Humanitarian Operations

Pinar Keskinocak

H. Milton Stewart School of Industrial & Systems Engineering
Georgia Institute of Technology

Promoting human welfare –
“Doing good with good OR”

- Natural and manmade disasters
- Ongoing problems
  - Energy, water, food, environment, poverty, terrorism & war,
    health, education, democracy, population
OR/MS Research in Public Sector

- Chaiken and Larson (1972), Methods for Allocating Urban Emergency Units: A Survey
- Larson (1972), Urban Police Patrol Analysis
- Larson and Odoni (1981), Urban Operations Research
- Jones and Eden (1981), O.R. in the Community
- Pollock, Rothkopf, Barnett (1994), eds., Operations Research in the Public Sector
- Johnson and Smilowitz (2007), Tutorial on Community Based Operations Research
- Kaplan (2008), Adventures in Policy modeling! Operations Research in the Community and beyond

Public sector examples

- Improving the performance of fire and police departments
- Delivery of meals to senior citizens (Meals-on-Wheels)
- Delivery of blood to hospitals
- Housing
- Needle exchange
- Drug policy – enforcement vs. treatment?
- Guns and violence
- Interlibrary loan delivery
- Public transportation

“Routine” events vs. “disasters”
Outline

- Overview and motivation
- Players/stakeholders
- Demand
- Supply
- Challenges
- Examples

Challenges, differences from the for-profit world, potential research directions

Types of disasters

- Disasters
  - Natural
    - Sudden Onset
      - Predictable Location
        - Predictable Timing
          - Hurricanes
          - Floods
      - Unpredictable Location
        - Unpredictable Timing
          - Tsunamis
  - Slow Onset
    - Famine
    - Drought
- Man-Made
  - Sudden Onset
    - Terrorist attack
    - Chemical leak
  - Slow Onset
    - Political crisis
    - Refugee crisis
Impact of disasters on people

- 6,637 natural disasters between 1974-2003 worldwide
- More than 2 million deaths
- 5.1 billion cumulatively affected people
- 182 million homeless people
- Reported damage: US$1.38 trillion

- Only in 2005, over 180,000 deaths and over US$ 200 billion economic loss occurred

Sources: (1) THIRTY YEARS OF NATURAL DISASTERS 1974-2003: THE NUMBERS - Centre for Research on the Epidemiology of disasters
(2) http://www.weforum.org/en/initiatives/drn/index.htm

Economic losses due to disasters

<table>
<thead>
<tr>
<th></th>
<th># people died/year</th>
<th>Economic damage/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last 50 years</td>
<td>~100,000</td>
<td>US$10.6 billion</td>
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<tr>
<td>Last 15 years</td>
<td>~41,000</td>
<td>US$29 billion</td>
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Total economic damages: all natural disasters (in current US$ billion) 1991 - 2005

Economic losses due to disasters

Relief is a “growth market”, with governmental aid doubling from 1990 to 2000

Disaster Timeline

Pre-disaster Mitigation & Preparedness
- Assessment
- Risk factors
- Vulnerability
- Planning
- Infrastructure
- Policy making
- Capacity building
- Pre-positioning resources
- Training/education

Disaster Response
- Relief operations:
  - First phase: Medic, food, shelter
  - Second phase: Housing
    - Food supply chain building
- Logistics stages:
  - Mobilization and procurement
  - Long haul
  - The last mile

Post-disaster Recovery
- Debris cleaning
- Infrastructure rebuilding
- Re-establishing communities
- Measure the effects of:
  - Infrastructure
  - Planning
  - Response
- Short and long term
- Lessons learned, feedback to planning and response
### Players/stakeholders

<table>
<thead>
<tr>
<th>Donors &amp; suppliers</th>
<th>Recipient agency</th>
<th>Delivering agency</th>
<th>People in need</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Government</td>
<td>NGOs</td>
<td>• Global or local NGOs</td>
<td></td>
</tr>
<tr>
<td>• Foundations</td>
<td>• IFRC</td>
<td>• Local organizations or governments</td>
<td></td>
</tr>
<tr>
<td>• Companies</td>
<td>• World Vision</td>
<td>• Military</td>
<td></td>
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<td>• WFP</td>
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<td></td>
<td>• CARE</td>
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<td>• Red Cross</td>
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<tr>
<td></td>
<td>• ... Governments</td>
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</table>

Coordination and collaboration is key!
- UNJLC, institutionalized in 2002, “facilitate and support the coordination of logistics capabilities among co-operating humanitarian agencies
- AidMatrix – portal to match donors and agencies

### Inter-organizational collaboration

- Fedex & Heart to Heart International and Red Cross
- UPS & CARE (& Georgia Tech)
- DHL & IFRC (Red Cross and Red Crescent) and UN
Why should industry care?

- Corporate social responsibility
- Responsibility towards employees
- Companies need to be involved in security and relief because “being dead is bad for business”
  
  Entrepreneur Stanley Weiss
  Business Executives for National Security

Industry support (Tsunami)

- UPS
  - Millions in monetary aid
  - Airlifted medical supplies and emergency relief items
  - Employees in affected areas collected clothing and blankets for donation
  - Engineers offered logistics expertise
  - Donated to Gifts In Kind International to help deliver products to emergency efforts and community-based health and human services agencies around the world

- FedEx
  - Complimentary shipping and storing of emergency supplies
  - Trained volunteers and financial support
  - Transportation services for distribution of medical supplies:
    - Pharmaceuticals, first aid, hygiene kits, water purification systems

- Money
- Resources
  - Capital
  - Human
- Expertise
Industry support (Tsunami)

- COSCO (Chinese shipping company)
  - Offered emergency seaborne transportation
  - Contributed to the Red Cross (10 million RMB)
- DHL (logistics subsidiary of Deutsche Post World Net)
  - Donated flight charters and money
- Deutsche Post World Net
  - Transported customer donated items to collection center where goods were auctioned and funds donated to aid organizations

“Logistics companies and Asian Tsunami relief”, Ethical Corporation Jan 2006

Walmart (Hurricane Katrina)

- Significant cash and supplies assistance
  - Donated $18 million in cash for emergency efforts
  - Provided $3 million in merchandise and in-kind donations to shelters
  - Provided $13 million assistance to store employees
  - Raised $8.5 million from customer contributions
- Other contributions
  - Opened a “tent store” with survival supplies in needy areas
  - Allowed vacant facilities to be used as shelters, supply depots, and food pantries
  - Relocated displaced employees to other stores
- In one town, in the first few days more than 90% of supplies were coming from Walmart

www.walmartfacts.com
Inter-organizational collaboration

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Fedex & HHI
DHL & UN

- Deutsche Post World Net (owner of DHL) announced partnership with United Nations to strengthen disaster preparedness
  - Will train UN workers, local groups, and custom officials
  - Training and partnership offered between the disasters is key...
    - "Often it’s not the goods that are lacking or the airplanes to bring in the goods, but the knowledge of how to distribute them in the right way"
      - Monika Wulf-Mathies of DHL

Financial Times, Dec 15, 2005

Inter-organizational collaboration

- NGO
- Govt.
- Industry

• Disaster Resource Network
Disaster Resource Network

- Initiative of World Economic Forum
  - Facilitate the development of public-private partnerships
  - Cross-industry guiding principles for private sector engagement in humanitarian relief
  - Support the engagement of private sector companies in response operations
- Consists of trained specialists from the airline and air cargo industry
  - Emirates Air, Aramex, Chapman Freeborn, DHL, DNATA, and TNT (TPG)
- 60+ private sector volunteers with release time from employers
- Developed in aftermath of Iran earthquake
- Airport Emergency Team took over Sri Lanka Colombo airport after tsunami
  - Reorganized unloading off the tarmac and directly to trucks to increase bottleneck capacity
  - Kept track of shipments arriving and reported back to organizations
- Moved 3000 tons of aid to Louisiana after Hurricane Katrina
  - Brought in pallets, leased forklifts
  - Organized a warehouse
- Delivered 6000 sets of shelter, food and water after Pakistani earthquake


Demand drivers

- Type, magnitude, location of the hazard
- Vulnerability
  - Local infrastructure, education, local economy, access to resources, local government and institutions, population size, recent events
- Local capacity
  - How well prepared is the community?

\[
\frac{\text{Vulnerability}}{\text{Capacity}} \times \text{Hazard}
\]

⇒ Highly unpredictable and dynamically changing!
Supply Types

- Relief items
- Personnel/volunteers
- Other resources

Supply Sources

- Procure after the fact (until recently)
- Most donations are earmarked for a particular disaster
- High uncertainty in the quantity, timing, and the type of donations
- Competition among NGOs for supply sources
- Tradeoffs in the choice of suppliers
- Supply availability highly dependent on the location
- Low visibility into existing inventory
Challenges with Donations

- Right product? Right place?
  - South African Food Crisis in 2002 (Tomasini and Van Wassenhove, 2004)
    - Worst food crisis in Africa in a decade
    - Most of the food donated by U.S. government
    - Rejected by local governments, stockpiles at ports or in transit
  - Inappropriate donations can cause bottlenecks in the supply chain
- The impact of the donations on local economy
  - U.S. agribusiness → US govt → deliver overseas → NGOs → sell in local markets → use $$ for projects
  - CARE gave up $45 million in food aid (2007)

Delivery

- Long haul and last mile
  - Financial, staff, equipment, supplies
- Transportation & communication infrastructure
  - Highly dependent on the location
  - May be damaged or disrupted
  - Dynamically changing conditions
- Political situation in the affected area and around
  - Cyclone in Myanmar vs. earthquake in China
Current state of SCM in most NGOs

- Decentralized
  - Across country offices, or even within the same country office
- No SCM “unit”, no (or very few) staff with SCM training
- Lack of standard procedures
  - “Ad hoc” operations for each response, establish/dismantle a unit for each disaster
  - Highly dependent on the staff and volunteers at that time
  - Lessons learned not carried over
- Lack of performance measurements (NGO and vendors)
- Little or no visibility about inventory
- Low usage of “technology”

Current state of disaster response – Tsunami example

- Assessment and planning
  - 62% said assessment plan was insufficient
  - Significant transportation difficulties
- Supply chain management
  - Only 26% had access to software for visibility
  - Plan of action was not communicated with the field
  - Few objectives or measurements in place for supply chain
- Collaboration and coordination
  - 44% did not work with other NGOs when planning supply chain
  - Organizations were chasing the same products

*Logistics and the Effective Delivery of Humanitarian Relief, Fritz Institute survey report
Compare with SCM in Walmart

- Sophisticated technology used for SCM
  - Design, planning, execution, communication
- Standardized/synchronized processes
- High visibility into resources and inventory
- Focus on SCM, trained experts
- Changes in demand, supply, and infrastructure are not “sudden onset”

SCM and Humanitarian Efforts

- “What is needed are supply managers without borders: people to sort goods, identify priorities, track deliveries and direct the traffic of a relief effort in full gear”
  Doctors Without Borders spokesman, on refusing donations of money
  Economist.com Global Agenda, Jan 5, 2005
- “We don’t need a donors’ conference, we need a logistics conference”
  European Ambassador at post-Tsunami donor conference
  New York Times, Jan 6, 2005
### OR/MS Research Across Disaster Timeline

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<td>40%</td>
<td>21%</td>
<td>24%</td>
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<tr>
<td>➤ 1/2 in risk analysis</td>
<td>➤ evacuation models</td>
<td>➤ VRP models with different objective functions,</td>
</tr>
<tr>
<td>➤ Majority focus on man-made emergencies</td>
<td>➤ the impact of health system preparedness on disaster outcomes</td>
<td>➤ Heuristics for crew assignment and routing of helicopters</td>
</tr>
<tr>
<td>➤ Oil spills, industrial accidents, computer network crashes</td>
<td></td>
<td>➤ Set covering models where multiple resources are needed to cover a location</td>
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<td></td>
<td></td>
<td>➤ Allocating of resources to different areas during search and rescue operations after an earthquake</td>
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12% on natural disasters, 48% on man-made emergencies, 40% general methods

Source: Altay and Green (2005), OR/MS Research in Disaster Operations Management

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#### Alternative classification

(as in Corbett and Van Wassenhove, 1993 and Denizel et al., 2003)

- Management science 50%
- Management engineering 15%
- Management consulting 35%

“Need real problem settings and real data along with novel solution approaches with generalizable results and description of future research implications.” (Denizel et al, 2003)

12% on natural disasters, 48% on man-made emergencies, 40% general methods

Source: Altay and Green (2005), OR/MS Research in Disaster Operations Management
Examples

- CARE: Inventory pre-positioning
  - Marco Gutierrez, Pinar Keskinocak (Georgia Tech) and Serhan Duran (METU)
  - Rigoberto Giron, John Solomon, David Gazashvili (CARE)

- Red Cross: Planning for pandemic flu
  - Ali Ekici, Pinar Keskinocak, Julie Swann, Pengyi Shi (Georgia Tech)
  - Marilyn Self (Red Cross)

- Debris collection
  - Antonio Cabrajal, Ozlem Ergun, Pinar Keskinocak, Monica Villarreal (Georgia Tech)

Summary of problem characteristics

- High complexity
- High uncertainty, dynamically changing environments, information may not be available or reliable
- Timing is key for decisions and actions
- Multiple players, multiple perspectives, multiple/conflicting objectives
- Difficult (but very important!) to assess the potential impact and consequences of actions (short term and long term)
- Important to consider the human/social/behavioral component
- Interdisciplinary nature

Lots of opportunities for adapting existing models and methods or developing new ones!
Center for Humanitarian Logistics

**MISSION:** Positive humanitarian “impact” worldwide

To improve humanitarian logistics and ultimately the human condition by system transformation and organization effectiveness through education, outreach, and solutions.

Education  Outreach  Research/Applications

Co-directors: Ozlem Ergun, Pinar Keskinocak, Julie Swann

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**Resources on the Web for Disaster News**

- [http://www.disasternews.net/](http://www.disasternews.net/)
- [http://redcross.wordpress.com/](http://redcross.wordpress.com/) (American Red Cross)
- [http://www.alertnet.org/](http://www.alertnet.org/) (by Reuters foundation)
- [http://www.nationalserviceresources.org/disaster-updates](http://www.nationalserviceresources.org/disaster-updates) (a weekly update of disasters)