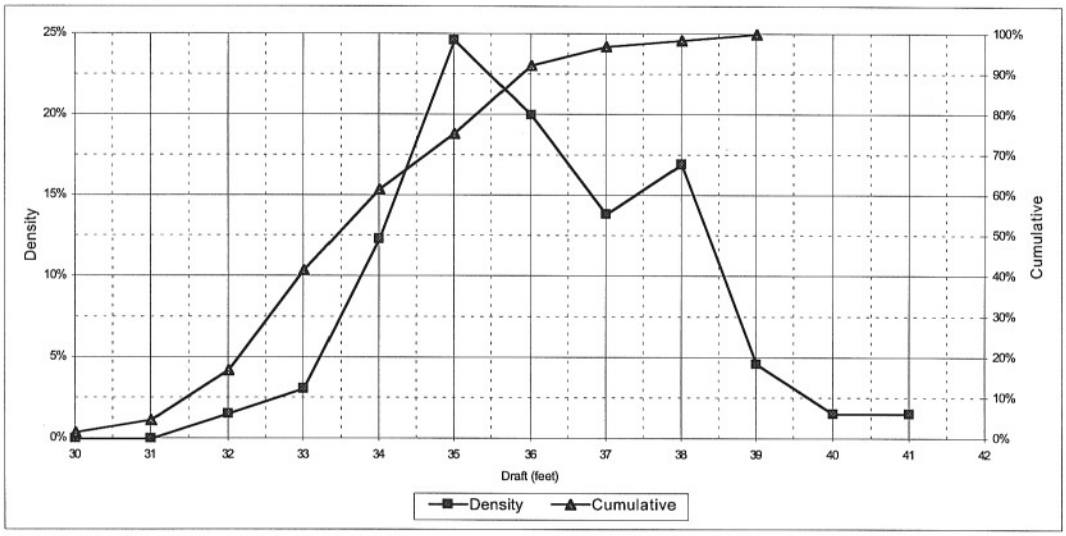
Exhibit 4
Distribution of New York Draft for Maersk's "M" Vessels



case, the under-keel clearance was minimal.[12] Maersk's draft distribution, as well as that recorded for most lines, was bell-shaped with an upward skew. The model reflects this draft distribution by employing a theoretical statistical distribution of the Beta family.[13]

Exhibit 4 presents the density and cumulative distribution of the draft of Maersk vessels in New York.

Current Channel Restrictions

An analysis of 1994 New York Maritime Association data indicates that 1.2% of the containerships drew 38 feet or over; 13.9%, 35 feet and over; and 58%, 30 feet or over. Presumably, the present 40-foot channel, assuming 2 feet of under-keel clearance and without taking advantage of the tide, does not constrain the lines except in rare cases. However, *actual* draft data already reflect the lines' response to constraints. That is, lines have been already calling with partially loaded ships, as evidenced by their complaints.

Exhibit 5 presents the density and cumulative distribution of the draft of containerships calling at New York in 1994.

Response to Channel Restrictions—Present Fleet

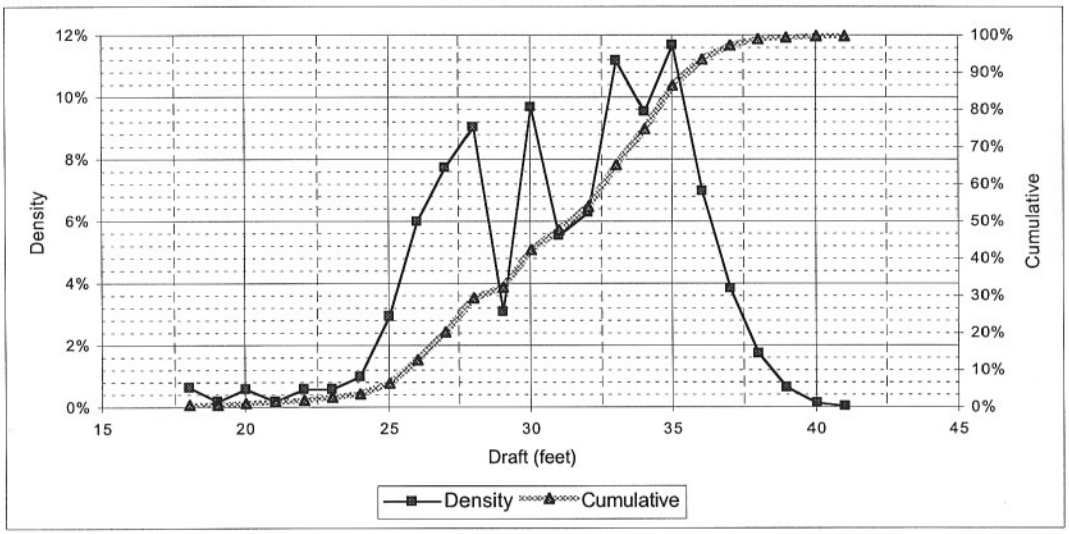
The draft response model focuses on the trade-off between *remaining* and *relocating* costs, according to the lines' regional rotations (FI, LO and MID). For the sake of clearer discussion, Philadelphia is selected here as the port of relocation.[14]

Decision to Relocate–FI Service

The decision by a FI service to quit New York and relocate to Philadelphia is based on comparing:

- revenue loss due to reduced loading; with
- feedering cost of New York cargo to/from Philadelphia.[15]

Exhibit 5
Distribution of Containerships Calling New York
(1994)



As the channel depth becomes more and more restricted (shallow), the revenue loss escalates until, at some point, they exceed feedering costs—and the line decides to relocate. The draft when this "switch" occurs is defined as the desertion draft and the reduction (difference) in draft that caused this relocation is called desertion margin. The desertion margin depends on vessel dimensions, especially its capacity (TEUs), design draft, operating draft, immersion factor (tons per inch), and average utilization ratio.

Cargo Composition

The cargo on-board New York's vessels is hierarchically split according to three levels:

- Inter-Coastal Split—between the East Coast and West/Gulf Coast. Accordingly, New York lines are divided into those serving a single and a multiple trade route. For example, Transatlantic services are single route while RTWs are multiple routes.
- Intra-Coastal Split—between the ports called on the East Coast.
- Local New York/Hinterland Split—between the cargo that is New York "proper" and the cargo that uses New York as a gateway, mainly to the Midwest.

The splitting hierarchy becomes clearer using a simple example. A RTW/westbound vessel may arrive at New York from North Europe carrying 60% of its cargo for East Coast ports and 40% for West Coast ports.[16] The East Coast boxes may consist of 50% New York with the rest divided between Norfolk and Charleston. New York cargo may consist of 68% local cargo with the rest destined to the hinterland represented by Boston, Chicago and Philadelphia. Altogether, local New York boxes may only account for about 20% of the total vessel load (0.60 x 0.50 x 0.68).

The desertion draft depends on cargo composition, especially the ratio between the

local and non-local New York. The higher the proportion of New York cargo, the higher the feedering cost from Philadelphia and the larger the desertion margin.

Model Results for a FI Service

The model results presented here relate to the base case of a 3,000 TEU vessel, with 39.5-foot design draft, on a multi-route service which includes three ports on the East Coast. Such a vessel is assumed to handle 855 TEUs per New York call, including 582 TEUs for local New York and 273 TEUs for New York's hinterland.

Assuming that the average drayage cost from the relocating port to New York is $165/TEU, the model calculates the desertion draft of such a vessel at 35.35 feet, 2.15 feet below the current operating maximum draft of 37.5 feet. At this point, all the 855 TEUs destined for New York are expected to be discharged at Philadelphia and drayed from there to New York. A similar calculation is performed for LO services.

Decision to Relocate–Midport Service

The decision by a line that first calls at Boston to quit New York and relocate to Philadelphia, depends on comparing the costs of:

- Remaining in New York but feedering *part* of the New York cargo from Boston; versus
- Relocating to Philadelphia and feedering *all* New York cargo from there.

As the draft becomes more restricted, more New York boxes have to be feedered from Boston. Since the drayage cost from Boston to New York ($/TEU) is higher than that from Philadelphia, at some point, the cost of feedering part of the boxes from Boston exceeds that of feedering all boxes from Philadelphia—and the line relocates.

Model Results for a MID Service

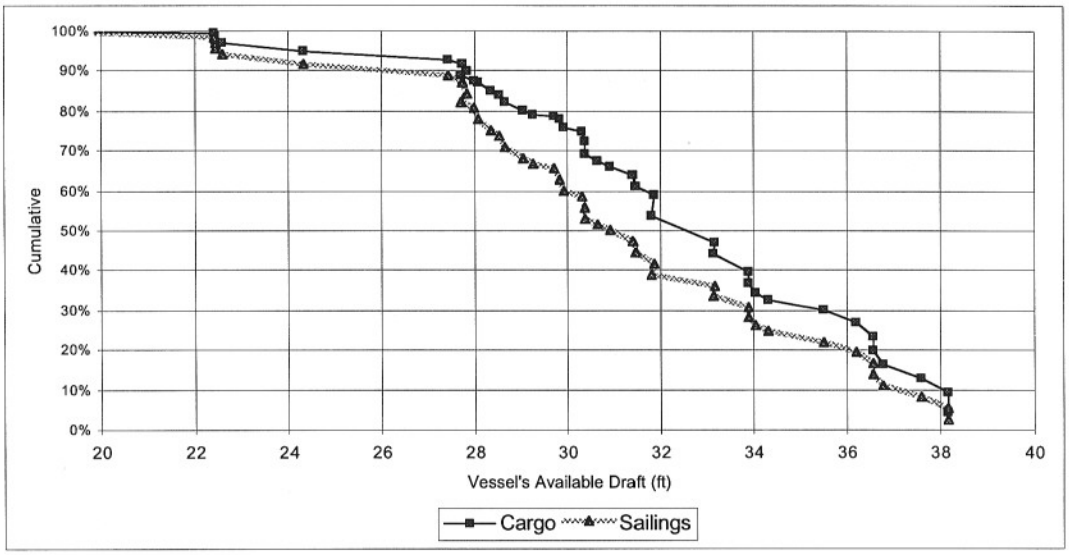
The model's results relate to the same 3,000 TEU vessel, on a single-route service, calling at three ports on the East Coast and serving both local New York and hinterland cargo. Following the cargo splitting assumptions of the base case, such a vessel will handle in New York 1,710 TEUs per call, including 1,184 TEUs of local New York and 526 TEUs of New York hinterland. The model calculates the desertion draft at 33 feet, or 4.5 feet below the current maximum operating draft.

Model Results for Entire New York Services–Vessel Calls and Cargo Loss

Currently, New York is called by 43 major services employing vessels ranging from 500 to 4,000 TEUs, with corresponding design drafts ranging from 21.9 to 44.2 feet. Each of the New York lines is specified by the size and draft of its vessels, type of service (Transatlantic, Pendulum, etc.), East Coast rotation (FI, MID or LO) and cargo composition (single, multiple route). Accordingly, for each line the model calculates its desertion draft. For example, Maersk's Pendulum, operating the "M" vessels with MID rotation, is the first service expected to quit New York. This may happen once the available draft is down to 38.5 feet, or at an equivalent channel depth of 40.5 feet (assuming 2 feet of clearance). Nordana's Med/Mid service is the last service expected to desert New York, which may happen when the channel depth reaches 21.4 feet.

Based on the present population of lines and services, the model calculates the lost volume (TEUs/Year) and sailings (Calls/Year) as a function of channel depth. The calculated losses in cargo are: 10.4% for the present depth

Exhibit 6
Loss of Trade Volume (TEUs) and Sailings as a Function of Draft Availability (ft) - 1995



of 40 feet, 31.3% for 37 feet, and 78.0% for 32 feet. The respective losses in vessel calls (sailings) are: 5.6%, 22.4%, and 63.0%.

Exhibit 6 presents cargo and sailing losses as a function of draft availability.

Model Results for Entire New York Services–Added Transport Cost

The third output of the model is an estimate of the added transport cost caused by draft restrictions. For this purpose, New York cargo is divided into three groups:

- Relocated—New York cargo carried by lines that have already deserted New York and their cargo is feedered to New York;
- Remained and Affected—New York cargo carried by lines still calling New York, but incurring higher costs due to partial loading; and
- Remained and Unaffected—New York cargo carried by lines calling New York with smaller and shallower ships unaffected by draft restrictions.

The amount of relocated and affected cargoes and respective costs escalate as the depth becomes more restricted. With a 40-foot channel, no services are bound to relocate. However, five services, which account for about 20% of the volume, are already calling partially loaded. The added costs that these services incur, when allocated over the entire New York cargo, is equivalent to an average of about $8/TEU. At 37 feet, 30% of New York cargo is relocated and the average cost rises to $62/TEU. At 21 feet, all New York services are relocated and the added cost per TEU is $165, which is the cost of drayage from the relocation port.

Exhibit 7 presents the added freight cost as a function of available draft.