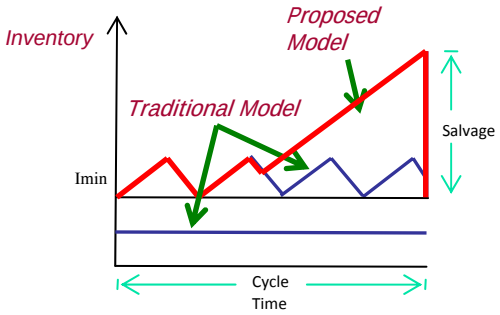
Research Synopsis

Supply Chain Management of the Strategic National Stockpiles

This project will develop models to assist in the design and management of the supply chain of the Strategic National Stockpile (SNS).



Modeling Area: Risk Management
Case Studies Supported: Chem/Bio Area
Principal Investigator: Maged Dessouky and Fernando Ordonez
Institution: University of Southern California

Brief Description:
SNS is part of the federal response to a bio-terrorist attack on the United States and it is composed of a combination of vaccines, prophylaxis, and medical supplies aimed at minimizing the damage of the attack. The SNS is currently divided into "Push Packages" directly managed by the government, which constitute about 20%, with the rest as Vendor Managed Inventories (VMIs) in control of pharmaceutical companies. The Push Packages constitute a stock that can be rapidly deployed and contains a set mix of supplies effective for a broad range of attacks. The VMI provide additional flexibility and cost efficiency as it can deploy the specific medicine to combat a bio threat. Given the possible biological and chemical threats facing the nation and the limited budget to set up the SNS, the effective allocation of these resources in designing the SNS are key in managing the risk posed by these threats. The purpose of this research is to develop models that can aid decision makers to effectively design and manage this complex supply chain process under a given funding level.

Objectives:
This research will (a) develop an inventory model for a representative VMI; (b) using the inventory model, develop a pricing model for the VMI taking into consideration the expiration and possible resale date of the drug; (c) develop a model that determines the best strategy for binning the push packages given a set of requirements for different medications; (d) assess the mix of inventory in the push packages versus the VMIs given a funding level; (e) incorporate geographical considerations in the design and managing of the SNS supply chain.

Interfaces to other Center Projects:
We will work closely with Terence O'Sullivan who has projects in the bio hazards area.

Major Products and Customers:
Project deliverables will consist of a report that will a) document the inventory, pricing, and bin packing models, b) provide guidance on how to best manage the supply chain of the SNS, and c) develop an illustrative example that demonstrates the use of the models in managing the supply chain of a sample drug.
Products: A suite of integrated models that includes inventory, pricing, and bin packing models; research publications and reports.
Clients: The CDC which manages the SNS.

Technical Approach:
A primary input to our research methodology is the bio-hazard threat risks and effectiveness of different medical alternatives. Based on these threat risks, we will develop a suite of integrated models for effective supply chain management of the SNS using a mixture of math programming, queuing, and spreadsheet models.

To date the VMI model has been developed. The VMI model is based on determining an economic production quantity and is a two bin (s, S) inventory system that is commonly used to model stochastic demand situations. The model determines the optimal stocking level given a set of demand requirements and costs including storage, cost of capital and ordering.

Year 2 of the project will focus on the development of the other models in the supply chain. The pricing model will determine the cost of vendors assuming that the VMIs are efficiently managing their supply chain. The pricing model will take into consideration the drug's expiration date and the flexibility the VMIs are given in reselling their inventory to the market.

The composition of the push packages should reflect their expected use and the likelihood of different bio-hazards. In addition, the push package composition should take into account how efficient different medicines are for different threats and the expiration date of drugs. Mathematical programming models and algorithms can be used to solve the problem of identifying the push package composition which will be most effective in reducing health threats.

To determine the optimal usage and mix of push packages and VMI inventory we will use a mix of queuing methods and mathematical programming problems. These models will determine the optimal design and usage of the SNS for given distributions of threats. The ultimate goal is to include geographical information of supplies and threats in creating these optimal decisions.

Major Milestones and Dates:

1. Completed the development of the inventory supply chain model of representative drug (January 1, 2008)
2. Completed the development of the solution approach to identify optimal solutions for the developed model (March 1, 2008)
3. Evaluate alternative scenarios for settings of the parameters including the holding cost, ordering cost, shelf life, minimum inventory requirement (August 15, 2008)
4. Develop a pricing model for the VMI taking into consideration the expiration and available to resale dates of the drug (January 1, 2009)
5. Develop a bin packing model for the push packages (May 1, 2009)
6. Develop models that integrate these decisions and take into account geographical distribution of resources and threats (December 2009).
7. Conduct rigorous testing of this methodology for the SNS and final developing of suite of integrated models (August 2010).