Rex Materials Group
Case Study
Adapting DDMRP to ETO & MTO
July 19, 2016

Our Business....

- 3 locations – Kansas, Virginia, Michigan
- Manufacturer of custom refractory products for OEM’s and the process industry
- 90% of products are designed for a specific customer
- Serving 14 different industries in 32 different countries
- Produce over 100 different materials for use at temperatures between 1000°F and 3000°F
- High Involvement Org across all functions
History

- In Business 60+ Years
- Largest Vacuum Former of Ceramic Fiber Shapes in the World
  - 100+ Different Formulations
  - Organic and Inorganic System
- State of the Art Fused Silica Operation
  - High Purity Formulations
Product Delivery….

- Sell 6,000+ different items each year.
- 99%+ of all products are made to order (MTO).
- Mfg cycle time ranges from 1 day to 3 wks.
- 40% of orders made and shipped <5 days.
- 30% of line items for < 5 pcs of an item.
- 30% of line items for >500 pcs of an item.

Pyrolite®

- Vacuum-Formed Ceramic Fiber Product
- Over 100 Compositions
- Variety of shapes and sizes
- Temperatures up to 3000°F
Combustion Chambers

• Custom engineered high temperature ceramic fiber components for use up to 3000°F.
  – Furnaces, Boilers, Water Heaters, Pool Heaters, Radiant Heaters.

Pyroform™

• Unique Combination of Thermal Insulating Properties and Durability.
• Lower Conductive Heat Losses compared to both Fused Silica and Castable materials.
• Extremely Low Thermal Mass.
• Aluminum Industry
Control Pins and Spouts

• FUSION™ SA
  – High purity fused silica materials tailored to achieve optimum properties required for molten metal applications.
  • For use in rolling ingot and billet casting operations.

Specialty Heaters

• Industrial, Laboratory, Hobby, and specialty heat processing markets

• Our Electrically Heated Components such as Panels, Modules, and Cylinders come in a variety of standard & Custom thicknesses and sizes.
Rex TCS™

- Thermal Control Solution for Plastic Extruders & Injection Molders
  - Save Up to 70% on Energy Cost

Business Strategy

- Theory of Constraints
  - Focus on Matching Production to Customer Consumption
  - Reduce Cycle Time to Customer Tolerance Time
  - Do Not Make Orders Early
  - Focus on the Bottleneck
  - Increase Throughput
Business Strategy

• Application Knowledge is KEY!
• Understanding Customer Requirements
• Must use the “Right” Material
• Mfg Delivers as Promised
  – 98%+ On-Time Delivery
  – Delivering to Customer Needs
• Continually Improve Key Processes/Materials

DDMRP History

2011- Added DDMRP to TOC
  • TOC was highly successful, continuous improvement says keep going.

Why DDMRP?
RMG as an ETO/MTO must have an agile supply chain. We must remain close to the customer and vendor, ready to respond.
  – Inventory performance was low.
    • Forecasts are always inaccurate.
    • Expediting waste from improper inventory positioning.
    • Lost business opportunity due to long lead time out of stock materials.
      – Customer tolerance times reduced.
    • Obsolete inventory due to short product life cycles.
DDMRP Implementation

Step 1: Strategic Stock vs. Lead Time Managed

*Inventory is not bad, reducing inventory is not the goal. Make it move and fast.*

- Stock Strategically
  - Customer Tolerance Time
  - Market Potential Lead Time
  - Variability, Demand & Supply
  - Flexibility in Manufacturing
  - Protect the Drum

- Lead Time Managed

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DDMRP Implementation

Step 2: Buffer Profiling

- Parts are grouped by family to set buffer profiles.
  - Make/Buy
  - Variability
  - Lead Time

- Buffer levels and zones are set using standard DDMRP calculations.

*It became very obvious very quickly that not all families would be protected using ADU. ETO/MTO was causing major distortion to ADU.*
**ADU distortion in ETO/MTO**

Typical order sizes must be protected, ADU would not protect due to the distortion of the average.

![Graph showing ADU distortion]

**Buffer Profiling - Adapted**

*Why:*
- We needed to adapt some of the calculations to align with our environment.
  - Inventory needs to provide protection, ADU does not provide protection for all of our item families.

*How:*
- Started by reviewing options.
  - Trial and Error
    - Max consumption
    - ADU + variability days

**Stayed true to the DDMRP theory, the protection is provided through variability adaptation.**
### Buffer Profiling & Adjustments

<table>
<thead>
<tr>
<th>Buffer</th>
<th>Volume</th>
<th>Flow</th>
<th>Level Control</th>
<th>Temperature</th>
<th>Pressure</th>
<th>pH Adjustments</th>
<th>Zones</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer A</td>
<td>100 L</td>
<td>50 L/h</td>
<td>Manual</td>
<td>25°C</td>
<td>10 bar</td>
<td>7.5</td>
<td>1</td>
<td>New buffer setup.</td>
</tr>
<tr>
<td>Buffer B</td>
<td>150 L</td>
<td>75 L/h</td>
<td>Automatic</td>
<td>30°C</td>
<td>8 bar</td>
<td>6.8</td>
<td>2</td>
<td>Buffer needs cooling.</td>
</tr>
<tr>
<td>Buffer C</td>
<td>200 L</td>
<td>100 L/h</td>
<td>Manual</td>
<td>35°C</td>
<td>12 bar</td>
<td>7.0</td>
<td>3</td>
<td>Buffer has high pressure.</td>
</tr>
</tbody>
</table>

**Stock Buffer Suggestions**

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
<th>Inventory</th>
<th>Date</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer B</td>
<td>75 L</td>
<td>40 L</td>
<td>7/20/2016</td>
<td>Buffer needs cooling</td>
<td>Buffer needs cooling.</td>
</tr>
<tr>
<td>Buffer C</td>
<td>100 L</td>
<td>60 L</td>
<td>7/25/2016</td>
<td>Buffer has high pressure</td>
<td>Buffer needs pressure relief.</td>
</tr>
</tbody>
</table>

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**Sync Manufacturing K-Squared Software System**
DDMRP Implementation

Step 3: Dynamic Adjustments

- Periodic Review
  - IT provides consumption on all parts at month end for rolling 12 month period.
  - Enter ADU, MAX, Variability information into Excel® with pro-cot calculations
- Demand Driven Manufacturing Software (Synchrono)
- LIVE SYSTEM
- UPDATES REQUIRED

Step 4: Demand Driven Planning

- RMG utilizes a real-time, demand driven planning, scheduling and execution software program.
  - Synchronized workflow driven from demand – not forecast.
  - Clearly defines priorities.
  - Manages against multiple considerations.
    - Promise Date
    - Supply constraints
    - Resource constraints
DDMRP Implementation

Step 5: Visible & Collaborative Execution

- Global visibility, allows real time, instant access across the organization.
- Provides the required information for sound decision making, without scheduling software.
  - Web based
  - Visual
    - Red/Yellow/Green buffer zoning
  - Synchronized
    - Priorities
    - Constraints
    - Alerts

Stock Buffer Trending
DDMRP Results at RMG

Increased Inventory Performance

2007 – Raw Material 50 days
2014 – Raw Material 28 days
2016 – Raw Material 23 days

DDMRP Results at RMG

- Meeting Customer Requirements.
- Minimized/Eliminated Expedites.
- Smooth Supply Chain within RMG.

GOAL: Positioned for Growth
SUCCESS!

But….

Could DDMRP help with our vendor and customer supply chains?
Identifying Customer and Vendor Opportunities

- Customer Requests for finished goods at RMG.
  - Standard lead times are not meeting requirements.
- Customer Requesting Expedites
  - Multiple requests for less than lead time delivery.
- Vendor Lead Times Longer than Tolerance
- Vendor Late to Request/Promise Dates
- Internal Request from Manufacturing
  - Demand Orders causing OT or consumption of flexible capacity.

Customer Case #1

- Expedite Requests
  - Demand Orders being built at RMG using flexible capacity, driving overtime.
  - Added freight cost through airfreight and expedited LTL shipments.
  - Administrative distraction; buyers, planners, customer service, production managers.
- Inventory not providing protection.
  - Too much of the wrong inventory, driving costs at both RMG and the customer.
The Action Items

• Gain visibility and understanding of the customers operating model.
• Identify a team to lead the effort to align the supply chain at both RMG and the customer.
• Define how the customer and RMG measure success as related to improved flow in the supply chain.

The Team

Customer Team
• Director of Supply Chain, Lead
  – Buyer
  – Master Scheduler

RMG Team
• Supply Chain – CDDP, Lead
  – IT
  – Customer Service
  – Manufacturing Manager
Gaining Visibility

• Data Collection
  – Master Scheduler at the customer location provided forecast data, actual consumption, and on hand inventory for 6 months.
  • RMG spent this time analyzing and understanding what was actually happening on the customer manufacturing floor vs. MRP.

As suspected we found…Chaos.
Forecast Inaccuracy

- Up to and including 100% inaccuracy
- MRP was ordering materials based on an inaccurate forecast.
  - The wrong materials were being ordered and built.
    - Expedites followed the orders because now they needed the right materials.
    - Inventory carried was roughly 3-4 months.
      - RMG facility 2 shipping days away.
      - RMG cycle time – 2 days.

Supply Chain Solution Requirements

The solution…
- Must allow production the flexibility to respond to market needs.
- Cannot rely on forecasts, they are inaccurate.
- Must be simple, and consider demands on peoples time.
- Cannot drive costs for RMG or Customer.
The Solution is Demand Driven

- Strategic inventory positioned at the customer location.
- Inventory levels based on ADU + variability.
- Inventory level adjustments made based on ramp up/down and seasonality.
- Demand orders placed based on ACTUAL demand/consumption.
- Quarterly meetings to insure that the supply chain remains agile by staying close to the customer and ready to respond.

What happened to Inventory?

- Right Sizing Inventory – does not always mean that inventory turns will increase.
- In this case inventory turns did increase.
  - Current on hand vs. buffer profile at time of analysis was a reduction of 67%.
  - Operating inventory went from 6 weeks on hand to 2 weeks average on hand per DDMRP calculations.
Measuring Success and Launching

• Measuring Success
  – Expedites, eliminated.
  – Short lead time, smaller batches, smooth flow.
  – Inventory right sized, reduced.

The only remaining question from our customer, “How soon can you have this in place?”

Measuring Success

• RMG Manufacturing
  – Smaller batches
  – Improved flow

• Inventory Performance
  – Providing excellent protection
  – Optimized by small amounts in numerous locations

• Customer Lead Time Expectations
  – Before DDMRP – 12 week TL Lead Time
  – After DDMRP – 4 week TL Lead Time
Next Steps

Internal implementation of DDMRP has proven to be extremely successful. Downstream and upstream implementations of DDMRP at customer and vendors has proven to be beneficial to both RMG and the customer or vendor.

- Continuous improvement
  - Identify Vendor/Customer opportunities for improvement and DDMRP application.
  - Evaluate Inventory performance systematically.
    - Identify all expedites as qualified spikes vs. requirement for adjustments.

Stock Buffering Request Process
When we better understand our Customers actual NEEDS and our Vendors Capabilities and Variability we can properly decouple and position inventory for highest performance.