Advanced Ship Unit Building & Load Optimization in 6.3

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## Advanced Ship Unit Building & Load Optimization in 6.3

<table>
<thead>
<tr>
<th>Limitations prior...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship Unit Repack</td>
</tr>
<tr>
<td>THU Capacity by Location</td>
</tr>
<tr>
<td>THU selection by Mode</td>
</tr>
<tr>
<td>Intersection from THU Profiles</td>
</tr>
<tr>
<td>Package Item Type &amp; PRU</td>
</tr>
<tr>
<td>Ship Unit Splitting</td>
</tr>
<tr>
<td>Load Configuration Set up &amp; rules</td>
</tr>
</tbody>
</table>
Limitations prior to 6.3

OTM 6.3’s advanced Planning & Optimizations capabilities help in leveraging OTM for better ROI.

This presentation discusses key areas specific to Ship Unit building and Load Optimization in 6.3

A few limitations in previous versions and how 6.3 is able to address them...

<table>
<thead>
<tr>
<th>SNo</th>
<th>Limitation</th>
<th>Solution in 6.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>There was no ability to re-pack partial pallets during load optimization.</td>
<td>The packing algorithm has been extend to repack partial pallets during load optimization</td>
</tr>
<tr>
<td>2</td>
<td>Locations could accept only ONE ship unit specification against mixed freight.</td>
<td>The location role now allows multiple THUs against mixed freight.</td>
</tr>
<tr>
<td>3</td>
<td>Stackability could ONLY be defined only at Ship unit specification /THU level. E.g. 40x40PALLET_BOOK_STACK_ABOVE 40x40PALLET_GLASS_STACKNONE</td>
<td>Stackability can now be defined at packaged item level or Ship Unit specification level.</td>
</tr>
<tr>
<td>4</td>
<td>Added to the above stackability issue, the mixable flag against packaged item increased the number of partial pallets (instances where stackability requirements for mixable items are different) resulting in loss of equipment space.</td>
<td>Stackability can now be defined at packaged item level or Ship Unit specification level (or both) allowing flexible rules efficient load configuration.</td>
</tr>
<tr>
<td>5</td>
<td>THU &amp; packaging unit had to be referenced in the order base line to determine optimal count of SU or packaging units.</td>
<td>Not required to specify the THU &amp; PU on order base line anymore. 6.3 can determine the best THU &amp; also the optimal count.</td>
</tr>
</tbody>
</table>
Advanced Ship Unit Building & Load Optimization in 6.3

Limitations prior...

Ship Unit Repack

THU Capacity by Location

THU selection by Mode

Intersection from THU Profiles

Package Item Type & PRU

Ship Unit Splitting

Load Configuration Set up & rules
Ship Unit Repack...

Repack Functionality Overview

• Initially considers order release lines during the order release ship unit building phase.

• Re-packs qualifying lines across various order releases during load configuration to select best equipment.

• Has the ability to delay the creation of optimal ship units to the shipment optimization stage.

• During Planning Phase, invokes the rate engine to rate different combinations of Ship Units.

• Leverages advanced packing rules to have the mode and ship unit decision made simultaneously.

Standard repack scenario

Allows optimal number of mixed freight ship units to be built dynamically and allows re-pack of ship units during load optimization.

<table>
<thead>
<tr>
<th></th>
<th>Order#1</th>
<th>Order#2</th>
<th>Order#3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI#</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>SU#</td>
<td>1 (PARTIAL)</td>
<td>1 (PARTIAL)</td>
<td>1 (FULL)</td>
</tr>
<tr>
<td>Shipment#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSU#</td>
<td>1 (FULL)</td>
<td></td>
<td>1 FULL</td>
</tr>
</tbody>
</table>

10 packaged items make up a full pallet
The packing algorithm leverages the new 6.3 data model to handle advanced packing scenarios.

Partial ship units from order release are consolidated during planning.

“Repack” flag allows packing algorithm to consolidate lines across order releases.
**Ship Unit repack...**

**Repack with Leg consolidation:** During leg consolidation, partial pallets from different order releases are consolidated to create full pallets on the second leg shipment.

### Diagram

- **San Jose** to **Boston**
  - **1 Full + 1 Partial Pallet**
- **Los Angeles** to **Boston**
  - **1 Partial Pallet**

### Table

<table>
<thead>
<tr>
<th></th>
<th>Order Release#1</th>
<th>Order Release#2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release Lane</td>
<td>San Jose-&gt; Boston</td>
<td>LA &gt; Boston</td>
</tr>
<tr>
<td>Release Packaged Item Count</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Release-level THU</td>
<td>1 PALLET (PARTIAL)</td>
<td>2 PALLETS (1 PARTIAL + 1 FULL)</td>
</tr>
<tr>
<td>Order Movement ID</td>
<td>OM1</td>
<td>OM2</td>
</tr>
<tr>
<td>Order Movement Lane</td>
<td>San Jose – Phoenix</td>
<td>Phoenix-Boston</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phoenix-&gt; Boston</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LA &gt; Phoenix</td>
</tr>
<tr>
<td>S_SHIP_UNIT_ID</td>
<td>97</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>101</td>
</tr>
<tr>
<td></td>
<td></td>
<td>99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>98</td>
</tr>
<tr>
<td>Packaged Item Count (OR line#1)</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Packaged Item Count (OR Line#2)</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Shipment ID</td>
<td>01090</td>
<td>01092</td>
</tr>
<tr>
<td>Shipment-level THU</td>
<td>1 PALLET (PARTIAL)</td>
<td>1 PALLET (FULL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 PALLET (FULL)</td>
</tr>
</tbody>
</table>

**OM Ship units are consolidated**

**Consolidated Leg**

10 packaged items make up a full pallet

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**Ship Unit repack..**

**S_SHIP_UNIT**

<table>
<thead>
<tr>
<th>Ship Unit ID</th>
<th>Ship Unit Count</th>
<th>Transport Handling Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100</td>
<td>1.00</td>
<td>Pallet</td>
</tr>
</tbody>
</table>

**Consolidated shipment (2\textsuperscript{nd} Leg)**

<table>
<thead>
<tr>
<th>Ship Unit ID</th>
<th>Activity</th>
<th>Ship Unit Count</th>
<th>Weight</th>
<th>Volume</th>
<th>Net Weight</th>
<th>Net Volume</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>-101</td>
<td>P</td>
<td>1.00</td>
<td>0.00 LB</td>
<td>0.00 CUMTR</td>
<td></td>
<td></td>
<td>0.00 M</td>
<td>0.00 M</td>
<td>0.00 M</td>
<td>0.00 M</td>
</tr>
</tbody>
</table>

**Order Release ID**

<table>
<thead>
<tr>
<th>Order Release ID</th>
<th>Total Package Count</th>
<th>Packaged Item</th>
<th>Item ID</th>
<th>Item Description</th>
<th>Packaging Unit Count</th>
<th>Packaging Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCENARIO 4 02-001</td>
<td>10</td>
<td>DEMO SKU</td>
<td>DEMO SKU</td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- The S_SHIP_UNITS on the second leg order movements will indicate that they will be repacked during shipment building.
**Pre-pack with repack:** OTM shall create one ship unit during release and will defer/delay ship unit optimization to shipment creation stage.

Order release with initial THU

THU Type = BOX_THU;

THU count = 1

(repack delayed to shipment optimization phase)

Shipment planned with

THU Type = PALLET;

THU count = 52

(Result of repack of ship Unit)
Advanced Ship Unit Building & Load Optimization in 6.3

- Limitations prior...
- Ship Unit Repack
  - THU Capacity by Location
- THU selection by Mode
- Intersection from THU Profiles
- Package Item Type & PRU
- Ship Unit Splitting
- Load Configuration Set up & rules
THU Capacity by Location ...

Allows business rules to define one or more transport handling unit for a specific location, each THU type with unique set of capacity constraints.

Planning shall leverage this data model to assign the correct THU based on order weight.

Destination Location can now receive more than one type of mixed pallet

Location with pallet size/capacity restrictions
Advanced Ship Unit Building & Load Optimization in 6.3

- Limitations prior...
- Ship Unit Repack
- THU Capacity by Location
  - THU selection by Mode
- Intersection from THU Profiles
- Package Item Type & PRU
- Ship Unit Splitting
- Load Configuration Set up & rules
THU selection by Mode...

OTM 6.3 allows Transport mode and THU to be linked to create cost-effective planning.

The Packing algorithm is enhanced to assign the optimal combination of mode and ship units during the order planning phase.

<table>
<thead>
<tr>
<th>Ordered Packaged Item count = 24 Nos.</th>
<th>Solution1</th>
<th>Solution2</th>
</tr>
</thead>
</table>
| 6 Nos. in 1 BOX (Parcel)  
24 Nos. in 1 PALLET (LTL) | 1 Parcel Shipment with 4 boxes | 1 LTL shipment with 1 pallet. |
|                                      | Cost = 75 USD | Cost = 100 USD |

Preferred solution

OTM 6.3 can make ship unit decision while it optimizes mode selection.

The cheaper option from transport mode & THU combination is assigned during the planning phase.

Changes were made to Transport mode data model to reduce planning run time.
THU selection by Mode...

**Transport Mode: Power Data**

- **Transport Mode ID**: PARCEL
- **Transport Mode Name**: PARCEL
- **Transport Mode Qualifier**: STANDARD
- **Conditional Booking Profile ID**: BOX
- **Color**: CYAN
- **Transport Handling Unit Profile ID**: BOX
- **Perform Shipping Space Calculation**: [ ]
- **Allow Remark/Reference Number Visibility**: [ ]
- **Consider Cost During SSU Repack**: [ ]
- **Mode Type**: [ ]
- **X12 Format Code**: [ ]
- **Domain Name**: TRAINING

**Planning Parameter Set**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default Value</th>
<th>Parameter Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJUSTED EQUIPMENT CAPACITY PERCENT</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>ALLOW SMALL DIRECT ORDERS TO BE SPLITTABLE</td>
<td>FALSE</td>
<td>FALSE</td>
</tr>
<tr>
<td>CONSIDER VOYAGE SCHEDULES IN CONTAINER OPT</td>
<td>FALSE</td>
<td>FALSE</td>
</tr>
<tr>
<td>CONTAINER OPT CONFIG ID</td>
<td>CONTAINER OPTIMIZATION DEFAULT</td>
<td>DEMO_CONOPT</td>
</tr>
</tbody>
</table>

**Con-Opt Configuration ID**

- **CONAINER OPTIMIZATION METRICS**
  - **VOLUME METRIC**: TRUE
  - **WEIGHT AND VOLUME METRIC**: FALSE
  - **WEIGHT METRIC**: TRUE

- **CONAINER OPTIMIZATION OBJECTIVES**
  - **MAXIMIZE CONTAINER UTILIZATION**: TRUE
  - **MINIMIZE NUMBER OF CONTAINERS**: TRUE
  - **OPTIMIZE COST**: TRUE

**THU profile restricts THUs to ensure a valid rate is found**

**Indicates that for this mode, the cost should be considered during SSU repack**
Limitations prior...

Ship Unit Repack

THU Capacity by Location

THU selection by Mode

*Intersection from THU Profiles*

Package Item Type & PRU

Ship Unit Splitting

Load Configuration Set up & rules

Logic Parameters
Intersection from THU Profiles...

OTM shall pick the best THU from intersection of THU profiles on Order, Packaged item & Location
Advanced Ship Unit Building & Load Optimization in 6.3

- Limitations prior...
- Ship Unit Repack
- THU Capacity by Location
- THU selection by Mode
- Intersection from THU Profiles
  - Package Item Type & PRU
- Ship Unit Splitting
- Load Configuration Set up & rules
• More items could be packed into a THU if they are have uniform packing characteristics.

• **Packaged Item Type** provides another layer of optimization between “same” and “mixed” freight items

• Items with same packaged Item type and packaging unit are considered LIKE. LIKE items with same TIHI could be packed into the same THU. This improves packing efficiency

• **PRUs** allow another dimension to define the packing hierarchy in terms of resource capacity (THU) and consumption (packaged item/order)
  
  • PRU Capacity: capacity of the resource in terms of PRU
  • PRU Consumption: usage from demand in terms of PRU
### Package Item Type & PRU...

#### 2 packaged items with LIKE characteristics: same packaged item type, packaging unit and TIHI

<table>
<thead>
<tr>
<th>Packaged Item ID</th>
<th>Description</th>
<th>Domain Name</th>
<th>Packaged Item ID</th>
<th>Description</th>
<th>Domain Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIKE_SANDAL_BOX_9.5</td>
<td>NIKE_SANDAL_BOX_9.5</td>
<td>TRAINING</td>
<td>NIKE_SHOE_BOX_9.5</td>
<td>NIKE_SHOE_BOX_9.5</td>
<td>TRAINING/NAOTM</td>
</tr>
<tr>
<td>NIKE_SANDAL_9.5</td>
<td></td>
<td></td>
<td>NIKE_SHOE_9.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Packaging Unit**: PACKAGING_UNIT

**Mixable**: Yes

**Hazardous**: Yes

**Package Weight**: 2.00 LB

**Unit Volume**

<table>
<thead>
<tr>
<th>Unit Width</th>
<th>Unit Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.18 M</td>
<td>0.10 M</td>
</tr>
</tbody>
</table>

**Diameter per Ship Unit**: Core Diameter

---

<table>
<thead>
<tr>
<th>Transport Handling Unit</th>
<th>Number Of Layers</th>
<th>Quantity per Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>PALLET</td>
<td>2</td>
<td>20</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>ID</th>
<th>Transport Handling Unit</th>
<th>Flexible Commodity Qualifier</th>
<th>Commodity Code</th>
<th>Order Release Equipment ID</th>
<th>Ship Unit Count</th>
<th>Total Gross Weight</th>
<th>Total Gross Volume</th>
<th>Gross Weight per Ship Unit</th>
<th>Gross Volume per Ship Unit</th>
<th>Net Weight per Ship Unit</th>
<th>Net Volume per Ship Unit</th>
<th>Pick Up Stop ID</th>
<th>Drop Off Stop ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCENARIO06_DEMO-001-001</td>
<td>PALLET</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>80.19 LB</td>
<td>1.26 CUMTR</td>
<td>80.19 LB</td>
<td>1.26 CUMTR</td>
<td>80.19 LB</td>
<td>0.21 CUMTR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Packaged Item ID</th>
<th>Item Name derived from Packaged Item</th>
<th>Total Package Count</th>
<th>Total Weight</th>
<th>Total Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIKE_SANDAL_BOX_9.5</td>
<td>NIKE_SANDAL_9.5</td>
<td>1</td>
<td>20.00 LB</td>
<td>0.05 CUMTR</td>
</tr>
<tr>
<td>NIKE_SHOE_BOX_9.5</td>
<td>NIKE_SHOE_9.5</td>
<td>3</td>
<td>60.19 LB</td>
<td>0.15 CUMTR</td>
</tr>
</tbody>
</table>

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Order base received with below 2 lines:
- 4 units of small box (4 PRUs)
- 1 unit of Large Box (2 PRUs)

Order release built with 1 Small Pallet & 1 Large pallet as below:
- 4 small boxes = 4 PRUs = 1 Large pallet
- 1 Large Box = 2 PRUs = 1 Small pallet
Advanced Ship Unit Building & Load Optimization in 6.3

Limitations prior...
Ship Unit Repack
THU Capacity by Location
THU selection by Mode
Intersection from THU Profiles
Package Item Type & PRU rules

*Ship Unit Splitting*
Load Configuration Set up & rules
# Ship Unit Splitting

Splitting the Order Release and its associated Ship Units Structures to place them into multiple pieces of equipment.

<table>
<thead>
<tr>
<th>SNo</th>
<th>Ship Unit Scenario</th>
<th>SU COUNT = 1</th>
<th>SU COUNT &gt; 1</th>
<th>ALLOW_REPACK</th>
<th>OTM Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Non-split order release</td>
<td>N</td>
<td></td>
<td></td>
<td>The order must be placed fully into 1 piece of equipment</td>
</tr>
<tr>
<td>2</td>
<td>order release with distinct ship units i.e. with unique Tracking Numbers</td>
<td>Y, N, N, N, N</td>
<td></td>
<td>compatible</td>
<td>The distinct sets of SUs can be placed into multiple pieces of equipment</td>
</tr>
<tr>
<td>3</td>
<td>Bulk</td>
<td>Y, Y, N, N, N, N</td>
<td></td>
<td>not compatible</td>
<td>The line-level data from the SU has quantities on it that can be split across equipments.</td>
</tr>
<tr>
<td>4</td>
<td>Partial Bulk</td>
<td>Y, Y, Y, N, Y, N, N</td>
<td></td>
<td>Not compatible</td>
<td>The ship units with “Bulk Splittable flag = Y” can split across equipments. Others must stay on one piece (same) equipment.</td>
</tr>
<tr>
<td>5</td>
<td>Multiple Pallets with same Product</td>
<td>Y, Y, N, Y, N, Y, N</td>
<td></td>
<td>Not compatible</td>
<td>The count of ship units can be split and placed on multiple equipments.</td>
</tr>
<tr>
<td>6</td>
<td>“n” Full pallets + 61 partial pallet</td>
<td>Y, Y, Y, N, Y, Y, N</td>
<td></td>
<td>compatible for partial pallet</td>
<td>The ship Units with IS_COUNT_SPLIT = Y may be split by count and placed into multiple equipments.</td>
</tr>
</tbody>
</table>
Advanced Ship Unit Building & Load Optimization in 6.3

- Limitations prior...
- Ship Unit Repack
- THU Capacity by Location
- THU selection by Mode
- Intersection from THU Profiles
- Package Item Type & PRU
- Ship Unit Splitting

Load Configuration Set up & rules
Load Configuration Setup & rules...

ConOpt Algorithm was enhanced in 6.3 to resolve current limitations.

LC variables like Stackability attributes and orientation attributes were defined at ship Unit specification level in previous versions.

LC rules defined against Ship Unit specification doesn’t allow flexibility to model the correct loading characteristics of ship units. This resulted in large number of SU specifications.

The input to ConOpt algorithm has been extended:
• Load configuration Setup
• Load configuration Rules
• Logic Parameters

• These enhancements extend the data model and assist in building better loads while leveraging the general strengths of the planning engine.
Load Configuration Setup & rules...

• LC Setup refers to below variables:
  • Pattern
  • Stackability
  • Orientation

• LC Setup can be assigned to Order base or order release Ship unit directly

**Load configuration Set up**

<table>
<thead>
<tr>
<th>Load Configuration Setup ID</th>
<th>Domain Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMO_LC_SETUP</td>
<td>TRAINING</td>
</tr>
</tbody>
</table>

**Pattern-based Load Configuration Profile ID**

| DEMO_PATTERN_LCP |

**Stackability**

- **Stackable Above**: No
- **Stackable Below**: No
- **Stacking Rule**: LIKE
- **Stacking Layers**: 1
- **Max Stacking Height**: 1.50 M

**Max Percentage of Unsupported Area**: 25.00

**Orientations**

- **Orientation**: ONSIDE LENGTHWISE
- **Preferred**: ✔
- **Floor Compatible**: ✔
- **Maximum Top Weight**: 0.10 LB
- **Maximum Overhang Length**: 1.50 M
- **Maximum Overhang Width**: 0.10 M

**Planning Parameter**

<table>
<thead>
<tr>
<th>CONTAINER OPT CONFIG ID</th>
<th>Logic Configuration ID</th>
<th>Logic Configuration Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMO_CONOPT</td>
<td>CONTAINER OPTIMIZATION DEFAULT</td>
<td>THE DEFAULT CONTAINER OPTIMIZATION LOGIC CONFIGURATION</td>
<td></td>
</tr>
</tbody>
</table>

**CONTAINER OPTIMIZATION ALGORITHM**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default Value</th>
<th>Parameter Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE 3D BASED LOAD CONFIGURATION</td>
<td>FALSE</td>
<td>TRUE</td>
</tr>
</tbody>
</table>
As LC Setup defined on transaction line is defined as non-stack, only maximum of 26 pallets can be built as one load. Therefore, the load of 51 pallets (26+25) is built into TWO equipments.

The equipment has capacity to load 26 pallets in one layer.
Load Configuration Rules:
• 6.3 allows Load configuration rules to be defined against a combination of below:
  • Equipment
  • Packaged item
  • Packing Unit
  • THU
  • Location

• OTM shall dynamically apply the Load configuration rule to the shipment based on above parameters in the transaction.

Load configuration Set up

load configuration set up is defined to stack ship units
The equipment has capacity to load 26 pallets in one layer. Based on stackability parameters defined in LC rule, equipment can take 2 layers of pallets. Therefore, the load of 51 pallets is built to ONE equipment.
Load Configuration Setup & rules

**Logic Parameters** control the way the LC rules are applied if there are multiple matching LC rule records.

**Search level** is required if more than one rule is defined for below combinations

1. THU & Packaged item
2. Equipment & Location

### Use Most specific Only
- Search levels 1 & 2
- Use most specific and intersect with others where there are null values
- Use most specific (Search Levels)
- Any null values are found, look for other matching rules

### THU-based set up is most specific

### Equipment-based set up is most specific

If there are mixed Packaged Items in the Ship Unit, the one with higher value of "Load Config Rule Ranking" will be used to determine the LC rule.
Q & A

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Phone: +1. 908.447.0627
Thank you

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