Cocaine Trafficking Network within the United States:

**Background:** Mexican based drug cartels dominate the supply and wholesale distribution of most cocaine in the United States. Joaquin “El Chapo” Guzman-Loera, the leader of the Sinaloa Cartel, intends to monopolize production, transportation, and wholesale distribution of cocaine across the United States.

**Problem:** Private and commercial vehicles are the primary means used to transport cocaine within the United States, and the cartel favors particular routes to supply the U.S. drug markets. El Chapo wants to optimally utilize these routes to maximize distribution profits and minimize interdictions by the Drug Enforcement Agency (DEA).

**Model:** The max-flow model is employed to analyze the network operation of preferred transit routes to satisfy the supply and demand of the cocaine industry within the United States. The model exploits the optimal major distribution hub cities and routes to use to ensure maximum profit and minimum interdiction. Figure 1 to the left depicts the nodes where the drugs enter the major city distribution hub, $I$, to the destination city $J$. These nodes are points of entry for cocaine into the United States. The major city distribution hubs are San Diego, Tucson, Laredo, and El Paso. Each of these cities provides an initial cocaine capacity in metric tons. The cartel’s primary hubs are in the southwest region of the DEA task force, which poses a threat to the cartel’s profit.

The implementation of artificial nodes permits the application of the seizure of a percentage of drugs during transportation which accounts for random traffic stops and current interdiction measures. Each city in the model connects to the end node representing the proportion of cocaine demand calculation, which is a function of population.

The cartel wants to distribute an initial supply of 278 metric tons of cocaine through the United States. Transporting the cocaine towards heavily populated cities in the United States is the most intuitive solution to maximize profit. Major hub cities have a maximum limitation on the quantity of metric tons of cocaine which can remain in the city for distribution. The metric tons which exceed this capacity must be transported from the major hub city to a destination city. Figure 2 identifies the 15 destination cities around the U.S which identify the network nodes as blue circles: Chicago, Dallas, Denver, Detroit, El Paso, Houston, Jacksonville, Laredo, Los Angeles, New York, Phoenix, San Diego, Seattle, Tucson, and Washington, D.C.
Interdictions by the Drug Enforcement Agency are the primary means of attack that the drug cartel wants to evade. An interdiction forces the cartel to utilize alternate routes to distribute the supply to the final destination major cities. This alteration to the trafficking plan may decrease the percentage of drugs that are successfully distributed and negatively impact the profit.

**Analysis:** The operator resilience curve, Figure 3, displays a steady rate of decline in total metric tons of cocaine received by the demand cities. The minor bumps in the curve represent the points where the interdiction arcs shift due to limiting returns.

**Results:** The amount of cocaine received by each city for different numbers of optimal interdiction locations is shown in Figure 4.
Figure 4: Metric tons of cocaine received by each city to satisfy demand.

The results recommend that the cartel maximize shipment of cocaine to Chicago, Dallas, and Detroit, as a result of the high demand and multiple routes available to transit in and out of these cities. For normal day-to-day operations without DEA interdictions, Los Angeles provides the optimal major distribution hub. When the DEA conducts between 1 to 3 interdictions, the model recommends shifting the distribution designated for Los Angeles to New York and Houston. When the DEA attacks the network with 4 or more interdictions, Washington, D.C., becomes a profitable location.

Future Work: The current network does not evaluate alternative modes of trafficking such as noncommercial vessels, ultralight aircraft, freight trains, and tunnels. This network also does not assess every single transit path available or account for the distance or time requirements to transit the routes. This model assesses only the primary trafficking routes, and as a result limits the overall optimization of the cartel’s profit. Future evaluation of the network should assess the expansion of the cocaine distribution to areas in Great Lakes, Pacific, and west central regions while reassessing the limitations as mentioned above.