DSS-RESPOND-O R-X RESilient Emergency **Preparedness for** Natural Disaster Response through Operational Research

•Joint projects : Lancaster Univ, Universitas Indonesia Team (UI, Yarsi, IPB), National Board for Disaster Management

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•Presented at PRAGMA 39, 22-24 June 2023

The modules developed and need advises

- Network generators (used open street maps data)
- Assisted Evacuation Planning
- Personal Routing and Scheduling

modules

• Assisted Evacuation Planning,

- given Zone points where population of persons and live stocks to be evacuated, Shelters – points for evacuated person and live stocks, Depots – points where the vehicles are kept (called Point of Interests- POIs), networks connecting the POIs (risk value and maximum speeds between points) –
- will provide some optimal solutions minimizing the objects (Num of Shelter to be opened, Max-Evac-Time, Risk, and Travel Time).

Output example

AEP Code	NG230531071340_NUSA_TENGGARA_BARAT_3_1.00
Disaster	Gempa Bumi
Date	02 Jun 2023
Alpha	1.00
Speed	40
Network Code	NG230531071340_NUSA_TENGGARA_BARAT
Poin Of Interest	17
Evac. Percentage(%)	100



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#	No.	Problem Type	Obj Order	Number Of Shelter	Max Evacuation Time (hr)	Risk	Total Time Travel (hr)	Fleet Cost	Optimal Solution	Line Index	Action			
2	1	FSC	1234	3	5.92	3784.5	30.31	2000000.0	⊘ Yes	0	ध≡ Detail 🝷			
	2	FSC	1243	3	6.69	3065.41	24.08	2000000.0	× No		ि≣ Detail ▾			
	3	FSC	1324	4	7.82	2543.17	20.88	1600000.0	× No		ि≣ Detail ◄			
	4	FSC	1342	4	7.47	2409.87	20.22	1600000.0	× No		ि≣ Detail ▾			
2	5	FSC	1423	3	6.94	2512.12	19.96	1800000.0	⊘ Yes	1	E Detail ◄			

i More Info 🔻

E	vac Dispatch						×	
	I More Info ▼			Column	·	Direction	- 7 ×	
	No.	Obj Order Vehicle		Туре		Dispatched To		
ľ	1	1234 DPBD-CAR - VC1		Pickup Truck		ABIAN TUBUH		
	2	1234	DPBD-CAR - VC2	Pickup Truck		AIK BERIK		
	3	1234	DPBD-CAR - VC3	Pickup Truck		ABIAN TUBUH		
	4	1234	DPBD-CAR - VC4	Pickup Truck		AIK BERIK		
	5	1234	DPBD-CAR - VC5	Pickup Truck		AIK BERIK		
	6	1234	LING-CAR - VC1	Military Truck		AIK DAREK		
I.	7	1234	LING-CAR - VC2	Military Truck		AIK BERIK		
	8 Evec Ope	1234	LING-CAR - VC3	Military Truck		AIK BERIK	AIK BERIK	
	Evac Ope	n Shelter						
	i More I	Info 🔻				Column		
	No.	Shelter Id			Shelter			
	1	0		ORARI NTE				
	2	2		LAPANGAN	RINJANI			
	3	6			LAP SUELA			

Evac Path								×
i More Info				Column	~	Direction	¥	
No.	Type Id	Time (hr)	Trips					Мар
1	Pickup Truck	5.0974	ABIAN TUBUH -> ORARI NTB (P = 10 : L = 0) AIK D	DAREK -> ORARI NTB (P = 10 : L = 0)	AIK B	ERIK -> ORARI NTB (P = 10 : L = 0)		ಸೆ map view
2	Pickup Truck	3.6336	AIK BERIK -> LAPANGAN RINJANI (P = 10 : L = 0) A 10 : L = 0)	AIK BERIK -> LAPANGAN RINJANI (P =	= 10 : l	_ = 0) AIK BERIK -> ORARI NTB (P	=	와 map view
3	Pickup Truck	1.4147	ABIAN TUBUH -> ORARI NTB (P = 10 : L = 0)					ぷ map view
4	Pickup Truck	4.4501	AIK BERIK -> LAP SUELA (P = 10 : L = 0) AIKMEL U AIKMEL UTARA -> LAP SUELA (P = 10 : L = 0) AIKI	Tara -> lap suela (p = 10 : l = 0) Mel utara -> lap suela (p = 10 : l	AIKME . = 0)	L UTARA -> LAP SUELA (P = 10 : L	= 0)	ぷ map view



Modules – Personal Routing and Schedulling

Given services (and the settings), Depots, Demand Points, Resting Points, Network Alpha, Demand, Personal (conducting the services) Will provide Optimal Personal Routing and Scheduling solution by miniziming UD (unsatisfied Demand), ACT (Average demand Completion Time), F (Fairness), and TR (transportation risk)

i PRS Solutions Info

Basic Information

PRS Code	NG230531071340_NUSA_TENGGARA_BARAT_3
Disaster	Gempa Bumi
Date	05 Jun 2023
Network Code	NG230531071340_NUSA_TENGGARA_BARAT
Poin Of Interest	17
Evac. Percentage(%)	100

×



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Label	UD	АСТ	F	TR	UD	АСТ	F	TR	UD	ACT	
EV- SOL 1	0	0	0.0666667	0.433959	0	0	0.423913	0.258315	0	0	
EV- SOL 2	0.0119048	0.294279	0	1.0424	0.025641	0.0901613	0	0.261468	0.025641	0.0774€	
EV- SOL 3	0.0119048	0.294279	0	1.0424	0.025641	0.0901613	0	0.261468	0.025641	0.07746	
EV- SOL 4	0	0.143199	0.5	0	0	0.0893825	0.891304	0	0	0.07702	

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	∃ Team Schedule		C	olumn 👻 Direction -	• 🛛 ×
Solution_id	Service Name	Planning Horizon Length	Average Demand Completion Time (hr)	Transportation Risk	Action
0	evacuation	541.123	229.784	2.211e+16	tail
1	evacuation	550.06	262.171	1.7416e+16	tail
2	evacuation	549.233	267.828	1.75363e+16	tail (1997) E Detail
3	evacuation	544.708	244.943	1.56893e+16	🗯 Detail
4	evacuation	544.72	239.151	1.57198e+16	<table-cell-rows> E Detail</table-cell-rows>

Showing 1 to 5 of 5 entries



of Solution Info Pe	er Day	
keyword	9 search	Column Y Direction - Y 7

Solution_id	Service Name	Period	Unsatisfied Demand	Average Demand Completion Time (hr)	Fairness	Transportation Risk	Detail
0	evacuation	0	84	9.76661	0.118519	55.0718	8⊒ Detail
0	evacuation	1	78	22.5476	0.242593	380.578	≋ ⊒ Detail
0	evacuation	2	78	23.6427	0.242593	1995.31	≋ Detail
0	evacuation	3	72	42.0871	0.17037	6117.87	8⊒ Detail

rsonel Schedul	ing										
tus Solution	ý)										
		Q search	h				Colu	imn	✓ Direction	~	V
Service Name	Period	Personnel_id	Team Member	Work Status	Resting Start Time	Working Start Time	Resting Finish Time	working Finish Time	Starting Location	Final Location	
evacuation	0	0	Toto-Aby	1	10:00	00:00	15 : 00	10:00	KANTOR BUPATI LOMBOK UTARA	LAPANGAN UMUM MATARAM	
evacuation	0	1	anto-dewi	1	00:29	00 : 00	05 : 29	23:00	KANTOR KECAMATAN LINGSAR	LAPANGAN UMUM MATARAM	
evacuation	0	2	dr ponco - dr siti	1	00 : 29	00 : 00	05 : 29	23:00	KANTOR KECAMATAN LINGSAR	KANTOR YSLPP	

100	Dashboard	Personel Scher	duling								
+	•	Kecamatan Batulayar Kecam	atan y		2	2 min	Kecamata Suela				Demand Point Resting Point Personnel Base Kecama Alas
1	N.	Gunun	gsan Kongata	: H	180		Kecamatan Wana:	atan Kecamatan Pringgabaya	#	Location	Туре
	1.1	Ma	Kecam Recam	da	Camatan	Kecamatan Montong Gading	Pringgasela Kecamatan Suralaga		1	Kantor kecamatan lingsar	Personel Base
	1		Kecamatan Labuapi	Pringgarata	Kecamat Kopan	Recamatan	amatan Isbagik Kecamatan Sukamulia Selong	×	2	Aik darek	Demand
11	-	Kecan Ger	natan Kecamatan ung Kuripan	M	The	Terara	Kecamatan Sakra Timur	natan an Haji	3	Aik bukaq	Demand
	Show	Source	Target	Travel Duration	Arrival Time To Destination	Service Start Time at Destination	Service Completion Time at Destination	Evacuation Route	4	Lapangan umum mataram	Resting
1	•	KANTOR KECAMATAN LINGSAR	AIK DAREK	0.774938	00:46	00 : 46	10:00			Taliwang	·· · /
2	2	AIK DAREK	LAPANGAN UMUM MATARAM	1.24588	11:14	11 : 14	05:29			And the second	Eth
э	2	LAPANGAN UMUM MATARAM	AIK BUKAQ	1.54328	17:23	17 : 23	23:00	_	2		S. * *
4		AIK BUKAQ	LAPANGAN UMUM MATARAM	1.49344	00:29	00:29	05:29		5		· my

Challenges and need advises

The prototype system is now under user testing, stage 2 (some improvements made after stage 1)

The system (the web apps and module codes) deployed in one machine with 32 cores, but still too slow for processing networks generation, AEP and PRS modules with more than 15 POIs;

The system will be tested with data from all provinces, at least on network generations where the networks will be used by AEP and PRS modules.