What does Lean Mean to an Equipment Supplier?

Appropriate level of

Automation

Capacity

Investment

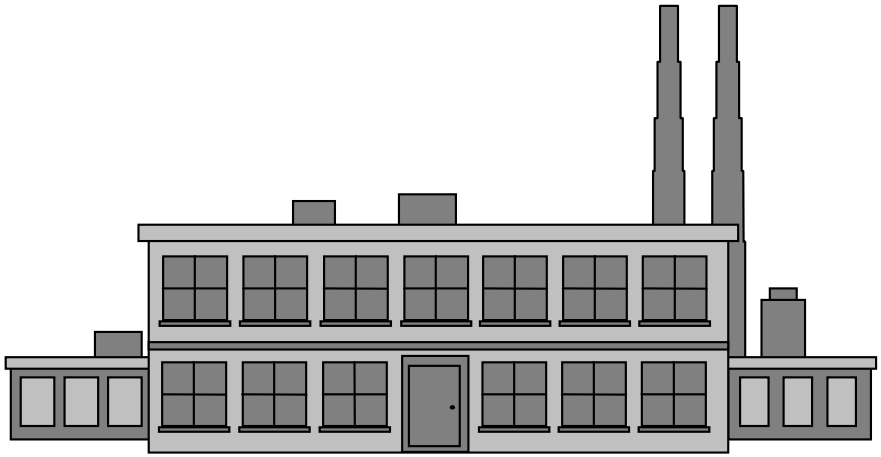
(applied to value added machine process steps) to support Lean Manufacturing Systems with simple and reliable Equipment.

What does Lean Mean to an Equipment Supplier?

- Eliminate all waste
- Provide Equipment with Lean Equipment Characteristics
  - Supports the Operator
  - Portable and Flexible
  - Simple
  - Zero Defect Quality
  - Supports One-Piece Flow
  - Reliable and Maintainable
- Only Capacitize for what is required
- Minimal Investment
- Minimal Lead time (processing, installation, build,change-overs)
- Correct Application of Automation
  - Safety
  - Quality
  - Ergonomics
- Ensure Automation dollars are Spent on Value Added Machine Process Steps

Manufacturing Plant Requirements

- **Lean**
  - **Balanced use of people, equipment, & material that gives us the lowest Life Cycle Cost.**
  - **Lowest Life Cycle Cost assumes all waste is eliminated.**
  - **Flexible**
  - **Portable Equipment**
  - **Staffing Flexibility: Able to efficiently staff operation for different volumes. Efficient for one operator to process part from start to finish.**
  - **Frequent Changeover**
- **Customer Focused Modules or Cells**
- **One Piece / Small Lot Material Transfer**
- **Value Added to Value Added Flow**
- **Takt Time**
- **People Engaged and Adding Value**



Takt Time

Takt Time is the time which should be taken to produce a part or assembly based on customer demand.

Customer cycle time is calculated as follows:

$$\text{TAKT Time} = \frac{\text{Total net operating time per shift or day}}{\text{Total customer(s) requirements needed per shift or day}} \times 60$$

Example:

480 min./shift
- 20 min AM break
- 20 min PM break

440 min. net operating time per shift

$$\text{Takt Time} = \frac{440}{1000} = .44 \times 60 = 26.4 \text{ sec/part}$$

Flow Manufacturing Summary

- **Simple, Reliable, & Capable equipment Laid Out According to the Sequence of Processing (Product Focus) in Manufacturing Cells.**
- **Operator does not wait on machine, machine waits on the operator**
- Change number of operators to adjust to volume changes
- **Ability for one person to run the cell efficiently**
- Operators run more than one piece of equipment (standardized operations, multi-functional worker)
- **One piece flow (small lot production) via pull system.**
- Operators are Responsible for the quality they produce
- Standardized work routines to increase operator reliability & safety
- Non-cyclical work
- **Product & Process is error proofed**
- Production is synchronized to customer usage (takt time)
- **Investment closely aligned to growth in volume, add modules as needed**
- **All tooling is quick change tooling**
- **Keep material outside the cell. Parts are loaded into the cell from the back of the cell.**
- **Locate material to minimize handling/optimize presentation to the operator.**
- **Size Equipment to minimize operator walk distance.**
- **Cells should be capable of benefiting from continuous improvement at least every 30 days.**
- **Equipment is designed according to the Lean Equipment Guidelines Book**

System Mock-up

- What is Mock-up?
  - Prototype of the Manufacturing System
  - Constructed from simple materials
    - » Creform
    - » Foamboard
    - » Cardboard
  - Detail focused on key operator interface
- Why Mock-up?
  - 3-D Model of the cell engages cross-functional team to better identify and eliminate sources of waste:
    - » Poor Layouts
    - » Inefficient Methods
    - » Poor Part Presentation and Material Handling
    - » Tooling and Machines not designed for the Operator
    - » Lack of Error Proofing
  - What-if Capability - Simple model facilitates making changes to the system

System Mock-up- Equipment Details

EQUIPMENT CONCEPT DETAILS

- Define Guarding
- Part Presentation
- Operator Machine Interface
    - Pace mechanism
    - Cycle initiation
    - Auto unload
    - Required Operator Visuals
- Error Proofing
- Material Handling
- Rejected Parts Handling

ERRORPROOFING

- Errorproofing is the only possible way to achieve Zero Defects
- Errorproofing is planned into the product/process early enough that methods can be incorporated (ie. Before D.V. & equipment RFQ)
- It must be developed jointly between Product Engineering, Manufacturing Engineering, & Quality/Reliability Engineering
- Source Inspection is the only true method for errorproofing
- The location of the source inspection (in order of preference)
  - Source - before the defect is made
  - Self - after defect is made but before passing on to next operation
  - Successive - at the next operation before more work is performed
- The inspection feedback may either be Halt or Warnings, depending on the severity of the defect.

Lean Equipment Guidelines

Supports the Operator:

- Easily Initiated Cycle Start
- Safety & Ergonomic Design
- All Lockouts Together
- Optimize Operator Work
- Simple Effective Guarding
- Reduce Machine Noise
- Simple Part Presentation Devices
- Provide Necessary Visual or Audio Controls
- Pacing Mechanism
- Minimize distance between machines
- Manual Load/auto Unload ... Back to the Operator
- Easily Initiated Cycle Start
- Machine Time < Operator Time

Simplicity:

- Generic "Small" Machines
- Simplify Processes - Required Complexity in Tools,
  Not Machines
- Utility Use Minimized
- "Off-the-Shelf" Vs. Purpose Built Machines
- Specifications Revised to Reflect Lean Principles
- Lightweight Components
- Deproliferation and Common Parts
- Proper use of Automation for Value Added Steps

Design for One-Piece Flow:

- Narrow "Effective" width
- "C" Frames
- Product Focused versus Process Focused
- Manual Backup for Complex Equipment

Portable/Flexible:

- Quick -Change Tooling
- Avoid Adjustments
- Interchangeable Fixtures
- Self Contained
- Flat Floor Installation
- Avoid Fastening to floor
- Fork Pockets and Casters
- Flexible Power/Air Connections

Zero Defect Quality:

- Built-in Simple Error Proofing
- Boundary Samples
- Support Standardized Work
- Plan for Reject Containment

Maintenance:

- Design for Planned Maintenance
- Designed for Maintenance Diagnostics
- Design for Accessibility
- Routine Maintenance Performed by Production
- Proper use of Standardization
- Appropriate Information Management
- Use of Modular Components

Capacity:

- Modular
- Each Cell Matched to an Assembly Plant

DELPHI
Automotive Systems