Practical enterprise AI
No black box

Augmenting human expertise with explainable AI for improved operational performance and better business outcomes.

HMX Corporation
Intelligent Production Optimization
Proof of Value Presentation & Managed Services
December 2021
The goal is to demonstrate the capabilities of HMX Intelligent Production Optimization Solution.

The scope is the implementation of a use case for constraint-based production schedule.

Proof of value success will be measured against mutually agreed success criteria.
HMX Intelligent Production Optimization (IPO): User Workflow

1. User sends email with updated planning input data to IPO

2. Planning input data is automatically uploaded by IPO from email into IPO application DB

3. IPO Cognitive Map automatically processes new planning input data and continually monitors for important situations

4. When important situations possibly impacting the plan are identified, IPO automatically takes actions to invoke Aleph5 optimizer and simulate new Production scenario

5. IPO ingests plan simulation results, generates goal satisfaction, situation metrics, stores to DB, and exports outputs to Excel and/or Power BI.

6. IPO automatically notifies key stakeholders of new simulated plan with goal satisfaction and situational KPIs, plan data and explanation.

Manufacturing Users
- Planners,
- Finance,
- Operations

NOTE: The diagram includes visual representations of email, planning input data, IPO application DB, Azure SQL Server, and Excel/Power BI outputs, with arrows indicating the flow of information and actions.
Proof-of-Value and Production Capabilities

<table>
<thead>
<tr>
<th>IPO Capability</th>
<th>Proof-of-Value</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning data input (step 2)</td>
<td>Manual, 1 example source (e.g., demand)</td>
<td>Automatic</td>
</tr>
<tr>
<td>Cognitive Map</td>
<td>Up to 5 goals/sub-goals, up to 10 situations, 1 situation triggers plan development, other situations set parameters that are used in plan development.</td>
<td>Multiple goals and situations, with upper limit set by license agreement</td>
</tr>
<tr>
<td>Use Cases</td>
<td>1 (e.g., develop a production plan for addressing a significant change in demand for beverages)</td>
<td>Multiple, with upper limit set by license agreement</td>
</tr>
<tr>
<td>BI Displays</td>
<td>Standard plan, utilization, inventory displays, IPO goal/situation metrics</td>
<td>IPO goal/situation metrics, plan displays specialized to manufacturer’s requirements</td>
</tr>
<tr>
<td>Email notification</td>
<td>Example for enabled situations, and with explanation</td>
<td>As specified by manufacturer for each situation.</td>
</tr>
</tbody>
</table>

Example Email Notification

Date: 02-Aug-2021 12:00:00 AM

Situation that Triggered Plan Development: Demand for beverages has changed significantly

Situation Description: This situation occurs when the most recent demand update is significantly different from recent demand forecast and indicates a possible insufficient supply to meet that demand.

Production Plan Results

Goal Impact: The production capacity limits in plant SGA will slightly reduce % goal satisfaction for “Maximize profit”.

Impact: High

Explanation:

- **Issue**: the supply of NO.003 150 CC is not sufficient to meet the predicted demand during the period from 1-Jun through 5-Jun.
- **Reason**: There is insufficient production capacity in machines currently available to produce NO.003 150 CC during the period from 1-Jun through 5-Jun.
- **Resolution**: Options include the following:
  - Change the priorities of other products to provide additional capacity.
  - Outsource production of 150,000 bottles to meet the demand.
  - Repurpose SGA #101furnace to Amber and allocate forming machines 1 and 2 to NO.003 150 CC.

Additional Diagnostic Notes: This situation has occurred intermittently (3 times in 8 planning periods) over the last 2 months, indicating a fluctuation in reported demand.
### 90-Day Proof-of-Value Schedule

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Start</th>
<th>End</th>
<th>Duration</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 0</td>
<td>Day 8</td>
<td>8</td>
<td>Finalize Letter of Agreement</td>
</tr>
<tr>
<td></td>
<td>Day 8</td>
<td>Day 13</td>
<td>5</td>
<td>Initial GDTA Preparation</td>
</tr>
<tr>
<td></td>
<td>Day 13</td>
<td>Day 18</td>
<td>5</td>
<td>GDTA Sessions over Teams</td>
</tr>
<tr>
<td></td>
<td>Day 18</td>
<td>Day 38</td>
<td>20</td>
<td>Design Document Preparation</td>
</tr>
<tr>
<td></td>
<td>Day 38</td>
<td>Day 73</td>
<td>35</td>
<td>Cognitive Map Implementation</td>
</tr>
<tr>
<td></td>
<td>Day 38</td>
<td>Day 73</td>
<td>35</td>
<td>Data Model Implementation</td>
</tr>
<tr>
<td></td>
<td>Day 73</td>
<td>Day 74</td>
<td>1</td>
<td>IPO PoV Deployment</td>
</tr>
<tr>
<td></td>
<td>Day 75</td>
<td>Day 90</td>
<td>15</td>
<td>PoV Execution</td>
</tr>
</tbody>
</table>
Proof-of-Value Test Cases and Success Criteria
Create a Cognitive Map

**Success Criteria**

- Cognitive map is successfully published and put into operation by programming the goal traversal module, which will start processing the available data and create a production schedule:
  - Goals are successfully created and edited
  - Situations are successfully created and edited
  - Cognitive map with missing situation assessors (situations marked in red) cannot be published
Define Assessors in a Cognitive Map

Success Criteria

- Cognitive map is successfully published and put into operation by programming the goal traversal module, which will start processing the available data and create a production schedule:
- Situation assessors are successfully created and edited.
Publish a Cognitive Map

Success Criteria

• Cognitive map is successfully published and put into operation by programming the goal traversal module, which will start processing the available data and create a production schedule:

• Cognitive map with all situation assessors defined (situations marked in blue) is successfully published.
Simulate and Analyze a Cognitive Map

Success Criteria
- The new situation is created, and the cognitive map published successfully.
- Simulation runs successfully
- Simulation outputs are successfully displayed in Power BI
Simulation Enables Verification and Validation

IPO simulation capability enables what-if scenario analysis by experts.
IPO constraint-based production schedule dashboards

Success Criteria

- IPO creates a production schedule
- IPO automatically sends a notification that a production schedule is complete to identified stakeholders via email with a link to access the production schedule in the email
- IPO creates a production schedule that accommodates the marketing changes and Power BI displays show the comparative impact of the change request(s) to pre-identified performance and profitability KPIs to demonstrate support for schedule acceptance decisions.
- IPO sends a notification to identified stakeholders that the new schedule based on change requests has been created with a request for review and/or approval.

The dashboard shown is for illustration purposes. For the PoV, the dashboards will reflect the requirements of the customer.
Inventory Balance & Demand Fulfillment

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inventory Initial ST</td>
<td>1,186.5</td>
<td>1,186.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
</tr>
<tr>
<td>2</td>
<td>Inventory Initial PT</td>
<td>9,307.6</td>
<td>9,307.6</td>
<td>14,227.2</td>
<td>12,803.1</td>
<td>12,442.8</td>
<td>14,874.4</td>
<td>14,731.1</td>
<td>12,115.6</td>
<td>13,332.5</td>
<td>14,796.4</td>
<td>19,178.2</td>
<td>18,668.7</td>
<td>18,353.3</td>
</tr>
<tr>
<td>3</td>
<td>Direct Inventory</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
<td>2,008.0</td>
</tr>
<tr>
<td>4</td>
<td>Inventory Initial Total</td>
<td>12,382.1</td>
<td>12,382.1</td>
<td>17,525.1</td>
<td>15,512.0</td>
<td>15,783.6</td>
<td>17,825.1</td>
<td>17,591.2</td>
<td>14,943.7</td>
<td>16,163.2</td>
<td>16,747.9</td>
<td>20,406.9</td>
<td>21,495.9</td>
<td>21,150.4</td>
</tr>
</tbody>
</table>

| VR | Production ST | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 | 18,082.4 |

**Solution:** S-AJU-IN3-VCDM sf

**Service:** E-E5 merna

**Demand Fulfillment**

- **Resource Utilization**

**Economic Analysis**

**Distribution to warehouse (shipments)**

**Inventory Balance**
Production Goal Satisfaction & Situation Metrics

- **Top Goal:** Production Plan Developed
  - Inventory Acceptable: 65%
  - Product Supply Mix Good: 100%
  - Utilization Acceptable: 100%
  - Outsourcing Plan Acceptable: 65%

**Explanation Displays**

- **Most Likely Causes**
  - Risk of Unmet Demand
  - Production Plant Issues
  - Natural Gas Costs Increasing
  - Data Quality Issues High

- **Situation**
  - Risk of Unmet Demand
  - Plant/Mach Outages
  - Risk of Oversupply
  - Predicted Demand Spike
  - Inventory Holding Time Increasing
  - Unusual Product Demand Mix
  - Demand Fluctuation High
  - Natural Gas Costs Increasing
  - Data Quality Issues High

- **Number of Situations**
  - Date of Occurrence: Jun 01 to Jun 07
IPO Service Provision

- IPO is offered as an Azure solution, and as a service with an SLA.
- Customer does not require knowledge of IPO or Cognitive Map maintenance.
- HMX or HMX Partner maintains the IPO application according to Customer requirements.
- A dedicated service representative is assigned to each customer by HMX.
- Customer works with the service representative on a regular basis to meet changing needs.
Proof of Value (PoV) Terms and Conditions

• For the PoV, we estimate the total cost to be $70k-$80k.
  • This is a maximum cost.

• Terms for PoV:
  • 25% of PoV cost due on signature of letter of agreement
  • 25% of PoV due on delivery of the PoV application
  • Remaining 50% will depend on the outcome of the PoV