BADM 567: Process Management

Module 7:

Measurement and Analysis for Process Improvements

Toyota Motor Manufacturing

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Today's Session

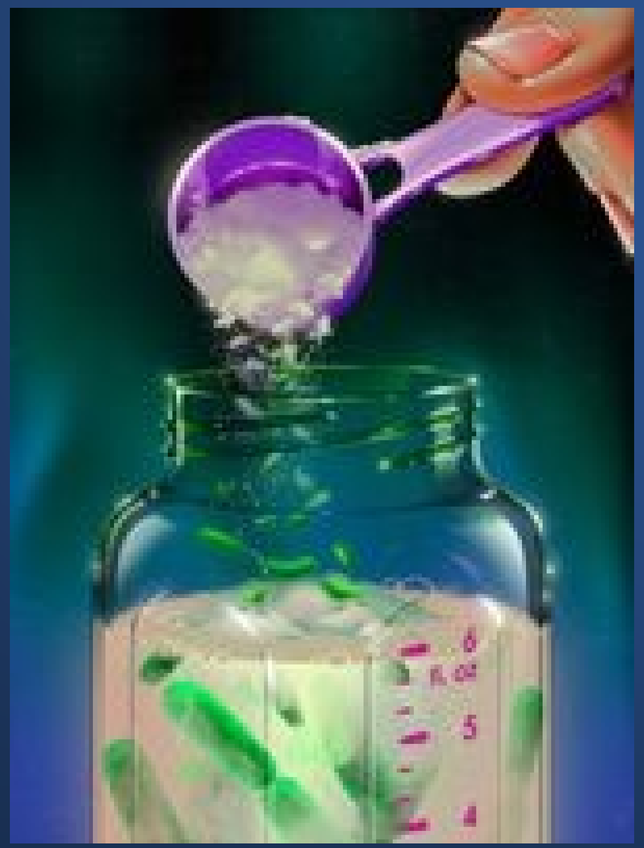
Statistical Process Control (SPC)

- Underlying idea
- Different types

Lean Management

- Application in Toyota Motor Manufacturing case
- Lean as sets of practices

How Deadly Bacteria Spread in a Similac Factory—and Caused the US Formula Shortage (Bloomberg, August 24, 2022)



"Abbott's routine testing had turned up cronobacter at the plant five times in the previous two years, which isn't unusual for a formula maker. "

https://www.bloomberg.com/news/features/2022-08-25/baby-formula-shortage-a-deadly-bacteria-and-abbott-s-abt-missteps?srnd=businessweek-v2#xj4y7vzkg&leadSource=uverify%20wall

Remember:
Applicability of Process Capability Analysis

Measurement data

Normal Distribution

Statistical Control Established

Statistical Process Control (SPC)

Thought Experiment

Consider these questions (Type your response in Chat):

- How much time does your favorite pizza shop take to deliver?
- Guess what proportion of customers receive cold pizza?

Reflect on how we generally think about such questions

- Every process has variation

Using measurement and analysis

- We can figure out extent of variability
- Assess process performance against that established extent of variability

flickr.com/taymazvalley (2015) https://images.app.goo.gl/cmZstAMiRGzTCeZN8

Variation

"The central problem of management . . . is to understand better the meaning of variation, and to extract the information contained in variation" Deming (1986: 20)

Deming, W. Edwards 1986 Out of the Crisis. Cambridge, MA: MIT Center for Advanced Engineering Study

Statistical Process Control

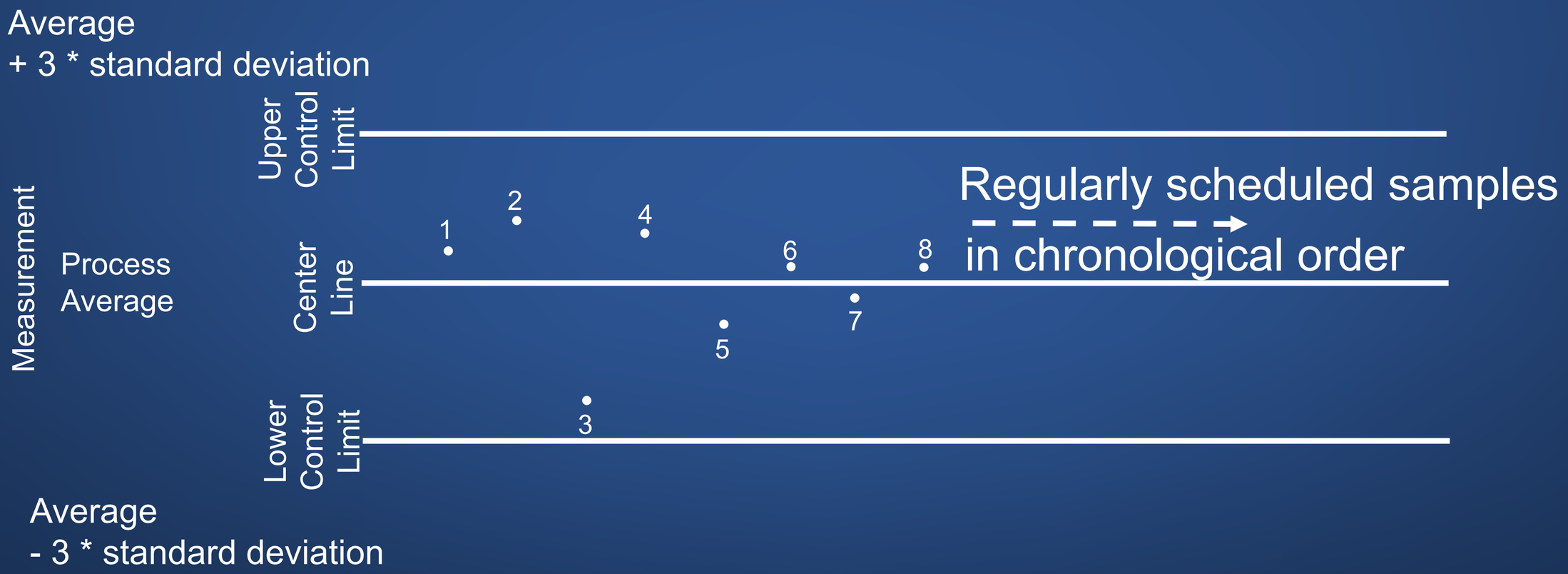
We need to assess variability so we can track it and recognize when we need to do something about it

(when there is an out-of-control occurrence)

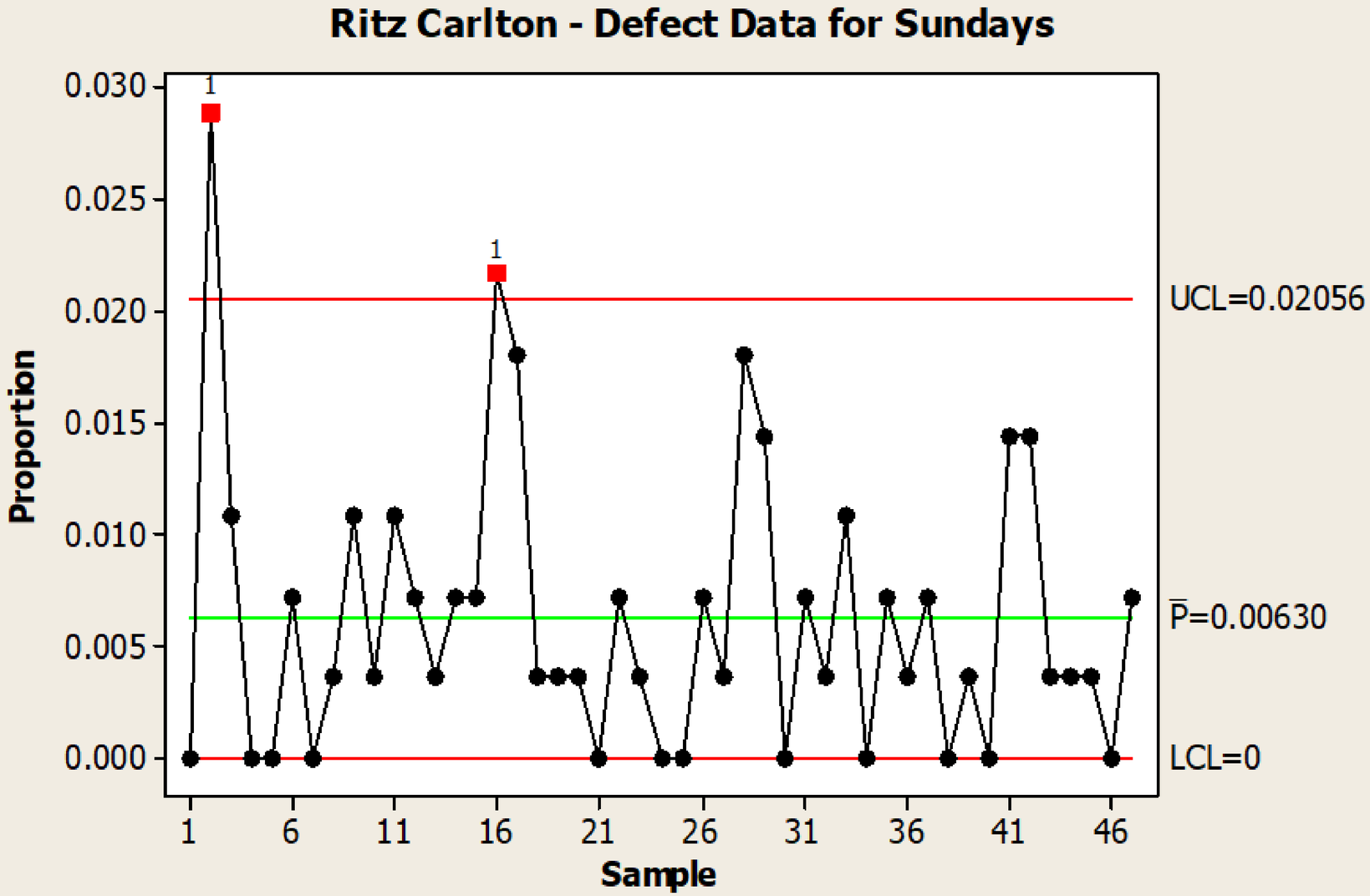
Statistical Process Control (SPC) is a methodology for:

- Establishing ***natural potential*** of process based on routine performance
- Monitoring process to ***identify occurrence*** of extraordinary variation

General Structure of Control Charts



Control Chart Example



Control Chart Calibration

1. Determine metric
2. Validate metric and measurement process
3. Determine sample size and frequency
4. Collect data and calibrate control chart
5. Determine process performance

Control Chart Use

6. Conduct process capability analysis
7. Collect data and plot on chart
8. Examine out-of-control occurrences
9. Observe any trends
10. Recalibrate control chart when called for

Select Among Popular Control Charts

At a customer service call center

- Time taken to answer call
- Calls not answered within 2 minutes
- Number of errors counted by call monitors

Video of Statistical Process Control (SPC) at Honda

Watch in your own time

https://youtu.be/Sdj-8ZBYYmo

(6 minutes and 48 seconds)

SPC charts in Lean Management

Trend charts and run charts

Used to examine “process behaviors”

Idea is to distinguish signal from noise

https://www.lean.org/the-lean-post/articles/react-less-and-improve-more-by-using-spc-more-effectively/

Wheeler, D. J. (2000). *Normality and the process behavior chart*. SPC Press.

Toyota Motor Manufacturing

Case Study

The Setting

Georgetown, Kentucky

Toyota's Assembly Plant

The Problems

Low line utilization rate

Off line cars with defective seats

Addressing the root cause means sacrificing utilization in the immediate term

https://pressroom.toyota.com/toyota-motor-manufacturing-kentucky-inc-tmmk-fact-sheet/

https://www.tripadvisor.com/Attraction_Review-g39440-d2691634-Reviews-Toyota_Visitor_Center_and_Plant_Tour-Georgetown_Kentucky.html

Poll Question #1

Just-In-Time (JIT) at Toyota assumes stable demand and supply.

True/False

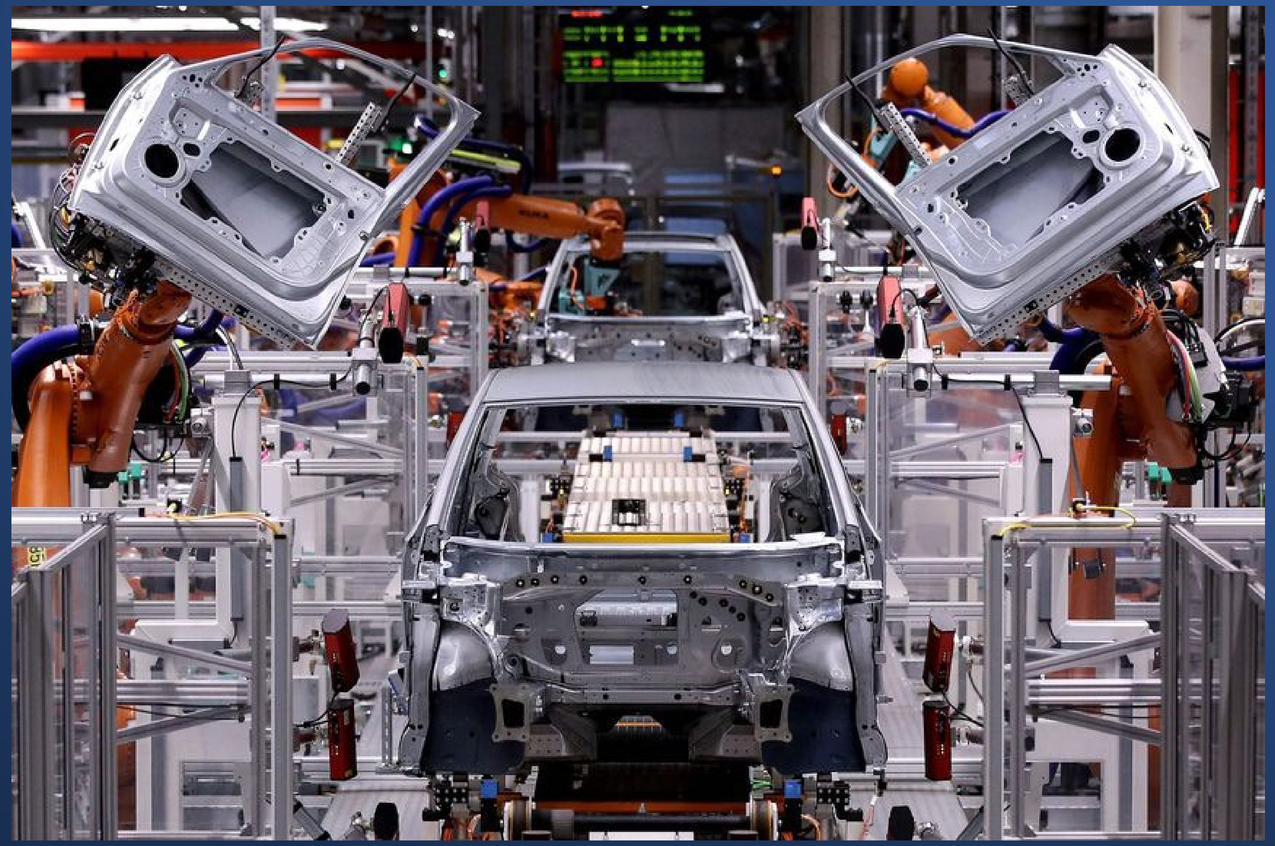
Underlying the Two Main Principles of Just in Time and Jidoka

Two assumptions:

Demand will change

Problems will crop up

Pandemic Shortages Haven’t Shattered the Case for ‘Just-in-Time’ Supply Chains (WSJ, Jan. 30, 2022)



https://www.wsj.com/articles/commentary-pandemic-shortages-havent-shattered-the-case-for-just-in-time-supply-chains-11643547604

Broad Questions

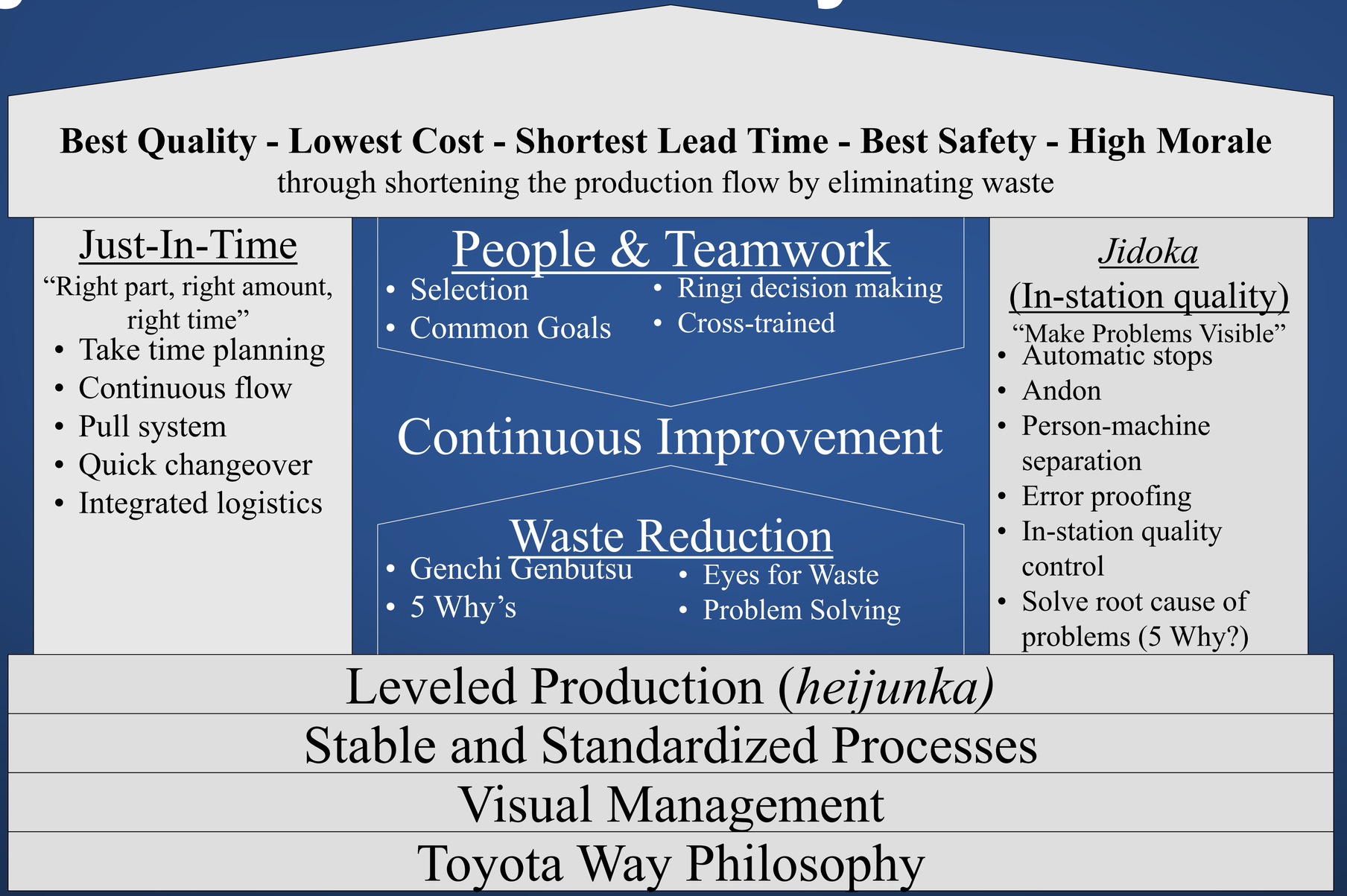
How was the TMM facility in Georgetown being set up?

How does the plant handle production scheduling and quality control?

What was the problem, how was it handled?

What do you suggest?

Toyota Production System



Liker (2004) The Toyota Way

Elements of TPS at TMM

1. Andon
2. Heijunka
3. Jidoka
4. Kaizen
5. Kanban
6. Takt time

Seats

Sole supplier (KFS)

Just in Time delivery

Run Ratio down from 95% to 85%

This translates to shortfall of 45 cars per shift, necessitating over time.

Real Problems

Team leaders either failing to detect defects, or failing to act on detected defects

Problem going unnoticed for too long

Integrity of TPS sacrificed

Actions at TMM

Revised seat reorder form

QC engineers from TMM sampling seats at KFS

5 - why analysis of inspection procedure at KFS

- Discovery: Poor lighting

Taped off area within overflow parking to indicate seat problem cars

- Tracking of cars moving out of overflow area

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Lean Management

Different Application of TPS

Video (6 minutes and 21 seconds)

https://www.youtube.com/watch?v=wz28yMcDvVM

Observe how lean practices are being used.

Breakout Session

How do you see lean practices being used in this application?

Definition of Lean

Shah and Ward (2007)

"An integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability"

Shah, R., & Ward, P. T. (2007). Defining and developing measures of lean production. *Journal of Operations Management*, *25*(4), 785-805.

Lean as Five Principles

Womack and Jones (1996, 2003)

1. Create product (goods/services) **value** from customers' perspective
   - Reduce waste - *muda*
2. Identify, study, improve the **value stream**
   - Observe the process – *gemba* (place where the work is done)
3. Ensure simple, smooth, error-flee **flow** without interruptions
   - Aim to match each process step to *takt time* (defined as the ideal cycle time)
4. Produce only what is **pulled** by the customer (instead of pushing product)
   - Use *kanbans* (defined as fixed containers or signals for inventory)
5. Strive for **perfection** through repetition of the previous four steps
   - Hold *kaizen* (Continuous Improvement) events, Implement 5S

Womack, J., Jones, D., 1996; 2003. Lean Thinking. Simon and Schuster, London

Lean as Focus on Seven Wastes

Sometimes Referred to as T I M W O O D

Types	Description	Example
Transportation	Unnecessary movement of material or customers	Supplies in multiple places
Inventory	Materials or customers in stock or in queue	Excess supplies, customers waiting
Motion	Unnecessary movement of employees	Walking back and forth, and searching
Waiting	Employee, machine, and customer idle time	Waiting for machine cycle, information waiting
Overprocessing	Redundant or unnecessary processing, doing what customer does not value	Inspection
Overproduction	Producing more, sooner than needed by next task	Unused printed reports
Defects	Errors, low quality, rework	Data entry error

Lean as Value Stream Mapping

- Valuable — Does elimination of task affect value for customer?

- Capable — Does task consistently provide good output?
  - Track scrap and rework
- Available — To what extent is the task up and running when needed?
  - Track machine uptime
- Adequate — Does the capacity of the task match demand rate?
  - Track utilization
- Flexible — Can the task efficiently switch over from one product to another?
  - Reduce setup time

Lean Practices and Lean Culture

Guitierrez et al. (2022)

Learning-oriented and innovation-oriented cultures make lean practices result in dynamic capabilities.

Gutierrez, L., Lameijer, B. A., Anand, G., Antony, J., & Sunder M, V. (2022). Beyond efficiency: the role of lean practices and cultures in developing dynamic capabilities microfoundations. International Journal of Operations & Production Management, 42(13), 506-536.

Practices and Principles

"While U.S. Manufacturers in many sectors have used practices from the Toyota Production System (TPS) to boost performance substantially since the mid- 80s, they have used it improperly, experts say; **instead of embracing TPS as an overarching philosophy, they have used it as a piecemeal toolbox**."

John Teresko in Industry Week, February 2006, p.34

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Thank You!