# MODELING INTRATHEATER DISTRIBUTION SYSTEMS

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## ABSTRACT

This research presents an optimization model that is intended to demonstrate the type of analysis that could be performed by a planning cell to improve operational processes for intratheater distribution systems. This model evaluates the ability of a system to support sustainment demand of forward units while considering risk to transportation vehicles and personnel. We also use the model to look at new types of distribution technologies, such as Joint Precession Airdrop System (JPADS). The model was developed using the General Algebraic Modeling System (GAMS).

### Model

The optimization model attempts to satisfy daily sustainment demand at a set of forward-deployed units by scheduling a series of airlift and truck convoy movements between sources of supply (e.g. regional logistics hubs) and the forward units. The mathematical model determines a movement schedule that satisfies all daily demands over the time horizon considered, while attempting to minimize the total risk to the re-supply movement system. Risk is defined as some weighted average of the number of sorties at high-risk airfields and the number of convoy truck-miles along high-risk routes. Because these two components of risk are somewhat incommensurate, the model identifies a trade-space whose endpoints are defined by a “minimum-risk-to-aircraft solution” and a “minimum-risk-to-truck-convoys solution.”

### Scenario

We constructed an example scenario that demonstrates the type of analysis that can be performed with the optimization model. Alternative movement plans are identified and evaluated against risk to transportation assets and personnel. The math models used in this analysis optimize the system with respect to the desired operational performance parameters over a range of resources, not just point solutions.

As an example of the changes to operational processes that can be evaluated, we consider two options: one with limited integration of supply and demand processes (each source of supply only has visibility over parts of the information/resupply requirements, each source of supply has control over its own limited set of transporter assets) versus an option with greater integration of these processes. The model can identify the best system performance under both options, demonstrating the benefits gained by integrating these two processes. Later, to evaluate the impact of a new technology, from a performance standpoint, we allowed the model a limited use of JPADS.