PO Container Estimation Tool Documentation

Version 1.0

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1 What is it?

The Purchase Order (PO) Container Estimation Tool generates estimates of the number of containers that will arrive at a port over the next several months. The estimates are based on purchase order data, product category parameters, and container parameters provided by the FLOW participant.

2 Why is this tool needed, and who should use it?

FLOW seeks to collect data on the amount of cargo, measured in container units, expected to be imported via coastal ports within the next 90 days. Once a PO is shipped, FLOW participants (beneficial cargo owners and PO managers) know and can provide information on the number of containers used for the shipment; however, for POs that have not yet shipped, due to uncertainty about the consolidation process and other factors, some FLOW members have had difficulty estimating the number of containers expected to be used.

This tool will help achieve the FLOW program objective of providing a 90-day forward view of incoming container volumes, by enabling FLOW members to share more PO data than they were previously able to share. The FLOW team developed this tool in collaboration with several volunteer FLOW participants.

FLOW members should consider using this tool if the PO data they are currently providing to FLOW does not provide at least a 90-day forward view of incoming container volumes.

3 What data is required?

Three different sets of data are required for the PO Container Estimation Tool: Raw Data, Product Category Parameters, and Container Parameters. The Raw Data contains the unshipped PO information. The product category parameters and container parameters contain the necessary conversions and time frames. The following data variables are required for each set of data:

Raw Data: This table contains a list of unshipped POs with expected discharge time frame, origin and discharge port information, number of product units, and product category.

Company	Submitting company name.
Date of File Pull	Date when the data was compiled, as YYYY-MM-DD.
PO Number	The ID of the purchase order.
Expected Year of Discharge	The year when the purchase order is expected to discharge at the port of discharge, as YYYY.
Expected Month of Discharge	The month when the purchase order is expected to discharge at the port of discharge, as MM.
Expected Day of Discharge	The day of the month when the purchase order is expected to discharge at the port of discharge, as DD. (optional)
Country of Origin	The country where the product units will ship from. The country code should follow ISO 3166-1 alpha-2.
Port of Loading	The port in the country of origin that the container will ship from, as UN/LOCODE.
Port of Discharge	Port where the container will discharge from the vessel, as UN/LOCODE.
PO Units	The number of units of product within the purchase order.
PO Product Category	The product category of the purchase order.

Product Category Parameters: This table contains a list of the company's typical general categories of products (e.g., apparel) and average number of product units per cubic meter for that product category. If changes are made to the parameters, a new entry should be created and the end date should be populated for the parameter to be replaced.

Company	Submitting company name.
Date of File Pull	Date when the data was compiled, as YYYY-MM-DD.
Product Category	The general category of the products that the participant produces (e.g., apparel).
Average Units per CBM	The average number of units per cubic meter for that product category.
Time Frame of Parameter Start	The beginning of the time frame that the parameter is valid, as YYYY-MM-DD. If changes are made to product categories or average units per CBM, a new entry should be created.
Time Frame of Parameter End	The end of the time frame that the parameter is valid, as YYYY-MM-DD. If changes are made to product categories or average units per CBM, a new entry should be created.

Container Parameters: This table contains a list of the types of containers typically used by the company (e.g., 42G1) with percent usage. For example, a company's typical container mix based on historical data might be 50% 42G1, 25% 22G1, and 25% 45G1. If changes are made to the parameters, a new entry should be created and the end date should be populated for the parameter to be replaced.

Company	Submitting company name.
Date of File Pull	Date when the data was compiled, as YYYY-MM-DD.
Container Type	This is the type of container that is used by the participant. The entry should follow ISO 6346.
Average CBM per Container	The average cubic meters (CBM) filled per container type. This may be less than the container's capacity due to less than container loads. The average CBM per container should be based on historical data.
Percent of Container Size/Type Usage	The percent usage of the container size/type used by the participant. The sum of percentages during a given time period should add up to 99%-100%.
Time Frame of Parameter Start	The end of the time frame that the parameter is valid, as YYYY-MM-DD. If changes are made to container percentages, a new entry should be created.
Time Frame of Parameter End	The end of the time frame that the parameter is valid, as YYYY-MM-DD. If changes are made to container percentages, a new entry should be created.

4 What is the Output?

The output is a table with the total number of containers per container type at each port. The table will have the following columns: expected year, expected month, port of discharge, container type, and number of containers. The number of containers at each port in each month will reflect the container usage parameters that are provided by the FLOW participant.

expected_year	expected_month	port_of_discharge	container_type	number_of_containers
2024	07	USLAX	45G1	11
2024	07	USLAX	20G1	6
2024	07	USLAX	42G1	22
2024	07	USSAV	45G1	8
2024	07	USSAV	20G1	1
2024	07	USSAV	42G1	10
2024	07	USNYC	45G1	12
2024	07	USNYC	20G1	7
2024	07	USNYC	42G1	20

This tool is run via automated ingestion processes using the input files provided by the FLOW participant. The tool output will be shared with the participant periodically for confirmation and review or adjustment of parameters.

Aggregated outputs will be shared via the FLOW Dashboard in accordance with standard review and release processes.

5 How do I get started?

To get started, prepare the three files described above and submit via the FLOW Portal or SFTP for review. Additional documentation on file specification is provided in the FLOW Container Estimation Tool Data Dictionary. The DOT FLOW team will contact you with any requests for change or to confirm the file is acceptable. To request a meeting to review these requirements, please email BTSDataPortal@dot.gov.

The submission schedule is once per month, by the 15th of each month, for submission of the Raw Data file. The two parameter files should be submitted whenever there are changes, with a recommended review frequency of once per quarter to ensure sufficient accuracy.

6 Methodology for Container Estimation:

6.1 Variables

The following are the variable definitions used in the calculations. The parenthesis are the units of the variable.

Input Variables:

u_i	The number of units of product of a PO. (units)
p_i	The average units needed per cubic meter(CBM) for a category. (units/CBM)
v_{Total}	The total PO Volume in each month. (CBM)
v_i	The total volume of a single PO. (CBM)
k_i	The average fill volume in cubic meters per container type. (CBM/containers)
w_i	The usage percentage of a container type. (percent)

Output Variables:

c_i	The number of containers for a container type. (containers)
C_{Total}	The total number of containers.

6.2 Calculations

We calculate the total PO volume(in cubic meters) per month. The volume of a PO can be calculated by dividing the number of units of the PO, u_i, by the average units needed per CBM for a category, p_i. The sum of all PO's in a given month will give the total PO volume of that month.

$$1.\ v_i = \frac{u_i}{p_i}$$

$$2.\ v_{Total} = v_1 + v_2 + v_3 + ... + v_n$$

We can then calculate the estimated number of containers per container type. The total number of containers is the sum of all containers per type. We can estimate the number of containers per type using the container usage parameters, w_i.

$$3.\ C_{Total} = c_1 + c_2 + ... + c_n = C_{Total} * w_1 + C_{Total} * w_2 + ... + C_{Total} * w_n$$

The total number of containers can be calculated by the ratio of the number of containers, c_i, and its usage parameter, w_i.

$$4.\ c_i = C_{Total} * w_i \qquad \leftrightarrow \qquad C_{Total} = \frac{c_i}{w_i}$$

Let's take two container types, i and j, and set their ratios equal. We can isolate the number of containers for type i.

$$5.\ \frac{c_i}{w_i} = \frac{c_j}{w_j} \qquad \rightarrow \qquad c_i = (\frac{c_j}{w_j}) * w_i$$

This means that the number of containers, c_i, can be calculated by their respective usage parameter, w_i, multiplied by the ratio of $\frac{c_j}{w_j}$. The total PO volume in a month as shown in equation 2 can be calculated using the number of containers per type, c_i, and their average fill volume, k_i.

$$6.\ v_{Total} = v_1 + v_2 + v_3 + ... + v_n = c_1 * k_1 + c_2 * k_2 + ... + c_n * k_n$$

Using equation 5, we can substitute every value of c_i using $\frac{c_1}{w_1} * w_i$ into equation 6. We can factor out c_1 and single it out to one side of the equation to calculate its value.

$$v_{Total} = c_1 * k_1 + (\frac{c_1}{w_1}) * w_2 * k_2 + ... + (\frac{c_1}{w_1}) * w_3 * k_3 + ... + (\frac{c_1}{w_1}) * w_n * k_n$$

$$v_{Total} = c_1[k_1 + (\frac{1}{w_1}) * w_2 * k_2 + ... + (\frac{1}{w_1}) * w_3 * k_3 + ... + (\frac{1}{w_1}) * w_n * k_n]$$

$$7.\ c_1 = \frac{v_{Total}}{[k_1 + (\frac{1}{w_1}) * w_2 * k_2 + ... + (\frac{1}{w_1}) * w_3 * k_3 + ... + (\frac{1}{w_1}) * w_n * k_n]}$$

We can calculate the number of containers for every container type using c_1 and equation 5. Once every container type is calculated, then we can calculate the total number of containers in each month using equation 3.