Military Supply Chain Network Resilience in Urban Warfare in the presence of Targeted Disruptions

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Introduction

The last decades, wars tend to make a shift from the rural, open fields such as in Afghanistan, towards more dense urban terrain due to urbanization. Recent events in the invasion of Russia in Ukraine have emphasized the importance of resilient supply chains to provide ammunition to the front line troops. Therefore, the following research question was constructed:

What strategies can improve the resilience of Military Supply Chain Networks in the presence of targeted disruptions, primarily focused on Urban Warfare?

Research Design in four steps

1. Literature study

Systematic Literature Review to available strategies to assess and redesign Military Supply Chain Networks. Academic relevance of the future research:

- *P*ast studies modelled Targeted disruptions based on highest node degree, not situational factors
- Network resilient was assessed in a *stationary environment*, not in a *dynamic environment*
- Literature focused more on *network performance* rather than *operational capabilities* of supply chains

2. Modeling of dynamic environment

The urban operation can be characterized by a series of grids which all platoons have to conquer. Each platoon operates in a grid which is planned based on 24 hours of operation and stock. When a platoon is ready, it has to wait until all other platoons are finished before continuation to the next.

The resupply process for platoons follows a cyclic decision making process as shown in Figure 1. The basic flow is a replenishment process in which regular replenishment with a lead-time of 24 hours take place. In the case the stock during the operation drops below a critical level, an emergency resupply with a lead-time of 2 hours can be requested. The cyclic process can hence be conducted multiple times during and after combat.

3. Modelling of targeted disruptions

The modelling of targeted disruptions will be focused on contextual factors and the impact of the disruption on the availability of goods at platoon level. The disruptions in the supply chain can take place on a node or an edge. The possible outcome of disruption presented in Figure 2. The probability a node or edge is disrupted is based on the *risk priority number* as presented in Figure 3.

Figure 1: Cyclic process during military operation

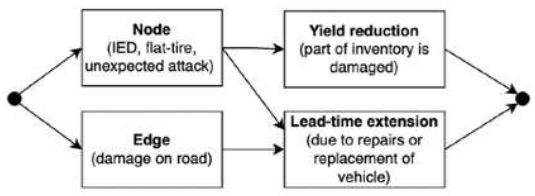

Figure 2: Outcomes of disruption on nodes or edges

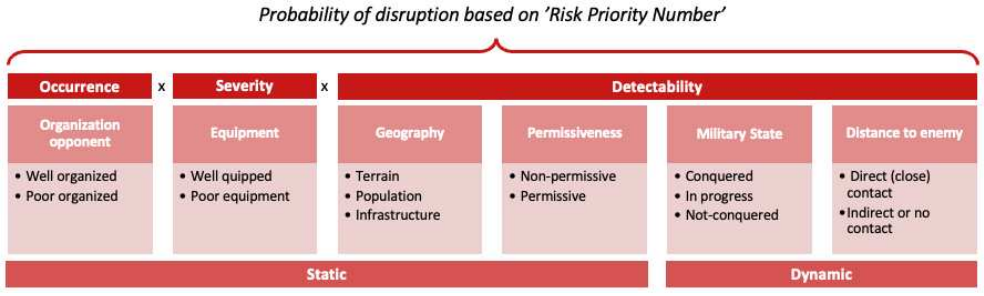

Figure 3: Disruption Risk Classification

4. Assessment of Resilience

The supply chain can be characterized as resilient if the availability of goods is always sufficient to continue the operation. Therefore, the probability that the *Inventory On Hand* of one platoon drops below the critical fighting margin of 25% can be used in a higher level Markov-chain to determine the probability of successful conquering of the grid by all platoons. Several replenishment strategies will be tested against the disruptions in order to conclude what a resilient design could be.

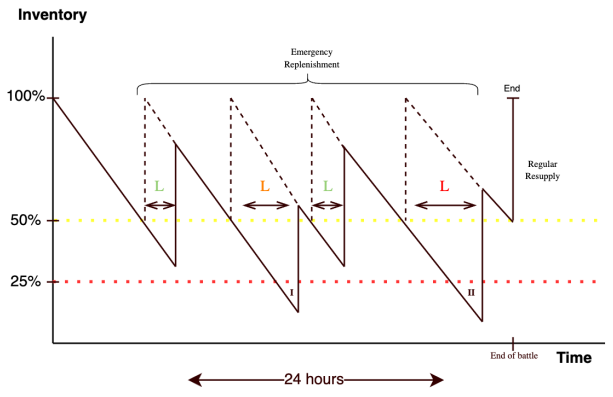

Figure 4: Example of inventory levels during combat