

Heijunka

Product & Production Leveling

Module 9.3

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Presentation for:
ESD.60 – Lean/Six Sigma Systems
MIT Leaders for Manufacturing Program (LFM)
Summer 2004

These materials were developed as part of MIT's ESD.60 course on "Lean/Six Sigma Systems." In some cases, the materials were produced by the lead instructor, Joel Cutcher-Gershenfeld, and in some cases by student teams working with LFM alumni/ae. Where the materials were developed by student teams, additional inputs from the faculty and from the technical instructor, Chris Musso, are reflected in some of the text or in an appendix

Overview

➤ Learning Objectives

- Introduce and demonstrate the concept of **Heijunka** –
- Understand the benefits of Heijunka
- Understand how to apply Heijunka in a typical manufacturing process
- Identify how Heijunka interacts with other Lean tools.

➤ Session Design (20-30 min.)

- **Part I:** *Introductions (1-2 min.)*
- **Part II:** *Definition of Heijunka and identification of its role in Lean manufacturing. (3-5 min.)*
- **Part III:** *Study models of Heijunka in use. Step through an example of Heijunka (7-13 min.)*
- **Part IV:** *Benefits and Trade-offs associated with Heijunka & Common “Disconnects,” (5-7 min.)*
- **Part V:** *Re-Cap and Concluding Comments (2-3 min.)*

Heijunka

Key Concepts

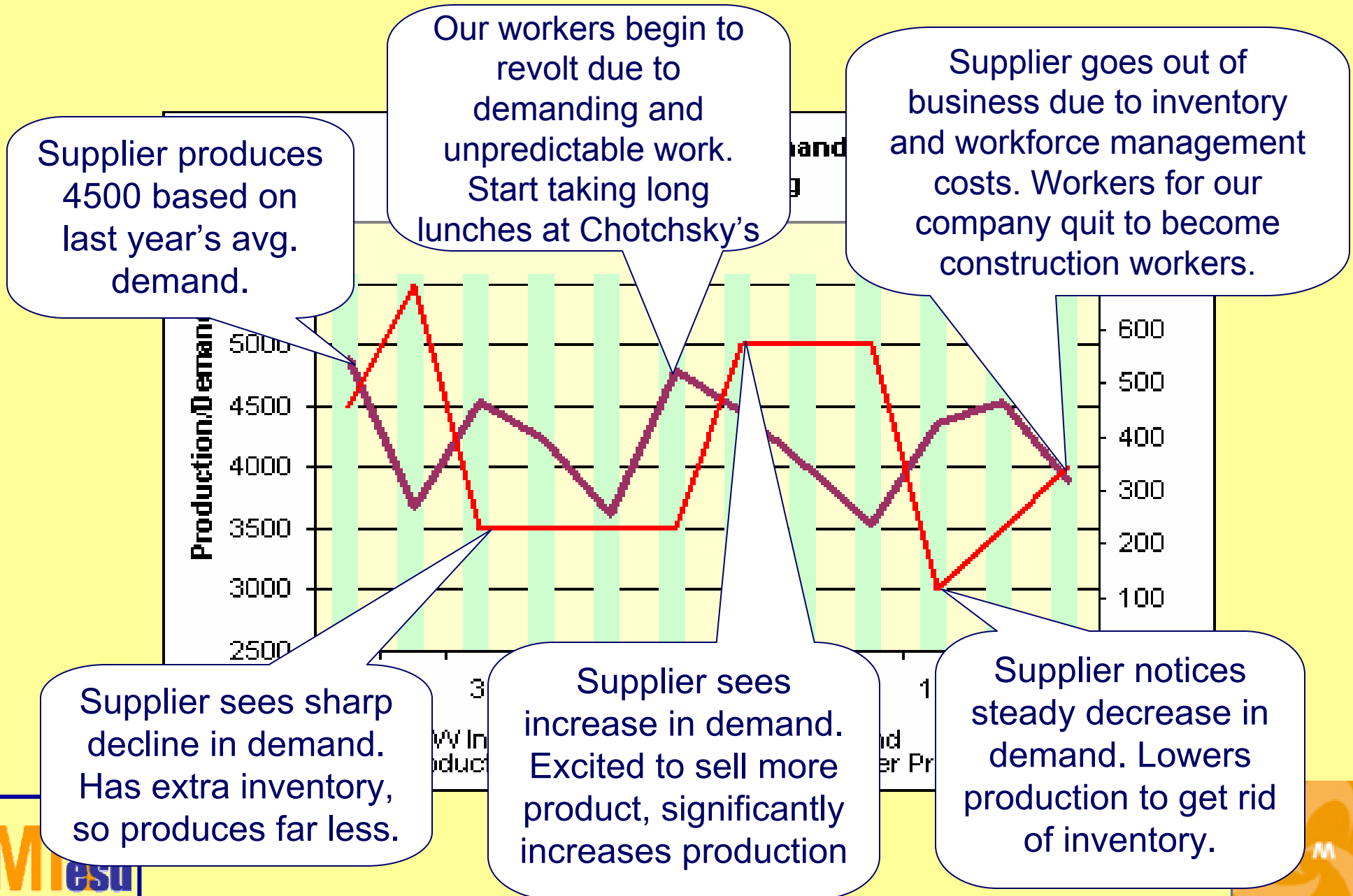
- Heijunka is defined as “The distribution of production volume and mix **evenly** over time¹”
 - Heijunka converts uneven Customer Pull into even and predictable manufacturing process
 - Heijunka is generally used in combination with other key Lean principles to stabilize value flow
 - Heijunka is a core concept that helps bring stability to a manufacturing process

¹ Lean Production Simplified, Pascal Dennis

The Need for Heijunka

- There are a number of reasons for implementing Heijunka:
 - **Product Leveling**
 - large batches of the same product may reduce set-up times and changeovers, but usually result in:
 - long lead times,
 - swelling inventories
 - greater opportunities for defects.
 - excessive idle time and/or overtime.
 - An even *mix* of products is critical to avoiding these impacts
- **Production Leveling**
 - Remember the “Beer Game”? Fluctuations in demand (Boller or “Bullwhip” Effect) are often highly amplified and delayed throughout the supply chain.
 - Responding to fluctuating customer demand can result in increased overtime or idle time.
 - Variable production schedules can be stressful = Unhappy workers.
 - A more *level* production volume eases these complications

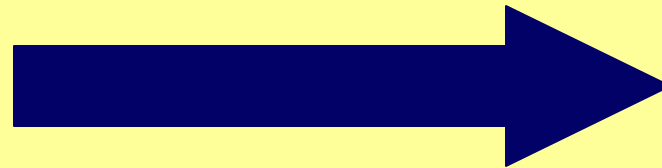
Chasing Demand – The “Bullwhip” Effect



What is Production Leveling?

A Simple Example

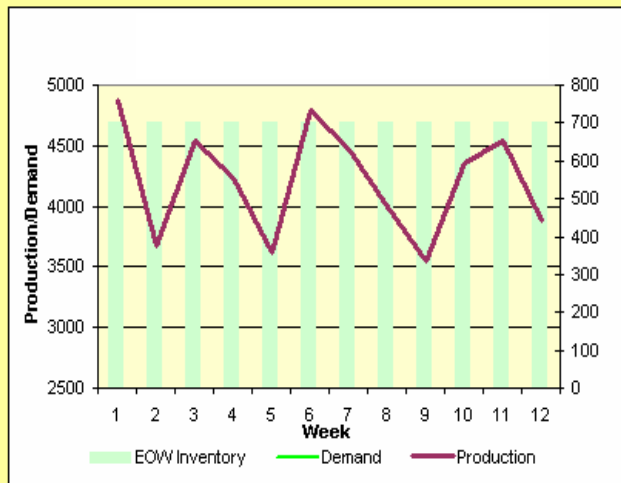
Week	Total Demand
1	4878
2	3672
3	4536
4	4230
5	3618
6	4788
7	4464
8	3996
9	3546
10	4356
11	4536
12	3888



$17,316 \div 4 = 4,329$
 $16,866 \div 4 = 4,217$
 $16,326 \div 4 = 4,082$

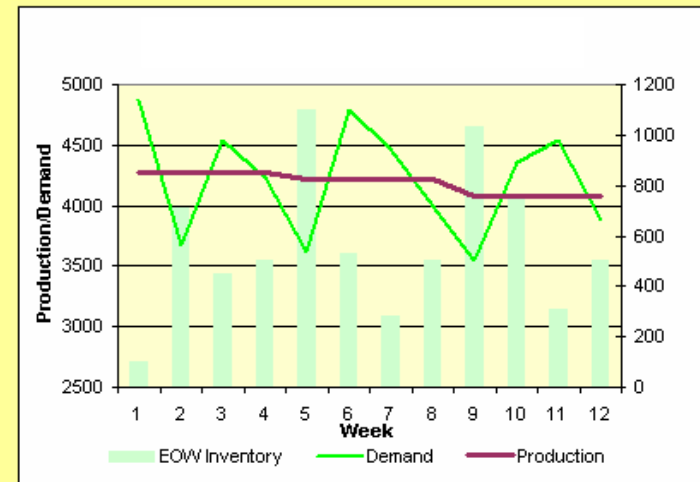
Weekly Leveled Production (4-week Leveling)
4329
4329
4329
4329
4217
4217
4217
4217
4082
4082
4082
4082

JIT



- Meet customer demand upon request (“just in time”)
- Reduced Finished Goods Inventory
- Unpredictable work schedules
- High variability for Supplier Cascade varying customer demand back upstreams
- Overtime occasionally
- Bullwhip Effect

vs. Production Leveling



- Meet customer demand in total over a given period of level production.
- Finished Goods Inventory to make up for short periods of higher demand*
- Predictable work schedules
- Stability transmitted to Supplier Reduces Inventory over the entire Supply Chain.
- Overtime savings
- Happy people Upstream

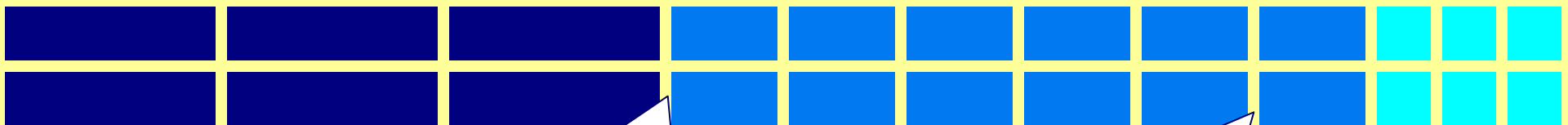
What is Product Leveling?

We make A's, B's, and C's: **A** **B** **C**

Week



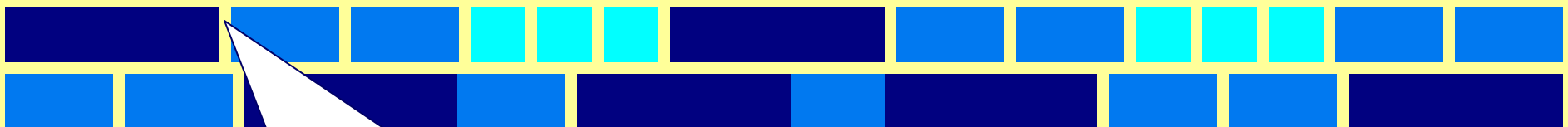
Batching



Extended downtime for machine conversions. Workers go home early.

Customer waiting for product A is tired of waiting. Goes to another supplier.

Product Leveling



Conversion times are reduced and machines are flexibly tooled.

Customers are happy with steady and predictable flow of product. Workers are happy with even work flow

Challenges for Heijunka

Technical Factors

- Tools needed for large-scale Heijunka Leveling are often lacking.
- With Heijunka, there is a need for larger Finished Goods Inventory. This can be seen as antithetical to Lean mission.
- Obsolescence of finished parts
- Can not immediately be implemented– requires predictable environment, customer data.
- Predicting demand is imperfect. Bad data can ruin process.

Social Factors

- Heijunka depends on Direct customer contact and accurate information about projected (future) events.
- Explaining why it's important to do standardized work before implementing HJ.
- Reduces operator flexibility which can draw resistance
- Requires discipline and much more planning

Concluding Comments

- If **Takt time** is described as the *heart beat* of Lean implementation, then **Heijunka** is the *deep breathing exercise* of Lean that brings stability (calm) to the manufacturing process, spreading it upstream to internal and external suppliers.
- “ Heijunka, You won’t be **HAPPY** without it!”²



² The Toyota Production System: Leaner Manufacturing for a Greener Planet. Published 1998,

Appendix: Instructor's Comments and Class Discussion for 9.3

- Heijunka reveals the limits of the label “lean” and points to a knowledge-driven process for ensuring stability, flow and pull
 - It is still about ensuring the customer has what they want, when they want it at the price they are willing to pay
- Consider the level at which Heijunka expertise needs to be established – plant-wide, departments, individual work areas?
- Most lean operations strike a balance between product leveling and production leveling
 - “Good not to have inventory, good to meet demand, but there really is some balance between the two”
- Worker happiness is an important measure of heijunka success
- Heijunka requires a lot of data, and can be tough to deal with
- Heijunka is not necessarily useful for businesses with level and dependable demand.

Appendix: Instructor's Guide

Slide	Time	Topic	Additional Talking Points
1-2	2-3 min	Introduction, overview and learning objectives	<ul style="list-style-type: none"> • Heijunka is Production Leveling Distributing production volume or production mix evenly over time.
3	3-5 min	Key Concepts	<ul style="list-style-type: none"> • Heijunka converts uneven customer pull into predictable value flow. Converts inefficient batching processes into coordinated multi-tasking
4-7	7-13 min	The Need for Heijunka What is Production Leveling? JIT vs. Heijunka Leveling	<ul style="list-style-type: none"> • Heijunka levels production, JIT results in level inventory. Safety stock is a key to Heijunka. • Heijunka is not implemented in a vacuum. It is effective when integrated with other lean tools, reduced set-ups, Takt time, Kanban planning etc.
8	2-4 min	What is Product Leveling?	<ul style="list-style-type: none"> • Product Leveling: Long Lead times, large unfinished inventories • Heijunka Product leveling seeks to break down batches into smaller interspersed runs
9	2-3 min	Challenges for Heijunka	<ul style="list-style-type: none"> • Imperfect Data, Large Safety Inventory, Increased Planning Required,
01	1-2 min	Conclusion	<ul style="list-style-type: none"> • Heijunka is the Deep Breathing Exercise for the Manufacturing Process • You won't be "happy" without Heijunka