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Managing Materiel Distribution in an Uncertain Environment

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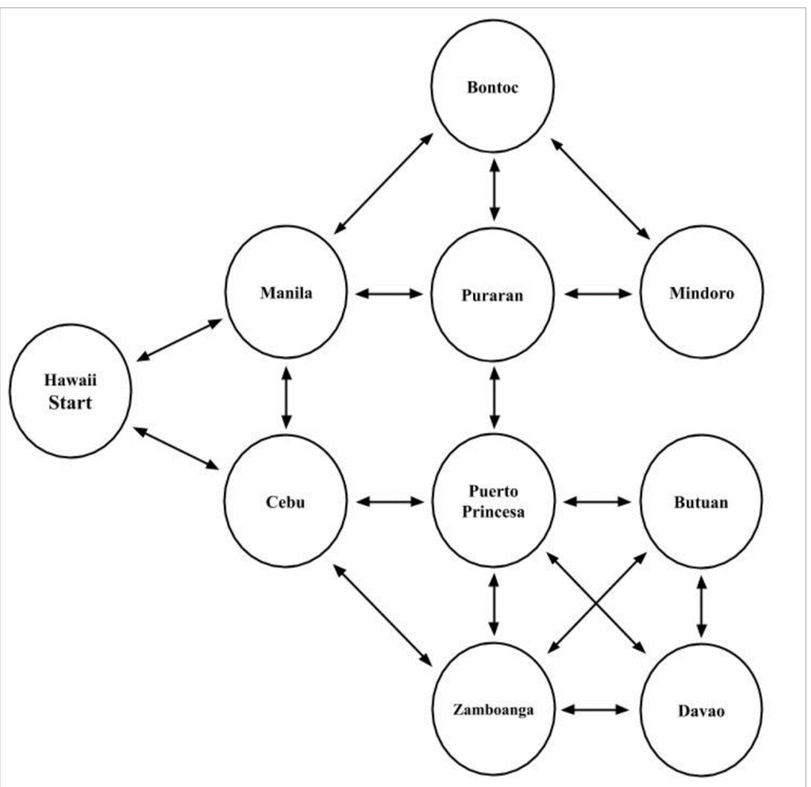
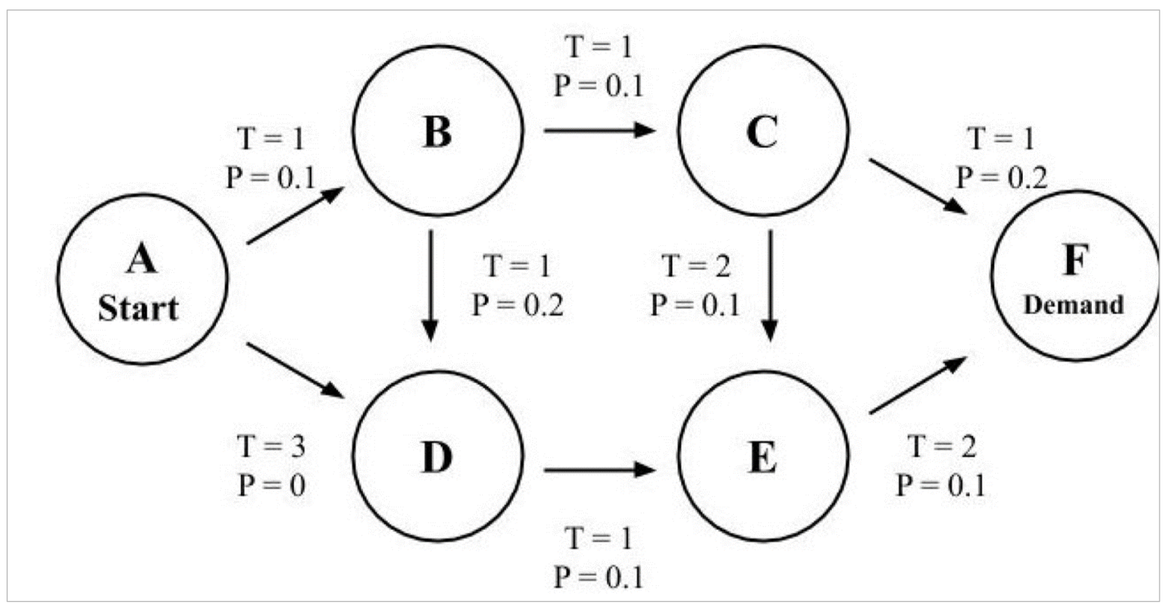
Background

- Logistical support is crucial to the success of most military operations and allows the U.S. Armed Forces to maintain operational flexibility and superiority.
- Degradations to a supply network may interfere with the U.S. Navy's ability to operate effectively in a forward theater.
- This project addresses the possibility of disruptions in a supply network and proposes ways to respond to such disruptions.



Network representation of Philippine case study. Supplies start in Hawaii and travel toward various destination nodes via air or sea routes.



Notional network delivering supplies from node A to Node F. Route A → B → C → F is the fastest if no disruptions occur. Route A → D → E → F is slower and less risky.

Model

- We develop six network optimization models, five proactive models and one reactive.
- Goal: to deliver items through the supply network to a demand location as quickly as possible.
- Disruptions are random occurrences.
- Some routes may be slow and stable. Other routes have the potential to be fast but also the risk of being very slow.

Case Study: Philippines in 2032

- Global War 2030 scenario: hot war in Pacific involving US, Russia, and China
- US routes supplies from Hawaii to various locations in Philippines.
- Examine several cases involving different types of disruptions to sea and air routes
- Some models generate routes that are much too conservative in an attempt to avoid any type of disruption

Model / Destination City	MinT_R 0.9	MinT_R 0.6	CCP 0.9	CCP 0.6	ReOpt	DP-Time
Bontoc	*INF	22	27	22	21.8	21.8
Puraran	19	19	19	19	21.1	19.0
Mindoro	*INF	24	28	24	32.1	26.0
Puerto Princesa	16	16	16	16	16.0	16.0
Zamboanga	15	15	15	15	15.0	15.0
Butuan	17	17	17	17	17.0	17.0
Davao	17	17	17	17	17.0	17.0

Results for one case. The MinT_R algorithm can be far too conservative in order to produce routes that avoid any disruption. The ReOpt algorithm. on the other hand, can be too aggressive as it does not adequately account for risk. CCP and DP-Time often generate more balanced results.

Main Conclusion

- Reactive models often perform well when the likelihood of disruption is small; however when the likelihood of a future disruption is high, the reactive model generates a far too risky route.

Future Work

- Examine networks where the disruption probability varies with time.
- Perform a more systematic comparison of the reactive model with proactive models.

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