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## **CONTAINER TERMINAL AND CARGO-HANDLING COST ANALYSIS TOOLKIT**

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## **Disclaimers**

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# Container Terminal and Cargo-Handling Cost Analysis Toolkit

For this task, the study team sought to determine the costs associated with container terminal operations and their influence on overall container shipping cost. Commercial ports publish prices (tariffs) for a wide variety of services and the study proposal included the development of a spreadsheet that would allow freight planners to build policy-based strategies to capture the impacts of current and new maritime services on Texas Gulf ports. This approach allows a technical dialog to be developed between TxDOT/MPO staff and the port/shipping sectors. Published port terminal activity costs (tariffs) should, however, be regarded as nominal—they may not reflect actual prices charged to a steamship company or major shipper. Negotiated prices reflect a range of factors, such as customer size, that are confidential. Fortunately, nominal prices do work for strategic planning because they show the cost differentials between ports that drive port selection on supply chains. Accordingly, the study team developed a basic model or toolkit that could be evaluated by TxDOT planners. The Container Terminal and Cargo-Handling Cost Analysis model was developed using tariffs from select Texas ports and the results are now presented.

## Types of Port Charges

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In 2002, the United Nations Economic and Social Commission for Asia and the Pacific<sup>1</sup> (ESCAP/UNDP) developed a Model Tariff Structure consisting of four service groups. These service groups include the navigation service, berth service, cargo operations, and other business services. Each service group comprises multiple services associated with various port operations. The navigation service comprises services relating to port dues, pilotage, and tug services, tug-berth system, channel width and draft restrictions, etc.<sup>2</sup> Berth services include berth hire, wharfage, and other support services that serve as the “true interface between marine transport and inland transport”<sup>2</sup>. Factors such as number, length, and types of berths and gantries, gantry capacity and efficiency, berth storage transfer capabilities and capacities, storage-inland transport transfer capabilities, and gate processing rates influence the performance of the total port system<sup>2</sup>. Cargo operations charges include wharfage charges, cargo transfer charge, special cargo handling, storage, packing/unpacking, and equipment/service/facility hire. Technological improvements in the areas of logistics, inventory controls, “just-in-time” service deliveries, and container tracking systems, coupled with innovative storage pricing schemes, have greatly improved the efficiency of port cargo handling and storage operations<sup>2</sup>. Other business services such as port security, management services, and provision of utilities are necessary for the overall management and operations of the port.

The following subsections describe in detail each of these service groups and their associated services and charges from a sample of three Texas Ports: the Port of Houston<sup>3</sup>, the Port of Brownsville<sup>4</sup>, and the Port of Corpus Christi<sup>5</sup>.

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<sup>1</sup> United Nations Economic and Social Commission for Asia and the Pacific, *Comparative Analysis of Port Tariffs in the ESCAP Region*, United Nations, New York, 2002.

<sup>2</sup> Pappu, Madhav, “A Systems Approach to Modern Port Planning and Management,” Conference Proceedings of the Institute of Marine Engineers (India) Millennium Seminar, p 107–116, 2001.

<sup>3</sup> Port of Houston Authority, Tariff Numbers 8 and 15, <http://www.portofhouston.com/general-terminals/tariffs/>

<sup>4</sup> Port of Brownsville, Tariff Number 6 – Sections 2 and 3, <http://www.portofbrownsville.com/tariffs/>

## Navigation Service Group

The navigation service group comprises all services and facilities required for a vessel to move from the open sea (or from one location in a port) to its stationary or secure area, including reverse direction movements and activities. Services charges categorized in this group include port dues, pilotage, and tug services.

### *Port Dues/Harbor Fee*

**Port of Houston:** The Port of Houston assesses additional harbor fees for vessels leaving and reentering the jurisdictional limits of the Port Authority, but provides an exemption for 1) government vessels not engaged in carrying cargo, troops, or supplies; 2) private, non-commercial pleasure craft; and 3) tugboats excluding integrated tug/barges (Port of Houston Tariff No. 8 Subrule No. 105).

**Port of Brownsville:** The Port of Brownsville charges the harbor fee “to assist in defraying the expense for the maintenance and regulating of the turning basin and ship channel” (Port of Brownsville Tariff No. 6, Item 340). Charges assessed by the Port of Brownsville are as follows:

1. All commercial vessels, self-propelled or not self-propelled, except river barges, not otherwise provided for, per call: \$150.00
2. All commercial vessels, self-propelled or not, except river barges, calling at the Bulk Cargo Dock, per call: \$200.00
3. River barges, per call (shifting to a fleeting area ends a call): \$100.00
4. Mexican fishing vessels: \$65.00
5. A harbor fee for LASH and SEABEE barges shall be charged as follows:
  - a. Vessel under 75 feet in length, per call: \$ 40.00
  - b. Vessel 75 feet and under 100 feet in length, per call: \$ 50.00

The Port of Brownsville exempts 1) fishing vessels, 2) vessels entering the Port of Brownsville Ship Channel that are bound to or from the Port of Port Isabel, 3) tugs calling at the Port of Brownsville for the sole purpose of towing vessels or barges in or out of the Port of Brownsville, and 4) river barges that are considered to be “tag-along” barges and are in the Port of Brownsville as a part of a tow and do not load or unload cargo in the Port (Port of Brownsville Tariff No. 6, Item 340).

**Port of Corpus Christi:** The Port of Corpus Christi does not charge port dues or harbor fees.

### *Pilotage*

According to the ESCAP/UNDP report, pilotage involves the use of a fixed visual reference on the ground or sea by means of sight or radar to guide vessels from the seaway to the river estuary and finally to the berthing area. Pilotage charges can be based on a vessel’s gross

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<sup>5</sup> Port of Corpus Christi, Tariff 100-A and Bulk Terminal Tariff 1-4,  
<http://www.portofcorpuschristi.com/index.php/business-development-212/port-tariff>

registered tonnage (GRT)<sup>6</sup> or the vessel’s dimensions, or be assessed on a per call basis. It can also be differentiated by the location where the pilotage starts and ends. The Port of Brownsville assesses a pilotage charge from the sea or Port Isabel to the Port of Brownsville or vice versa (Port of Brownsville Tariff No. 6, Item 325). Sample 2010 pilotage charges for normal self-propelled vessels are shown in Table 1. Information on Port of Houston pilotage rates on the Houston Ship Channel to or from Sea or Bolivar Roads can be found on the Houston Pilots website<sup>7</sup>; Port of Corpus Christi information is available on the Aransas-Corpus Christi Pilots website<sup>8</sup>.

**Table 1: Port of Brownsville 2010 Pilotage Charges for Normal Self-Propelled Vessels**

1	Draft charge of \$20.64 per foot of draft. Minimum draft charge of 20 feet: \$412.78
2	Tonnage charge: Summer deadweight or international gross tonnage, whichever is more; a charge of \$0.0344 per metric tons.
3	Transportation/fuel surcharge of \$32.76 per pilot boat movement. (As long as the price of crude oil remains below \$100 a barrel; if price of crude rises above \$100 a barrel then \$50.00 per movement.)
4	Port safety/radio charge of \$21.84 per pilot, per movement.
5	Minimum charge per movement \$819.00 for a normal cargo vessel; \$546.00 minimum for oceangoing tugs/supply vessels.

*Harbor Tug or Towing Services*

Harbor tug charges are assessed based on either the characteristics of the ship or the tugs performing the operation. When based on the tug, the charges are commonly assessed based on the size of the tugboat in addition to an hourly usage charge. However, in some cases it is charged as a fixed rate irrespective of the time taken for the operation and differentiated by the vessel’s type and size<sup>1</sup>. At the Port of Brownsville, tugboat services are provided by private operators and charges are quoted upon request (Port of Brownsville Tariff No. 6, Item 330).

In Houston, the harbor tug service tariffs are available online from the respective service providers (Bay-Houston Towing Company, Signet Maritime Corporation, and Suderman & Young Towing Company). The same is true in Corpus Christi (Bay-Houston Towing Company, G&H Towing, Signet Maritime Corporation, and Suderman & Young Towing Company).

**Berth Service Group**

The berth service group comprises all services and facilities, including berth hire, wharfage, and other support services available to a vessel owing to its location at that berth (or anchorage)<sup>1</sup>.

All three ports assess a berth hire and wharfage/dockage charge.

<sup>6</sup> Although the word “tonnage” is used, this is actually a measurement of the space available to hold cargo. It is widely used throughout the world for assessment of charges.

<sup>7</sup> Houston Pilots, Houston Pilots, <http://www.houston-pilots.com/tariffs.aspx>

<sup>8</sup> Aransas-Corpus Christi Pilots, Pilot Tariff, <http://www.aransascorpuschristipilots.com/tariffs.html>

*Berth/Dockage Charges*

Dockage is the charge assessed a vessel for berthing at a wharf, pier, bulkhead structure, or bank, or for mooring to a vessel so berthed. A berth is a water area at the edge of a wharf, including mooring facilities, used by a vessel while docked.

**Port of Houston:** At the Port of Houston, dockage charges are applicable on all commercial vessels and the daily rates are set forth in Tables 2 and 3. The rate to be applied is determined by multiplying the Length Overall (LOA) in feet or meters by the rate in cents per foot or per meter. Dockage is charged on the overall length of the vessel as shown in Lloyd’s Register of Shipping. The table establishes the dockage charge per 24-hour day. After the first 24-hour period, any period of 12 hours or less is billed at one-half the applicable rate; any period in excess of 12 hours, whether or not the vessel occupies the berth for the full succeeding 24-hour period, is charged at the applicable rate for a full 24 hours (Port of Houston Tariff No. 8, Subrule No. 110). In addition, vessels loading or discharging cargo, and utilizing wharf shed(s) and/or wharf(s) for the assembly or distribution of 100 tons or more of such cargo, are assessed a shed and/or wharf use hire charge. The charge is equivalent to the first day’s dockage set out in Subrule No. 110 and is based on the overall length of the vessel as shown in Lloyd’s Register of Shipping. The Port Authority reserves the right to measure any vessel when deemed necessary, and to use such measurements as the basis of the charge (Port of Houston Tariff No. 8, Subrule No. 112). Additional information on dockages charges for the Port of Houston can be found in the Port of Houston Tariff No. 8 and Tariff No. 15 documents.

**Table 2: Port of Houston Tariff No. 8—Houston Ship Channel and the Public Owned Wharves Dockage Charges**

Vessel Length in Feet			Vessel Length in Meters		
LOA Categories		Rate per Foot	LOA Categories		Rate per Meter
0	199	\$2.49	0.0	60.7	\$8.17
200	399	\$3.27	60.7	121.6	\$10.73
400	499	\$4.45	121.6	152.1	\$14.60
500	599	\$5.97	152.1	182.6	\$19.59
600	699	\$6.94	182.6	213.1	\$22.77
700	799	\$8.82	213.1	243.5	\$28.94
800	899	\$10.61	243.5	274.0	\$34.81
900	And Over	\$12.70	274.0	And Over	\$41.67

**Table 3: Port of Houston Tariff No. 15—Bayport Container Terminal Dockage Charges**

Dockage Based on Length in Feet			Dockage Based on Length in Meters		
LOA Equal or Over Feet	LOA Less than Feet	Rate per Foot	LOA Equal or Over Meters	LOA Less than Meters	Rate per Meter
000	200	\$2.85	0.00	60.96	\$9.36
200	300	\$3.44	60.96	91.44	\$11.28
300	350	\$3.44	91.44	106.68	\$11.28
350	400	\$3.86	106.68	121.92	\$12.66
400	450	\$5.06	121.92	137.16	\$16.68
450	500	\$5.23	137.16	152.40	\$17.17
500	550	\$6.98	152.40	167.64	\$22.90
550	600	\$7.10	167.64	182.88	\$23.31
600	650	\$8.11	182.88	198.12	\$26.62
650	700	\$8.25	198.12	213.36	\$27.06
700	800	\$10.53	213.36	243.84	\$34.56
800	900	\$12.65	243.84	274.32	\$41.52
900	and over	\$15.14	274.32	and over	\$49.67

The Port of Houston also assesses a berth charge for the cleaning of berth assignments for each vessel loading and/or discharging cargo on, to, or across wharves. A charge of \$362.60 is assessed for each vessel loading and/or discharging cargo in excess of 500 tons, and a charge of \$265.70 is assessed each vessel loading and/or discharging cargo of 500 tons or less (Port of Houston, Tariff No. 8, Subrule No. 114). The Bayport Container Terminal at the Port of Houston assesses a charge of \$270.37 for each vessel loading and/or discharging cargo on, to, or across wharves for the cleaning of berth assignments, including space utilized in transit sheds, or on open wharves (Port of Houston Bayport Container Terminal, Tariff No. 15, Subrule No. 071).

**Port of Brownsville:** Dockage charge by the Port of Brownsville is commonly assessed based on the highest GRT of the vessel as shown in Lloyd’s Register of Shipping. Table 4 provides information on dockage charges as assessed by the Port of Brownsville.

**Table 4: Port of Brownsville Dockage Charges**

	<b>Docks 1–4, 7, 8, 10– 13, &amp; 15</b>	<b>Bulk Cargo Dock</b>	<b>Oil Docks 1, 2, 3, 5 Liq. Cargo Dock &amp; Express Dock</b>	<b>Unimproved Bank Space</b>
	<b>(per GRT)</b>	<b>(per GRT)</b>	<b>(per GRT)</b>	<b>(per LOA)</b>
Vessel is on berth and ready to load/unload cargo or to receive bunkers, stores or other services	\$0.15 \$100.00 Min.	\$0.25 \$100.00 Min.	\$0.15 \$100.00 Min.	N/A
Vessel is fitting for grain or waiting for berth to load/unload cargo or to receive stores or other services	\$0.05 \$50.00 Min.	\$0.05 \$50.00 Min.	\$0.05 \$50.00 Min.	\$0.05 \$50.00 Min.
Vessel is at layberth for lay-up or for repairs for vessel not waiting to load/unload cargo or to receive stores or other services (Must be approved by the Harbormaster)	\$0.09 \$100.00 Min.	\$0.09 \$100.00 Min.	\$0.09 \$100.00 Min.	\$0.09 \$25.00 Min.
Scrap vessel is at layberth waiting to be scrapped at the Port of Brownsville	\$0.09 \$100.00 Min.	\$0.09 \$100.00 Min.	\$0.09 \$100.00 Min.	\$0.09 \$25.00 Min.
Drilling rigs	\$0.09 \$100.00 Min.	\$0.09 \$100.00 Min.	\$0.09 \$100.00 Min.	\$0.09 \$25.00 Min.
Vessel in port to receive bunkers only—1 <sup>st</sup> 24 hours only	\$0.075 \$100.00 Min.	\$0.125 \$100.00 Min.	\$0.075 \$100.00 Min.	\$0.045 \$25.00 Min.
Barge in port for bunkering operations only and tied to a vessel	N/C	N/C	N/C	N/C
River barges (charge per 24 hours or fraction thereof)	\$75.00	\$75.00	\$75.00	\$50.00

The Port of Brownsville requires that cleaning be performed by the shipping agency and/or stevedores, and states that charges will be assessed based on the Brownsville Navigational District’s standard labor and equipment rates.

**Port of Corpus Christi:** Similar to the other ports, dockage charges are computed by the Port of Corpus Christi for each 24-hour period. Dockage for self-propelled vessels, seagoing dry cargo barges, seagoing tank barges over 360 feet LOA, integrated tug barges (ITB), and articulated tug barges (ATB) are assessed a charge based on overall vessel length as shown in Lloyd’s Register of Shipping (see Table 5). Dockage for ITB and ATB vessels includes charges for the tug boat, since the barge and tug are operated as a single unit (Port of Corpus Christi Tariff 100, Item 300).



**Table 5: Port of Corpus Christi Dockage Charges**

Vessel Length in Feet			Vessel Length in Meters		
LOA In Feet		Rate per Foot	LOA In Meters		Rate per Meter
0	199	\$2.57	0.0	60.7	\$8.42
200	399	\$3.38	60.7	121.6	\$11.05
400	499	\$4.76	121.6	152.1	\$15.63
500	599	\$6.41	152.1	182.6	\$21.01
600	699	\$7.34	182.6	213.1	\$24.05
700	799	\$9.45	213.1	243.5	\$31.00
800	899	\$11.39	243.5	274.0	\$37.32
900	and over	\$13.60	274.0	and over	\$44.64

For vessels loading or discharging cargo and using wharf sheds and/or wharf for assembly or distribution of such cargo, a shed and/or wharf use charge based on the quantity of cargo loaded or discharged are assessed charges as stated (Port of Corpus Christi Tariff 100 Item 270).

1. Under 500 net tons \$125.00
2. Over 500 net tons and under 1,000 net tons \$225.00
3. Over 1,000 net tons and under 5,000 net tons \$400.00
4. 5,000 net tons and over \$525.00

For the Port of Corpus Christi Bulk Terminal, vessels are charged a dockage rate of \$0.45 cents per GRT (self-propelled ships and oceangoing barges) or net registered tonnage (inland waterway barges). GRT charges are based on the highest gross tonnage published in the Lloyd’s Register of Shipping (Port of Corpus Christi Bulk Terminal Tariff 1-A Item 210).

The Port of Corpus Christi also states that vessel owners, operators, agents, and other users assigned to use wharves and transit sheds of the Port Authority are responsible for cleaning the property assigned for their use. If the user does not clean the Port Authority property assigned for use, the Port Authority will provide labor and equipment to clean such property and charge the responsible person or entity cost plus twenty-percent, minimum \$200.00, per wharf or shed or portion thereof (Port of Corpus Christi Tariff 100, Item 275).

*Loading, Unloading, and Wharfage Charges*

A wharfage charge is assessed against the cargo, empty containers, and bunker fuel passing or conveyed over, onto, or under wharves or between vessels (to or from barge, lighter, or water) when berthed at wharf or when moored in a slip adjacent to a wharf. Wharfage is solely the charge for use of wharf and does not include charges for any other service.

**Port of Houston:** The Port of Houston assesses loading, unloading, and wharfage charges in cents per short ton of 2,000 pounds or metric ton of 1,000 kilos. The charges apply to all shipments at actual weight, except as otherwise noted. Wharfage charges vary considerably by commodity and a complete list of charges by commodity can be found in Tariffs 8, 14, and 15. General rates for wharfage for all commodities, not otherwise specified, is \$3.53 per metric ton (\$3.20 per short ton) and loading and unloading charges are \$26.19 per metric ton (\$23.76 per short ton) (Port of Houston Tariff 8 Subrule No. 145). For the Port of Houston Bayport

Container Terminal (Tariff 15 Subrule No. 120), wharfage is assessed a charge of \$4.13 per metric ton (\$3.75 per short ton) and loading and unloading is assessed a charge of \$32.77 per metric ton (29.73 per short ton). A wharfage charge for loaded containers is assessed at \$61.23 a container and empties are assessed at \$13.25 a container.

The Port of Houston charges only once for cargo discharged by a vessel to a wharf for transshipment to another vessel if (a) the cargo is transshipped within 30 days; (b) the same shipper and consignee appear on the bill of lading of the vessel to which the cargo is transshipped as appeared on the bill of lading covering the shipment prior to discharge to the wharf; and (c) the cargo has not been removed from the wharf while awaiting transshipment (Port of Houston Tariff 8 Subrule No. 143).

**Port of Brownsville:** The Port of Brownsville also assesses a wharfage charge based on a metric short ton system (2,204.6 lbs.) that varies considerably by commodity. The general wharfage charge for all commodities, not otherwise specified, is \$1.37 per metric ton (Port of Brownsville Tariff No. 6, Item 275). Wharfage charges for loading and unloading containers are as follows (Port of Brownsville Tariff 6 – Cargo Item 279):

- |  |                       |
|--|-----------------------|
| 1. All loaded containers: 20 ft. and 40 ft. containers | \$25.00 per container |
| 2. All empty containers: 20 ft. and 40 ft. containers  | \$ 2.00 per container |

For cargo discharged from vessels and remaining on the wharf for transshipment by vessel, the Port of Brownsville assesses a wharfage charge only on the inward movement if it is reshipped in 30 days under the same ownership. If cargo remains on the wharves more than 30 days, inward and outward wharfage will be assessed.

**Port of Corpus Christi:** For the Port of Corpus Christi, wharfage rates for all commodities, not otherwise specified, is \$3.10 net ton (2,000 lbs.) or \$2.74 per cubic meter (Port of Corpus Christi Tariff 100, Item 500). Loading and unloading of rail cars and trucks is performed by licensed firms authorized to work at the Port of Corpus Christi and charges are quoted upon request. For Corpus Christi's bulk cargo terminal, wharfage on dry bulk commodities handled at the terminal are assessed a wharfage charge of \$1.28 per net ton (\$1.41 per metric ton) on all commodities (Port of Corpus Christi Bulk Terminal Tariff 1-A, Item 200). The Port of Corpus Christi offers free wharfage for cargo discharged from vessels for transshipment to another vessel over the Port Authority's General Cargo Docks if inward wharfage has already been paid and if reloaded within 30 days (Port of Corpus Christi Tariff 100, Item 265).

## **Cargo Operations**

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Cargo operations encompass activities and services utilized in the handling of cargo through the port including cargo transfer, storage, and terminal use. Cargo transfer services are usually provided by authorized stevedoring companies and charges are quoted by the stevedoring companies upon request.

### **Storage**

**Port of Houston:** The Port of Houston provides a free time period for wharf demurrage after which charges are calculated for the period that the property remains on the wharves and premises of the Port Authority (Port of Houston Tariff 8 Subrule No. 137).

Free time periods are provided as follows:

- 1) Inbound non-transshipped steel, not palletized or skidded, intended for direct discharge as shown on documentation submitted to the Port Authority (“Direct Discharge Steel”): 15 days
- 2) Single consignments of one commodity (not covered by the above) of 2,000 tons or more on one bill of lading from one shipper to one consignee:
  - a. Inbound cargo: 45 days
  - b. Outbound cargo: 45 days
- 3) 45 days at the Turning Basin Terminals on cotton and cotton linters exported from Port Authority wharves.
- 4) 30 days on transshipped cargo
- 5) 10 days on inbound cargo unstuffed from containers or break-bulk cargo that is not transported to or from a Port Authority wharf by a vessel
- 6) 10 days on outbound cargo stuffed into containers or break-bulk cargo that is not transported to or from a Port Authority wharf by a vessel
- 7) 30 days on all inbound cargo not covered above; and
- 8) 30 days on all outbound cargo not covered above.

After expiration of the free time period, the following charges are assessed for wharf demurrage:

- 1) \$0.13 per day, per bale on cotton and cotton linters
- 2) On all other cargo –
  - a. \$0.27 per day, per ton for the first 7 days
  - b. \$0.36 per day, per ton for the next 13 days
  - c. \$0.59 per day, per ton for the 21st day and for each day thereafter.
- 3) The minimum charge for all wharf demurrage will be \$15.00 per bill of lading.

**Port of Brownsville:** The Port of Brownsville provides a free time period for storage after which a penalty charge is assessed as shown in Table 6 (Port of Brownsville Tariff 6 – Cargo Item 255):

**Table 6: Port of Brownsville Free Time and Penalty Storage Rates**

Storage Location	Waterborne Cargo		Non-Waterborne Cargo	
	Free Time	Penalty Storage Rate after Expiration or Free Time (per metric ton per day)	Free Time	Penalty Storage Rate after Expiration or Free Time (per metric ton per day)
Covered Storage—General Cargo Sheds	30 Days	11.030	None	120
Open Docks and Dock-side Patios	30 Days	2.210	None	120
Off-Dock Patios	60 Days	2.210	None	120
Unimproved Bank Space	30 Days	16.54030 days	None	120
Containers, Loaded and Empty, on Open Docks, Dock-side Patios and Off-Dock Patios	N/A	N/A	None	\$5.00 per container per day

**Port of Corpus Christi:** For the Port of Corpus Christi, all cargo, except dry bulk commodities, handled over the Port Authority’s general cargo wharves, placed in open storage areas or on other Authority property, is subject to the following free time and storage charges (Port of Corpus Christi Tariff 100, Item 280):

- 1) On-dock storage is free for all cargo except dry bulk for up to 30 days. After 20 days, storage charges per square foot per 30-day period or fraction thereof apply as follows:
  - a. On-dock covered storage: \$0.75 per square foot
  - b. Off-dock covered storage: \$0.50 per square foot.
  - c. Cotton and cotton linters in bales: \$0.10 per bale per 24-hour period (or fraction thereof)
- 2) Open storage is a long-term storage option available at \$2,500 per acre (or fraction thereof) per month

**Terminal Use Charge**

**Port of Houston:** The Port of Houston assesses a charge of \$46.00 per container on all cargo not subject to wharfage charges that is stuffed or stripped into or from containers on Port Authority property or facilities (Port of Houston Tariff 8 Item 136).

**Port of Corpus Christi:** According to the Port of Corpus Christi, all cargo moved through the Bulk Terminal public pad by rail or truck for which no Bulk Terminal wharfage charges apply other than the use of the Bulk Terminal rail dump are assessed a terminal use charge of \$1.25 per net ton (\$1.38 per metric ton) (Port of Corpus Christ Bulk Terminal Tariff 1-A Item 205).

## Other Business

Other businesses refer to the provision of utilities such as water, bunkers, fuel oil, and electricity. There are also charges for services and provisions that are not captured in the sections above, such as fumigation, failure to vacate berth, pallet use charges, checking, receiving and stacking cargo, standby dockage, facility use fees, trimming of cargo, standby labor, and harbor security fees, handling of fire or water damaged cargo, fuel surcharge, property damage, etc. These charges are relatively minor in comparison with the charges described above.

### *Harbor Safety Fee*

**Port of Houston:** The Port of Houston assesses a port security fee for commercial vessels and cargo movements at the following rate (Port of Houston Tariff 8 Subrule No. 051):

- 1) Vessels (including, without limitation, barges): 8% of total dockage assessed per port call
- 2) Cargo (applicable only to cargo loaded or discharged at Port Authority berths or wharves):
  - a. Break-bulk: \$0.47 per ton (2000 lbs.)
  - b. Bulk cargo (dry or liquid): \$0.0375 per ton
  - c. Containers: \$3.50 per loaded container
  - d. Vehicles: \$1.00 per unit

**Port of Brownsville:** The Port of Brownsville assesses a security surcharge fee against cargo on a per unit basis (Port of Brownsville Tariff 6 – Cargo Item 277). The security surcharge is in addition to all other fees and is as follows:

1. Vessels and barges: 6% of total dockage assessed per port call
2. Security surcharge – cargo
  - a. Break-bulk \$0.0275 per metric ton
  - b. Bulk \$0.0275 per metric ton
  - c. Liquid bulk \$0.0275 per metric ton
  - d. Containers \$2.600 per box
  - e. Vehicles \$5.000 per vehicle
  - f. Heavy lift/project cargo \$0.130 per metric ton

**Port of Corpus Christi:** The Port of Corpus charges a harbor safety fee (HSF) “to assist in defraying the administration, maintenance and operation expenses of a fire response vessel and marine patrol vessels, including personnel and equipment.”

For commercial ships and barges entering the Authority’s Waterways, the HSF is as follows:

1. Ships.....\$2,032.00
2. Barges.....\$230.00

In addition, the Port of Corpus Christi states that “for commercial cargo barges that are in the Authority’s Waterways for a period of thirty (30) consecutive days or more without leaving

the Authority’s Waterways, an HSF of \$920.00 will be assessed [monthly] for each continuous 30-day period” (Port of Corpus Christi Tariff 100 Item 301).

## Terminal Operating Cost Model

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The above review of port tariffs indicates that the determination of port charges associated with a particular vessel varies greatly from one port to the other. However, the information above can be used in developing a general port terminal operating cost model based on the variables identified.

The cost associated with a single vessel calling at a port can be represented by Equation 1:

$$C_T = C_N + C_B + C_C + C_O \quad \text{Equation 1}$$

where  $C_T$  = total cost of the vessel call

$C_N$  = costs associated with navigational services

$C_B$  = costs associated with berth services

$C_C$  = costs associated with cargo operations

$C_O$  = all other costs not captured in any of the variables above

Based on the information gathered from the tariff documents, costs associated with the navigational services are a function of port dues ( $C_{\text{port dues}}$ ) and pilotage ( $C_{\text{pilotage}}$ ) as shown in Equation 2. Port dues are assessed based on either a fixed fee or the vessel size as represented with the Equation 3. For example, Port of Houston port dues are calculated based on the length of the vessel and the Port of Brownsville charges a fixed fee. Pilotage charges are usually assessed based on the size of the vessel, time in tow, the distance travelled, or a combination of these as shown in Equation 4.

$$C_N = C_{\text{port dues}} + C_{\text{pilotage}} \quad \text{Equation 2}$$

$$C_{\text{port dues}} = \begin{cases} f(\text{size e. g. length})_{\text{vessel}} \\ \text{Fixed fee} \end{cases} \quad \text{Equation 3}$$

$$C_{\text{pilotage}} = f(\text{vessel size, time in tow, distance traveled})_{\text{vessel}} \quad \text{Equation 4}$$

Cost associated with berth services, can be broken down into dockage costs ( $C_{\text{dockage}}$ ) and wharfage costs ( $C_{\text{wharfage}}$ ) as shown in Equation 5.  $C_{\text{dockage}}$  is a function of vessel size and the time spent at the dock or berth for loading and unloading and can be represented with Equation 6.  $C_{\text{wharfage}}$  is a function of the type, volume, weight, and size of cargo being loaded or unloaded, which can be represented by Equation 7.

$$C_B = C_{\text{dockage}} + C_{\text{wharfage}} \quad \text{Equation 5}$$

$$C_{\text{dockage}} = f(\text{size, time at dock})_{\text{vessel}} \quad \text{Equation 6}$$

$$C_{\text{wharfage}} = f(\text{type, volume, weight, size})_{\text{cargo}} \quad \text{Equation 7}$$

Cost associated with cargo operations can be broken down into cargo handling costs ( $C_{cargo\ handling}$ ), storage costs ( $C_{wharfage\ storage}$ ), and terminal use costs ( $C_{terminal}$ ) as shown in Equation 8. Storage costs here include wharfage demurrage, and short-term and long-term storage options provided by a port. Terminal use here is defined as costs associated with activities that occur during the storage period, e.g., packing/unpacking. Cost data for cargo handling is provided by stevedoring companies upon request but the variable is included here should the data become available. However, all three cost categories can be generalized as a function of the type, volume, weight, and size of cargo as shown in Equations 9 to 11.

$$C_c = C_{cargo\ handling} + C_{storage} + C_{terminal} \quad \text{Equation 8}$$

$$C_{cargo\ handling} = f(\text{type, volume, weight, size})_{cargo} \quad \text{Equation 9}$$

$$C_{wharfage\ storage} = f(\text{type, volume, weight, size})_{cargo} \quad \text{Equation 10}$$

$$C_{terminal\ use} = f(\text{type, volume, weight, size})_{cargo} \quad \text{Equation 11}$$

$C_o$  is the most difficult cost category to model because these ancillary services vary greatly from port to port and vessel call to vessel call. As discussed earlier, it involves services and provisions such as provision of utilities, standby labor, handling of fire or water damaged cargo, fuel surcharge, property damage, etc. However, costs associated with harbor safety fee can be represented by Equation 12.

$$C_{harbor\ safety\ fee} = f(\text{percentage of } C_{dockage})_{vessel} + f(\text{volume, weight, size})_{cargo} \quad \text{Equation 12}$$

### Example Application of the Model

To illustrate how the model can be applied, we'll use the example of a representative fully cellular containership calling at the Port of Houston for 2 days. Data from the Port of Houston Bayport Container Terminal Tariff 15 document is used; the example assumes a fully loaded vessel (maximum possible charge). Table 7 presents the vessel characteristics.

**Table 7: Vessel Characteristics**

<b>TEU Capacity</b>	8,000 TEUS 5,000 containers
<b>LOA (Feet)</b>	1,118.30
<b>Summer Load Line Draft (Feet)</b>	48.13
<b>Extreme Breadth (Feet)</b>	143.89

$$C_{port\ dues} = \$603.00 \text{ (vessel 250 ft. and over in length)}$$

$$C_{pilotage} = \$77.87 + [(1118.3 \times 143.89 / 100) \times 5.858] = \$9,504.38$$

$$C_{\text{dockage}} = \frac{\$15.14}{\text{ft./day}} \times 1,118.30 \text{ ft.} \times 2 \text{ days} = \$33,862.12$$

$$C_{\text{wharfage}} = \$61.23 \times 5,000 = 306,150.00$$

$$C_{\text{cargo handling}} = \text{throughput charge of } (\$100 \times 5,000) = \$500,000$$

$C_{\text{wharfage storage}}$  = Free if the container remains in storage area 7 days or less.

$C_{\text{terminal use}}$  = excluded

$$C_{\text{harbor security fee}} = (0.08 * \$33,862)_{\text{vessel}} + (\$3.50 \times 5000)_{\text{cargo}} = \$20,208.96$$

$$C_T = \$603.00 + \$9,504.38 + \$33,862.00 + \$306,150.00 + \$500,000.00 + 20,208.96 = \$870,328.33$$

Total charges exclude items such as charges for extra cargo handling, terminal use, and other services and provision.

## **Summary**

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As stated earlier, determining port charges associated with a particular vessel varies greatly from one port to the other. The complexity stems from the sheer number of port operations associated with a single vessel calling at a port. This first attempt at a vessel terminal operating cost model seeks to generalize costs associated with a ship calling at a port. Further review and validation of the generalized models is required in order to accurately report on identified charges. Nonetheless, the model seeks to provide an opportunity for transportation stakeholders to compare costs associated with container terminal operations and factors that influence shipping costs.