Sustainable Production Definition

“The creation of goods and services using processes and systems that are
- non-polluting;
- conserve energy and natural resources;
- economically viable;
- safe and healthy for workers, communities, and consumers; and
- socially and creatively rewarding for all working people.”

(Lowell Center for Sustainable Production, 1998)
Sustainability


- “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

- This involves the three pillars of environmental, economic, and social sustainability

Green Manufacturing

- Green manufacturing attempts to establish a solid foundation for all three pillars to achieve a sustainable business operation

For complete sustainability, all three must be given attentions
Lean Services and Office Kaizen

Waste Management Hierarchy

- To have the largest energy and environmental impact
  - Eliminate the processes you can, reduce what you cannot eliminate
- One very effective means of reducing processes is **Lean**

Principles of Lean

- **Let customers identify Value**
  - Companies provide what customers really want
  - A product/service is not just an object, but a whole experience
- **Identify the Value Stream**
  - Value Stream: Sequence of all activities and resources required to bring a product/service to customers
- **Make the value stream Flow**
  - Create smooth and uninterrupted flow for products/processes
- **Pull from downstream**
  - Operations are performed when needed, not before
- **Always pursue Perfection**
  - Continuous improvement is a way of life (Womack & Jones, 1996)
Merging Lean and Green

- A Lean and Green Enterprise is one that seeks
  - Operational excellence,
  - Energy efficiency, and
  - Environmental sustainability

The Seven Wastes

**Waste**: Anything that adds cost or time without adding value
9th Waste Added for Green

**Environmental Waste** - “any use of resources or a substance released into the air, water, or land that could harm human health or the environment”
-- Lean and Environment Toolkit (EPA)

**Green Examples:**
- “Energy, water, or raw materials consumed in excess of what is needed to meet customer needs”
- “Pollutants and material wastes released into the environment”
- “Hazardous substances that adversely affect human health or the environment during their use in production or their presence in products”

**Lean Wastes – Example**

- **Incoming Queue**
- **Milling Process**
- **Outgoing Queue**

- **Lean Wastes**
  - Waiting, WIP

- **Energy Wastes**
  - Electricity, Heat

- **Environmental Wastes**
  - Scrap, Fumes
Waste Elimination

- Waste is all around, we don’t usually see it because it has become “normal”
- We need to train our eyes to be able to see waste

**Lean Concepts and Tools** can help you to

- Locate the wastes, eliminate them, and sustain your efforts

Lean Tool: Visual Workplace

**Visual Workplace** - Provides visual indicators so that goals and the current status of the workplace can easily be identified

**Green Impact:**

- This can include energy usage goals, which can help workers and managers to be conscious of energy use and opportunities for energy reduction
Lean Tool: TPM

**Total Productive Maintenance (TPM)** – a systematic care and maintenance program conducted by the operators on their machines/equipment to increase productive time.

**Green Impact:**
- Ensures that equipment and machinery are operating at peak efficiency, thus reducing energy consumption and decreasing the likelihood of system downtime.

Lean Tool: Quick Changeover

**Quick Changeover** – a procedure to reduce the setup and changeover time for a process.

**Green Impact:**
- Reduces the time the line is down.
- It also reduces the energy used to make the changeover and provide light and heat during non-productive time.
Lean Tool: Error Proofing

**Error Proofing** – a method to eliminate errors from occurring, prevent errors from being passed on to the next process, or detect errors once they occur

**Green Impact:**
- Attempts to identify errors as soon as possible or to eliminate them altogether
- This saves the energy and material required to fix or replace errors

Lean Tool: Right-Sized Equipment

**Right-Sized Equipment** – a method that ensures that the appropriate machines and equipment are used to complete a process step

**Green Impact:**
- Selecting equipment that has just enough capability and speed to satisfy the flow of a production cell can provide tremendous energy savings over an outdated machine that has much more capacity than is required
Lean Tool: Value Stream Mapping

**Value Stream Mapping (VSM)** – an effective tool that is used to provide a holistic view of the process of converting raw materials into finished products

**Green Impact:**
- Traditionally, VSM has focused on identifying and eliminating manufacturing wastes to reduce the production lead time
- Reducing these wastes will often provide some energy savings and positive environmental impacts

Energy and Environment VSM (EE-VSM)

- A modified VSM is needed to fully realize the potential energy and environmental savings
- EE-VSM is introduced to enhance the traditional VSM to incorporate both energy and material usage throughout the complete manufacturing conversion and delivery process
- EE-VSM will enable manufacturers to:
  - Reduce the delivery lead time and
  - Reduce wasteful energy consumption and
  - Reduce environmental wastes
VSM Icons – Energy Flow

Value-Adding Line
Lean Sustainability Metrics

- **Productivity Metrics**
  - Total Lead Time
  - Value Added Time / Non-Value Added Time
  - Throughput

- **Sustainability Metrics**
  - Energy Consumption
  - Water Consumption
  - Material Usage
  - CO₂ Emissions
Lean Sustainable Production Assessment Tool

- The tool is introduced to help visualize and analyze both the productivity and sustainability metrics.

- It consists of:
  - Real-time Dashboard
    - Consists of a meter for each metric
    - Represents the current state of the system
  - Continuous Improvement Dashboard
    - Used to ensure achieved improvement levels are maintained and that progress is being made.

Real-time Dashboard

- Meters include:
  - Target value
  - Buffer zone (yellow)
  - Good zone (green)
  - Bad zone (red)
Continuous Improvement Dashboard

- Energy Consumption
- Total Lead Time
- CO₂ Emissions

Note: Only a portion of the dashboard is shown.

Summary

- Combining Lean and Green is a natural fit
- It enables the possibility of a truly sustainable business
- One that has Environmental, Economic, and Social Sustainability
  - Good for everyone:
    - the company,
    - its shareholders,
    - its customers,
    - society, and
    - the environment!!!
Conclusion

If Lean and Green are performed correctly,

Green = Green

For more info – send inquiries to ff.chen@utsa.edu
References