ANTERUS

Container Management
Supply Optimization and Forecasting Model

Case Study CS-005B

Problem: A global container management consortium needs to forecast and stage containers of various types at depots throughout the world to meet the demands of its member fleets. Due to the complexity of scheduling, resource allocation, and the seasonal variation in demand they were able to satisfy only a small fraction of their member's requirements. The aggregate cost of the consortium's inability to satisfy demand ran in excess of several hundred thousand dollars per day in unnecessary container leasing, in container unavailability, and in lost commerce.

Background. The global container management consortium (whose operating headquarters we will henceforth call GCMC) with headquarters in London manages the world-wide supply, allocation, and movement of containers for fourteen member shipping lines. In this respect, they are a holding company for the containers shared by its member fleet owners. As Figure 1 illustrates, the reach of GCMC is global; containers are staged at ports around the world to meet the current and forecasted demands of the member lines.

Figure 1. The GCMC Member Depots and Ports Around the World (A Sample)
(including ports such as Gothenberg, Rotterdam, Marseilles, New York, Los Angeles, Singapore, Sydney, Hong Kong, Inchon, Tokyo, and Darwin)

There are fourteen member shipping lines in the consortium. These lines move cargo around the world in various kinds of containers. Containers come in several types:

dry, refrigerated, and liquid. Each type has several sizes. The combination of types and sizes means that fifteen different, distinct containers are available. Sixty percent of the containers belong to the fleet owners and are held by GCMC through fixed agreements of about ten years (at the end of their life, these containers are simply sold). The remaining forty percent are held in the form of master leases and third party arrangements.

With over one hundred ports and depots around the globe, GCMC is responsible for satisfying member fleet requests for these fifteen different container types on a specific date and at a specific location. As an example, a fleet member might make a request such as,

At Singapore, on 16 June 2003 by 1400 hrs:
Deliver 8 20' drywall containers,
9 16' liquid containers, and
2 16' Refrigerator containers

In satisfying this demand, GCMC must contend with a wide spectrum of conflicting constraints: lease agreements, tariffs, on-hand and in-transit container quantities, shipping schedules and transit times, ship hold capacities, container serviceability, average depot through-put times, harbor capacities, world-wide weather patterns, and emerging economic and political conditions.

The Solution. Based on the global supply and demand of containers in the GCMC consortium, we developed a model that found one or more feasible solutions for delivering the right type, and the right number of containers to a specific port based on either minimal cost or minimal risk constraints. Minimal costs relied on the model's ability to predict the availability of existing or incoming containers at a port and route, if necessary, these containers, on outbound fleet ships, to the target port. Minimal risk relied on the model's accurate on-site inventories and the ability to exercise leasing agreements with container suppliers. If requested, the model would also produce solutions that included some balance between minimal cost and minimal risk.

Solving the container management problem involved not only maintaining an inventory of containers (by type and capacity) and tracking the flow of containers throughout the fleet, but understanding the behavior of container use in order to develop an accurate demand forecast that accounts for the periodicity of demand, seasonality, fleet utilization, and a variety of other crucial factors affecting container availability. The model not only fused container inventory and allocations (from the GCMC booking system), but accurately forecast container demand by fleet at each port (by adaptively learning the over-all statistical behavior of each fleet over time).

Managing containers to account for cost or risk minimization, required staging dates, and minimum necessary quantities is a complex and extremely difficult task. There are several ways to position containers at a port,

- *Retain existing or incoming containers at a port to meet shipper demands.* Each major port has a supply of containers. Cargo freighters also bring additional containers into a port as well as pick up some containers from the existing stockpile. The types of containers, the number of each type, and their over-all serviceability at any port is more or less random. This means that a shipper, without a way to control and forecast container movement, cannot plan to use existing or incoming containers since they may not be available when needed, my not arrive as scheduled, may not actually correspond to the container manifests, or may not be in serviceable condition. Figure 2 illustrates how containers are moved around the world from one port to another.

Figure. 2 Moving Containers to GCMC member ports

Container movement is also complicated by natural surplus and shortage sites. As an example, Rotterdam is almost always a surplus of all the lines while Hong Kong is a surplus for two lines and a shortage port for three lines. Retaining containers at a deport to meet future demand reduces cost but increases the risk that the proper kind of container in the required quantity may not be available.

- *Exercise leasing options for local container suppliers.* GCMC maintains on-demand leasing relationships with container suppliers throughout the world. Containers can be leased locally and dropped off at remote leasing sites (that is, as an example, containers leased in Marseilles can be dropped off at Singapore.) Since containers already in the system are either purchased or already on-lease, exercising a lease increases the cost to stage a container (although it reduces the risk that the container will not be available.)

- *Reposition containers within the same geographic area.* Inter-area and intra-area positioning provides a means of load balancing the available containers. This means loading and shipping empty containers or using inland transport (barge, rail, truck) to deliver containers of near-by ports.

- *Acquire containers from friendly lines.* GCMC maintains partnership and affiliate relationships with other shipping lines. These lines can provide containers in ways similar to the methods employed within the GCMC member lines – by offloading empty containers at a required depot or by exercising their own lease arrangement to provide new containers. Using the friendly lines option significantly increases costs and moderately mitigates risk.

Combining these container acquisition strategies, the supply and forecasting model iterates through a set of possible solutions, ranking each one according to its probable cost and level of risk. Using uncertainty measurements that allow the model to process somewhat vague or elastic information (such as "*if the distance between ports is somewhat long*" or "*if the number of refrigerated containers is large*") a schedule of shipments, retentions, and lease options is developed. The adaptive learning capabilities of the model also take into account ports where container inventory counts and types are systematically inaccurate or where other kinds of uncertainties in demand requirements, container availability, or forecasted staging levels exist.

As a Result. The Supply Optimization and Forecasting Model accurately and consistently predicts container demand at each port for each of the member fleets. By reducing container leasing, improving availability, reducing risk, and accelerating the flow of goods throughout the GCMC shipping lanes, the model, in production since 1989, has not only offset the original penalty costs associated with poor scheduling and forecasting, but, by streamlining the management, planning, and forecasting initiatives of the fleets, saves the consortium an estimated one million dollars a day.