

## Moving Through the Barriers of Chaotic Manufacturing

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### Keywords

Lean Manufacturing, Six Sigma, Scheduling, MES, CPM

### Summary

Making Lean effective in a complex discrete manufacturing environment with multiple value streams and competing resources is dauntingly difficult. Symptoms include product proliferation, dynamic routings, key resources (equipment or people) that are impractical to duplicate, and rapidly changing customer orders, i.e. "Chaotic Manufacturing."

If your continuous improvement program is stalled or falling back to the old way of doing things, then you may have "Chaotic Manufacturing."

Technology to schedule materials, people, equipment and tools can take you beyond this barrier. Move to the next level, "Your Production System."

These barriers often cause a Lean Manufacturing program to stall or fall back to the old way of doing things. Technology to schedule materials, people, equipment and tools can get you beyond these barriers. Then, a generic improvement program goes to a new level and becomes "Your Production System" - YPS.

### Analysis

Lean has become pervasive among manufacturing companies with particularly high adoption during the past few years. Surveys among manufacturers conducted by ARC show an increase from 35% in Q4 2005 to 69% of manufacturers in Q1 2007 - nearly doubling in 18 months. The associated Lean methodologies - Value Stream Mapping (VSM), 5S, Set-up reduction, cellular manufacturing, Kanban, etc. - have become well documented and utilized. For many, their Lean program works and provides improved business performance. References to a Lean program are often seen in quarterly and annual financial reports from public companies.

While success among some discrete manufacturers is clear, about a third have initial gains and then fall back to the old way of doing things - i.e. their Lean program is failing. The reasons for this failure are varied. One



reason often referred to is the complexity of their manufacturing environment. For many, the combined effects of rapid change and complexity have reached the point of being "Chaotic Manufacturing."

### What is "Chaotic Manufacturing"?

Chaos is inherently unpredictable. Indicators of this chaos include multiple product lines, varied production routings, dynamic customer demand, and competition among products for the same production resources. Routings vary by product and component, and do not have a consistent, "connect the dots" straight path - sometimes they are even dynamic and recursive. These multiple product lines with independent value streams and routings

Dynamic	Trend
Product proliferation and options	Increasing
Production lot or order size	Smaller
Quantity of lots and orders	Higher
Frequency of schedule changes	Increasing
Speed of New Product intro.	Faster
Agility to meet the needs of a dynamic global market	Increasing
Cost control pressures as markets mature	Accelerating with globalization
Is the effect of a change predictable?	No; unintended consequences

#### Is your Manufacturing is Chaotic?

create overlapping requirements for the same resources - machines, people (skills), tools and materials - creating spurious, moving and often hidden constraints.

Many manufacturing sites - particularly in the discrete industries including Machinery, Industrial Equipment, Aero and Auto suppliers - are experiencing growing complexity in their operations. At the same time, the demands for improved speed and agility are also increasing. The often conflicting goals of more customization, faster delivery, lower costs, and higher quality lead to a chaotic manufacturing environment.

### The Barriers Imposed by Chaotic Manufacturing

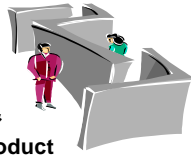
Lean is best known for its success at Toyota with high volume production and assembly lines. Lean has also proven to be successful in many highly repetitive and lot-based manufacturing environments. The program finds consistency within the major value streams and builds on them with methods like standardized work, cellular manufacturing, Heijunka (work load leveling), and Kanban (pull manufacturing).

Unfortunately, there are many discrete manufacturing environments where there are no dominant value streams. Because of inconsistent routings and changing consumption, the Kanban loop is not static. This multiplicity of

routings is incompatible with Kanban. Also, since demand is unpredictable and dynamic, Heijunka (one piece flow, tack time) is problematic.

#### **Complexity:**

Multiple manufacturing styles, outsourcing, inconsistent, changing & overlapping routings, product proliferation, localization



#### **Resources:**

Equipment and tooling can not be duplicated (size, cost), skills limitations (expensive, training), global materials sourcing



Forcing production into lines creates inefficiencies since many routings use a portion of the machines and not always in the order that they are laid out. Machines cannot be duplicated (expensive, large, and/or environmental issues) forcing the "lines" to converge on these "monuments." Managing constraints (as in Theory of Constraints - TOC) focuses on these machines without visibility for the other constraints (material, people and tools).

Each manufacturing operation must have the needed material, people (skills), equipment and tools in the same place at the same time. Unfortunately, often one or more are missing causing production to wait for the absent resource.

These missing resources are your constraints and they change rapidly. Since production control software rarely monitors all four resources, they are invisible constraints.

### **Barriers to Lean Manufacturing**

#### **Moving beyond the Barriers**

Constraints (material, people, equipment and tools) are often hidden and difficult to manage. As people hit these invisible constraints, they will do what has worked in the past and fall back to the "Old Ways of Doing Things." When a Lean program falls back, tribal knowledge and gut guesses resurge for decision making. Manufacturing continues with high inventory, inconsistent lead-times, and low on-time delivery. Quality issues are difficult to isolate and resolve.

When adopting a generic improvement program, some may say that "we are different" and they may well be right. New technology in the form of a software application has become available for managing this kind of Chaotic Manufacturing.

nMetric ([www.nmetric.com](http://www.nmetric.com)) offers a production and resource management application that, at its core, contains an advanced, patented scheduling engine. Their 4C@SITE® software looks forward to bring together materials, people, equipment and tools at the same place and point in time. This forward looking scheduling examines time horizons for a month, week, shift,

and the operator's immediate queue of jobs. It examines and resolves conflicts and constraints for the four major types of resources - materials, people, equipment and tools.

**Plan:**

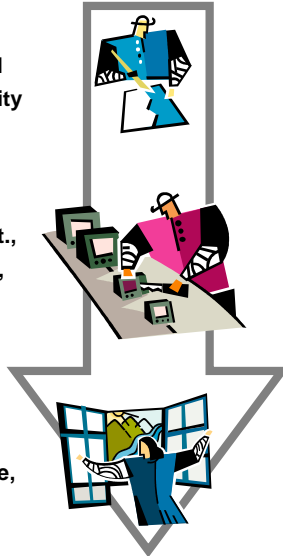
Production planning, BOM management, finite capacity scheduling

**Operate:**

Dispatching, resource mgt., routing, work instructions, inventory mgt., Kanban signals, maintenance

**Inform:**

Production status, order status, ERP interface, performance analysis, reporting



**Key Functions for Production Management**

The 4C@SITE® solution extends beyond scheduling to provide a modular production management application with key functions of plan (production scheduling, capacity planning), operate (dispatch, data collection, routing, WIP tracking, resource allocation, quality, and inventory management) and inform (status, traceability, reporting, and analysis). The ERP system is continually updated with the current schedule of ship dates. The web-based architecture provides visibility and situational awareness to all those authorized in the enterprise. Real-time visibility into operations provides information for fact-based decision support.

**Business Improvements past the Barrier**

With an improved scheduling engine and visibility, production becomes easier to manage and your manufacturing operations are more responsive with better customer on-time deliveries. The improved scheduling avoids the constraints to provide realistic and timely production schedules. The visibility "turns the lights on" within your plant providing agility with quick responsiveness when things change. There is much less need to react to issues when you are prepared; less fire fighting and more fire prevention.

The business benefits in going beyond the barrier to manage a chaotic environment include:

- Visibility into production issues for improved decision support in real-time, i.e. empower the people who do the work
- Improved on-time delivery with higher customer satisfaction by giving customers real ship dates rather than guesses based on a "standard" lead time.
- Lower inventory in raw materials, work in process (WIP), and finished goods

- Higher quality with less inventory
- Lower capital expenditures by filling-in the gaps of your Enterprise level system (ERP) rather than replacing it or commissioning a major upgrade

**Track More:**

Product proliferation, more options, smaller lot size with more lots, costs to control

**Faster:**

Frequent order changes, faster new product intro, global market dynamics

**Visibility and Agility**

Breaking through the barriers of Chaotic Manufacturing allows adoption of Lean in a way that fits your business processes. Then, the Lean program becomes “Your Production System” (YPS).

**Conclusions**

- Lean can work in a dynamic environment. Consider adopting technology to help break through the barriers of Chaotic Manufacturing.
- Chaotic Manufacturing contains a nonlinear, dynamic environment. It needs a scheduling engine that considers the four categories of resources - materials, people (skills), equipment and tools - to look forward and optimize production.
- Consider technology that addresses all four resource constraints with real-time and forward-looking visibility for the status of operations on the shop floor. Upcoming constraints and related issues can be identified with preventative actions taken before bottlenecks and other problems occur. All parts of the company can operate with a common awareness of status, plans and the defensive moves.
- nMetric helps those with complex manufacturing to get beyond the constraints of multiple value streams (to achieve make to order; customer driven, on time shipping) and get to YPS.

*This paper was written by ARC Advisory Group on behalf of nMetric. The opinions and observations stated in the paper are ARC's. For further information or to provide feedback on this paper, please contact the author at rrio@arcweb.com.*