MODELING RELIABLE OPTIONS FOR OVERSEAS COMBAT SUPPORT BASING

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ABSTRACT

This research identifies a robust set of facility locations for the Air Force to place combat support basing materiel that will cover a broad range of potential missions (e.g., training, humanitarian, and major combat operation) that may occur around the world using mixed integer programming models. Because the Air Force faces risks associated with the loss of access to such storage sites, this research addresses the ability of the network to perform well even when parts of it fail, a concept referred to as reliability. These models are then used to identify additional costs necessary to build varying levels of reliability into the solutions. The solutions take into account risk and uncertainties, while meeting time constraints associated with the delivery of the materiel. The models were developed using the General Algebraic Modeling System (GAMS).

Multiple Posture Model

Initially, a "naïve" approach to reliability modeling is taken. The first step is to create an optimization model that identifies a set of overseas basing locations and allocates commodities across those locations, assuming that all of the facilities are available (zero probability of node failure). Once the location and allocation of commodities has been identified, the next step is to march through sequentially, and remove each location one by one from the solution set, to identify the different costs associated with each node failure. This model is used to identify a baseline case to compare the solutions of other model variations against; and also, to show why the more advanced modeling techniques developed are needed.

Single Node Failure Reliability Model

The multiple posture model assumes that the policy maker knows in advance which node access would be lost to, and can make decisions to fortify the network against this loss. In reality, the sequencing is reversed and the policy maker needs the ability to design a network which satisfies demand, regardless of which facility access is lost too. The single node failure reliability model accomplishes this task. Where the previous model returned multiple solutions, with a different posture for each loss-of-access scenario, this model returns a single reliable posture. The research shows that the solution returned from the model ensures that if any one node is removed from the solution set, demand is met and all constraints are satisfied.

Multiple Node Failure Reliability Model

The single node failure reliability model returned a single reliable posture which satisfied all constraints even when access was lost to any individual node within the posture. Due to the large amount of computing power needed, it is difficult to use the model to examine the case of simultaneous loss of access to multiple nodes. To overcome this problem, this research constructs an alternative version of the single node failure reliability model which takes considerably less computing power to solve and therefore, can be expanded to consider simultaneous loss of access to multiple facilities.