Towards an Integrated Production Planning and Alcohol Vessel Scheduling System for LTDI

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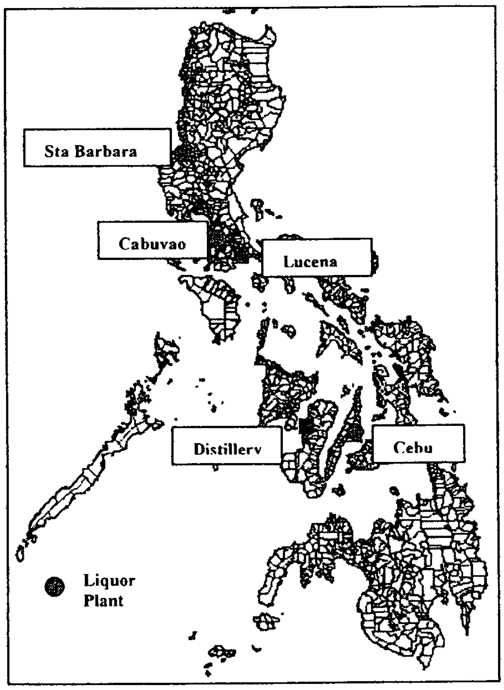
1.0 Overview of Operations

To support its liquor production operations, La Tondeña Distillers, Inc. (LTDI) maintains four bottling plants and a distillery throughout the Philippines (*see Figure 1*). While the bottling plants are close to market locations due partly to a returnable container system, the distillery is located near its raw material (molasses) sources creating quite a distance for moving alcohol to the liquor plants. Operational concerns like tide level requirements of vessels, unavailability of an alcohol depot near the sea, and low storage capacities at the plants are additional complicating factors in the alcohol supply process of LTDI. In the past, some plants experienced running out of alcohol.

Figure 1. Facility Locations



Tide level is a critical factor in delivering alcohol to the bottling plants. Silt from nearby rivers has lowered the water level at the distillery port and at Lucena depot. Thus, when vessels arrive or are about to leave port in these areas, they occasionally have to wait for sufficient tide before they can move on. In fact, regular dredging is necessary at the Lucena depot for it to be accessible.

Strong waves have rendered the Sta Barbara depot unusable. Without a depot and with relatively low storage capacity, unloading to this plant takes at most 5 days as alcohol is trucked from the vessel directly to the plant and as vessels have to occasionally wait for alcohol stocks to be depleted. Among all plants, Sta. Barbara consumes the most alcohol.

Prior to implementing the vessel scheduling module, shipment destination is determined based on remaining days-level alcohol inventory at the plants. Such criterion is evidently sound albeit insufficient. For instance, if upon arrival at the plant, tide level is inadequate, vessels and precious alcohol become tied up waiting at that plant resulting in possible stock-outs in other plants. Furthermore, production surge at a plant induces faster alcohol depletion that results in stock-out, or in double handling when alcohol at a closer plant is re-loaded onto trucks and hauled to the requiring plant.

2.0 An Integrated Module

Evidently, liquor bottling and alcohol deliveries need be synchronized in order to minimize alcohol stock-outs at the liquor plants. An integrated production planning and alcohol vessel scheduling system aims to realize this synchronization.

Production Planning Module

The production planning module generates production volumes for each liquor plant that minimizes total production and distribution cost. These production volumes are translated into daily alcohol requirements at the liquor plants which become inputs to the vessel scheduling module.

An LP-based module, it uses MS-Excel for front-end and CPLEX optimizer as back-end. As in other systems of this type, an LP model is constructed from the inputs supplied by the user and CPLEX optimizer is called to solve the model.

While the module is still being finalized, production plans are being drawn manually albeit centrally at the head office.

Alcohol Vessel Scheduling Module

The alcohol vessel scheduling module generates a one-month daily schedule of alcohol shipments to plants that minimizes alcohol stock-out at the plants given requirements.

Shipment destination is determined by a heuristic algorithm that essentially compares the plant stock-out effect of switching the destinations of two successive vessel dispatches from the distillery. Around this basic dispatch criterion are refinements that accounts for among others, effects of capacity differences among vessels, restrictions on vessel destinations, and tie-breaking criterion.

The module includes a routine that determines whether or not inventories of different alcohols may be juggled across tanks of various sizes in order to accommodate an incoming shipment. *Different alcohols may not be combined in a single tank.* This algorithm is based on Chvatal's (*see Reference*) solution for the knapsack problem.

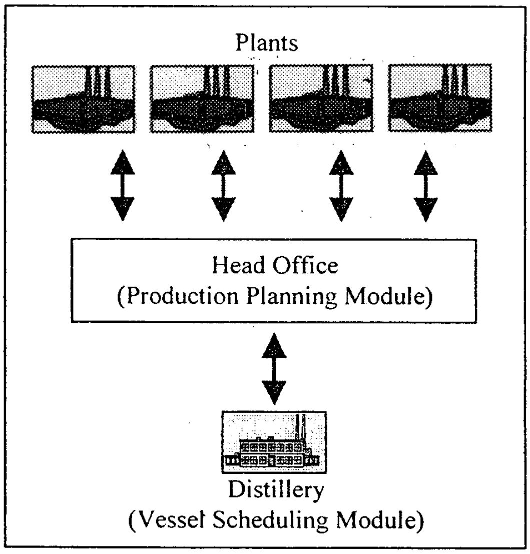
Alcohol supply from LTDI distillery is actually inadequate for its entire requirements. Thus, while the module may not fully eliminate stock-outs, it minimizes unnecessary ones and more importantly, it identifies where augmentation from imports and locally contracted supply may be delivered.

3.0 Implementation and Directions

Because it needs to coordinate all users of the distillery port, responsibility for vessel scheduling is given to the distillery. Head office will host the production planning module.

Under a real-time link between plants and distillery to the head office: all users are able to view vessel and production schedules; plants are able to input plant-specific data to the production planning module; head office is able to input plant alcohol requirements to the vessel scheduling module. (*see Figure 2*)

Figure 2. System Information Flow



Reliable telecommunication links from the plants and distillery to the head office are however, limited. Thus, while real-time links are envisioned for the long-term, e-mail exchanges across users, for both data and output, are planned for the short-term.

The vessel scheduling module has already been turned over to the distillery and the production planning module is in its final development stages.

4.0 Reference

Chvatal, V., Linear Programming, W.H. Freeman, New York, 1983.