# RESilient Emergency Preparedness for Natural Disaster Response through Operational Research(RESPOND-OR)

Lead Research Organisation: Lancaster University
Department Name: Management Science
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## Abstract

Funding
details

Natural disasters have grave consequences for human, social and economic environment. Although large-scale natural disasters occur worldwide, statistical evidence suggests that their negative impacts are much more pronounced in less developed countries. Between 2003-2013, natural disasters in developing countries cost about $550 billion and affected 2 billion people. Indonesia and Sudan are among the countries enormously affected by the economic and societal consequences of natural disasters. In Indonesia, a natural disaster may trigger another natural disaster, either simultaneously or in a sequential order. In addition, the disaster response in Indonesia needs to take into consideration the archipelago structure of the country. In Sudan, the prevalent disaster, which is flooding may trigger a health emergency that requires simultaneous consideration. Furthermore, the disaster response operations in Sudan are characterized by high risk due to civil conflicts.

The optimization of disaster preparedness and response interventions provides ample potential to decrease the magnitude of the negative impacts of the disasters with significant economic and societal benefits for the sustainability of the impacted communities. However, available approaches are mostly based on generic assumptions that tend to oversimplify the decision-making needs of disaster management agencies. Specifically, available disaster preparedness and response models do not adequately address the following challenges:

1. Modelling of the allocation of disaster response resources for combined large-scale natural disasters that happen simultaneously and/or sequentially, i.e. earthquakes triggering tsunamis, or outbreak of diseases following floods.

2. Integrated modelling of strategic disaster preparedness and operational disaster relief decisions.

3. Modelling the routing and scheduling of humanitarian support resources in the presence of civil disobedience and social conflict.

4. The incorporation of fairness criteria in modelling disaster preparedness and response decisions.

The lack of models capturing the real world complexities leads to inefficient allocation and use of scarce disaster preparedness and response resources. Therefore, there is an urgent need to address the mathematical modelling and associated computational and data management challenges stemming from the complexity of the real world decision-making environment of disaster management agencies. The RESPOND-OR project will develop the next generation of models which will incorporate the requirements of all relevant stakeholders. The complexity of the proposed models will necessitate the development of new hyper heuristics that will provide good quality solutions in very short computational times.

The mathematical models, the solution algorithms, and the data management and visualization tools will underpin the development of a Decision Support System (DSS) that will enhance the decision-making capabilities of disaster preparedness and response organizations in Indonesia and Sudan. The research team has an internationally leading profile in the areas of mathematical modelling, heuristic development, stochastic optimization, data management and visualization, and disaster preparedness and response management. The research team has an excellent record in stakeholder engagement. We will work very closely with our stakeholder partners to ensure that the outcome of RESPOND-OR will be scientifically sound and fully aligned with their needs.

## Planned Impact

The strategic vision of the RESPOND-OR project is to develop and implement cutting edge mathematical models and solution algorithms that will underpin the development of a Decision Support System (DSS) for disaster preparedness and response in Indonesia and Sudan. The emphasis is on both the development and use of the proposed DSS. This will have a tremendous economic and societal impact by enabling more efficient and effective allocation and use of the available disaster preparedness and response resources. The proposed research is addressing an important issue that affects the sustainability of communities located in disaster-prone areas. The project results will impact the following stake holding groups: i) disaster preparedness and response organizations, ii) policy makers, iii) research communities, and iv) general public. In what follows we discuss the project impacts on the identified stake holding groups.

(i) Disaster Preparedness and Response organizations: Disaster preparedness and response involve both governmental and non-governmental organizations. The DSS that will be developed by the RESPOND-OR project will help these organizations to optimise the allocation of their emergency preparedness resources. For instance, the optimization of the resilience of critical infrastructure networks such as the transport network, will contribute to the reduction of the disaster damages, and will increase the efficiency of population evacuation operations. The optimum routing, rostering and scheduling of humanitarian assistance and emergency response volunteers will increase the timeliness of disaster response.

(ii) Policy Makers: In Indonesia and Sudan disaster preparedness and response is high in the policy agenda. Both governments need to investigate policy options for ensuring the sustainability of communities located in disaster prone areas. The proposed DSS will allow policy makers to analyse trade-offs regarding the efficiency and fairness of their disaster preparedness and response policies. Furthermore, the proposed DSS will support post action assessment, which can inform potential changes on the way government allocates disaster management resources. The results of these assessments will ultimately influence governmental policies.

(iii) Research Communities: The proposed research will contribute to the advancement of knowledge in the fields of Operational Research, Mathematics, Data Science, Computational Science, Information Systems, and disaster preparedness and response. The results of the RESPOND-OR project will improve the mathematical understanding of complex disaster preparedness and response problems.

(iv) General Public: This research has the potential to generate significant social and economic impact of people living in disaster-prone areas. The development of models for improved disaster preparedness and response through coordinated and targeted prevention and recovery activities, and resourceful disaster response will reduce the disruption of the socio-economic activities of the affected communities.

## Funded Value:

**£515,923**

## Funded Period:

Sept 19 - Mar 22

## Funder:

GCRF

## Project Status:

Closed

## Project Category:

Research Grant

## Project Reference:

EP/T003979/1

## Principal Investigator:

[Konstantinos Zografos](#)

## Research Subject:

Mathematical sciences (100%)

## Research Topic:

[Mathematical Aspects of OR (100%)](#)

## Organisations

- [Lancaster University (Lead Research Organisation)](#)
- [National Disaster Management Authority (BNPB) (Collaboration)](#)
- [RedR Indonesia (Collaboration, Project Partner)](#)
- [Government of Indonesia (Collaboration)](#)
- [National Council of Civil Defence (Collaboration)](#)
- [Humanitarian Forum Indonesia (HFI) (Collaboration, Project Partner)](#)
- [Nile Basin Initiative NBI (Project Partner)](#)
- [BNPB Nat Disaster Man Agency (replace) (Project Partner)](#)
- [BNPB (Nat Disaster Man Agency) (Project Partner)](#)

| **People** | **ORCID iD** |
|---|---|
| [Konstantinos Zografos (Principal Investigator)](#) | |
| [Juliana Sutanto (Co-Investigator)](#) | |
| [Bertha Maya Sopha (Co-Investigator)](#) | |
| [Akhmad Hidayatno (Co-Investigator)](#) | |
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| [Kevin Glazebrook (Co-Investigator)](#) | |

## Publications

The following are buttons which change the sort order, pressing the active button will toggle the sort order
[Author Name](#)
[descending (press to sort ascending)](#)
[Title](#) [Publication](#) [Date Published](#)
[10](#) [25](#) [50](#)

Abushama H (2022) *Risk Estimation and Network Generation*

Abushama H (2022) *Security Forces Rostering Problem*

Gultom Y (2021) *Route Subnetwork Generation using OpenStreetMap Data for Emergency Response Problem Modeling in Indonesia*

Pirogov A (2022) *Modeling and Solving the assisted evacuation problem for natural disasters: A multi-objective programming approach*

Sopha BM (2022) *Manual for Building Multi-Method Simulation for Jakarta Flood Evacuation*

Suhartanto H (2022) *Decision Support System (DSS) User Manual*

Tarhan I (2022) *Mutli-objective rolling horizon personnel routing and scheduling approach for natural disasters*

Tarhan I (2022) *Dynamic Personnel Routing and Scheduling for natural disasters*

Tarhan I (2024) *A quadrant shrinking heuristic for solving the dynamic multi-objective disaster response personnel routing and scheduling problem* in European Journal of Operational Research

Tarhan I (2023) *A multi-objective rolling horizon personnel routing and scheduling approach for natural disasters* in Transportation Research Part C: Emerging Technologies

- Key Findings
- Impact Summary
- Research
  Databases and
  Models

- Collaboration
- Software and Technical Products
- Engagement Activities

| Description | • We mapped the decision-making processes for evacuation planning, personnel routing and scheduling, and distribution of relief supplies. This mapping was done with the active participation and interaction of the relevant stakeholders involved in and affected by Disaster Response Operations in both Indonesia and Sudan, to ensure that the RESPOND-OR models will reflect their requirements. The mapping of the decision-making processes involved in disaster response operations led to the identification of i) the objectives and constraints stemming from the Indonesian and Sudanese disaster response decision making context, and ii) the types of data needed to support decisions related to assisted evacuation, personnel routing and scheduling, and allocation and distribution of disaster relief supplies.

• Following the mapping of the disaster response decision making process, we developed models (along with their computer implementation), for supporting decisions related to: i) assisted evacuation, ii) disaster response personnel routing and scheduling, iii) allocation and distribution of disaster relief supplies, and iv) security personnel rostering.

• For the optimization of Assisted Evacuation Planning (AEP) decisions, we developed deterministic models, and models that incorporate uncertainty. The proposed models consider efficiency, fairness, and risk objectives, and incorporate the AEP requirements in Indonesia and Sudan. For the optimization of disaster response Personnel Routing and Scheduling (PRS) decisions, we developed static and dynamic models that consider the efficiency, fairness, and risk objectives and incorporate the PRS requirements in Indonesia.

• For the AEP and PRS models, we developed exact and heuristic algorithms. The exact solution approaches used for the static AEP and the deterministic PRS were based on a two-stage lexicographic optimization framework. For solving the deterministic AEP model, we developed a random sequence multi-objective hyper-heuristic. For solving the AEP problem under uncertainty, we used a robust optimization framework based on the concept of recoverable robustness.

• For solving the dynamic personnel routing and scheduling (PRS) problem we developed a heuristic algorithm based on the Quadrant Shrinking Method (QSM). The AEP and PRS models and algorithms were used to solve problem instances with data from Indonesia and Sudan. The heuristic algorithms developed for solving the deterministic AEP and the static disaster response PRS models for Indonesia were integrated into the RESPOND-OR Decision Support System (DSS).

• The RESPOND-OR DSS includes the AEP and PRS modules, a database that includes the data needed to run the AEP and PRS modules, and a user interface that allows the user to navigate the system, to enter data, and to visualize the results generated by the AEP and PRS modules. The RESPOND-OR DSS allows decision makers to examine trade-offs between efficiency, fairness, and risk associated with alternative AEP and PRS decisions.

• We have developed a multi-objective model for optimizing decisions regarding the allocation and distribution of relief supplies (ADRS). The proposed model reflects the requirements of ADRS in Indonesia and considers efficiency and fairness objectives. The current computer implementation of the proposed ADRS model is based on an exact algorithm and can solve small sized instances of the ADRS problem.

• We developed a simulation model for Jakarta flood evacuation using Agent-Based Modeling (ABM) and Discrete Event Simulation (DES) methods to evaluate the effectiveness of flood management contingency plan with respect to the evacuation time and the total number of successful evacuees. The simulation model embeds |
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Geographic Information System (GIS) to represent the actual geographical locations of the residents, the assembly points, and the shelters. The simulation model dynamically shows the number of residents arriving at each shelter over time, and the resources (trucks and boats) used over time.

•We developed a mathematical formulation that deals with the rostering of security forces personnel to protect the shelters' occupants and belongings of evacuated families. The problem represents a challenging and demanding optimization problem, where personnel should be assigned to the most appropriate shifts so as to meet the demands. The model reflects the Security Forces Personnel Rostering (SFPR) requirements in Sudan. We implemented a selection hyper-heuristic method to solving the problem. We have further tested the RESPOND-OR Decision Support System with potential users and on the basis of the feedback received we have improved the user interface of the DSS and we have developed a new user manual for the DSS both in English and Bahasa Indonesian. The new version of the DSS can be found here https://dss-respondor2.cs.ui.ac.id/ , the new user manuals can be found here https://drive.google.com/file/d/10qToGa8mTzY_YOPrvWVqPJRfIDPduit8/view .

Our current findings are directly linked to the economic development and welfare of both Indonesia and Sudan. Specifically, the use of the proposed models along with the required data will help the policy/decision makers to make evidence-based decisions regarding the trade-offs between the objectives considered in making the following types of decisions: i) assisted evacuation, ii) disaster relief personnel routing and scheduling, iii) allocation and distribution of relief supplies, and iv) security personnel rostering decisions. It is worth noting that the proposed models have been developed by considering the decision-making context of the specific countries and therefore are expected to provide recommendations that will be applicable to the local setting. Therefore, the recommendations provided by the proposed models are expected to improve the performance of the disaster response operations in terms of providing disaster relief support to the affected areas in a timely, safe, efficient, and fair manner.

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| **Exploitation Route** | We have developed in 2023, a new version of the RESPOND-OR DSS. The updated version of the DSS will be used within the framework of a new project, that will take place in 2024, to train disaster response personnel in developing and testing scenarios regarding assisted evacuation and disaster relief personnel routing and scheduling activities, The training of the personnel of BPBDs, and the testing of scenarios will improve the disaster response capabilities of BPBDs and consequently will support the socioeconomic development of their regions, and the well being of the population of the disaster affected areas.<br><br>Overall, the findings of our research will lead to the improvement of the welfare and economic development of the disaster hit communities in terms of i) saving lives, ii) improving the health conditions and well-being of the affected population), and iii) improving social cohesion and avoiding civil unrest through the fair provision of disaster relief services. |
| **Sectors** | Communities and Social Services/Policy |
| **URL** | https://www.lancaster.ac.uk/lums/research/areas-of-expertise/centre-for-transport-and-logistics/projects/respond-or/ |

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| **Description** | The outputs of the RESPOND-OR project include: i) The RESPOND-OR Decision Support System (DSS) for supporting assisted evacuation and disaster relief personnel routing and scheduling decisions in Indonesia, ii) a model for optimizing decisions regarding the allocation and distribution of disaster relief supplies in Indonesia, iii) a simulation model for planning assisted evacuation operations for the Jakarta flood, iv) a model for optimizing security personnel rostering decisions in Sudan, and v) a model for optimizing assisted evacuation decisions in Sudan. The RESPOND-OR decision support tools have been developed in line with the requirements of relevant stakeholders involved in disaster response management in Indonesia and Sudan. Furthermore, the RESPOND-OR project raised the awareness of the participated stakeholders regarding the use of optimization and simulation-based decision support tools in making relevant disaster response management decisions. The feedback |

received from the Indonesian stakeholders regarding the alignment of the proposed tools with their requirements was very positive. A final RESPOND-OR workshop has been scheduled in March 2022, to demonstrate the RESPOND-OR DSS to the Indonesian stakeholders and plan its pilot use. It is worth noting that the National Disaster Response Authority of Indonesia (BNPB) have already expressed their willingness to integrate the RESPOND-OR DSS into their Disaster Risk Assessment System (InaRisk). Another notable impact of the RESPOND-OR project relates to capacity building in the area of disaster response management in Indonesia, Cambodia, Vietnam, Laos, and Sudan. Specifically, the RESPOND-OR project has been used as example demonstrating the potential offered by Operational Research in improving disaster response decision-making within the framework of the GCRF/EPSRC capacity building project titled CREST-OR. In addition, the Embassy of Indonesia in the United Kingdom and the Indonesian Forum on Disaster Risk Reduction organized a webinar with the participation of more than fifty Indonesian and Sudanese academics working in the area of disaster response management to disseminate the findings of the RESPOND-OR project. The RESPOND-OR is continuing its impact related activities through the project RESPOND-OR-X. The objective of this project is to further enhance the usability of the RESPOND-OR and consequently its acceptability by disaster management organizations and professionals in Indonesia. As a result of the RESPOND-OR-X a new version of the RESPOND-OR/RESPOND-OR-X and updated user manuals in English and Indonesian have been released. In a workshop held in Jakarta in November 2023, the new version of the RESPOND-OR/RESPOND-OR-X DSS was demonstrated to Indonesian academics, disaster management professionals, and NGOs . An official of the Indonesian National Disaster Countermeasure Agency (BNPB) stated that : "the disasters become more complex ... With this system, we can evacuate people faster, ... and deploy our resources with a very specific schedule. Now when we deploy people, sometimes we don't consider work times ... many volunteers are difficult to take a rest, because there is no system to schedule our manpower. In the future, we can implement this system (DSS) with BNPB, BPBD. We hope we can grow further with the system, and ... it can help us in the emergency situation." In order to accelerate the adoption and use of the RESPOND-OR/RESPOND-OR-X DSS, we (Lancaster University in collaboration with the University of Indonesia) will introduce in 2024 a new project, in collaboration with Regional Indonesian Disaster Countermeasure Agencies (BPBDs) and other Indonesian Universities in order to: i) train professionals of the Regional Indonesian Disaster Countermeasure Agencies (BPBDs) in using the Decision Support System, and ii) test assisted evacuation and disaster response personnel routing and scheduling scenarios in their respective regions. The decision support tools developed within the framework of the RESPOND-OR project contribute to the achievement of Sustainable Development Goals 11 and 13 (SDG 11, SDG13). The RESPOND-OR tools consider efficiency, fairness, and risk objectives in optimizing disaster response decisions and therefore they will assist disaster management agencies in Indonesia and Sudan to improve the safety, resilience, sustainability of communities impacted by natural disasters in both countries. The RESPOND-OR tools also contribute to the achievement of SDG 13 since they will improve the capabilities of disaster management agencies in Indonesia and Sudan to combat the impacts of climate change. Consequently, the RESPOND-OR results contribute to the decrease of the magnitude of the negative impacts of natural disasters in Indonesia and Sudan with significant environmental, economic and societal benefits for the disaster hit communities in these countries. Lancaster University (LU) is "committed to creating a fairer and more inclusive University for all staff, students, visitors and our wider university community, where equality, diversity and inclusion is an integral part of our University's plans and activities" (https://www.lancaster.ac.uk/edi/). LU is a member of the Athena SWAN Charter since 2008. In our project, three out of seven work packages (WP1, WP2, WP7) were led by female researchers. Moreover, our advisory board had female representation. We have also tried to involve female researchers and practitioners in the RESPOND-OR dissemination and awareness activities, and to receive their input regarding the use of the RESPOND-OR DSS. Furthermore, the recruitment panel for the Lancaster University's Research Associates included Prof. Juliana Sutanto who is one of the RESPOND-OR Co-Is. The recruitment and management of the RESPOND-OR at Universitas Indonesia (UI) adhere to the equal opportunity policy at UI (http://green.ui.ac.id/sustainability/sdgs-5/). Article 2 of the

UI Rector's Regulation Number 33 of 2018 concerning Human Resource Management of UI stated the principles of professionalism, fairness, and equality of rights that do not differentiate between humans based on ethnicity, religion, race and gender, and provide rights for persons with disabilities. When there was a need for hiring seven people for field data collections in Yogyakarta, equal opportunity for people of different genders was ensured. Three of the seven hired data collectors in Yogyakarta are female; the rest including the three researchers at UI are male. The recruitment and management of the RESPOND-OR at the Universitas Gadjah Mada (UGM) adhere to the equal opportunity policy at UGM. The UGM Rector's Regulation Number 18 of 2016 concerning Human Resource Management stated the principle of non-discrimination by gender, race, ethnicity, and religion. The project provides equal opportunities for male and female researchers during the recruitment of research assistants. There are three female researchers in the team. The recruitment and management of the RESPOND-OR at the University of Khartoum (UofK) are in accordance with UofK non-discrimination policy. The team members have been chosen to ensure equal opportunity amongst genders, as well as the representatives of the key stakeholders. The overall main contributors to this project are seven males and six females from the University of Khartoum, Ministry of Health, National Commission of Civil Defence, and Ministry of Irrigation and Water Supplies.

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| **First Year Of Impact** | 2023 |
| **Sector** | Communities and Social Services/Policy |
| | Societal |
| **Impact Types** | Economic |
| | Policy & public services |

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| **Title** | A mathematical model and an algorithm for solving the security forces personnel rostering problem |
| **Description** | A mathematical model for the security forces personnel rostering problem in the context of Sudan has been developed and a heuristic algorithm for solving the problem has been implemented in Python. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2022 |
| **Provided To Others?** | No |
| **Impact** | The algorithm has been developed to solve instances of the security forces rostering problem in the context of disaster response operations in Sudan. |

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| **Title** | A quadrant shrinking heuristic for solving the dynamic multi-objective disaster response personnel routing and scheduling problem |
| **Description** | A Quadrant shrinking heuristic is proposed for the generation of Pareto efficient solutions to the multi-objective problem of disaster relief personnel routing and scheduling (DDRPRS) problem, which considers efficiency, fairness and transportation risk objectives. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2024 |
| **Provided To Others?** | Yes |
| **Impact** | The proposed heuristic is applied for routing and scheduling personnel involved in evacuation and medical operations based on data from the 2018 Lombok Earthquake in Indonesia. The proposed heuristic is able to provide a large number of Pareto Optimal solutions which can cover the entire Pareto frontier in a short timeframe. |

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| **Title** | A quadrant shrinking heuristic for solving the dynamic multi-objective disaster response personnel routing and scheduling problem |
| **Description** | In this file, we provide data regarding the location of the demand points and disaster response personnel bases that are used in the computational experiments of the |

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| | following paper: 'Tarhan, I., Zografos, K.G., Sutanto, J. and Kheiri, A. (2023). A quadrant shrinking heuristic for solving the dynamic multi-objective disaster response personnel routing and scheduling problem, European Journal of Operational Research (https://doi.org/10.1016/j.ejor.2023.09.002)'. Description |
| **Type Of Material** | Database/Collection of data |
| **Year Produced** | 2023 |
| **Provided To Others?** | Yes |
| **Impact** | This dataset provides input for the computational experiments of the quadrant shrinking heuristic for solving the dynamic multi-objective disaster response personnel routing and scheduling problem. Moreover, this dataset provides input for making personnel routing and scheduling decisions. This dataset along with the associated model can be used to run the model to make decisions regarding the routing and scheduling of disaster response personnel |
| **URL** | http://www.research.lancs.ac.uk/portal/en/datasets/a-quadrant-shrinking-heuristic-for-solving-the-dy... |

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| **Title** | Algorithm for static and dynamic disaster relief personnel routing and scheduling |
| **Description** | A heuristic algorithm for both the static and dynamic disaster relief personnel routing and scheduling problem has been developed and implemented in C++ / CBC Solver |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The algorithm has been developed to solve small and large test instances of both the static and dynamic personnel routing and scheduling problem in the context of disaster response operations in Indonesia. |

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| **Title** | Data for the location of the demand points and disaster response personnel bases |
| **Description** | Data regarding the location of the demand points and disaster response personnel bases that are used in the computational experiments of the following paper: 'Tarhan, I., Zografos, K.G., Sutanto, J., Kheiri, A. and Suhartanto, H. (2023). A multi-objective rolling horizon personnel routing and scheduling approach for natural disasters. Transportation Research Part C: Emerging Technologies, 149, 104029' (https://doi.org/10.1016/j.trc.2023.104029, Corrigendum: https://doi.org/10.1016/j.trc.2023.104117). |
| **Type Of Material** | Database/Collection of data |
| **Year Produced** | 2023 |
| **Provided To Others?** | Yes |
| **Impact** | This dataset provides input for the computational experiments of the multi-objective rolling horizon personnel routing and scheduling approach for natural disasters. This dataset provides essential input for making personnel routing and scheduling decisions. This dataset along with the associated model can be used to run the model to make decisions regarding the routing and scheduling of disaster response personnel. |
| **URL** | https://www.research.lancs.ac.uk/portal/files/375798955/Additional_Data_Location_Information_for_the... |

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| **Title** | Data instance of Jakarta flood (Indonesia) |
| **Description** | This dataset provides input to the mathematical model dealing with assisted evacuation decision. Currently this data is available only to the RESPOND-OR research team and the relevant stakeholders. |
| **Type Of Material** | Database/Collection of data |
| **Year Produced** | 2020 |
| **Provided To Others?** | No |
| **Impact** | This dataset provides essential input for making assisted evacuation decision. The development of this research dataset contributes to raising the awareness of the stakeholders regarding the development of a coherent data management approach. |

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| **Title** | Data instance of Lombok earthquake (Indonesia) |
| **Description** | This dataset provides input to the mathematical models dealing with personnel routing and scheduling, and allocation and distribution of relief supplies decisions. Currently this data is available only to the RESPOND-OR research team and the relevant stakeholders. |
| **Type Of Material** | Database/Collection of data |
| **Year Produced** | 2020 |
| **Provided To Others?** | No |
| **Impact** | This dataset provides essential input for making personnel routing and scheduling, and allocation and distribution of relief supplies decisions. The development of this research dataset contributes to raising the awareness of the stakeholders regarding the development of a coherent data management approach. |

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| **Title** | Data instance of Sudan flood |
| **Description** | This dataset provides input to the mathematical models dealing with assisted evacuation, and security forces personnel scheduling decisions. Currently this data is available only to the RESPOND-OR research team and the relevant stakeholders. |
| **Type Of Material** | Database/Collection of data |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | This dataset provides essential input for making assisted evacuation, and security forces personnel scheduling decisions. The development of this research dataset contributes to raising the awareness of the stakeholders regarding the development of a coherent data management approach. |

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| **Title** | Data instance of Yogyakarta volcano eruption (Indonesia) |
| **Description** | This dataset provides input to the mathematical model dealing with assisted evacuation, and personnel routing and scheduling decisions. Currently this data is available only to the RESPOND-OR research team and the relevant stakeholders. |
| **Type Of Material** | Database/Collection of data |
| **Year Produced** | 2020 |
| **Provided To Others?** | No |
| **Impact** | This dataset, which was collected during Mount Merapi eruption in Yogyakarta, provides essential input for making assisted evacuation, and personnel routing and scheduling decisions. The development of this research dataset contributes to raising the awareness of the stakeholders regarding the development of a coherent data management approach. |

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| **Title** | Evacuation Simulation Model for Jakarta Flood |
| **Description** | The simulation model for Jakarta flood evacuation is developed using multi-method simulation to evaluate the effectiveness of the contingency plan with respect to the evacuation time and total number of successful evacuees. It models the evacuation decision-making of the residents and the evacuation process requiring resources (trucks and boats). The evacuation decision-making is developed based on empirical studies, whereas the location of shelters and allocation of resources are based on the existing Flood Management Contingency Plan. The simulation model embeds GIS to represent the actual geographical locations of the residents, the assembly points, and the shelters. The simulation model dynamically shows the number of residents arriving at each shelters over time, and the resources (trucks and boats) used over time. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The result of the simulation model can be used as an experimental tool to evaluate the existing contingency plan and to explore the required allocation of resources to improve evacuation. The simulation was demonstrated to BNPB (National Disaster Management Authority in Indonesia), who often supports Jakarta flood disaster |

responses. The simulation was also presented in a webinar, which was supported by the Embassy of Indonesia in the United Kingdom, and the Indonesian Forum on Disaster Risk Reduction.

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| **Title** | Hyper-heuristic algorithm for solving the deterministic multi-objective assisted evacuation problem |
| **Description** | A hyper-heuristic algorithm for solving the multi-objective deterministic assisted evacuation problem in Indonesia has been developed and implemented in Python 3.9. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2022 |
| **Provided To Others?** | No |
| **Impact** | The algorithm has been developed to solve test instances of moderate vehicle fleet size used in Assisted Evacuation Operations in the context of disaster response operations in Indonesia and Sudan. |

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|---|---|
| **Title** | Indonesia Map graph/network generator |
| **Description** | Set of scripts to generate map graph/network as an input for the optimization models |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2020 |
| **Provided To Others?** | No |
| **Impact** | The resultant network/sub-network is an input to the optimization models. |

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|---|---|
| **Title** | Mathematical model for assisted evacuation planning |
| **Description** | A mathematical model for the assisted evacuation planning problem has been developed and implemented in C++ / Gurobi |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The tool has been developed to solve small test instances of the assisted evacuation problem in the context of disaster response operations in Indonesia. |

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| **Title** | Mathematical model for personnel routing and scheduling |
| **Description** | A mathematical model for the personnel routing and scheduling problem has been developed and implemented in C++ / CPLEX |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The tool has been developed to solve small test instances of the personnel routing and scheduling problem in the context of disaster response operations in Indonesia. |

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| **Title** | Mathematical model for the allocation and distribution of relief supplies |
| **Description** | A mathematical model for the allocation and distribution of relief supplies in Indonesia has been developed and implemented in C++/ CPLEX. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2022 |
| **Provided To Others?** | No |
| **Impact** | The model has been developed to solve small test instances of the allocation and distribution of relief supplies in the context of disaster response operations in Indonesia. |

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| **Title** | Mathematical model for the allocation and distribution of relief supplies |
| **Description** | A mathematical model for the allocation and distribution of relief supplies in Indonesia has been developed and implemented in Python / Gurobi. |

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| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The tool has been developed to solve small test instances of the allocation and distribution of relief supplies in the context of disaster response operations in Indonesia. |

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|---|---|
| **Title** | Mathematical model for the dynamic disaster relief personnel routing and scheduling |
| **Description** | A mathematical model for the dynamic disaster relief personnel routing and scheduling problem has been developed and implemented in C++ / CPLEX |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The model has been developed to solve small test instances of the dynamic personnel routing and scheduling problem in the context of disaster response operations in Indonesia. |

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| **Title** | Multi-objective rolling horizon Disaster Response Personnel Routing and Scheduling model for natural disasters |
| **Description** | The proposed multi-objective DRPRS model considers efficiency, fairness, and transportation risk objectives. The model is solved lexicographically and is applied for routing and scheduling personnel while considering evacuation and medical services as part of the 2018 Lombok Earthquake, Indonesia. Model runs were conducted through Visual Studio 2019 and ILOG CPLEX 12.10. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2022 |
| **Provided To Others?** | Yes |
| **Impact** | The proposed model aids to the exploration of trade-offs among different objectives in the preparedness phase. It also aids to the comparison/analysis of impacts when considering different strategies/policies of alternative disaster response service types. |
| **URL** | https://doi.org/10.1016/j.trc.2023.104029 |

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|---|---|
| **Title** | Network generator - Sudan |
| **Description** | The developed network generator has been extended to estimate the risk associated with the network transportation in Sudan. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The tool has been developed to support the implementation of the assisted evacuation module. |

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|---|---|
| **Title** | Sudan Map graph/network generator |
| **Description** | A software tool has been developed to generate map graphs needed for the decision support system. An algorithm for finding bi-objective shortest paths (considering the distance and the risk associated with the links) has also been implemented. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2021 |
| **Provided To Others?** | No |
| **Impact** | The tool has been developed to support the implementation of the evacuation, personnel scheduling, and distribution of relief supplies problems. |

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|---|---|
| **Title** | Two-stage iterative algorithm for the assisted evacuation problem under uncertainty |

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| **Description** | A Two-stage iterative heuristic algorithm for the assisted evacuation problem under uncertainty has been developed and implemented in Python 3.9. |
| **Type Of Material** | Computer model/algorithm |
| **Year Produced** | 2022 |
| **Provided To Others?** | No |
| **Impact** | The algorithm has been developed so as to solve moderately-sized instances (concerning the vehicle fleet size). The algorithm is designed for supporting evacuation operations in response to natural disasters and considers evacuation operations in Indonesia. |

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|---|---|
| **Description** | New Partner - BPBD Sleman |
| **Organisation** | Government of Indonesia |
| **Department** | Sleman Regency Regional Disaster Management Agency (RDMA) |
| **Country** | Indonesia |
| **Sector** | Public |
| **PI Contribution** | Definition of data requirements. |
| **Collaborator Contribution** | Access to data, documents, and staff expertise. |
| **Impact** | Data requirements. |
| **Start Year** | 2020 |

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|---|---|
| **Description** | New Partner - NCCD |
| **Organisation** | National Council of Civil Defence |
| **Country** | Sudan |
| **Sector** | Public |
| **PI Contribution** | Mapping of the decision making scenarios for evacuation planning and security forces personnel scheduling problems. Definition of data requirements. |
| **Collaborator Contribution** | Provide access to data, documents and staff expertise. Hosting the research team. |
| **Impact** | Map graph/network generator. Problem definitions of evacuation planning and security forces personnel scheduling. |
| **Start Year** | 2019 |

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|---|---|
| **Description** | Partner in the original application and still cooperating - BNPB |
| **Organisation** | National Disaster Management Authority (BNPB) |
| **Country** | Indonesia |
| **Sector** | Public |
| **PI Contribution** | Mapping of the decision making scenarios for the evacuation planning, personnel routing and scheduling, and allocation and distribution of relief supplies problems. Definition of data requirements and development of the map/graph generator. |
| **Collaborator Contribution** | Access to data, documents, staff expertise, and meeting facilities. BNPB also liaise the research team to Disaster Management Agency of the Sleman Regency (BPBD Sleman) for field data collection. |
| **Impact** | Definition of the evacuation planning, personnel routing and scheduling, and allocation and distribution of relief supplies problems. Modelling, data, and computational requirements. Map graph/network generator. |
| **Start Year** | 2019 |

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|---|---|
| **Description** | Partner in the original application and still cooperating - BPBD DIY |
| **Organisation** | Government of Indonesia |
| **Department** | Sleman Regency Regional Disaster Management Agency (RDMA) |
| **Country** | Indonesia |
| **Sector** | Public |
| **PI Contribution** | Mapping of the decision making scenarios for evacuation planning, personnel routing and scheduling, and allocation and distribution of relief supplies problems. Definition |

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|---|---|
| | of data requirements and development of the map/graph generator. |
| **Collaborator Contribution** | Access to data, documents, staff expertise, meeting facilities, and office space. |
| **Impact** | Definition of the evacuation planning, personnel routing and scheduling, and allocation and distribution of relief supplies problems. Modelling, data, and computational requirements. Map graph/network generator. |
| **Start Year** | 2019 |

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|---|---|
| **Description** | Partner in the original application and still cooperating - HFI |
| **Organisation** | Humanitarian Forum Indonesia (HFI) |
| **Country** | Indonesia |
| **Sector** | Charity/Non Profit |
| **PI Contribution** | Mapping of the decision making scenarios for the evacuation planning, personnel routing and scheduling, and allocation and distribution of relief supplies problems. |
| **Collaborator Contribution** | Access to relevant documents and staff expertise. |
| **Impact** | Definition of the evacuation planning, personnel routing and scheduling, and allocation and distribution of relief supplies problems. |
| **Start Year** | 2019 |

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| **Description** | Partner in the original application and still cooperating - RedR |
| **Organisation** | RedR Indonesia |
| **Country** | Indonesia |
| **Sector** | Charity/Non Profit |
| **PI Contribution** | Mapping of the decision making scenarios for the evacuation planning, personnel routing and scheduling, and allocation and distribution of relief supplies problems. |
| **Collaborator Contribution** | Access to documents and relevant staff expertise. |
| **Impact** | Problem definitions of evacuation planning, personnel scheduling, and allocation and distribution of relief supplies. |
| **Start Year** | 2019 |

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|---|---|
| **Title** | RESPOND-OR Decision Support System |
| **Description** | The RESPOND-OR Decision Support System (DSS) aims to assist the disaster response agencies in Indonesia in making two disaster response decisions: i) assisted evacuation, and ii) personnel routing and scheduling. Accordingly, the DSS has two main modules: i) Assisted Evacuation Planning (AEP), and ii) Personnel Routing and Scheduling (PRS). The AEP and PRS modules utilize the network data generated by the system in providing solutions/recommendations for a defined disaster location. |
| **Type Of Technology** | Webtool/Application |
| **Year Produced** | 2022 |
| **Impact** | BNPB (National Disaster Management Authority in Indonesia) has recognized the value of the RESPOND-OR DSS and agreed to integrate it with BNPB InaRisk system, pending approval of a funding application submitted by Prof. Heru Suhartanto from Universitas Indonesia to the Directorate General of Higher Education at the Ministry of Education, Culture, Research, and Technology in Indonesia. |
| **URL** | https://dss-respondor2.cs.ui.ac.id/ |

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|---|---|
| **Description** | 1st Stakeholders' Workshop (UK, Indonesia) |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Policymakers/politicians |
| **Results and Impact** | In this first stakeholders' workshop, which was conducted online, we presented the findings of the first work package (WP1) of the project. The aim of WP1 is to develop the RESPOND-OR modelling, data, and computational requirements. The participated |

stakeholders provided feedback regarding the objectives, constraints, and data input requirements of the RESPOND-OR models.

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| **Year(s) Of Engagement Activity** | 2020 |

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|---|---|
| **Description** | 1st Stakeholders' Workshop (UK, Sudan) |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Policymakers/politicians |
| **Results and Impact** | In this first stakeholders' workshop, which was conducted online, we presented the findings of the first work package (WP1) of the project. The aim of WP1 is to develop the RESPOND-OR modelling, data, and computational requirements. The participated stakeholders provided feedback regarding the objectives, constraints, and data input requirements of the RESPOND-OR models. |
| **Year(s) Of Engagement Activity** | 2020 |

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|---|---|
| **Description** | A Decision Support System for Allocation and Distribution of Relief Supplies in Indonesia (Brown Bag Session) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | Local |
| **Primary Audience** | Postgraduate students |
| **Results and Impact** | Qorib Munajat presented his work on 'A Decision Support System for Allocation and Distribution of Relief Supplies in Indonesia' during the Brown Bag session (Wednesday, 16th March 2022) organised by the Department of Management Science of Lancaster University Management School |
| **Year(s) Of Engagement Activity** | 2022 |

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|---|---|
| **Description** | A Three-stage Mixed-Integer Linear Programming (MILP) Model for the Fair and Efficient Allocation and Distribution of Disaster Relief Supplies (EURO2021) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | Presentation of a 'A Three-stage Mixed-Integer Linear Programming (MILP) Model for the Fair and Efficient Allocation and Distribution of Disaster Relief Supplies' at the EURO 2021 Conference (July 11-14, 2021). This work is authored by Qorib Munajat, Konstantinos G. Zografos, Juliana Sutanto |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | http://files.convin.gr/various/EURO21-Conference_e-Handbook_Full_version.pdf |

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|---|---|
| **Description** | A framework of multi-stakeholder coordination in humanitarian operations: A case study of Merapi Volcano eruption (International Federation of Operational Research Societies (IFORS) 2021) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |

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|---|---|
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | In this online conference, which had more than 800 people registered, Mrs. Sekar Sakti (a Research Assistant of Dr. Bertha Maya Sopha from Universitas Gadjah Mada, Indonesia) presented a framework of multi-stakeholder coordination in humanitarian operations using a case study of Mount Merapi eruption in Yogyakarta, Indonesia. The framework can be used as a reference for practitioners and researchers to explore effective coordination mechanism in humanitarian operations. |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | https://www.euro-online.org/ifors2021/program/stream/184?includedfrom=www.euro-online.org |

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|---|---|
| **Description** | A multi-objective rolling horizon personnel routing and scheduling model for large-scale natural disasters (3rd IMA and OR Society Conference on Mathematics of Operational Research) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | National |
| **Primary Audience** | Other audiences |
| **Results and Impact** | Presentation titled 'A multi-objective rolling horizon personnel routing and scheduling model for large-scale natural disasters' authored by Istenc Tarhan, Konstantinos Zografos, Juliana Sutanto and Ahmed Kheiri. This presentation was given during the 3rd IMA and OR Society Conference on Mathematics of Operational Research (between 22-23 April, 2021), Birmingham, UK |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | https://cdn.ima.org.uk/wp/wp-content/uploads/2020/06/Final-Programme-3rd-IMA-and-OR-Society-Conferen... |

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|---|---|
| **Description** | A quadrant shrinking heuristic for generating efficient solutions for routing and scheduling disaster relief teams (EURO HOpe Mini-Conference 2022) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | This international conference organized by EURO Hope group aims to regularly meet the academicians that study humanitarian operations and other professionals in governmental and non-governmental institutions that are involved in humanitarian operations. Main activity of this event is the presentations of the academicians. These presentations are enriched with the presentations, talks and debates of the professionals in governmental and non-governmental institutions. |
| **Year(s) Of Engagement Activity** | 2022 |

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|---|---|
| **Description** | A quadrant shrinking heuristic for multi-objective personnel routing and scheduling problem for large-scale natural disasters (INFORMS 2021) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |

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|---|---|
| **Results and Impact** | Presentation of the paper titled 'A quadrant shrinking heuristic for multi-objective personnel routing and scheduling problem for large-scale natural disasters' authored by Istenc Tarhan, Konstantinos Zografos, Juliana Sutanto and Ahmed Kheiri. The paper was presented in INFORMS Annual Meeting (between 24-27 October, 2021), Anaheim, California, USA |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | https://meetings.informs.org/wordpress/anaheim2021/schedule/ |

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|---|---|
| **Description** | Abaseen Meeting with RESPOND-OR |
| **Form Of Engagement Activity** | A formal working group, expert panel or dialogue |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Third sector organisations |
| **Results and Impact** | The event involved a delegation from the Abaseen Foundation, who have undertaken direct action in Pakistan in response to flooding emergencies. |
| **Year(s) Of Engagement Activity** | 2022 |

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|---|---|
| **Description** | Academic Networking Meeting- Global Engagement team at Lancaster University |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | Local |
| **Primary Audience** | Other audiences |
| **Results and Impact** | An Academic Networking meeting took place in Lancaster University. Dr. Ahmed Kheiri presented an overview of the RESPOND-OR project. |
| **Year(s) Of Engagement Activity** | 2023 |

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|---|---|
| **Description** | An invited speaker at a seminar organized by the Indonesian Supply Chain and Logistics Institute (ISLI) and EPSRC/GCRF ReliefOps project |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | National |
| **Primary Audience** | Other audiences |
| **Results and Impact** | Dr. Bertha Maya Sopha from Universitas Gadjah Mada was invited as a speaker in a hybrid seminar organized by the Indonesian Supply Chain and Logistics Institute (ISLI) and EPSRC/GCRF ReliefOps project. The topic of the seminar is creating synergy in building a resilient disaster supply chain. The seminar was attended by the Indonesian researchers and practitioners in logistics, supply chain, and disaster management. |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | https://isli.or.id/event/seminar-sinergitas-membangun-rantai-pasok-bencana-yang-tangguh/ |

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|---|---|
| **Description** | Heru Suhartanto's presentation at the International (Hybrid) Seminar on New Paradigm and Innovation on Natural Science and Its Application |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |

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|---|---|
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | The faculty of Science and Mathematics of Diponegoro University in Indonesia organised the International (Hybrid) Seminar on New Paradigm and Innovation on Natural Science and its Application. Heru Suhartanto presented the work related to the RESPOND-OR project with title: "When Optimization, Decision Support System and High-Performance Computing integrated to support the Disaster Data and Process Management". |
| **Year(s) Of Engagement Activity** | 2023 |
| **URL** | https://isnpinsa.undip.ac.id/ |

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|---|---|
| **Description** | Heru Suhartanto's presentation at the Southeast Asia International Joint-Research and Training Program; HPC & Trustworthy Cyberinfrastructure : Challenges & Opportunities |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Professional Practitioners |
| **Results and Impact** | The (hybrid) workshop of Southeast Asia International Joint-Research and Training Program; HPC & Trustworthy Cyberinfrastructure : Challenges & Opportunities took place in Taiwan and was organized by the National Center for High-performance Computing (NCHC). Heru Suhartanto presented research work related to the RESPOND-OR project, namely: Challenges - When Optimization, Decision Support System and High-Performance Computing integrated to support the Disaster Data and Process Management-Personal Routing and Scheduling Module. |
| **Year(s) Of Engagement Activity** | 2023 |
| **URL** | https://event.nchc.org.tw/2023/seaip/ |

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|---|---|
| **Description** | ICMS meeting "Mathematical Sciences for Global Challenges Research Fund (GCRF) initiatives" |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | Researchers who are recipients of the EPSRC-GCRF grants on the disciplinary theme of "Tackling global development challenges through mathematical sciences" or "Building capacity to tackle global development challenges through mathematical sciences research" interacted to identify new global challenges arising in low and middle income (LMIC) countries and develop synergies. Prof. Zografos presented the RESPOND-OR project. The potential for future collaboration with other researchers working in the emergency management area was explored. |
| **Year(s) Of Engagement Activity** | 2020 |
| **URL** | https://www.ccimi.maths.cam.ac.uk/events-archive/mathematical-sciences-for-global-challenges-researc... |

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|---|---|
| **Description** | Kick-off Meeting (UK, Indonesia, Sudan) |
| **Form Of Engagement Activity** | A formal working group, expert panel or dialogue |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |

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|---|---|
| **Primary Audience** | Study participants or study members |
| **Results and Impact** | In this kick-off meeting, which was conducted online, Lancaster University provided an overview of the project objectives and management structure. The participating stakeholders provided initial feedback regarding the project plan and content. |
| **Year(s) Of Engagement Activity** | 2019 |

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|---|---|
| **Description** | Modelling and solving the assisted evacuation problem with risk, efficiency, and fairness considerations (3rd IMA and OR Society Conference on Mathematics of Operational Research) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | National |
| **Primary Audience** | Other audiences |
| **Results and Impact** | Presentation on 'Modelling and solving the assisted evacuation problem with risk, efficiency, and fairness considerations' at the 3rd IMA and OR Society Conference on Mathematics of Operational Research (20-23 April 2021, online event), authored by Aleksandr Pirogov (presenter), Konstantinos G. Zografos, Juliana Sutanto, Ahmed Kheiri. |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | https://cdn.ima.org.uk/wp/wp-content/uploads/2020/06/Final-Programme-3rd-IMA-and-OR-Society-Conferen... |

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|---|---|
| **Description** | Muhamad Fathurahman's presentation at the LandSAGE 4 Lecture Activity: a project to provide decision support for monitoring and mitigation of natural disasters (landslides, mudflows, and floods) in Southeastern Asia using Cyber-enabled Collaboration |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | The LandSAGE 4, Mahidol University Thailand, Universitas YARSI Jakarta organised a lecture activity that took place online. Muhamad Fathurahman presented research work related to the RESPOND-OR project with title: "Introduction to inaRISK and DSS: Network Generation Module". |
| **Year(s) Of Engagement Activity** | 2023 |

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|---|---|
| **Description** | OR62 Online Conference |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | In this online conference, which had more than 700 researchers registered, Prof. Zografos presented the methodological framework used to incorporate the real-world complexities and stakeholder requirements in modeling disaster response decisions related to: i) assisted evacuation, ii) personnel routing and scheduling, and iii) allocation and distribution of relief supplies. |
| **Year(s) Of Engagement Activity** | 2020 |

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|---|---|
| **URL** | |

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|---|---|
| **Description** | Preparation and Coordination for Field Data Collection of Merapi Eruption in Yogyakarta (UK, Indonesia) |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Policymakers/politicians |
| **Results and Impact** | The research team at Universitas Indonesia had intensive discussions with BNPB, BPBD DIY, and BPBD Sleman on possible real-time data collection in Yogyakarta when there was an initial warning of Mount Merapi eruption. Subsequently, seven local students were hired to collect field data from BPBD DIY, BPBD Sleman, the affected villages and the shelters. Templates for the data collection are provided by Lancaster University. |
| **Year(s) Of Engagement Activity** | 2020 |

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|---|---|
| **Description** | Presentation of the RESPOND-OR project during the CREST-OR Scoping Workshop Agenda |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | The activities and developments brought upon by the RESPOND-OR team and their research, were presented during the CREST-OR Scoping Workshop Agenda (Thursday 15 June, 8:30am-11:00am). The activities and research findings of the RESPOND-OR were presented. |
| **Year(s) Of Engagement Activity** | 2021 |

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|---|---|
| **Description** | Presentations to stakeholders (Sudan) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | National |
| **Primary Audience** | Policymakers/politicians |
| **Results and Impact** | The University of Khartoum research team introduced the RESPOND-OR project to the Sudanese stakeholders (National Commission of Civil Defence (NCCD), Emergency Response Unit of Ministry of Heath (MoH), and Humanitarian Aid Commission (HAC)) at their headquarters. Following the introduction of the RESPOND-OR project, interviews were conducted during 2019-2020, at various locations to collect relevant data and access documents to support the implementation of the decision support system. |
| **Year(s) Of Engagement Activity** | 2019 |

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|---|---|
| **Description** | RESPOND-OR-X Decision Support System (DSS) workshop in Jakarta on November 30, 2023 |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |

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| **Primary Audience** | Professional Practitioners |
| **Results and Impact** | The RESPOND-OR seminar took place in Jakarta, Indonesia. Lancaster University and University of Indonesia researchers presented the RESPOND-OR-X DSS capabilities, and received feedback from the workshop participants. The audience of this workshop were national and regional disaster countermeasure agencies, non-governmental organisation representatives, and academic experts.The feedback received is that the DSS was used to develop a new project for training the employees of Regional Indonesian Disaster Countermeasure Agencies (BPBDs), and for testing assisted evacuation and disaster relief personnel routing and scheduling scenarios for the BPBDs. |
| **Year(s) Of Engagement Activity** | 2023 |
| **URL** | https://portal.lancaster.ac.uk/intranet/news/article/researchers-help-indonesia-better-prepare-for-n... |

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|---|---|
| **Description** | RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR) (2nd stakeholder workshop (preliminary verification)) |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | The 2nd stakeholder workshop (preliminary verification) was organised online on June 8, 2021. The developments of the RESilient Emergency Preparedness for Natural Disaster Response through OR (RESPOND-OR) were discussed with Indonesian stakeholders. The presentation was authored by Konstantinos G. Zografos (presenter), Juliana Sutanto, Ahmed Kheiri, Aleksandr Pirogov, Istenc Tarhan, Qorib Munajat.

The Co-Is of RESPOND-OR from Universitas Indonesia, Prof. Heru Suhartanto, and Universitas Gadjah Mada, Dr Bertha Maya Sopha also presented the data management and the simulation of the evacuation of people respectively to the RESPOND-OR stakeholders. |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | https://www.lancaster.ac.uk/lums/news/respond-or-supporting-disaster-management-and-humanitarian-aid... |

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|---|---|
| **Description** | RESilient Emergency Preparedness for Natural Disaster Response through Operational Research (RESPOND-OR) Webinar (1 March 2022) |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | International |
| **Primary Audience** | Other audiences |
| **Results and Impact** | The RESPOND-OR webinar (supported by the Embassy of Indonesia in the United Kingdom and Indonesian Forum on Disaster Risk Reduction) disseminated the results of the RESPOND-OR project to the broader academic community and contributed to the international scientific discourse regarding the optimization of emergency preparedness and response decisions. The RESPOND-OR team made the following presentations:

i) 'Assisted Evacuation Planning' by Aleksandr Pirogov (presenter), Konstantinos G. Zografos, Juliana Sutanto, Ahmed Kheiri,
ii) 'Video demonstration of the DSS for Assisted Evacuation Planning module' by Heru Suhartanto (presenter), Muhamad Fathurahman, Toto Haryanto,
iii) 'Disaster Response Personnel Routing and Scheduling' by Istenc Tarhan (presenter), Konstantinos G. Zografos, Juliana Sutanto, Ahmed Kheiri, |

iv) 'Video demonstration of the DSS for Disaster Response Personnel Routing and Scheduling module' by Heru Suhartanto (presenter), Muhamad Fathurahman, Toto Haryanto,
v) 'Evacuation Simulation' by Bertha Maya Sopha (presenter), Hilya Mudrika Arini, Sekar Sakti,
vi) 'Security Forces Rostering and Risk Estimation' by Hiba H. S. M. Ali (presenter), Khalid Elbadawi (presenter), Hisham Abushama, Salih Salih, Ahmed Kheiri.

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| **Year(s) Of Engagement Activity** | 2022 |
| **URL** | https://www.linkedin.com/feed/update/urn:li:activity:6902953933304922112/ |

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|---|---|
| **Description** | Towards the development of a Decision Support System for Disaster Response Management: The Case of the RESPOND-OR project (The OR Society's 63rd Annual Conference) |
| **Form Of Engagement Activity** | A talk or presentation |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | National |
| **Primary Audience** | Other audiences |
| **Results and Impact** | Presentation 'Towards the development of a Decision Support System for Disaster Response Management: The Case of the RESPOND-OR project' during the OR Society's 63rd Annual Conference (14-16 September 2021, online), by Konstantinos G. Zografos (presenter), Juliana Sutanto, Ahmed Kheiri, Aleksandr Pirogov, Istenc Tarhan, Qorib Munajat |
| **Year(s) Of Engagement Activity** | 2021 |
| **URL** | https://www.theorsociety.com/events/previous-annual-conferences/ |

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|---|---|
| **Description** | Workshop for Preparation of A Simulation Model (Indonesia) |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | National |
| **Primary Audience** | Policymakers/politicians |
| **Results and Impact** | This online workshop was used to get insights for developing a simulation model for modelling evacuation decisions during the Jakarta flood disaster. From the information collected, the project team at Universitas Gadjah Mada (UGM) has built a framework of the evacuation model. |
| **Year(s) Of Engagement Activity** | 2020 |

| | |
|---|---|
| **Description** | Workshop for Preparation of Data Collection at BNPB (Indonesia) |
| **Form Of Engagement Activity** | Participation in an activity, workshop or similar |
| **Part Of Official Scheme?** | No |
| **Geographic Reach** | National |
| **Primary Audience** | Policymakers/politicians |
| **Results and Impact** | Using the template from Lancaster University, the research team at Universitas Indonesia conducted face-to-face workshop in BNPB to understand the existing disaster response process and map the data availability. Following the workshop, the research team at Universitas Indonesia collected the relevant data and documents from BNPB. |
| **Year(s) Of Engagement Activity** | 2019,2020 |

**Data**

[The Data](#) on this website provides information about publications, people, organisations and outcomes relating to research projects

**APIs**

A set of REST [API's](#) enable programmatic access to the data. Refer to the application programming interfaces [GtR](#) and [GtR-2](#)

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