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GIS-based Accessibility Study for Emergency Responses to Traffic Crashes Along BRT 1 Corridor In Dar Es Salaam, Tanzania

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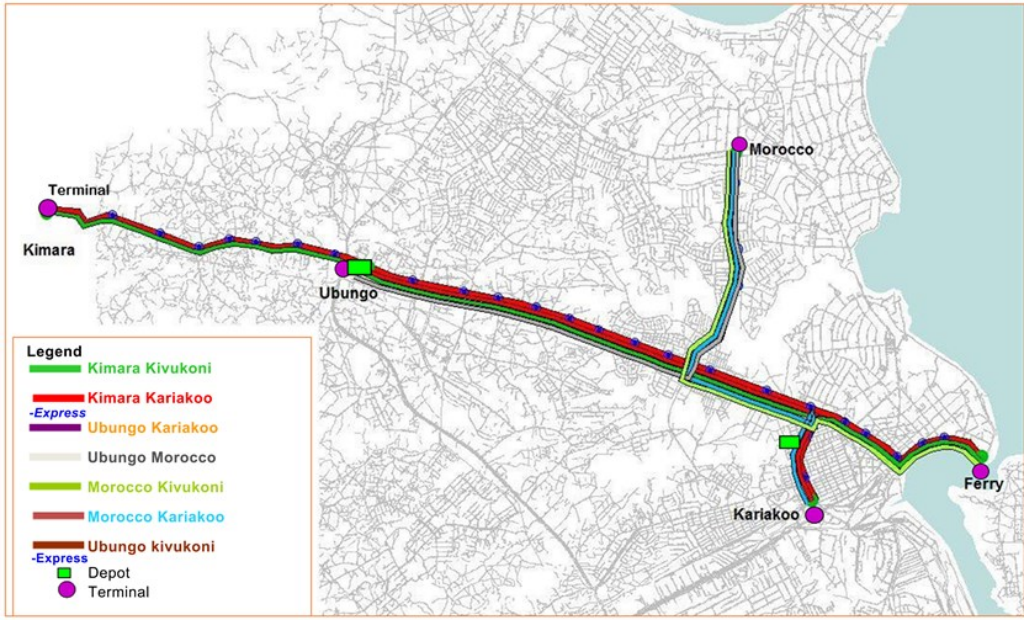
When a serious crash occurs on a congested urban corridor, what determines survival?

- **Location of the crash?**
- **Nearest capable responder?**
- **Travel time through traffic?**
- **Coordination at scene?**

ALL OF THESE!

INTRODUCTION

- The Bus Rapid Transit (BRT) 1 corridor is the East Africa's first full-scale BRT system corridor with high mixed traffic volume.
- Crashes along this corridor require responders who are not only nearby, but also able to reach the scene through complex traffic conditions.
- Delay after a crash can turn survivable injuries into fatalities.
- Emergency response depends on both availability and physical accessibility.



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WHO RESPONDS TO CRASHES?

Police

Fire and Rescue Force

Ambulance

Tow Truck

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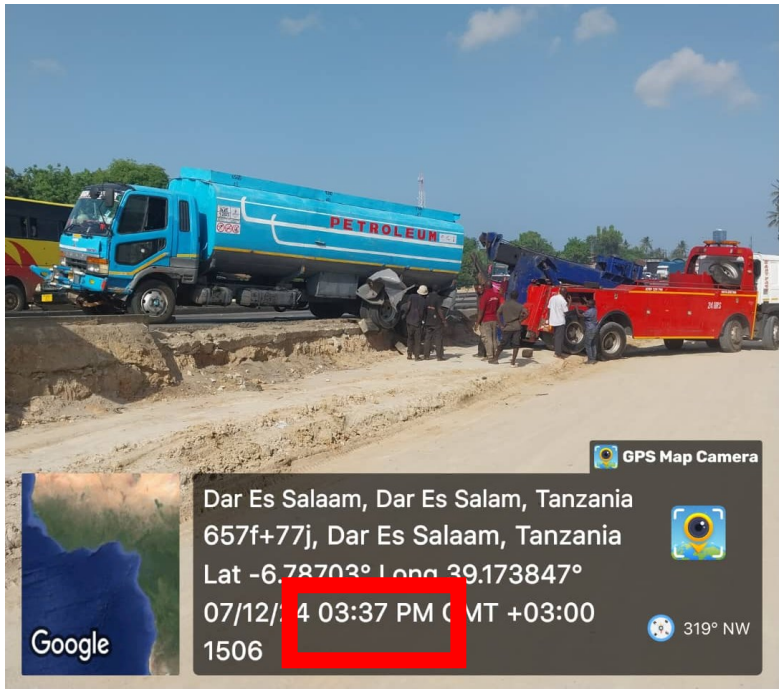
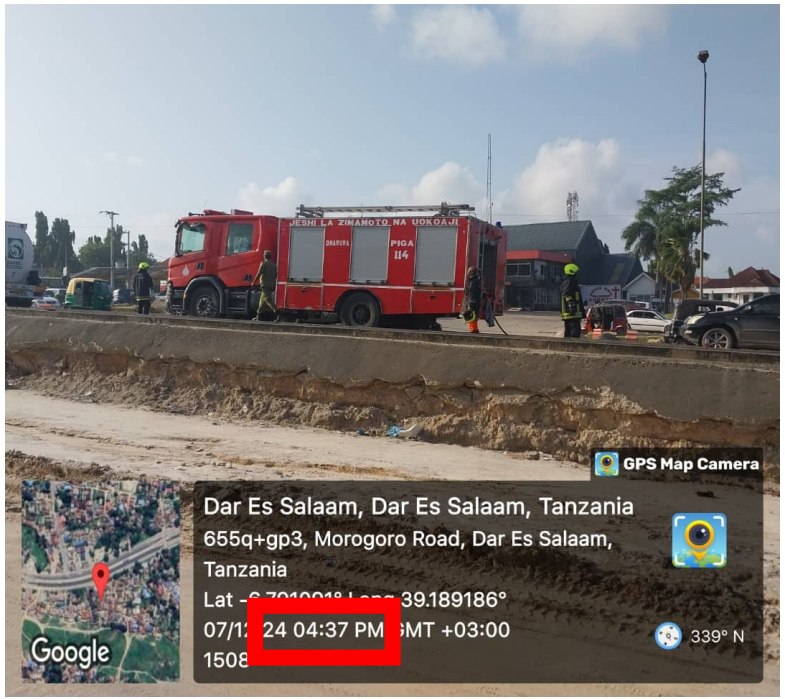
Example Situation: A crash occurred at 2:30 PM, Full attendance to the crash was completed at 5:50 PM (3 hr and 20 min)





RESEARCH OBJECTIVE

Main objective: assess accessibility of emergency response services to traffic crashes along the BRT 1 corridor in Dar es Salaam.

1. Where are the most frequent crash hotspots?
2. How are emergency facilities distributed relative to those hotspots?
3. Where can responder locations be optimized to improve access?

METHODOLOGY FRAMEWORK

Availability

Are the relevant services present and sufficiently distributed?

+

Physical accessibility

Can responders reach crash hotspots through the actual road network?

Crash hotspot mapping

Facility mapping

Network / proximity analysis

Location-allocation scenarios

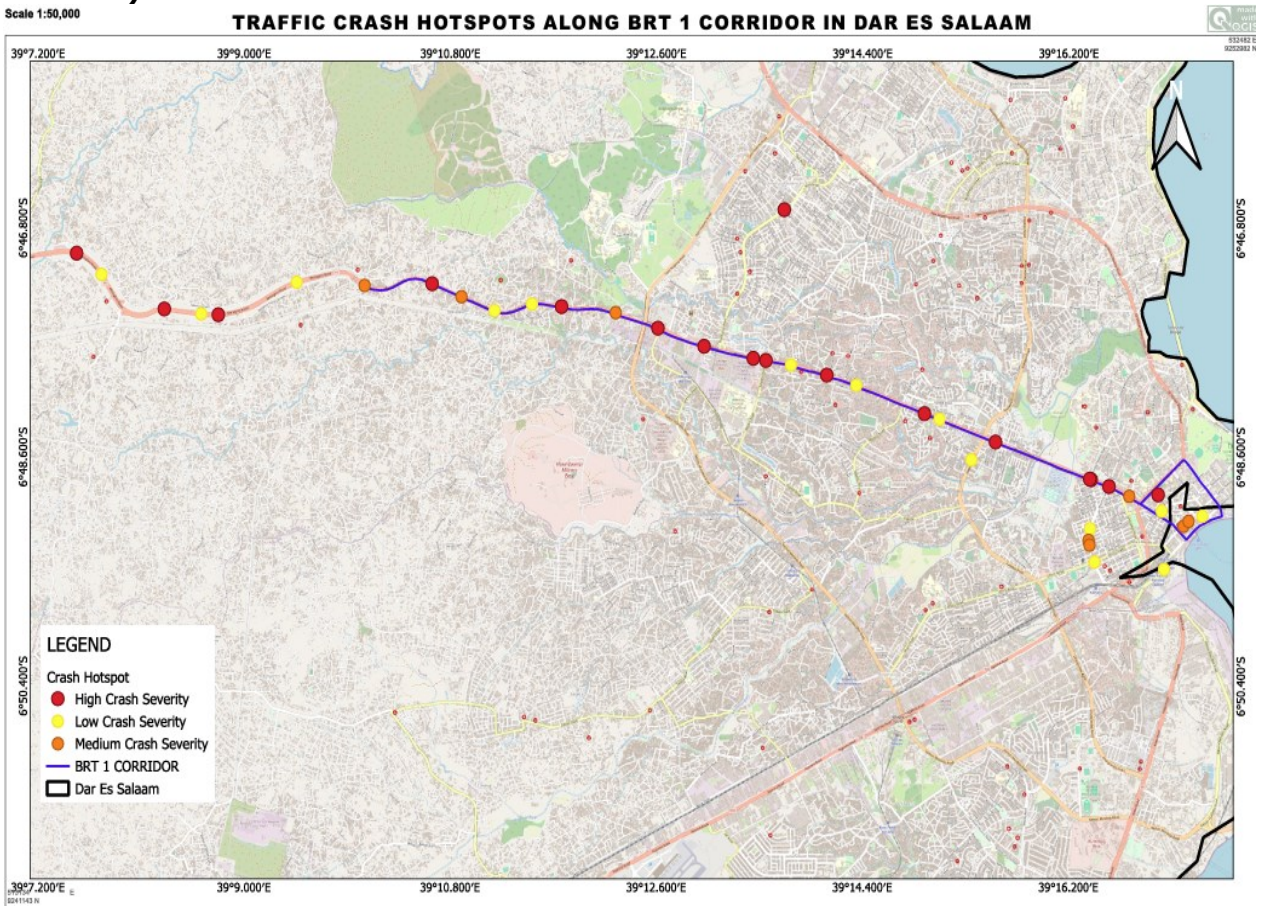
GIS allows crash patterns, facility locations and network constraints to be analysed together

METHODOLOGY FRAMEWORK

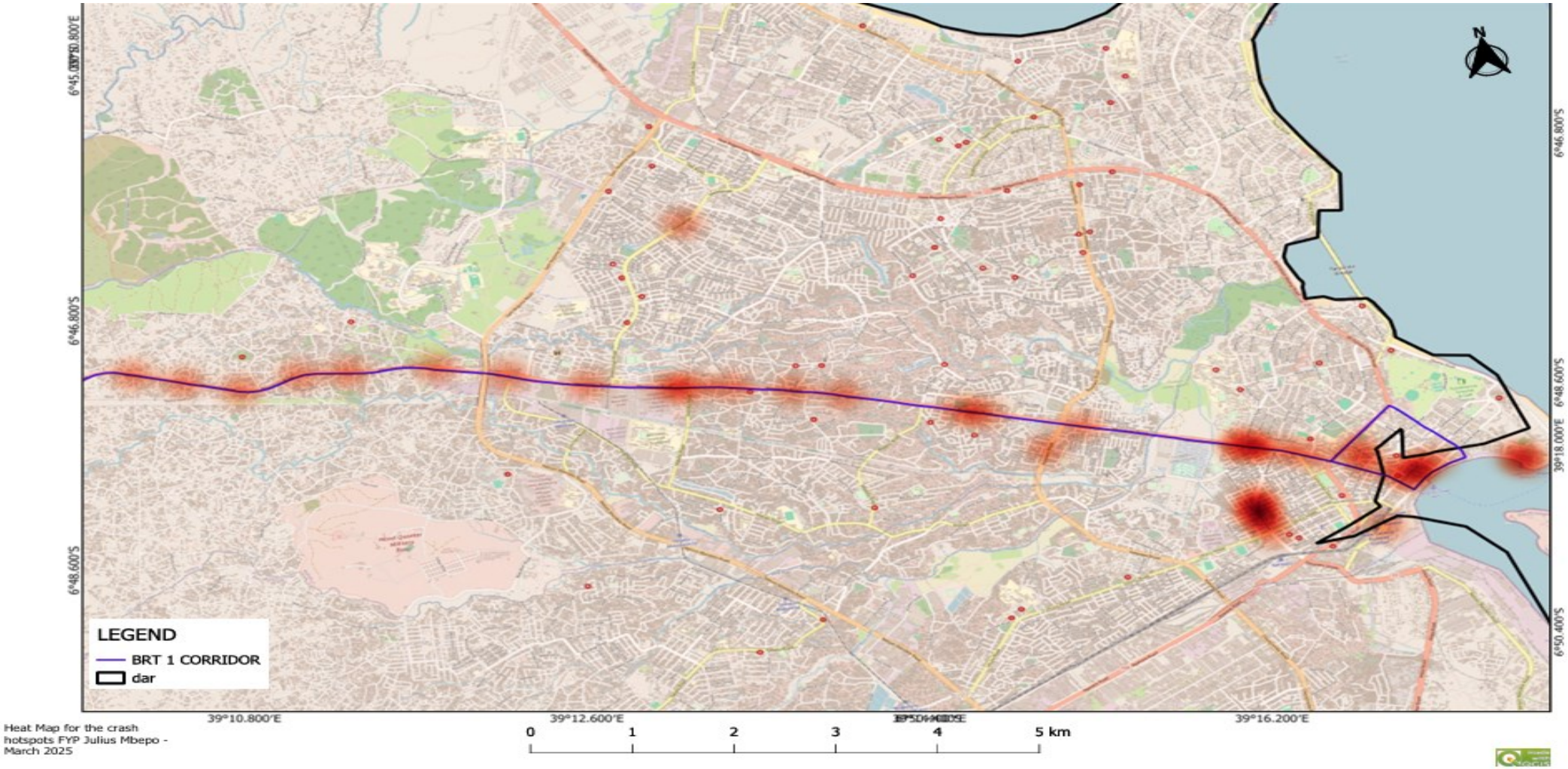
Input data	Spatial analysis	Network assessment	Recommendations
Crash records Road network Facility locations Travel time checks	Geo-referencing Kernel density estimation Proximity analysis	Route verification ETA comparison Responder performance gaps	Location-allocation Operational priorities Policy actions

RESULTS: Crash Hotspots Mapping

Spatial distribution of crash hotspots along the BRT 1 corridor. **Data source**: Dar Rapid Transit Agency (DART), 2023-2024)



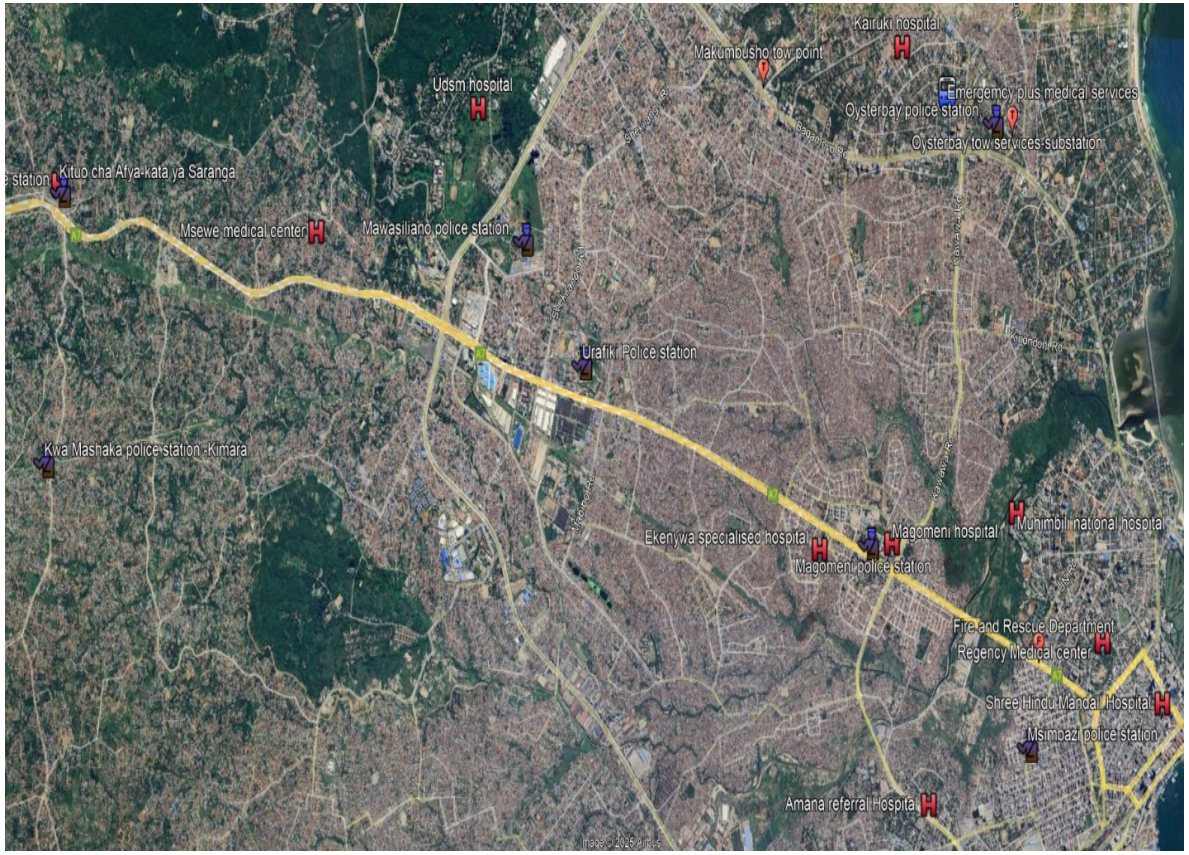
RESULTS: Crash Hotspots Along BRT 1



Heat Map for the crash hotspots FYP Julius Mbepo - March 2025

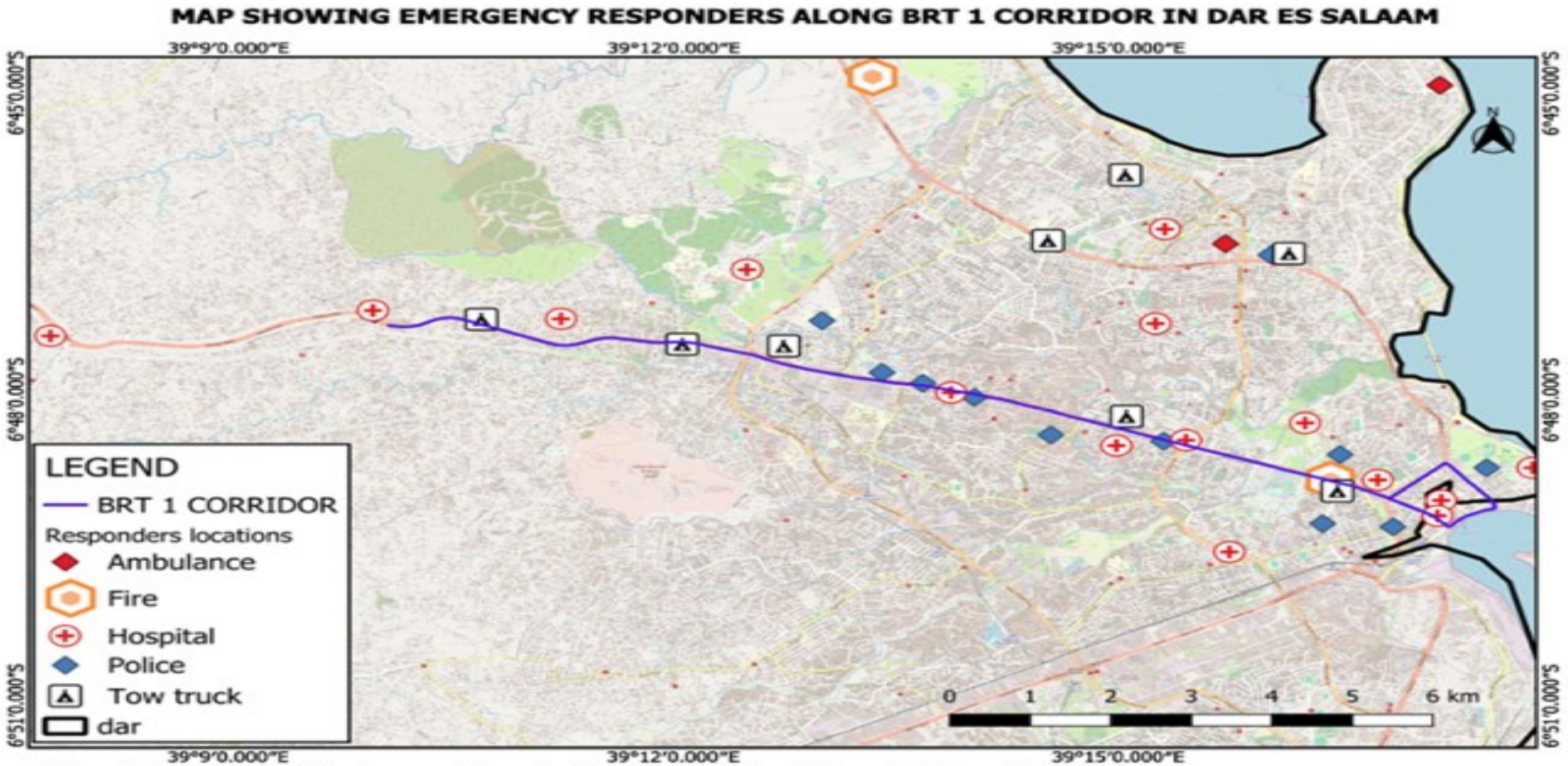
RESULTS: Facility Mapping

Police stations	Hospitals	Tow trucks services	Fire rescue	City ambulance
-Oysterbay Hq -Oysterbay RTO office -Urafiki -Mawasiliano -Kimara Mwisho -Magomeni Msimbazi -Kwa Mashaka -Ubungo Maji -Kivukoni stop police	-Muhimbili -Amana referral -Bochi -Ekenywa -Magomeni Regency -Shree Hindu Mandal -Ubungo municipial hospital	-Makumbusho point -Mikocheni Oysterbay point -Kinondoni Ubungo	-Upanga Fire Hq -Lugalo	-Masaki



Mapped emergency responders along BRT 1

RESULTS: Facility Mapping

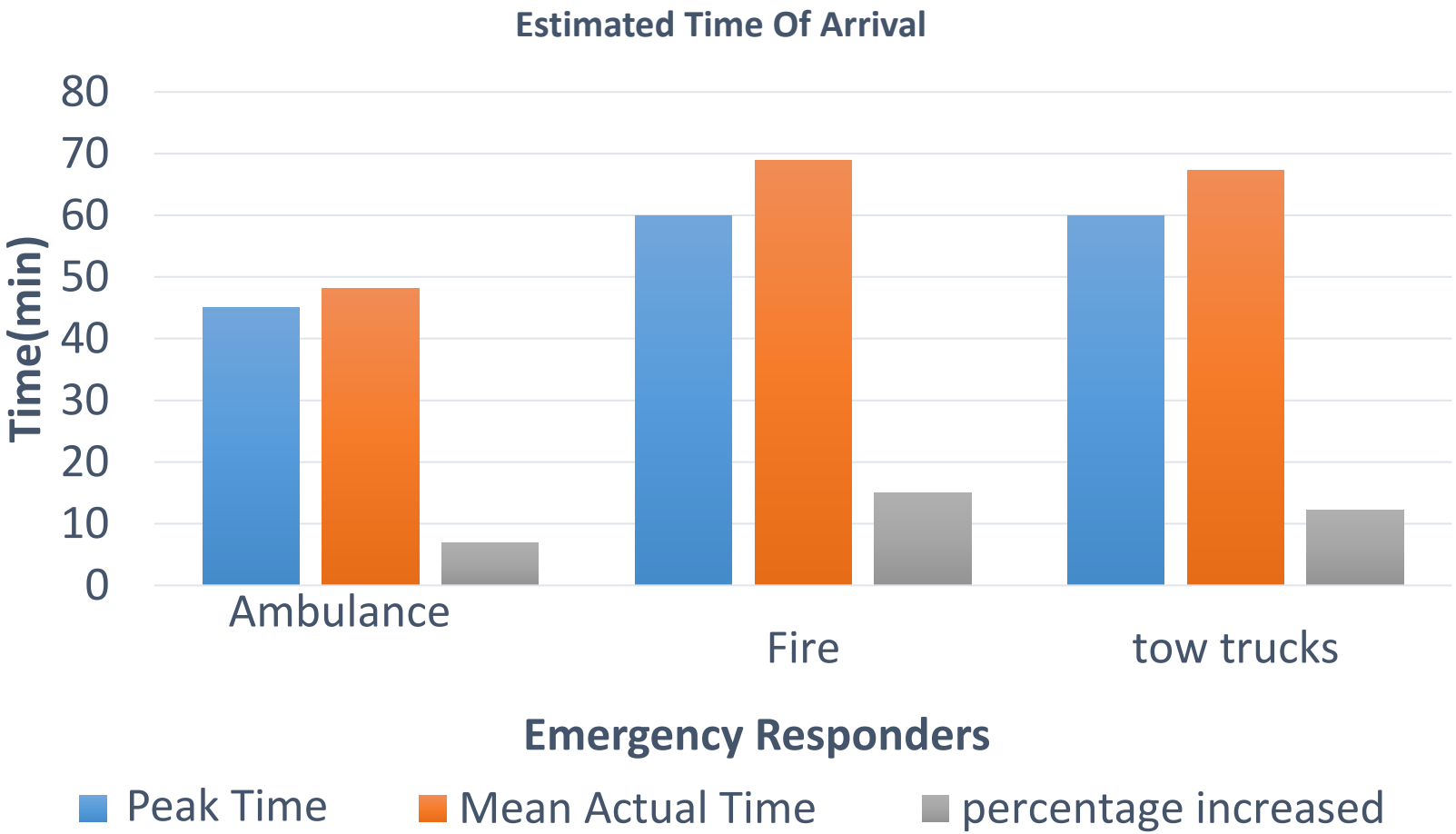


RESULTS: Network/Proximity Analysis to Crash Sites

Emergency Facility	Routes Distance (km)	Normal Travel Time (minutes)	Peak Travel Time (minutes)
Bochi hospital-ambulance service	Route 1; 12.469 Route 2; 9.209	28.703 23.815	47.406 37.623
Makumbusho Tow truck services	Route 1; 11.438 Route 2;13.516	44.316 50.548	65.754 74.064
Fire Station- Kariakoo	Route 1; 14.246 Route 2;19.114 Route 3; 16.120	41.368 38.670 34.179	62.734 67.341 58.357
Fire station- Lugalo	Route 1; 9.258	28.516	37.774
Amana Hospital Ambulance services	Route 1;13.524 Route 2; 17.624	30.286 36.435	37.048 45.248

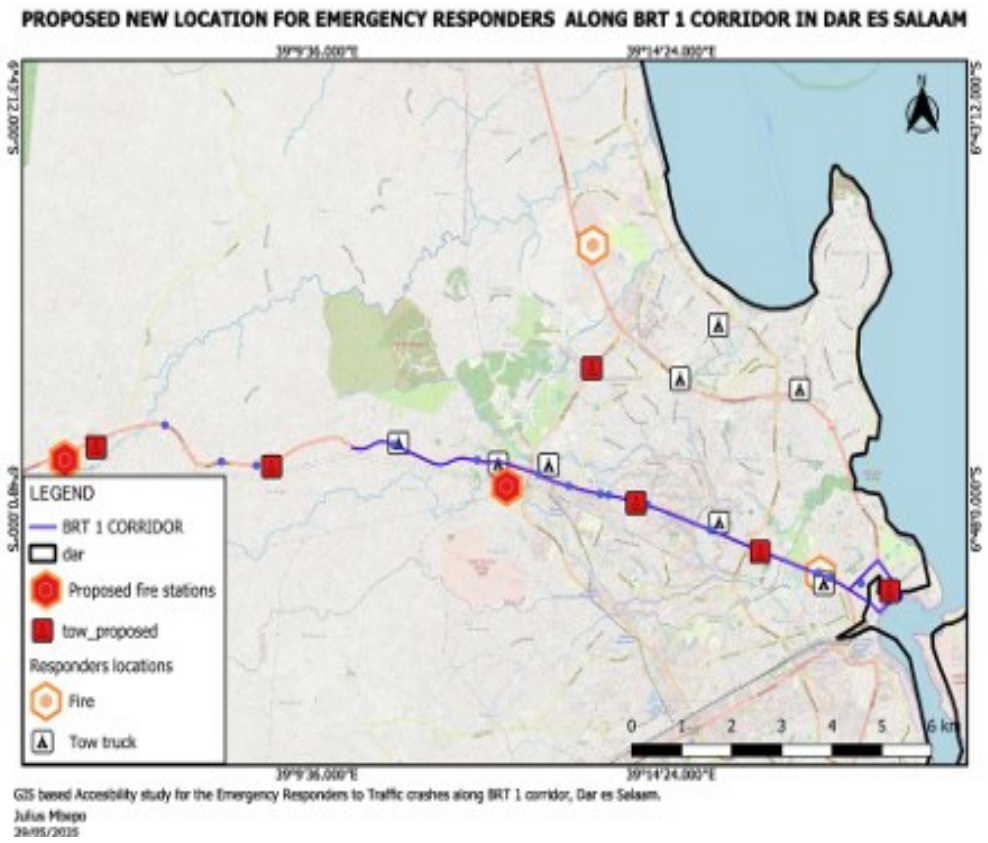
- Calculated the shortest routes from emergency facilities to crash sites, considering road length and travel time
- Travel time are estimated under different traffic conditions (normal/off-peak and peak hours)

RESULTS: Network/Proximity Analysis to Crash Sites



Ambulance: 6.9%
Fire: 14.9%
Tow trucks: 12.2%

RESULTS: location-allocation points to targeted resource placement



- **Recommended additional allocation points**
  - ✓ **Fire and Rescue force** at**;** riverside and Mbezi Mwisho
  - ✓ **Tow truck services** at**;** TPDC gas station, Tandale, Msimbazi river, Samora avenue, Matosa road, Kwa Yusufu-mbezi
- **Reasons**
  - ✓ Reduce response times to about 45%
  - ✓ Ensure responders are within about 2-3.5 km of historical crash points

LESSONS LEARNED

From GIS finding	Operational implication	Action for agencies
Crash clustering	Prioritize hotspot segments	Pre-position response resources
Facility gaps	Some areas underserved by specific responders	Target Fire / tow allocation, review resource allocations
Estimated travel time delays	Traffic and routing reduce performance	Use corridor traffic control and dispatch protocols
Stakeholder demand for maps	Outputs are useful beyond research	Share maps in routine operations, improve coordination

KEY TAKEAWAYS;

1. Crash hotspots should guide emergency response planning, not only engineering countermeasures.

2. Facility presence is not enough, network accessibility and operational readiness determine actual response.

3. GIS-based location-allocation can support practical decisions on where to place responders and how to coordinate them.

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THANK YOU!

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