DEC-HUMLOG Decision Aid Models and Humanitarian Logistics

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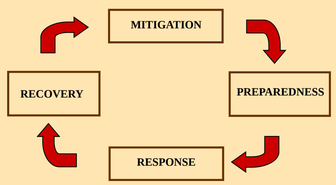


This poster shows the activities of our research group, called "**DEC-HUMLOG Decision Aid Models and Humanitarian Logistics**". Currently, the group's work is mainly devoted to the development of decision support models in humanitarian logistics. Humanitarian logistics is the kind of logistics that aims to alleviate suffering people. The most wide context for applying it is disaster management but it also appears in other contexts, as it is the case of some aid distribution operations not linked to a specific disaster (World Food Programme, vaccination campaigns) or development projects providing basic services. However, it is in disaster management where the application of humanitarian logistics is more complex and difficult and where more differences with business logistics appear.

Vitoriano, B., Montero, J., Ruan, D. (2013) Decision Aid Models for Disaster Management and Emergencies. Atlantis Press.
Vitoriano, B., Rodríguez, J.T., Tirado, G., Martín-Campo, F.J., Ortuño, M.T., Montero, J. (2015) Intelligent Decision-Making Models for Disaster Management. Human and Ecological Risk Assessment 21, 1341-1360.

Preparedness

Forest fires

Stochastic model

First stage decisions:
- Hired personnel, training
- Purchase of resources (air tankers, line construction vehicles)

Random variables:
- Wind direction and strength
- Temperatures
- Absence of rain

Second stage decisions:
- Resource allocation
- Fuel treatment

Multicriteria model

Multiples goals to optimize:
- Suppression cost
- Safety of firefighters
- Risk of escaped fire
- Damages
  - Caused by fire
  - Caused by preventive measures

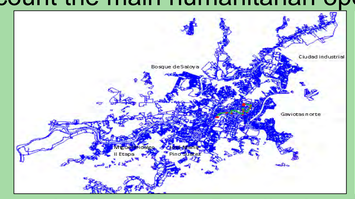
Goal:
Integrated stochastic multicriteria model

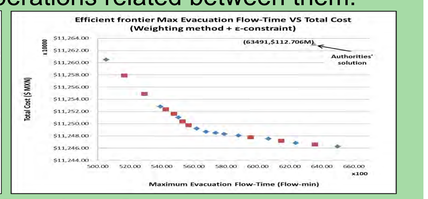
EC grant H2020-MSCA-RISE-2015 691161 GEO-SAFE
Mobility staff: Vitoriano, B., León, J., Ortuño, M.T., Romero, P.

Evacuation and distribution

Preparedness phase taking into account the main humanitarian operations related between them:
- Evacuation
- Distribution of humanitarian aid
- Facilities location
- Stock management

Characteristics:
- Integration with GIS
- Multiobjective programming: Evacuation flow-time, Distribution flow-time, Cost
- Applied to floods in Villahermosa City (Mexico), 2007



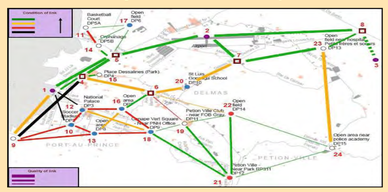


Mejía, C., Gaytán, J., Caballero, R., Molina, J., Vitoriano, B. (2014) A multicriteria optimization model for a humanitarian logistics problem: An integral approach, Journal of Operations Management, submitted.

Response

HADS: Distribution of Humanitarian Aid

Case Study: Haiti Earthquake 2010



Logistic map: aid distribution centres, demand nodes, state of roads, etc.

Different attributes considered:
Cost, equity of distribution, priority of a location, time of response, reliability (state of roads), security (avoid ransack)

Criteria aggregation: GOAL PROGRAMMING MODEL

Static version
Simplified version based on double flow: humanitarian aid and vehicles

Dynamic version
Explicit control of timing of the operations and vehicles routes

METAHEURISTIC solution method

Constructive Algorithm: Build feasible solutions quickly
GRASP and Ant Colony Optimization: Build improved solutions

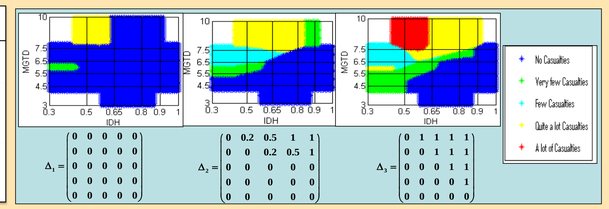
Vitoriano, B., Ortuño, M.T., Tirado, G., Montero, J. (2011) A multi-criteria optimization model for humanitarian aid distribution, JOGO 51: 189-208.
Tirado, G., Martín-Campo, F.J., Ortuño, M.T., Vitoriano, B. (2014) A lexicographical dynamic flow model for relief operations, International Journal of Computational Intelligence Systems 7 (Sup1): 45-47.
Ferrer, J. M., Ortuño, M. T., Tirado, G. (2015) A GRASP metaheuristic for humanitarian aid distribution. Journal of Heuristics, published online.

SEDD: Evaluation of disasters' consequences

Disaster consequences → needs of the affected population → requirements of relief operations

Just before or shortly after a disaster strikes:
- uncertainty about what's happening
- urgent strategic decisions to be taken

Matrix	%CC	%NC	%TC	%ERROR	COST	PRED	VAR	P_DIF
No dissimilarity	54,15	0	54,15	45,85	1,4534	1,0415	0,0708	0,8497
Asymmetric linear order	**55,18**	**0**	**55,18**	**44,82**	1,0699	1,5518	0,7965	0,4093
Avoid underestimation	50,52	0	50,52	49,48	**0,9689**	**2,0181**	**1,339**	**0,2176**



Rodríguez, J.T., Vitoriano, B., Montero, J. (2010) A natural-disaster management DSS for Humanitarian Non-Governmental Organisations, Knowledge Based Systems, 23, 17-22.
Rodríguez, J.T., Vitoriano, B., Montero, J. (2011) A disaster-severity assessment DSS comparative analysis. OR Spectrum, 33, 451-479.
Rodríguez, J.T., Vitoriano, B., Montero, J. (2012) A general methodology for data-based rule building and its application to natural disaster management, Computers and Operations Research 39, 863-873.

Recovery & Development

REC-HADS: Recovery operations

Case Study: Haiti Earthquake 2010

Links under some reliability level considered unavailable

Joint infrastructure recovery and distribution flow model with:
- Recovery budget
- Criteria: Demand satisfied, time, security, reliability

Criteria aggregation: Hierarchical Compromise Programming

Applications: Response phase during and after emergency

Liberatore, F., Vitoriano, B., Ortuño, M.T., Tirado, G., Scaparra, M.P. (2014) A hierarchical compromise model for the joint optimization of recovery operations and distribution of emergency goods in Humanitarian Logistics, Computers and Operations Research, 42: 3-13.

Logistics for development: Photovoltaic Rural Electrification

Remote and underdeveloped areas without access to electrical network: photovoltaic electrification

Morocco: Providing basic service (fee for service). Public-private partnership

Maintenance quality defined by government

Cost defined by ESCOs (public tender)

Uncertainty: corrective maintenance, collecting fees

Planned: preventive maintenance

Model: Estimating cost and sizing

Carrasco, L.M., Martín-Campo, F.J., Ortuño, M.T., Vitoriano, B., Narvarte, L. (2015) Design of decentralised maintenance structures in photovoltaic rural electrification. Energy, submitted.

This work has been partially supported by grants TIN2012-32482 from the Government of Spain, S2013/ICE-2845 (CASI-CAM) from Government of Madrid, EC H2020-MSCA-RISE-2015 691161 GEO-SAFE and Research Group UCM-Santander GR3/14 970643