Supply Chains for Disaster Response and Resilience: an Academic Perspective

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Supply chains for humanitarian aid

• Goal: supply goods and services to people affected by emergencies
  • Estimate demand, assess infrastructure
  • Procure supplies and manage inventory
  • Locate warehouses, vehicle fleets
  • Route vehicles, make deliveries

Credit: DigitalGlobe. www.gearbits.com

http://www.wfp.org/photos/logistics-warehouse
Photo: WFP/Richard Lee
Response and resilience

- Two ways to be resilient to disaster:
  - Aid response capability
  - Markets and ability to pay

- This presentation focuses on response capability, but markets are also critical
An Academic Perspective

• Research
  • *Understand and improve disaster response systems*
  • Glimpses of four research projects
  • Labs and centers for disaster response logistics research

• Education
  • *Develop leaders in crisis response*
  • Degree programs
  • Courses
  • Exercises, experience
With a fleet of vehicles, and some idea of the priorities in this emergency, how do you decide which cargo to load on each truck?
Project 1: Transportation Planning

Erica Gralla (GW), Jarrod Goentzel (MIT), Charles Fine (MIT)
UN World Food Programme, Logistics Cluster

- Total deliveries is most important, cost least
- Prefer to prioritize weighted mix of items, locations

- Use utility function for decision support
  - Score alternative plans: which cargo to load on next truck?
  - Guide optimization
  - Ensure consistent prioritization

\[ U(\text{plan}) = u(\text{tot. delivered}) + u(\text{prio. by item}) + u(\text{prio. by loc.}) + u(\text{speed}) + u(\text{cost}) \]
Project 2: Transportation procurement

Marie-Eve Rancourt (UQÀM), François Bellavance (HEC Montréal), Jarrod Goentzel (MIT)

UN World Food Programme Ethiopia

• In poorly understood transportation markets, how does a shipper know if he is paying the right price?

• In North America, distance alone explains about 80% of the variability in prices.

• In Ethiopia, what explains the variation? Not distance alone.

Chart source: Chris Caplice, MIT CTL
Data source: Chainalytics LLC

Data source: WFP Ethiopia
Project 2: Transportation procurement

Marie-Eve Rancourt (UQÀM), François Bellavance (HEC Montréal), Jarrod Goentzel (MIT)
UN World Food Programme Ethiopia

• Factors that best explain variation:
  • Competition
  • Infrastructure

• Policies should target these factors

• Potential impact: “What-if” scenarios

• Better road conditions reduce shipping costs by 18% (intl) and 12% (domestic)

• Increased competition reduces shipping costs by 44% (intl) and 39% (domestic)
Project 3: Information for decision support

Julia Moline (MIT), Jarrod Goentzel (MIT), Erica Gralla (GW)
FEMA, US Coast Guard, Lincoln Laboratories

• Utilize all collected information to aid decision-making

Deliver information to survivors, and ask questions about needs

Understand who needs what: inform resource allocation for service delivery

• Most-needed services
• Trends in requests
Project 4: Information requirements

Erica Gralla (GW), Jarrod Goentzel (MIT), Bartel van de Walle (Tilburg)
UN Office for the Coordination of Humanitarian Affairs

- What do response decision-makers need to know?

**Context and Scope**
- Scope of emergency situation
  - Impact: damage to infrastructure, livelihoods, etc.
- Geographic areas affected
- Assistance requirements
- Affected population
  - Number of affected, locations
  - Status of affected: displaced, vulnerable, etc.
- Context: socio-political, environment, etc.
  - Local socio-political context
  - Local environmental context, livelihoods
  - Local community capacity, coping mechanisms
- Public and media perception
  - Public, awareness, attention
- Media perception
- Political will, donor will

**Humanitarian Needs**
- Needs
  - Number in need
  - Types of needs
  - Locations of needs
  - Needs of sub-groups: displaced, vulnerable
- Priorities
  - Geographic priorities
  - Sector priorities
  - Within-sector priorities

**Capacity and Response Planning**
- Other actors' capacity and response:
  - Including government, military, local community, aid organizations
- Responses of other actors
- Involvement of military, government
- Internal capacity and response
  - Internal response plan
  - Internal capacity, structure
  - Available resources: financial, personnel, stocks, technical

**Looking Forward**
- Long term reconstruction
- National development strategies
- Needs and plans for recovery
- Preparedness
- Information to collect before crisis

**Operational Situation**
- Security and risk
  - Security and future threats
  - Risks and risk tolerance
- Access
  - Limits to access
  - Logistics capacity and structure
- Monitoring, early warnings
  - Monitor potential problems
  - Measuring and outputs
  - Measurable indicators for output
  - Minimum standards and strategic priorities

**Coordination and institutional structures**
- Coordination and information-sharing mechanisms
- Coordination of international response, various levels
- Coordination of internal response: local, national, regional
- Relevant laws and standards

**Responder Requirements**
- Basic infrastructure for responders
- Security, access

**Information**
- Available information
- Sources of information
- Accuracy, validity
- Agreement on needs
- Extent of assessments
- Actions to improve access to information

**Response timeline**
Research Centers

Bring together research and education
GW Institute for Crisis, Disaster, and Risk Management

- Research, education, and operational participation
- 18 years research, 14 years education programs
- Research areas:
  - Government and corporate crisis mgt
  - Risk management
  - Planning for extreme events
  - Disaster response and recovery
  - Transportation system safety, security
  - Volunteer management
  - Medical and public health emergency management

Gralla Lab

- www.seas.gwu.edu/~egralla/
- Key topics
  - Humanitarian logistics
  - Human decision-making
  - Decision support

Training exercises and simulations

Transportation planning

www.gwu.edu/~icdrm
Labs worldwide

- MIT (Boston)
- UQAM (Montreal)
- INSEAD (Fontainebleau)
- Georgia Tech (Atlanta)
- Northwestern (Chicago)
- Hanken (Finland)
- ...
Teaching

Programs, courses, exercises, etc.
GW Institute for
Crisis, Disaster, and Risk Management

- **Masters** in Engineering Management with focus in Crisis, Emergency, and Risk Management
- **PhD** in Engineering Management
- **Graduate Certificates**: CERM, EM & Public Health, Homeland Security Emergency Preparedness and Response
- 250+ Masters and Certificate graduates, ~40 PhD graduates

www.gwu.edu/~icdrm/
Educational programs beyond GW

• Variety of masters programs, in engineering, management, international affairs
  • MIT – Engineering Systems, SCM, Technology and Policy, Transportation
  • Georgia Tech – Industrial and Systems Engineering
  • Harvard – Public Health, Interdisciplinary
  • Tufts – Humanitarian Assistance, Law and Diplomacy
  • Many more programs with options for relevant concentrations

• Executive education

• PhD programs
GW ICDRM Core Courses

• **Crisis and Emergency Management**

• **Information Technology in Emergency Management**
  • The role of information in crisis and response management, determining disaster and crisis information requirements; information technologies applied to crisis, disaster and emergency management; causes and effects of information breakdowns during crises and disasters.

• **Management of Risk and Vulnerability**
  • Developments of concepts required for risk based planning and risk management. Objectives of and methods for vulnerability assessment for natural disasters, technological hazards, and terrorist threats. Risk analysis, risk perception, risk communication and risk mitigation.

• **Management of Terrorism Preparedness and Response**
  • Terrorism, terrorist methods, and human/infrastructure vulnerability are described. Current preparedness and response programs. Mitigation, preparedness and response requirements to manage mass terrorism within the context of all-hazard emergency management. Case studies.

• **Medical and Public Health Emergency Management**
  • Medical and public health management issues encountered in crises, emergencies and disasters are examined and presented at the technical level of a non-medical emergency manager. The spectrum of medical, public health, psychological and behavioral problems are described, as well as incident management organization and processes that addresses these concerns and integrate medical and public health assets into the response.
Sample Course: Humanitarian Logistics

- Humanitarian context, supply chain fundamentals
- Forecasting (Case: Red Cross)
- Needs Assessment, Distribution Tracking (Case: Haiti Earthquake)
- Procurement, Mobilization (Case: Haiti Earthquake)
- Inventory Management (Case: Partners in Health)
- Integrated Supply Chain (Case: Plumpy’Nut)
- International Transportation (Case: Djibouti Port, Port au Prince airport)
- Inland Transportation (Case: WFP Ethiopia)
- Warehousing (Case: WFP Ethiopia)
- Coordination & Prioritization (Case: UN Logistics Cluster)
- Performance Measurement (Case: International Rescue Committee)
- Technology and Information Management

Offered as ESD.283 at MIT (by Jarrod Goentzel) and to be offered at GW soon (by Erica Gralla).
Simulations, exercises, and games

• Full-scale exercises
  • UN World Food Programme
  • Boston/Harvard Humanitarian

• Tabletop exercises and games
  • Wide variety, e.g. beer game
  • Used in courses throughout GW, elsewhere

• Educational value
  • Skills
  • Experience
  • Build relationships

http://humanitarian.mit.edu/education/listing
Closing Thoughts

- Diverse research projects all aimed to support good decision-making
  - Which cargo to load on a truck
  - Which transport infrastructure investments to make
  - Questions to ask in understanding the demand for services
  - Key information for disaster response decision-making

- Critical areas for future research
  - Decision support
  - Information management: prioritization, collection, analysis

- Goal is to improve the practice of disaster response
  - Research to understand systems and build knowledge
  - Education to spread knowledge, build experience and relationships, make better decisions
  - Practice: close cooperation with practitioners, to solve real problems