EVALUATING AND SUSTAINING LEAN

Dr. David S. Cochran
Jason Barnes
Joe Sepkovich

January 28-29, 2016
TODAY’S AGENDA

• Welcome from the NE Indiana Advanced Manufacturing Lean Network

• Introductions:
  • Name, company, position, and describe how you evaluate and sustain Lean

• Evaluation with the Manufacturing System Design Decomposition (MSDD) assessment tool

• Collective System Design (CSD) to Design and Sustain Lean Enterprise and Manufacturing Systems
Are JIT and Jidoka Requirements or Solutions?
TPS (aka “Lean”) is an Enterprise Design that responds to Customer Need about Quality & Delivery (in addition to price)

Need: On-time Delivery

JIT: Make only what is needed, when it is needed, in the quantity that is needed;

Produce only what customer operation demands... to actual usage, not to forecast.

Need: Receive Quality Products

Jidoka: Do not advance a defect;

Mechanical automation enables the “Separation of Worker from Machine”... key to volume flexibility with cells.

TPS

High Quality, Low Cost, Short Leadtime, Volume and Mix Flexibility

Kaizen & Improvement

JIT

JIDOKA

Level Production

Standard Work

The Foundation is Single-Piece Flow in Cells with less than 10 Minute Set Up Time

Pokayoke mistake-proof operations through learning loop

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INTRODUCTION OF THE MANUFACTURING SYSTEM DESIGN DECOMPOSITION (MSDD) EVALUATION
LEAN IS THE RESULT OF ACHIEVING ALL OF THE REQUIREMENTS IN THE MSDD...

KEY REQUIREMENTS

QUALITY

IDENTIFY & RESOLVE PROBLEMS

PREDICTABLE OUTPUT

DELAY REDUCTION

OPERATIONAL COSTS

INVESTMENT STRATEGY
MSDD SURVEY IS THE EVALUATION TOOL

Average:
\[
\frac{(4 + 4 + 5 + 4)}{4} = 4.25
\]
RESULTS INDICATE AREAS THAT NEED IMPROVEMENT
We invite you to now take the survey...
Who are the System Designers?
**Design Process**

1. **Customers**
   Who Are They?

2. **Needs**

3. **FRs?**

4. **PS**

**Value Stream**

- **Supplier**
  1 out of 6 is a defect

- **Assy Adj**
  Defects/20 = 10

**FRs**

- FR1 - **Provide a sure, healthy environment**
  - NBD - Safety, Health, Training, Team
  - NTH - Safety Training, Health, Team
  - KTH - Training, Health, Team

- FR2 - **Provide customer-focused life cycle**
  - NBD - VMI, Forecast
  - NTH - VMI, Forecast, PPS
  - KTH - VMI, Forecast, PPS

- FR3 - **Provide customer information**
  - NBD - Service, Support
  - NTH - Service, Support, Team
  - KTH - Service, Support, Team

- FR4 - **Do not advance defects**
  - NBD - FA & Inspection
  - NTH - FA & Inspection, Team
  - KTH - FA & Inspection, Team

- FR5 - **Again, all of the above**
TITLE: Collective System Design Workshop

Collective System Design (CSD) is a framework for designing and sustaining your lean enterprise. Why CSD?

Collective because everyone must have and understand same goals, performance measures, requirements, standard work, and the standard work improvement process to achieve system requirements.

System Design because understanding of the relationship of how standard work and the system are designed to achieve performance goals and requirements is critical to practicing and sustaining lean within your organization.

Content: The workshop features an overview of the CSD methodology, describes how lean accounting and value streams are designed to sustain lean, and then immediately engages the participants in an interactive simulation exercise to apply the concepts to a manufacturing system to achieve customer needs for least total cost.

Bio: David Cochran is an Associate Professor of Systems Engineering and Director of the Center of Excellence in Systems Engineering (http://cese.ipfw.edu/) at Indiana University-Purdue University Fort Wayne (IPFW). Dr. Cochran is a two-time recipient of the Shingo Prize for Manufacturing Excellence for his work about the Toyota Production System and the design, implementation and leadership of systems to become lean. He earned a PhD in Industrial and Systems Engineering from Auburn University in 1994 and Master of Science Degree in Industrial and Manufacturing Engineering from Penn State in 1989.

PROVIDER: Prof. David Cochran, Jason Barnes, and Joe Sepkovich, IPFW Center of Excellence in Systems Engineering

DATE: Tuesday, August 5 from 9:30 AM to 4:00 PM (EDT) Owens Community College, Findlay, OH

WORKSHOP CAPACITY: 24

TARGETED AUDIENCE: Senior Leadership including VPs, plant and ops managers, controllers, IT / ERP personnel, logistics
DESIGN PROCESS

1. Customers
   Who Are They?

2. Needs

3. FRs?

4. (PS)

IGN
CISC

15 secs

Supplier
1 out of 6
Is A Defect

15 secs

Value Stream

Takt Time (secs / part) =

24 units / shift

Task Time = 8 secs / unit

Assy Act

Detect Pareto

$X_D = \frac{\text{2 units}}{\text{86}} = \frac{20 \text{ units}}{\text{100}} = 0.20$

$	ext{100%}

8R
3 1/2''

8G
8B
Shift

FR1 - Provide a safe, healthy environment
   - NBD - Safety Group, Audits, Training
   - ATB - Health Program
   - KTH - Child/Kid Recreation

FR2 - Produce customer-consumed by every time
   - NBD - Raw Materials
   - ATB - Powerline Inverter (10 kVA)
   - KTH - Control

FR3 - Produce the customer get key
   & Same as above

FR4 - Do not advance defects
   - NBD - First Inspection
   - ATB - Nond. Visual Previews
   - KTH - Final Inspectors & Groups

FR5 - Again, All of the above!
**1. Customers Who Are They?**

**2. Needs**

**3. FRs?**

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**FR1 - Provide a Safe, Healthy Environment**
- NBO - Safety Group, Audits, Training
- ATD - Wellness Program
- Honda - OSHA Recordables
- KTH - Wellness Program, Safe Driving

**FR2 - Produce Customer-Consignment Qty Every Time**
- NBO - FGI Sheets & Counters
- ATD - Safety Score Report (G-Days)
- Honda - Flow vs Actual
- KTH - Someone on controls

**FR3 - Produce the Customer Qty Mix**
- Same as above

**FR4 - Do Not Advance Defects**
- NBO - FDA Inspection
- ATD - Move + Visual Pareto
- Honda - GEMS Direct PSS
- KTH - Final Inspectors + Group Lead

**FR5 - Again, All of the Above!**

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**FR6 - When a Problem Occurs, Rapidly Identify & Resolve**
- NBO - Correct 5 Why
- ATD - 8D
- Honda -
  - KTH - Notify, Stop, Sort, Control, Contain, 5M

**FR7 - Produce Products w/ the Least Time in System (1-6 Accomplished)**
- NBO - KANBAN
- ATD - ½ Improvement, Top 4 List
- Honda -
  - KTH - ½ Improvements Case Studies

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*Red Team!*
FUNCTIONAL REQUIREMENTS (FRs) OF MFG. SYSTEM DESIGN ... TESTED WITH LEGOS

FR1 – Provide a *safe, healthy work* environment – *The Foundation*

FR2 – Produce customer-consumed *quantity* every time interval – *from JIT*

FR3 – Produce customer-consumed *mix* every time interval – *from JIT*

FR4 – Do not advance a defect to the next customer operation – *from Jidoka*
   *the best case is to not make a defect in the first place...*

FR5 – Achieve FR1 through FR4 *in spite of variation* – *Robust Design*

FR6 – When a problem occurs accomplishing FR1 through FR4, *rapidly identify* the problem condition and *resolve it in a pre-defined way* – *Controllable Design*

FR7 – Only *Once FR1 through FR6 are achieved (the system is stable)*, Produce products with least time in system – *Reduce cost further by reducing Standard WIP Inventory and additional Waste(s)*
COLLECTIVE SYSTEM DESIGN STEPS

1. Determine System Boundary and Value Streams within a System Boundary
2. **A New Tone… It’s the Work Method & System, Not the Person**
3. Identify Constituents/Customer (internal and external) Needs
4. Translate **Needs to Functional Requirements** (FRs: what we want to achieve) for each Value Stream
5. **Map Physical Solutions (PSs: how we propose to achieve)** to FRs, determine PS Implementation Sequence and Standard Work Procedure → Content, Sequence, Time of all work
6. **Plan, Do, Check, Act (PDCA): Learning loop** to Improve the System Design Decomposition (Map) and Standard Work
7. **Establish Organization Structure (test with physical (lego) models)** using Collective System Design Map… that Knows How to Identify and Resolve Problems… called “Green Sheet Standard Work”
8. Agree on Outcome Measures $M_{FR}$ and Implementation Measures on Doing Work $M_{PS}$
9. **Use cost of not achieving System FRs to cost-justify investments in resources to achieve deficient FRs**
10. Sustainability – consequence of practicing Collective System Design (CSD)
THE FLAME MODEL OF COLLECTIVE SYSTEM DESIGN (CSD) BEGINS WITH THE TONE OF PEOPLE

We see the results from our Thinking

We don’t see our Thinking

4 Layers of a CSD

Precedence of Design Relationships

CSD Flame Model
WHY CSD?

- Provides a methodical way to communicate design relationships from high-level to lowest-level of implementation
- The Design decomposition (or mapping) process results in understanding path dependency

**FR: Functional Requirement(s):** What a Value Stream must achieve to satisfy the customer(s) need

**PS: Physical Solution:** Proposed Solution (Hypothesis) to Achieve FR

- Gets everyone one the same page about what the system must accomplish
- Once the System Design Map is built, we use it to justify investment to achieve the deficient FRs.
COLLECTIVE SYSTEM DESIGN (CSD) CAN EXTEND MSDD

Key Requirements

Quality

On-time & Rapid Delivery

Resource Allocation

- Quality
- Problem solving
- Predictable output
- Delay reduction
- Operation Costs
- Investment

CSD creates a logic model / mental model of FR-PS relationships
Collective System Design (CSD) expresses the Thinking with FRs and PSs:

- **Functional Requirement (FR)** – Measure on an FR is $M_{FR}$
- **Physical Solution (PS)** – Measure on a PS is $M_{PS}$

Not every FR or PS requires a measure.

*Standard work is a record of problems solved to date*
Collective System Design Map:
The Implementation Sequence of PSs is critical –
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10. Sustainability – consequence of practicing Collective System Design (CSD)
Collective System Design (CSD) implements a Learning Loop through Standard Work.
COLLECTIVE SYSTEM DESIGN STEPS

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10. Sustainability – consequence of practicing Collective System Design (CSD)
USE COST OF NOT ACHIEVING FRs TO JUSTIFY INVESTMENT IN RESOURCES

- Limited resources typically cause FRs to be taken off the table.
- CSD mapping enables assessment of the consequences that would result if enterprise FRs are eliminated.

- 25% of the direct labor build hours were waste as a result of not achieving these 6 FRs on the program
- System Design Certification teaches leaders how to achieve life cycle cost and quality targets

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18 PEOPLE, 18 DIFFERENT VIEWS OF THE SYSTEM... WHAT IS THE IMPACT ON DECISION MAKING?
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