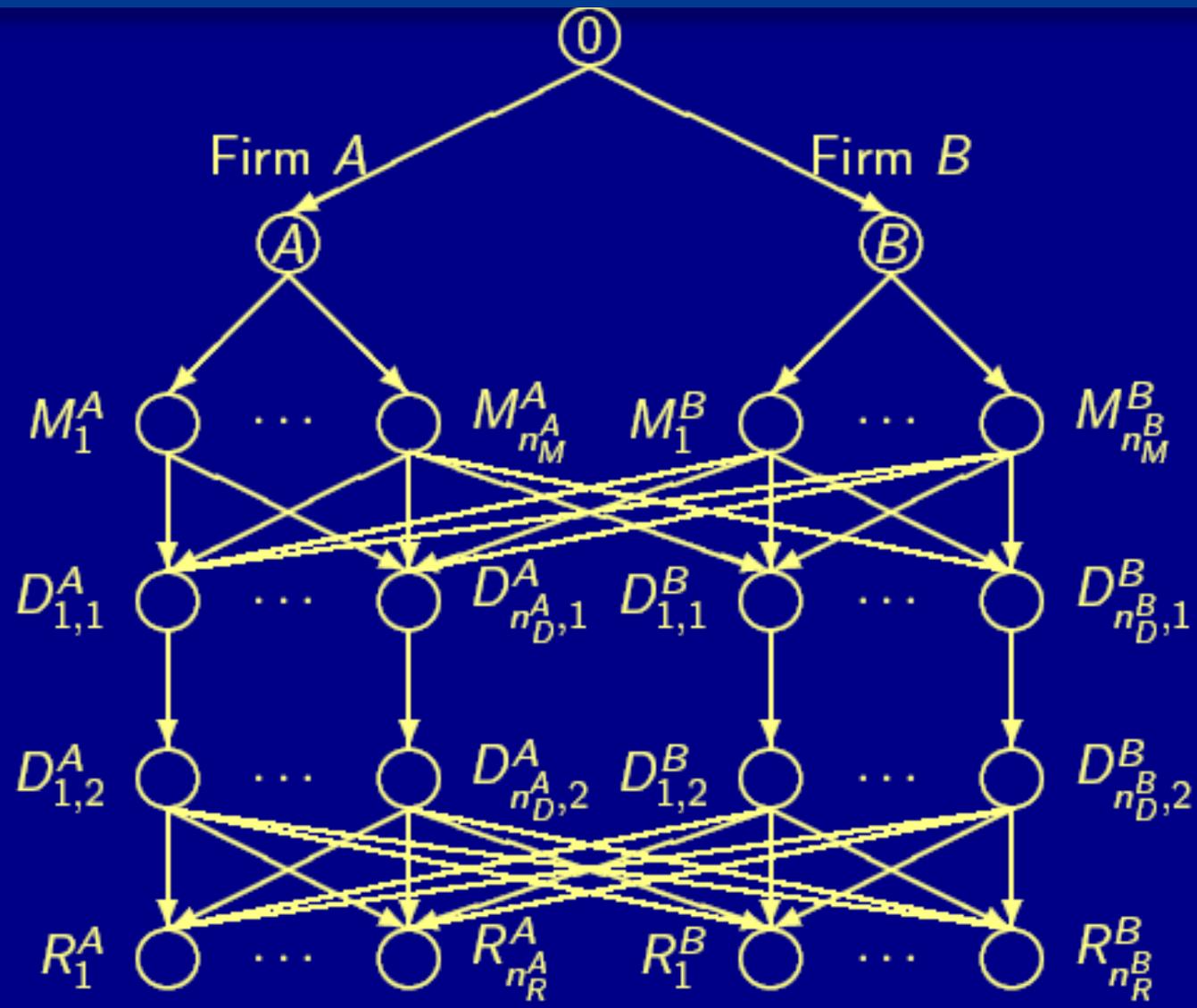
Langabeer and Seifert (2003) determined a direct correlation between how effectively supply chains of merged firms are integrated and how successful the merger is. They concluded, based on the empirical findings of Langabeer (2003), who analyzed hundreds of mergers over the preceding decade, that

Improving Supply Chain Integration between Merging Companies is the Key to Improving the Likelihood of Post-Merger Success!

Supply Chain Prior to the Merger



Supply Chain Post-Merger



Quantifying the Synergy of the Merger

The synergy associated with the total generalized costs which captures the total generalized costs is defined as:

$$S^{TGC} \equiv \left[\frac{TGC^0 - TGC^1}{TGC^0} \right] \times 100\%$$

This framework can also be applied to teaming of humanitarian organizations in the case of humanitarian logistics operations; <http://hlogistics.som.umass.edu>

Humanitarian Logistics: Networks for Africa



Research



Practice

Education



Rockefeller Foundation Bellagio Center Conference, Bellagio, Lake Como, Italy

May 5-9, 2008

Conference Organizer: **Anna Nagurney**, John F. Smith Memorial Professor
University of Massachusetts at Amherst



Source: BBC News

Ethiopia's Food Crisis

Flooding in Kenya



Source: www.alertnet.org

Famine in Southern Africa



Source: BBC News

Humanitarian Relief

In 2001 the total U.S. expenditure for humanitarian economic assistance was \$1.46B, of which 9.7% represents a special supplement for victims of floods and typhoons in southern Africa (Tarnoff and Nowels (2001)).

The period between 2000-2004 experienced an average annual number of disasters that was 55% higher than the period of 1995-1999 with 33% more people affected in the more recent period (Balcik and Beamon (2008)).

According to ISDR (2006) 157 million people required immediate assistance due to disasters in 2005 with approximately 150 million requiring assistance the year prior (Balcik and Beamon (2008)).

Humanitarian Supply Chains

The supply chain is a critical component not only of corporations but also of humanitarian organizations and their logistical operations.

At least 50 cents of each dollar's worth of food aid is spent on transport, storage and administrative costs (Dugger (2005)).

The costs of provision may be divided among different products (food, clothing, fuel, medical supplies, shelter, etc.), which may increase efficiencies and enhance the organizations' operational effectiveness.

Vulnerability of Humanitarian Supply Chains

Extremely poor logistic infrastructures: Modes of transportation include trucks, barges, donkeys in Afganistan, and elephants in Cambodia (Shister (2004)).

To ship the humanitarian goods to the affected area in the first 72 hours after disasters is crucial. The successful execution is not just a question of money but a difference between life and death (Van Wassenhove (2006)).

Corporations' expertise with logistics could help public response efforts for nonprofit organizations (Sheffi (2002), Samii et al.(2002)).

In the humanitarian sector, organizations are 15 to 20 years behind, as compared to the commercial arena, regarding supply chain network development (Van Wassenhove (2006)).

The Integrated Humanitarian Supply Chain

Humanitarian organizations may not only benefit from multiproduct supply chains (cf. Perea-Lopez, Ydtsil, and Grossman (2003)), but also from the integrated management and control of the entire supply chain (Thomas and Griffin (1996)).

Coordination enables the sharing of information, which, according to Cachon and Fisher (2000), can reduce supply chain costs by approximately 2.2%.

By offering services to enhance the World Food Programs existing logistics, the humanitarian organization, TPG, reduced operating and delivery costs enabling WFP to feed more people (Shister (2004)).

Contributions

We build on supply chain network models with nonlinear costs that can also capture the reality of congestion, which may occur in humanitarian disaster relief operations.

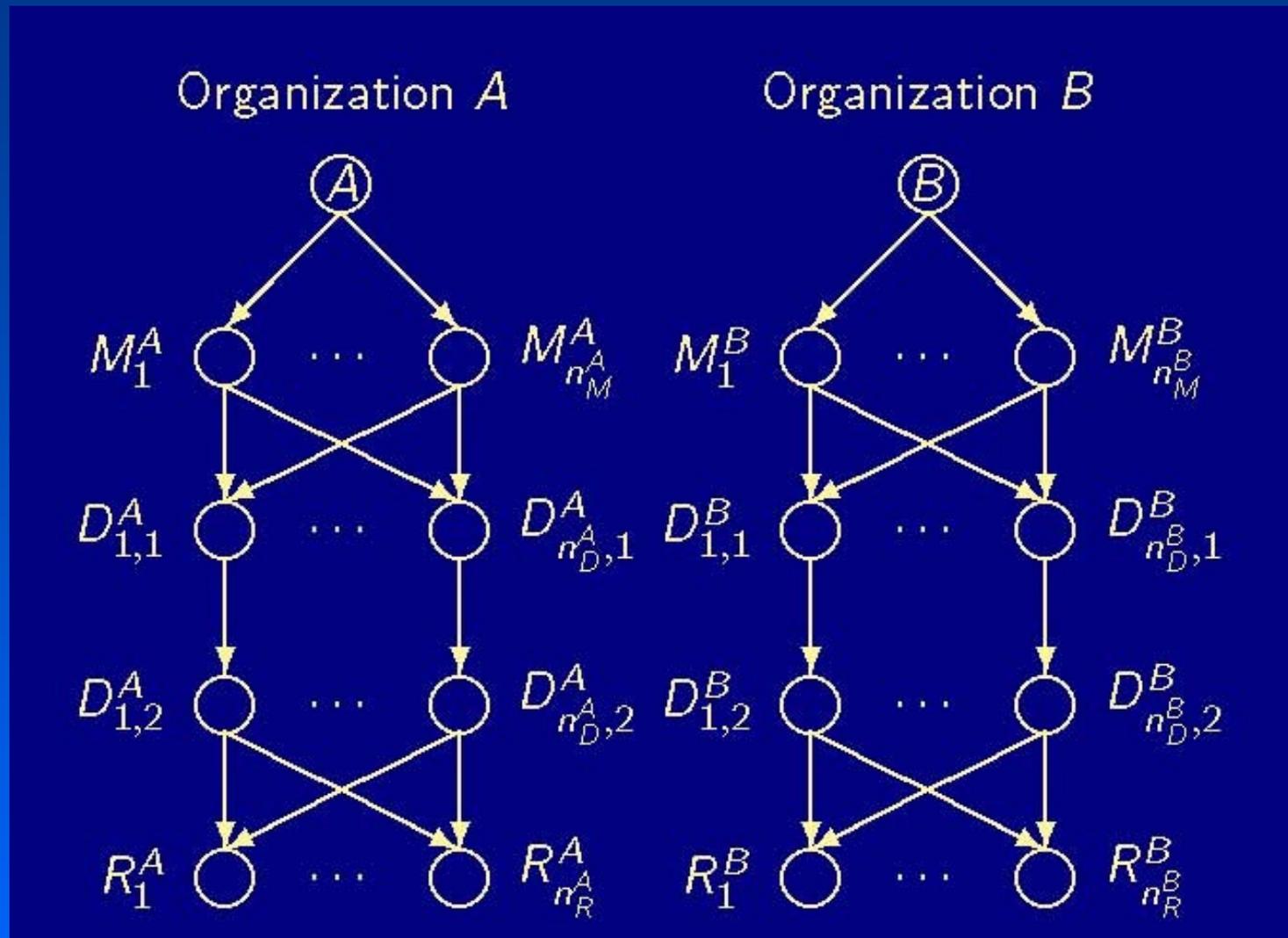
We build on the recent work of Nagurney (2009) who developed a system-optimization perspective for supply chain network integration in the case of horizontal mergers.

Contributions

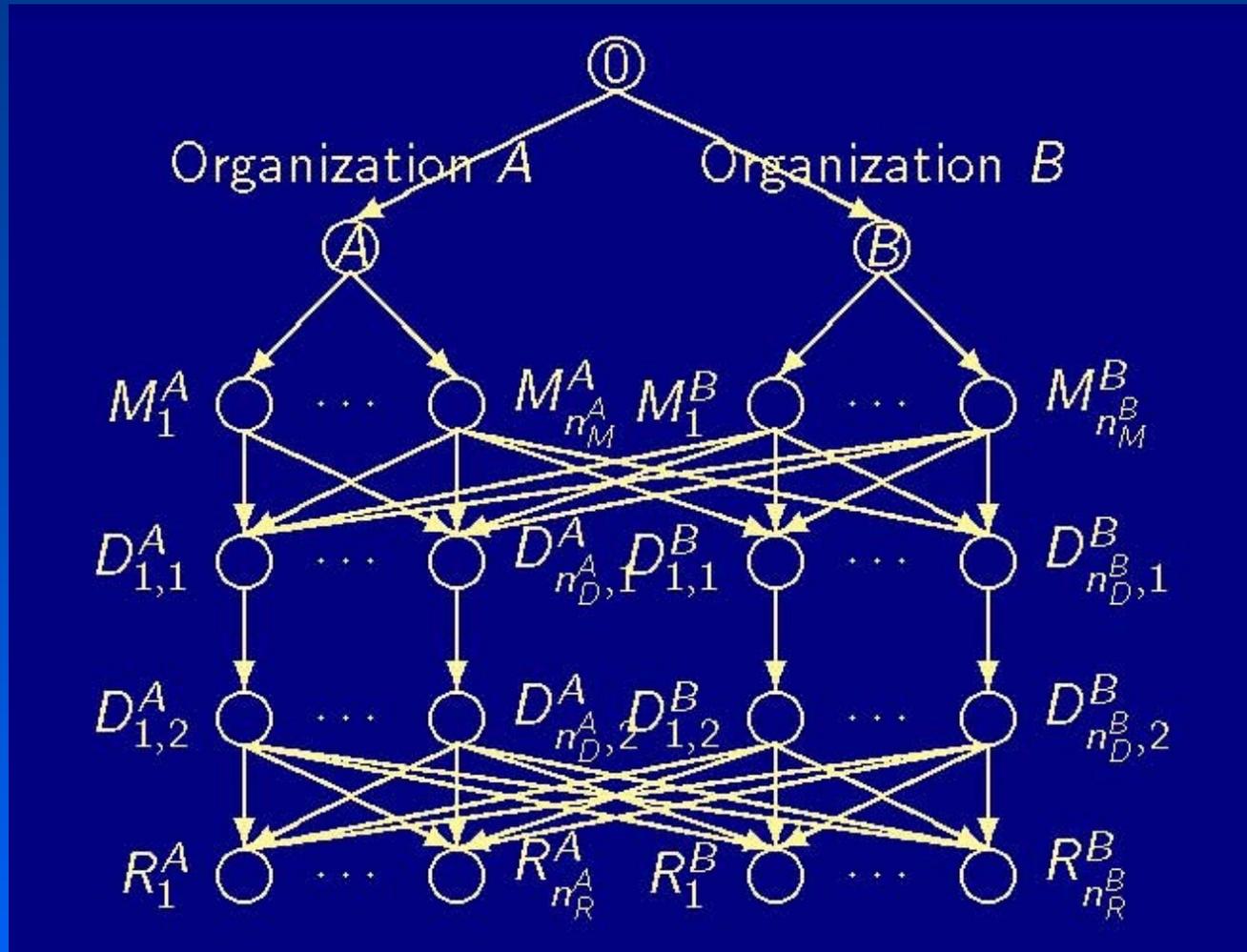
We also focus on supply chain network integration and we extend the contributions in Nagurney (2009) to include multiple products and with a humanitarian logistics perspective.

We analyze the synergy effects associated with the “merging” of two humanitarian organizations, in the form of the integration of their supply chain networks, in terms of the operational synergy. Here we consider not only monetary costs but rather, generalized, costs that can include risk, environmental impacts associated with the humanitarian operations, etc.

Supply Chains of Humanitarian Organizations A and B Prior to the Integration



Supply Chain Network after Humanitarian Organizations A and B Integrate their Chains



Quantifying Synergy Associated with the Integration of Multiproduct Decision-Making Organizations

The synergy based on total costs and proposed by Nagurney (2007), but now in a multiproduct context, which we denote here by S^{TC} , can be calculated as the percentage difference between the total cost pre vs the total cost post the integration:

$$S^{TC} \equiv \left[\frac{TC^0 - TC^1}{TC^0} \right] \times 100\%.$$

References - for Further Reading

Link to Network Economics course materials as well as several other related courses conducted by Nagurney on her Fulbright in Austria:

http://supernet.som.umass.edu/austria_lectures/fulmain.html

Overview article on Network Economics by Nagurney:

<http://supernet.som.umass.edu/articles/NetworkEconomics.pdf>

Background article on the importance of the Beckmann, McGuire, and Winsten book, *Studies in the Economics of Transportation*:

http://tsap.civil.northwestern.edu/boyce_pubs/retrospective_on_beckmann.pdf

Preface to the translation of the Braess (1968) article and the translation:

http://tsap.civil.northwestern.edu/bouce_pubs/preface_to.pdf

<http://homepage.rub.de/Dietrich.Braess/Paradox-BNW.pdf>

Link to numerous articles on network modeling and applications, vulnerability and robustness analysis, as well as network synergy:

<http://supernet.som.umass.edu/dart.html>

Link to books of interest: <http://supernet.som.umass.edu/bookser.html>



The Virtual Center for Supernetworks



Supernetworks for Optimal Decision-Making and Improving the Global Quality of Life

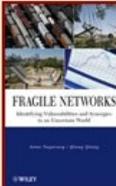
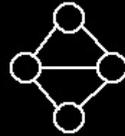
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The Virtual Center for Supernetworks at the Isenberg School of Management, under the directorship of Anna Nagurney, the John F. Smith Memorial Professor, is an interdisciplinary center, and includes the Supernetworks Laboratory for Computation and Visualization.

Mission: The mission of the Virtual Center for Supernetworks is to foster the study and application of supernetworks and to serve as a resource to academia, industry, and government on networks ranging from transportation, supply chains, telecommunication, and electric power networks to economic, environmental, financial, knowledge and social networks.

The Applications of Supernetworks Include: multimodal transportation networks, critical infrastructure, energy and the environment, the Internet and electronic commerce, global supply chain management, international financial networks, web-based advertising, complex networks and decision-making, integrated social and economic networks, network games, and network metrics.

<p>Announcements and Notes from the Center Director Professor Anna Nagurney</p> <p>Updated: March 14, 2010</p>	<p>Professor Anna Nagurney's Blog</p> <p>RENeW</p> <p>Research, Education, Networks, and the World: A Female Professor Speaks</p>	<p>INFORMS Podcasts: Anna Nagurney on Supernetworks</p> <p>Why did closing New York's Time Square to cars improve traffic? How are energy and finance like large networks? Can biologists learn from operations researchers? Anna Nagurney, Director of the Virtual Center from Supernetworks at UMass Amherst shares fascinating insights about networks in the latest INFORMS podcast. Tune in at www.scienceofbetter.org/podcast</p> 	<p>June 10- 14, 2009 New York City</p> <p>World Science Festival</p>
<p>New Book</p> <p>Fragile Networks</p> <p>Available June 2009</p> 	<p>Spring 2010 Operations Research / Management Science Seminar Series</p> 	<p>Photos of Center Activities</p> 	<p>The Braess Paradox Translation</p> <p>Information Photos</p> 
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Thankyou!

For more information, see
<http://supernet.som.umass.edu>



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