Advanced ATP and Its Application

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Advanced ATP

• An execution mechanism that allocates and re-allocates available resources, including raw materials, work-in-process, finished goods, and even production and distribution capacities, in response to actual customer orders
• Advanced ATP synchronizes and matches the forecast-based push and order-driven pull “forces” to lower stock-out, higher resource utilization and less waste.

Real-Time ATP

• Response and order commitment are given for each customer order immediately after order receipt based on pre-allocated resource availability
• Back-end resource availability including material, production capacity, distribution capacity are required to be pre-allocated into front-end availability at either SKU level, or options (features) level, or finished goods level to increase promising speed

Two-Stage ATP

• Customer orders are responded and committed immediately with initial “soft” order confirmation by real-time ATP then given “hard” order delivery date after checking more detail resource availability based on batch ATP.

Flexibilities in ATP Environment

• Customer order flexibility – high profit orders vs. low profit orders, confirmed orders vs. pseudo orders
• Production flexibility – regular time vs. overtime
• Location flexibility – order splitting and re-pointing
• Transportation flexibility – express mode vs. regular mode
• Resources flexibility – expedite or de-expedite.

Multiple Performance Measures

• Customer service level – Due date violation, loss sales, etc.
• Total revenue – Committed orders times sales price.
• Total cost – Holding cost, production cost, transportation cost.
• Production and transportation smoothness & utilization

Batch-mode ATP

• Customer orders are collected over a predetermined “batching interval” (e.g., one hour, 8-hour shift, one day) and response and order commitment are generated for a batch of orders at the end of each batching interval.

MIP Formulation

• Major decision variables
  \[ Z^*(t) \] : Order accept or deny indicator (0/1) for order \( k \) in time \( t \)
  \[ X^*(t) \] : Delivery indicator (0/1) for order \( k \) in delivery mode \( m \)
  \[ D^*(t) \] : Quantity delivery for order \( k \) via mode \( m \) in factory \( f \)
  \[ Y^*(t) \] : Production indicator (0/1) for order \( k \) in factory \( f \) and time \( t \)
  \[ Q^*(t) \] : Quantity produced for order \( k \) in factory \( f \) and time \( t \)

• Objective Function
  Minimize: revenue + customer service – total cost
  Constraints
  ✓ Order promising and fulfillment constraints
  ✓ Delivery assignment constraints
  ✓ Production assignment constraints
  ✓ Material conservation
  ✓ Production capacity requirements constraints
  ✓ Delivery capacity requirements constraints
  ✓ Material substitution and compatibility

Applications of Batch ATP in Toshiba

• Data was collected for an electronic product (EP)
  ✓ ATP Time Horizon: 9 weeks
  ✓ Customer Orders: 4994
  ✓ Product Models: 4355
  ✓ Available Resources: 765 MOs, 456 PCs with 5-20 candidates

<table>
<thead>
<tr>
<th>Total due date violation (qty*date)</th>
<th>C-ATP</th>
<th>A-ATP</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>429016</td>
<td>351521</td>
<td>-18.1%</td>
</tr>
<tr>
<td>Total inventory holding cost (qty*date)</td>
<td>1614023</td>
<td>1577228</td>
<td>-2.3%</td>
</tr>
<tr>
<td>Production quantity by flexible resources</td>
<td>18439</td>
<td>15797</td>
<td>-14.3%</td>
</tr>
</tbody>
</table>

Pareto frontier for 2 objective criteria:

• Single run takes 6 minutes