Humanitarian Relief LOGISTICS

Through a variety of projects, new research center at Georgia Tech aims to have a positive impact on the world by improving the multi-billion dollar humanitarian relief sector.

By Ozlem Ergun, Pinar Keskinocak and Julie Swann

PHOTOS COURTESY OF GEORGIA TECH

Natural (and man made) disasters cause billions of dollars in damage, but the impact on the lives of those affected is immeasurable.

Past catastrophes have highlighted the severe difficulties governments and global aid agencies have in planning for and responding to these events.

FEW CAN FORGET THE IMAGES BROADCASTED AROUND THE WORLD OF DAMAGE CAUSED AFTER HURRICANE KATRINA HIT THE GULF COAST AND BY THE TSUNAMI IN SOUTH ASIA. In the last few years, the world has seen an increase in major natural disasters. Unfortunately, these catastrophes are not anomalies, but rather a pattern of increased volatility often attributed to changing weather patterns and human occupation of hazardous locations – and they are expected to continue. In addition to these natural disasters, man-made crises arising from terrorist activities and war often have similar effects on populations in terms of dangerous conditions and lack of basic necessities, including shelter, water, food and safety.

With the increasing occurrence of natural and man-made disasters that leave massive destruction in their wake, quicker response and improved coordinated humanitarian relief efforts are needed to get populations in crisis the aid that they need.

Humanitarian relief aid is typically provided on an urgent basis in response to a humanitarian crisis through governments and global aid agencies. Unfortunately, past catastrophes have highlighted the severe difficulties that these organizations have in planning for, and responding to, these events. Examples are well-known: advanced warning systems for the tsunami could have reduced the injuries and fatalities; agencies had difficulty reaching Pakistani earthquake victims due to weather and damaged infrastructure; levees in New Orleans were inadequate, officials were slow to respond with help, and the aid that was procured and transported mismatched the needs. Many of these inefficiencies could have been avoided with advanced planning and capacity building, as well as effective management of response activities.

In response to this, the H. Milton Stewart School of Industrial and Systems Engineering's (ISyE) Supply Chain & Logistics Institute (SCL) at Georgia Tech established a Center of Focused Research on Humanitarian Relief Logistics to help improve the human condition through advanced science and technology. The Center, co-directed by Professors Ozlem Ergun, Pinar Keskinocak and Julie Swann, will coordinate various research, outreach and educational efforts to improve humanitarian relief planning, capacity building and effective management of response activities. Many other faculty and students from ISyE are also involved in the efforts.

The Stewart School's experience in improving logistics in private industry will be a significant strength to the humanitarian field. To address the many different kinds of issues that span across various disciplines, Ergun, Keskinocak and Swann plan to work together with an interdisciplinary team that includes other faculty and researchers across Georgia Tech's campus and beyond. They are also partnering with government agencies, nongovernmental organizations (NGOs) and private corporations. These partnerships are essential because they allow the humanitarian relief team to collect data and identify research areas that can make a greater impact. A special emphasis has been placed on building a bridge between industry and humanitarian relief aid agencies.

Researching the Infrastructure

WITHIN THE RESEARCH, significant focus areas include: (1) design of the supply chain and distribution network, (2) transportation and dynamic control, and (3) demand management, including inventory and forecasting decisions. Pro-

By incorporating decentralized behaviors into the optimization models, the network and operational tools can be designed to achieve performance closer to optimal.

jects will also include an evaluation component, as this is a crucial step towards assessing the systems, as well as the impact to the end user.

Within many of these problems, an important aspect is decentralization. When a natural, security or health crisis occurs, often the hierarchical infrastructure, such as transportation and communications networks, breaks down and the people responding to the crisis manage the recovery operations through locally based activities without observing other parts of the system. By explicitly incorporating the decentralized behaviors into the optimization models, the network and operational tools can be designed to achieve performance closer to the optimal system.

Humanitarian Research Course

IN SPRING 2007, Keskinocak developed and led a new graduate-level class in humanitarian research focusing on the applications of operations research and management science with public impact. The course topics included humanitarian logistics, preparedness (food and vaccination plans) for pandemic response, pre-positioning inventory for humanitarian response and vaccine procurement.

Students participating in the course were divided into teams to research the following real-world projects (among others) in collaboration with faculty advisors and nonprofit organizations.

Pandemic response. ***Research team: students Jad Allam, Ali Ekici, Shaudi Hosseini, Xiao Liu and Randeep Ramamurthy, advised by professors Keskinocak and Swann and motivated by discussions with the Centers for Disease Control and Prevention and the American Red Cross.***

WHEN AN EPIDEMIC OCCURS, it spreads in a limited area and affects the population in that local area. However, a pandemic could affect the entire world. Given the increased instances of the Avian flu over the past few years, experts think that a pandemic flu might happen in the near future. Epidemiologists have warned that one in every three people on the planet could be infected during a pandemic, with many of them requiring hospitalization.

With this in mind, the pandemic response team constructed a model to predict the number of people infected and geographical locations, using data for the state of Georgia. They developed optimization models to design networks to distribute food and vaccines to affected populations. They will also use the disease simulation to analyze health aspects such as the number and location of clinics to be set up including staffing requirements and logistics needs.

Georgia Tech Stewart School of ISyE Professors Julie Swann, Ozlem Ergun and Pinar Keskinocak (l-r) review a presentation on humanitarian relief logistics.

Pre-positioning inventory for emergency response. ***Research team: students Serhan Duran, Marco Guiterrez, and Adaora Okwo, advised by professor Keskinocak in collaboration with CARE-USA.***

DEMAND FOR EMERGENCY SUPPLIES such as water, tents and food caused by natural disasters is highly unpredictable. Most humanitarian organizations like CARE rely completely on local suppliers during a response to emergencies. This has the benefits of stimulating the local economy and accelerating the process of reconstruction. However, when the emergency is of a large scale, such as the Asian Tsunami, availability of local supplies can become a problem. Supplies have to be imported from unanticipated places slowing the response considerably. By stockpiling relief items in strategic locations around the world, humanitarian organizations can have supplies and transportation systems ready in anticipation of potential emergencies.

The research team analyzed the impact of such strategies on the expected timeliness of response. The team developed recommendations about the number of warehouses to open and the amount and type of supplies to store. The project complemented previous studies about pre-positioning and provided CARE with high-level guidance about these important decisions. CARE, along with three other organizations, is now starting to stockpile supplies in one of the warehouses where the highest benefit was identified and plans to expand its network gradually.

Quantitative models for vaccine procurement. ***Research team: students Aykagan Ak, Jessica Heier and Clarence Wardell, advised by professors Ergun and Keskinocak in col-***

laboration with the Pan American Health Organization (PAHO).

THE PAN AMERICAN HEALTH ORGANIZATION (PAHO) is the regional office for the Americas of the World Health Organization. Through its Revolving Fund for Vaccine Procurement (RF), PAHO procures vaccines for 37 countries in Latin America and the Caribbean. In 2006, the level of expenditure on these purchases was approximately $160 million.

The RF has supported countries with the achievement of high coverage of basic vaccines and, from 1997, with the accelerated uptake of new vaccines including measles-mumps-rubella (MMR), pentavalent (DTP-HepB-Hib) and seasonal influenza. The RF has also supported successful polio eradication and measles elimination in the region through national vaccination campaigns requiring high volume procurement of the relevant vaccines.

The PAHO-Georgia Tech collaboration set out to identify opportunities for improvement throughout the vaccine supply chain and within the vaccine procurement process specifically. The primary outcomes of the project include:

- assessment of demand forecast accuracy and recommendations for improvement,
- improved estimates of the cost of transporting vaccines,
- quantitative models for bid award allocation, and
- assessment of the benefits and the challenges of bundle bidding in vaccine procurement.

The CHALLENGE of HUMANITARIAN Relief LOGISTICS

– BY DONALD RATLIFF

Humanitarian relief is perhaps the most challenging supply chain and logistics domain.

From a technical perspective:

1. Demand for relief is largely unpredictable since it is caused by unpredictable natural and man-made events (hurricanes, earthquakes, wars, etc.) and varies tremendously in magnitude, criticality and type of materials needed.
2. Relief locations required change from one occurrence to the next and often during a single occurrence.
3. Infrastructure available to move and store relief material is often not well known and may be significantly damaged or disrupted.
4. Resources available provide support varies depending on the relief location and in many cases the degree to which the effort appeals to providers of these resources.
5. Relief supply chains must typically be designed and executed in a very short time period.
6. Visibility of needs, resources available and status are extremely limited.

From an organizational perspective:

1. There are huge coordination difficulties with multiple decentralized organizations and large numbers of individuals all trying to help.
2. Relief efforts are often funded by donations that are dramatically larger after the disaster event occurs, making it extremely difficult for relief organizations to develop and maintain the logistics expertise found in commercial organizations.
3. There is very limited information and decision technology to purchase that clearly fits the needs of humanitarian relief organizations, and there is no group within these organizations to clearly define the technology needs and advocate for development and procurement of such technology.

Contrast this with the following characteristics of best-of-breed commercial supply chains such as that of Wal-Mart.

1. There is sophisticated technology used by highly trained experts to accurately estimate demand for products, optimize the design and execution of the supply chains, provide real-time visibility of needs and status, and facilitate collaboration among entities.
2. Changes in demand, infrastructure and resources occur reasonably slowly and are generally known well in advance.
3. Supply chain and logistics is given a very high priority and is provided human resources to focus on continuous improvement.
4. There are clear lines of communication and control and a very high degree of definition and standardization of processes and synchronization among processes.

When supply chain and logistics professionals see the difficulties in providing relief to the victims of Hurricane Katrina or the wars in Africa, it is clear that our profession can and should do a better job. The big question is how? Can we design and build technology for humanitarian relief that will address the real issues and be simple enough to implement and operate to be practical? Can we bring together experts from industry and academia to develop better processes for disaster relief supply chains? The focus of the Center for Humanitarian Relief Logistics at Georgia Tech is to consider these and other innovative ways of working together to make a difference.

Donald Ratliff

Donald Ratliff *(don.ratliff@isye.gatech.edu), executive director of the Supply Chain & Logistics Institute, is UPS and Regents' Professor of Industrial and Systems Engineering (ISyE) at the Georgia Institute of Technology.*

The center is developing case studies and tabletop exercises focused on private and public organizations and their response to disaster logistics.

Education, Training and Outreach

THE HUMANITARIAN RELIEF Logistics Center's research activities will be coordinated with education, training and outreach activities to fulfill the much-needed pipeline of expertise in this area. Along with the graduate class, the humanitarian research team will host workshops, seminars, learning opportunities and short courses.

On Feb. 5, 2008, the Center for Humanitarian Logistics will host in collaboration with the Georgia Tech Business Network a panel discussion on humanitarian relief in Atlanta, with speakers from NGOs, government and industry. Past seminars organized by the center include Anthony Nsangu Simbeye, a supply chain specialist with World Vision Zambia, and Steve Hansch, who has 25 years of experience working in the humanitarian industry and teaches courses in humanitarian logistics.

Currently, graduate student Marco Gutierrez is advancing the relationship with CARE, through a grant from philanthropist Greg Block, to perform a general supply chain capabilities assessment. He will conduct an evaluation of current logistics practices and assist in preparing a supply chain improvement plan with an overall objective of enhancing its emergency preparedness and response capacity. The grant supports Gutierrez's work as well as CARE's membership in the Leaders in Logistics program with the SCL, where organization leaders partner with SCL to support research and educational programs within their respective fields.

Doctoral student Moin Islam spent the summer in Ghana, Zambia, and other parts of Africa. Islam, advised by Swann and Vande Vate, has worked with World Vision to learn more about the basic tenets of supply chain management while learning about the realities of delivering humanitarian relief. Islam's efforts were jointly supported by World Vision and EMIL.

The Humanitarian Relief Logistics Center is currently developing a number of case studies and tabletop exercises focused on both private and public organizations and their response to disaster logistics, such as The Home Depot's hurricane response efforts. These teaching tools will be available for use by other universities, NGOs, government agencies and private companies.

The center is also enabling opportunities for undergraduate students to participate in the work in humanitarian logistics. Some of these efforts include student teams who will work with the Office of the United Nations High Commissioner for Refugees (UNHCR) and the World Health Organization (WHO) in spring 2008 to improve supply chain processes and decisions through ISyE's Senior Design course. UNHCR has the mandate to work with and for refugees and displaced persons. The team will focus on improving the response time of the supply chain to needs in the field including such issues as pre-positioning. The team working with WHO will do predictive modeling for diseases such as malaria and resource allocation across a country in Africa to improve lives saved. Keskinocak's graduate course will be offered again in spring 2008 with new projects and partnerships under development.

The Center's web site (www.scl.gatech.edu/research/humanitarian/) will also serve as a place where people who are interested in working in humanitarian relief and organizations

When a crisis occurs, often the hierarchical infrastructure, such as transportation and communications networks, breaks down.

looking for talent with expertise in logistics and supply chain can connect through a job placement board.

Effecting Change

DISASTER LOGISTICS is an instrumental tool for humanitarian organizations; however, it can apply to private industry as well, especially to companies that take leadership in social responsibility. Working with the Center of Focused Research on Humanitarian Relief Logistics in the Stewart School of ISyE is one way to have a positive impact on the world. This interdisciplinary center fills a critical need in the several billion-dollar humanitarian relief sector. The overall area needs a tremendous amount of work, so there are many opportunities to have substantial impact.

For questions, advance news of events or to become involved in the Humanitarian Relief Logistics Center, contact the humanitarian relief team at humlog@isye.gatech.edu. ORMS

__Pinar Keskinocak__ is an associate professor and __Ozlem Ergun__ and __Julie Swann__ are assistant professors with the H. Milton Stewart School of Industrial and Systems Engineering at Georgia Institute of Technology. All three are co-directors of the school's Center of Focused Research on Humanitarian Relief Logistics.

A PASSION for Positive GLOBAL IMPACT

Georgia Tech ISyE professors ***Ozlem Ergun, Pinar Keskinocak*** and ***Julie Swann*** have a passion for applying their industrial engineering and O.R. knowledge and expertise in ways that seek to develop advanced response methods and technologies that will have a positive global impact. Here is a little insight into what motivates them.

Ergun and Keskinocak were born and raised in Turkey, a country that has been inundated by both natural and man-made disaster. In 1999, for example, the country experienced a 7.4 magnitude earthquake in Izmit that left tens of thousands of people dead or homeless.

In 1994 and 2002, Turkey responded to devastating oil spills as the result of shipping accidents in Bosporus, causing extensive contamination to seawater and marine life. The country also faces debilitating forest fires that recur almost every year. Recently, scientists have predicted that in the next 30 years, there is a 60 percent chance that Istanbul will be hit with a major earthquake.

In addition to natural and man-made disasters, Turkey is a developing country. Ergun and Keskinocak have personally experienced the challenges that citizens face as a result of growth. They have both developed an astute awareness of the issues associated with such areas as poverty, education, women's rights, unemployment, rapid urbanization and environmental degradation, among others.

Ozlem Ergun

Ozlem Ergun does research in helping organizations to better run their transportation and logistics operations. She has recently focused on understanding how collaboration among different entities can help the entities be more efficient, as well as create value for the overall system. One of the main challenges in responding to a humanitarian event is to coordinate the actions of many different private, government and non-governmental organizations. Ergun enjoys applying her research in collaborative decision-making to a fundamental problem in the humanitarian area where better coordination might translate into saving lives.

Pinar Keskinocak

While ***Pinar Keskinocak*** remains involved in the areas of supply chain management and transportation, helping companies improve their operations and profitability, she has always been passionate about ways to apply operations research and management science techniques to positively impact human lives. As a result, she spends a significant portion of her time researching both health and humanitarian applications of O.R. Her goal and her passion are to make a positive impact in these areas of critical need.

Julie Swann

Julie Swann shares the goals of Ergun and Keskinocak in positively impacting society through advances in science and technology, but her interest in humanitarian logistics came about through a different avenue. She originally planned to apply her interest in science towards a medical career until she discovered O.R., where she could use her mathematical skills to improve systems and processes. Concurrently she became excited about impacting policy through scientific study, which has resulted in her research towards answering important questions in healthcare policy. She has also applied her research to improve management of supply chains. In humanitarian logistics her interests in logistics, healthcare and public impact intersect.

Swann's family has been directly affected by Hurricane Katrina, and she looks forward to not only helping specific organizations improve their planning and response, but also effecting system-wide transformation in the humanitarian logistics.