A Lean Supply Chain Manufacturing Model

Gary Marzec
Program Manager
Jennifer Hauge
Marketing Representative

ABSTRACT

In this paper, we will discuss the challenges of supply chain management in the manufacturing industry, and specific tools and applications to make managing the supply chain more effective.

INTRODUCTION

Challenges with on-premise ERP systems and communication links limit the ability for firms to connect across the manufacturing supply chain to suppliers, customers, and their remote inventories. Building a lean supply chain structure is possible through the use of forecast models, bar code scanners, smart phone applications, e-commerce, website portals, and pull signals [Kanbans]. There are several ways of using these lean technologies today, and the success of using a lean manufacturing model increases by adopting improved communication methods through the internet and other web-based technologies. These same tools are available for toll processors, distributors, material owners, brokers and end customers. The relationship between supply chain members strengthens as the exchange of information becomes faster and more reliable. The result is that all partners can benefit by saving time and money by limiting dual entry of information, reducing reliance on paper documents, maintaining servers, and managing software updates.

Firms using ERP applications must continually look to increase operational efficiencies to reduce overhead expenditures. A solution for an inefficient model is replacing on-premise systems with an outsourced, web-based system when the realization of having to upgrade is reached. These web-based systems are generally referred to as Software-as-a-Service (SaaS), ASP, and most recently Cloud Computing. As with IT clouds have several applications that make up the structure. This paper will cover some of the structure makeup and how e-commerce, EDI and SaaS positively affect titanium and specialty metals manufacturers.

A benefit to using virtual applications is reducing the need of having a large IT department on hand to update and maintain software and services. Manufacturers are now able to focus on core competencies instead of devoting time and resources to their IT department. Using Cloud Computing applications allows the entire supply chain to access accurate, real-time information while cutting waste and streamlining work flow production. More importantly, using these ERP applications makes it easier to do business by standardizing and automating processes and procedures. Combined with other lean philosophies, the result is a fully connected, virtual system with near real-time, accurate information.

DISCUSSION

I. Today’s Challenges

Manufacturing supply chains are complex and difficult to navigate in the best of circumstances. Multiple communication avenues exist through forecast schedules, Kanbans, phone calls, faxes, emails and websites. Additional documentation of shipping bill of ldings, receiving reports and production reports adds to the chasing of paper from place to place. The biggest challenge of using these techniques is being able to effectively manage delays and constant manual interface. To complicate matters, every customer, supplier and manufacturer have different sets of business rules and management structure.

Beyond corporate structures, other barriers exist including different levels of uncertainty. Increased costs, disruptions in the chain or fear of data integrity problems are all issues supply chain partners face when decided to upgrade¹. Being able to manage and reduce these concerns to external partners is important when making the case for changes and upgrades. As in most cases, change itself is often the hardest hurdle to jump. Having a strong integration plan increases the success of upgrading systems as. Similarly, not having
a clear plan may result in a bullwhip effect of materials moving across the supply chain, creating excess inventory and stock-outs\(^3,4\). This leads to making unfavorable decisions to either produce the unavailable stock over time, or absorb the overhead cost of storing the excess inventory.

Outside factors include negative economic cycles and disruption of the supply chain. With today’s economic uncertainty, IT budgets are trimmed, making the possibility for these important changes difficult. Besides an economic barrier, the hassle of disrupting the supply chain and dealing with unhappy partners is a valid reason for dissuading against numerous upgrades. These include not receiving correct data, training for new ways of transferring information and downtime for upgrades and system maintenance. Disruptions, even for a short period of time, equate to lost revenues and unsatisfied customers.

These challenges create the need and opportunity to explore what options are available, and which ones are the most viable to meet the changing needs of titanium and specialty metals manufacturing.

**II. Managing Supply Chain Activities with On-Premise ERP Systems vs. Cloud Computing Applications**

On-premise or traditional ERP systems have a limit concerning supply chain activities including inventory visibility, traceability, and syncing material information with orders. With these systems, suppliers are required to manually update and constantly check the status of material, leading to inaccurate data. Inaccurate information directly relates to inventory discrepancies and long lead times for customers. Adding remote inventories to the mix leads to a messy and cumbersome paper trail. Remote inventories cut down on warehousing and storage costs, but still require folders, copies and manual entry of information. This information must be faxed and copied for accounting, shipping, lab facilities and customers.

This transition to consignment, brokered or remote inventories allows for material to be reconciled only when taken for production. Moving to this environment is a logical choice for titanium and specialty metal owners. Inventory is costly to keep, and when finances are tied up with warehousing fees, it takes away from implementing necessary system upgrades.

Traceability of material and specs is difficult when moved from facility to facility. Paperwork is often behind once material physically reaches the final destination, and must be updated manually. Consequently, when quality issues surface, managers have to wait for the paperwork to move through the channel in order to make decisions. The final process is for accounting to manually reconcile the invoices, shipping, receiving documents for the material. From this example, it is easy to see where improvements are needed.

Adding to increase costs, document handling is increasing year to year. Production growth equates to more paperwork, and the hiring of more employees to handle the work load. With this, the likelihood of errors also increases. Aside from increasing document handling costs, and lack of traceability, on-premise systems also require upgrades, patches and modifications in order to handle frequent changes in the metals industry. For companies with a diverse business model, building an ERP system with supply chain features to fit specified needs is a solution. However, with this comes a high price tag. A second option is using two or even three different systems, or a best-of-breed approach. Choosing the latter often results in duplicate entry of information, as well as long training periods on all the systems. Either way, both options are costly, cumbersome and require a long list of customizations, training, and upgrades. Along with these issues, upgrading on-premise systems have components that may not be beneficial to the business unit. Periodic upgrades require more budget planning, time and training with the upgrades and may not actually mirror what is happening in the changing paces of manufacturing. An alternative is an ERP system with supply chain connectivity through the web, or cloud applications.

If a Cloud Computing based ERP application is chosen, outsourcing the application allows for human and technical capital to be better utilized internally. IT staff can focus on core competencies rather than fixing system problems or dealing with installing system upgrades and patches. More regular upgrades to the system means a minimal learning curve for users, and very little support from internal IT staff. These upgrades are included in the fees, so there is no need to allocate massive amounts of IT budgets for system upgrades every 3 to 4 years. Considerations of a SaaS system include time to implement, the level of security, flexibility, and responsiveness. In most comparisons, a Cloud Computing model has a successful return on investment.

Time to implement depends on the level of customization. Core competencies of a web-based system are easily transferred from job to job. Most manufacturers have a niche, or do one thing well. Accounting for this niche requires some level of customization if the customer wants the system to work to fit their way of doing business.

A valid concern that is often voiced is the level of security when using web portals and internet domains. A SaaS provider that has control measures (fire walls and private lines) can easily address issues in the case any arise. These are often much more in-depth controls and disaster recover features than any manufacturing plant could realistically achieve on their own.
Supply chains are constantly changing with small companies growing, mergers and acquisitions between large firms, regulations, and the cyclical environment of the economy. Having a system that can easily adapt to these changes is important. On-premise systems are typically too rigid to handle these environments and require massive amounts of re-design and customization. Cloud Computing applications offer flexible options that are able to handle unforeseen adjustments across the supply chain.

Responsiveness of a firm’s staff goes hand-in-hand with having a flexible, lean supply chain. This also means support from SaaS vendors as well. Having a vendor that has a plan for each customer past the implementation phase should be accounted for. Relationships are strengthened by supplying accurate, up-to-date information to customers and vendors.

Another advantage to using a SaaS system is the ability to further connect the supply chain with the use of e-commerce and EDI. EDI is used by suppliers, processors and customers to send data electronically and rid the system of paper dependency.

III. How B2B E-Commerce Solutions Work - Improved Access to Suppliers and Customers

A large part of Cloud Computing is using e-commerce. This takes material information found on purchase orders, sales orders, bill of lading, invoices and test results and transfers them electronically. While e-commerce has been around for decades, metal manufacturers have been slow to use this approach to send and receive material information, activate a pull system, and create an effective supply chain plan. Advancements include AS2 and syncing of internal and external processes through e-business communication. The slow response may be related to the growing pains in the early years. There are benefits of using e-commerce and EDI today versus several years ago:

Historically, electronic data interchange (EDI) allowed expensive but limited content with a few remote partners, while Kanban provided low cost yet rich connections with many nearby customers or suppliers. Besides pressure up and down the supply chain, there was little motivation to use EDI. Today, the internet resolved these tradeoffs, and now all supply chain partners can be effectively integrated.

An increasingly common option to ensure data accuracy when using this transfer method is the use of ‘error queues’. These queues are built to capture any information that is incorrect, and is held until repaired by reprocessing or through manual correction. Using a SaaS based system allows errors to be corrected in a virtual environment through the use of sync queues. Vendors or staff that have extensive plans in place for managing e-commerce data is able to do so with error queues and database reporting. Direct linking to the database allows for faster correction, up-to-date reports, and most importantly an audit trail for data integrity. This application can be beneficial for the titanium and specialty metals arena. Genealogy of heats, test results, and production reports need to have complete data accuracy as the material moves across the supply chain. The error queues will increase the reliability of data, and the sync queues help create the reports needed for management and auditors.

Unless firms are large enough to staff an entire e-commerce team along with the regular IT staff, the cost most effective approach comes from outsourcing to e-commerce specialists. There are several ways to integrate solutions like EDI, either by developing it internally, or outsourcing to specialists. Overall, this application greatly improves both access and communication flow between suppliers, processors and customers.

IV. Smart Use of Technology to Manage Supply Chain and Processes

When the decision is made to implement lean techniques, a major question is “How to go about doing it?” The best answer involves planning, finding the right partners, and knowing which technologies are most effective are the beginning steps.

Managing these processes can be difficult, so partnering with supply chain firms to help with external integration while staff is working on internal integration can greatly reduce risk, increase returns and reduce uncertainty levels across the supply chain. Pull systems and Kanbans are the most widely used in manufacturing. Access to inventory data is more difficult across large supply chains. Ward & Zhou assert:

IT integration facilitates the use of pull systems, or Kanbans. Without information systems, pull systems can only work well in one link of a supply chain. Internal IT systems such as advanced planning and scheduling can help bottleneck/constraint removal and facilitate cycle-time reduction. With internal and external IT integration, pull systems can transmit the order information through the entire supply chain in a timely fashion, thus reducing customer lead time. External IT systems such as direct connections between suppliers and buyers help reduce production lot size, enhance pull-system effectiveness, and facilitate agile manufacturing approaches.
Continual improvements of these applications need to occur in order for them to work effectively. Barcodes increase the success of a pull system by sending information that was once transferred by paper documents electronically through the supply chain. An improvement in this area is the development of e-Kanbans. Scanning the kanban with barcode devices instead of manually moving cards from place to place is a more proficient way of using B2B communication. Along with Kanbans, forecast models give a better picture of material demand and inventory levels while e-kanbans track and store the information in real-time, eliminating the manual process of traditional kanbans. E-business solutions like e-kanbans, AS2 connections, and the use of SaaS based ERP systems create a full circle lean approach to managing the supply chain.

V. SCM Optimization

To further supply chain optimization, combining e-commerce with pull signals and kanbans creates a virtual, secure business environment for firms. Accordingly, firms create a proactive solution for customers instead of a reactive one. Errors that are caught internally can then be corrected or quality issues resolved, resulting in higher customer satisfaction and shorter cycle times for customers. Along with having a SaaS based system another proactive solution is having a pull system. Instead of working off of schedules, material is pulled through the supply chain based on customer need. JIT, lean inventories, or vendor managed inventories are established, greatly reducing overhead for suppliers and processors.

Increasing the effectiveness of these philosophies is having access to systems and applications through the web and mobile devices. Smart phone connectivity is now available for sales representatives and quality assurance managers to upload real-time information on-site while making dispositions of damaged material. This is one area where optimization is starting to be realized where none were previously.

With quality issues of material continuing to surface in recent years, it is more important than ever to research automation. Part of this has to do with how the process and material is documented. Production, genealogy, and damage are recorded, drastically decreasing the likelihood of errors in the generated reports. Whether the quality issue is found at the beginning with billet or coil specs, or a defect in the finished part ready to be shipped to the end customer; having these tools gives quality assurance a faster, more reliable way of communication. The advantage of diagnosing and fixing quality problems before it reaches the customer will pay large rewards in the long run by not having to recall products or appeasing angry customers.

VI. Who is using it?

Lean technology and B2B solutions have a larger presence in other industries, and the same models can be applied to metals manufacturing. Cloud Computing vendors that have extensive industry knowledge of metals manufacturing make these avenues readily available.

Retailers have been using e-commerce and lean technologies for years. Low-cost retailers were the first to require vendors and suppliers to use connections via EDI, XML, and AS2. Adoption was slow at first, but soon the advantages couldn’t be ignored. These advancements allow for global success. While an extreme case, the results are seen across the industry. Similarly, firms like Dell and Cisco use these technologies to capture information from customers, are able to coordinate suppliers, and improve overall leanness of their operations.\(^5\)\(^6\). It has been slower to market for manufacturing. Toyota is known for their Total Quality Management (TQM) and Kaizen/Continuous Improvement models. Kaizen and TQM models have been in place since the 1950's. New improvements with SaaS systems and the overall Cloud Computing concept take TQM a step further by tracking delivery lead-times, transaction costs, and inventory turns.\(^7\) Large steel manufacturers use e-commerce, EDI and other lean technologies as a way to increase supply chain visibility. Automotive companies are demanding more and more the use of e-commerce from suppliers and customers to track material and parts. As these technologies become a more accepted practice, the industry will see positive changes in supply chain costs, customer satisfaction and overall system effectiveness.

VII. Conclusion

While lean supply chains are pertinent for a company's survival, it is equally important that a company remains easy to do business with. This is accomplished by having greater control of the supply chain, decreasing inventory levels, and becoming more responsive to the customer. Shorter lead times equate to satisfied customers, and considerably reduce the bullwhip effect, contributing to a successful outcome.\(^8\)\(^9\). Introducing one technology over another may have positive short term results, although a long term strategy would encompass a combination of all topics discussed.

Lean technologies reduce inventory and uncertainty with RF scanners and e-kanbans while forecast models give more accurate data for demand. Exchanging real-time information gives greater visibility across the entire supply chain. Suppliers, vendors, processors
and mills can make this happen by using both internal and external solutions. External solutions that include aspects or complete use of Cloud Computing generally provide the best return on investment. Most importantly, it makes doing business easier and more effective for everyone involved. As Cloud Computing continues to grow and expand capabilities, so will ideas for exploring areas of little to no connectivity for processors, suppliers, brokers and everywhere in between.
REFERENCES


Appendix I. Manufacturing Supply Chain Flowchart

[Diagram showing the flowchart with nodes labeled as Material Owner, Freight (F), Toll Processor, Service Center/Toll Processor, Service Center, Broker, Customer, and arrows indicating the flow of the process.]
Appendix II. A Total Cost of Ownership Comparison: On-Premise vs. SaaS

TCO On-Premise ERP System

TCO SaaS ERP System

* varies based on customer requirements
Appendix III. Staff Comparisons

SaaS
- Networking
- Business Analysts

Client Server
- Developers
- DBA
- Networking
- Business Analysts

Mainframe
- Developers
- DBA
- Networking
- Systems Analyst
- Business Analyst
- Demanding Support
A Lean Supply Chain Manufacturing Model

ITA Conference
October 3-6, 2010

Gary Marzec
Program Manager
Agenda

Background on NGC
Benefits of Cloud Computing & Software as a Service
How E-Commerce Works
Technology Applications
Supply Chain Optimization thru Virtualization
Recap and Final Thoughts
<table>
<thead>
<tr>
<th>Aerospace Systems</th>
<th>Electronic Systems</th>
<th>Information Systems</th>
<th>Shipbuilding</th>
<th>Technical Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Scale Systems Integration</td>
<td>Radar Systems</td>
<td>Command &amp; Control Systems</td>
<td>Naval Systems Integrator</td>
<td>Systems Support</td>
</tr>
<tr>
<td>C^4ISR</td>
<td>C^4ISR</td>
<td>Network Communications</td>
<td>Surface Combatants</td>
<td>Base and Infrastructure Support</td>
</tr>
<tr>
<td>Unmanned Systems</td>
<td>Electronic Warfare</td>
<td>Intelligence, Surveillance &amp; Reconnaissance Systems</td>
<td>Expeditionary Warfare Ships</td>
<td>Range Operations</td>
</tr>
<tr>
<td>Naval BMC2</td>
<td>Navigation &amp; Guidance</td>
<td>IT/Network Outsourcing</td>
<td>Marine Composite Technology</td>
<td>Training and Simulations</td>
</tr>
<tr>
<td>Global / Theater Strike Systems</td>
<td>Military Space</td>
<td>Intelligence</td>
<td>Coast Guard Cutters</td>
<td>Technical and Operational Support</td>
</tr>
<tr>
<td>ISR Satellite Systems</td>
<td></td>
<td></td>
<td>Nuclear Aircraft Carriers</td>
<td>Life Cycle Optimization</td>
</tr>
<tr>
<td>Missile Defense Satellite Systems</td>
<td></td>
<td></td>
<td>Nuclear Submarines</td>
<td>Performance Based Logistics</td>
</tr>
<tr>
<td>MILSATCOM Systems</td>
<td></td>
<td></td>
<td>Fleet Maintenance</td>
<td>Modifications, Repair and Overhaul (MRO)</td>
</tr>
<tr>
<td>Environmental &amp; Space Science Satellite Systems</td>
<td></td>
<td></td>
<td>Aircraft Carrier Overhaul &amp; Refueling</td>
<td>Supply Chain Management</td>
</tr>
<tr>
<td>Directed Energy Systems</td>
<td></td>
<td></td>
<td></td>
<td>Lead Support Integrator (LSI)</td>
</tr>
<tr>
<td>Strategic Space Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NORTHROP GRUMMAN PROPRIETARY
Benefits of Cloud Computing

- Lower Total Cost of Ownership
- Speed of Implementation
- Increased Security
- Easier, More Regular Upgrades
- Improved Service Levels with More Responsive Support

Excellent ROI
Supply Chain Management (SCM) Challenges

**Manual Processes**
Time spent manually entering data and an increased chance of error

**Lack of Visibility**
Missed delivery dates due to poor communication with suppliers

**Inefficient Inventory Management**
Inaccurate inventory levels due to poor supply and demand predictions

**Poor Customer Service**
Lost revenue due to slow response
SCM Solution: Red Zone Burden to Green Zone Advantage

Integration
Efficiency

Reduced Costs

Computers interfacing with computers (EDI)

XML
X12/Edifact
Flatfile EDI

Paper chasing and manual interface

Web Portal
E-mail
Autofax
Fax
Paper

NORTHROP GRUMMAN PROPRIETARY
How is E-Commerce Handled? Multiple Layers, Multiple Options

3. Intelligent Queues

- Trading Partner
- Communications Layer
  - Translation Layer
  - Database Layer
    - Reporting Layer
    - Error Queue Layer
    - Email Alert Layer
  - Remote Queue Transfer
- Core System
- Legacy System
- Users
Supplier Connections Using a SaaS Hub

Category I Supplier (advanced connections)
- Process & Inventory
- Shipping

Category II Supplier (basic connections)
- Process & Inventory
- Shipping

SaaS Hub
- Process Owner
- Direct File Transfer
- Web Portal
Bar Coding Application Functions

- Increase productivity by reducing data overhead
- Reduce errors by automating data

Logistics
- Shipping
- Label Printing
- Label Scanning
- Receiving
- Location Change

Production
- Production Release
- Traveler Print
- Traveler Scanning

Physical Inventory
- Inventory Status
- Download
- Inventory Scan
- Reconciliation
Other Applications: Mobile Phone with Barcode Scanner

Launch your Smartphone Internet Browser

Quality Assurance Applications for Outside Processing and Internal

Material Lookup, History, Specifications, and QA Dispositions/Results

View Heat Number, Material Status, Part Number, Dimensions and Material Specifications all from a Mobile Device
The Conventional Supply Chain

Producer/Broker

Customer

Unloading Confirmation

Paper BOL for Barge

Checklist

BOLs
Production Report
Invoice

Freight Bills

Shipping Documents
Production Reports
Purchase Orders
Schedules

Processing/Distribution

Logistics

Unloading
Manage the Supply Chain
Using Cloud Computing Applications

SaaS Hub
Process Owner

SaaS Hub
Supply Chain Member

830- Schedule
850- Purchase Order
856- ASN
862- Shipping Schedule
863- Test Results
870- Production

830- Schedule
850- Purchase Order
856- ASN
861- Receiving
862- Shipping Release
863- Test Results
870- Production

856 Ship Notice ASN

870 Production

856 Shipping

861 Receiving
Inventory Management Using a Pull System

A method of controlling inventory by replenishing only what has been consumed.

Customer provides Demand Forecast and a pull signal when replenishment is needed.

Inventory is provided based on planning and shipping schedules.

Pull signal is acknowledged and initiates delivery orders as needed to stay within internal order quantities and stock levels.

Relationship is fully integrated and automatically responsive.

End Result: Lower costs, fewer inventory shortages, and higher customer satisfaction.
How Pull Inventories Work

Production Scheduling

Customer

830 Planning Schedule
862 Ship Schedule-Pull Signal

Order Management

Supplier

Receiving

856 Ship Notice
861 Receiving Advice
824 Application Advice/
820 Bank Transfer

Shipping
EDI Flow thru the Supply Chain

Original Equipment Manufacturer (OEM)
- Planning: 830 Planning 862 Shipping
- Requirements: Schedules
- Scheduling: 856 Advanced Ship Notice
- Receiving: 824 Application Advice 861 Receipt Advice

Tier 1 Supplier
- Planning: 830 Planning 862 Shipping
- Requirements: Schedules
- Receiving: 824 Application Advice 861 Receipt Advice
- Shipping: 856 Advanced Ship Notice

Producer
- Planning: 830 Planning 862 Shipping
- Requirements: Schedules
- Shipping: 856 Advanced Ship Notice
- Receiving: 824 Application Advice 861 Receipt Advice
Recap

Challenges
- Lack of visibility
- Long lead times
- Inconsistent Customer Service

Virtual Supply Chain Optimization
- E-Commerce
- SaaS/ERP
- Device Applications

Pull System Concepts
- Schedules & Forecasts
- Virtual Connectivity Scenarios
Thank You!