



**2009 Sustainability  
Conference**  
Leading Kansas in Sustainability  
kansas state university

# Bringing Awareness on Sustainable Green Manufacturing to Students

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Cottonwood Room: Curriculum  
11:30 a.m. – 11:45 a.m.



## Outline

- ❑ What is manufacturing?
- ❑ Why manufacturing?
- ❑ Where to start?
- ❑ How to bring awareness?
- ❑ Examples of student work
- ❑ Summary



# What is Manufacturing?

- defined by the DOL...

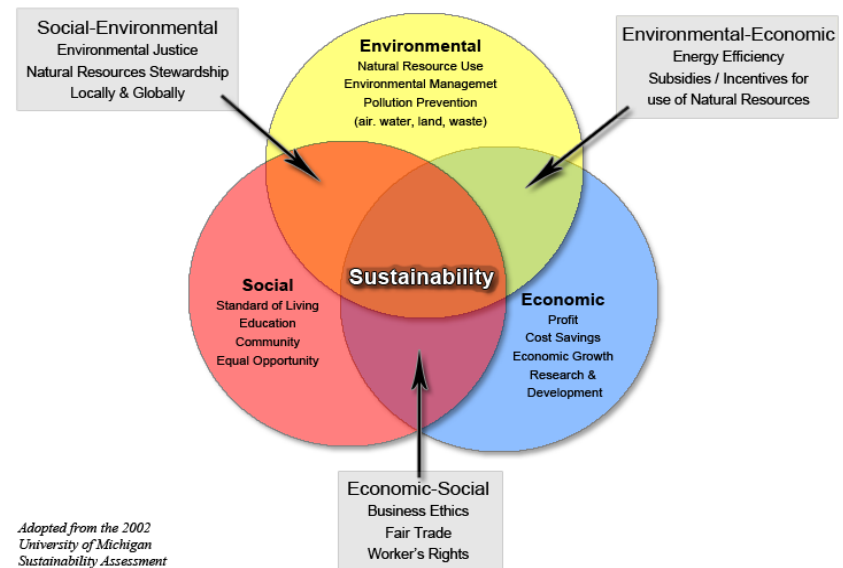
"establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products."

# Buzz Words

## Lean, Green, Sustainable

- ❑ **Lean**  
a systematic approach to identifying and eliminating waste, doing more with less resources, less time, and less inventory
- ❑ **Green**  
*minimizing pollution and risk to human health and the environment*
- ❑ **Sustainable**  
processes that are non-polluting, conserve energy and natural resources, are economically sound and safe for employees, communities, and consumers

*The Three Spheres of Sustainability*





# Why manufacturing?

- ❑ US Manufacturing sector employed 16m-18m a decade ago
- ❑ US lost 3m in last 10 years
- ❑ US manufacturing accounts for \$1.5 trillion in gross domestic product (GDP)
- ❑ Equals to 8<sup>th</sup> largest economy in the world
- ❑ Where KS stands? 183,000 manufacturing jobs and ranks 28<sup>th</sup> in US.



# How to start?

- ❑ Faculty Student Projects
- ❑ Internships
- ❑ Workshops, seminars
- ❑ Develop a new course
- ❑ **Projects or assignments in existing courses**

## MET 481 Automated Manufacturing Systems II

Covers systems for manufacturing operations including facilities, supplies, materials, production, and control. Topics include design, programming, and feedback for manufacturing, production set-up, automated work cells, and decision issues.



# How to bring awareness?

- ❑ **Objective:** Foster better understanding of manufacturing and its impact on social, economic and environmental issues.
- ❑ **Assignment**
  - Select a topic related to sustainable green manufacturing concept interest to you for a specific industry such as automotive, aviation, food and beverage, pharmaceutical, petroleum refining, plastics, and energy. Write a concept paper addressing the following:
    - Define the terms green, sustainable, and lean manufacturing.
    - Explain what is envisioned as green, sustainable, and lean manufacturing
    - What regulations or laws are in place?
    - Explain drivers and barriers for green, sustainable, and lean manufacturing
    - Discuss implementation problems of green and sustainable design and manufacturing systems
    - Identify a case study in specific industry sector and explain how current practices of green and sustainability concepts are implemented.
    - Explain briefly your opinion about green and sustainable manufacturing and its future.

# Examples of Student Work

With the expected growth in population, urbanization and energy use, we as engineers must continue to act on behalf of the environment to sustain a viable future.

- Sustainable manufacturing is a positive business strategy that can deliver economic benefits as well as reducing environmental impacts.
- “Industry owes it to society to conserve material in every possible way.....mostly for the conservation of those materials whose production and transportation are laying an increasing burden on society.”



Land of humans



Land of nature



# Examples of Student Work

## Ford

- The foam in Ford vehicles are 40% soy based.
- Most automotive companies use natural fibers in interior panels.
- Model T once contained 60 lbs of soybeans in its paint and molded plastic parts.
- 1972- First full sized, full-powered hybrid is developed from Buick Skylark.
- 1996-Natural-fiber composites are first used in automotive interior panels.



## General Motors

- Tonawanda Engine Plant
- World's largest Engine Manufacturing facility
- Flex fuel engines
- 95% waste materials recycled
- 23,000 tons of waste produced and recycled
- nearly 5% used for waste to energy facilities
- Zero landfill status



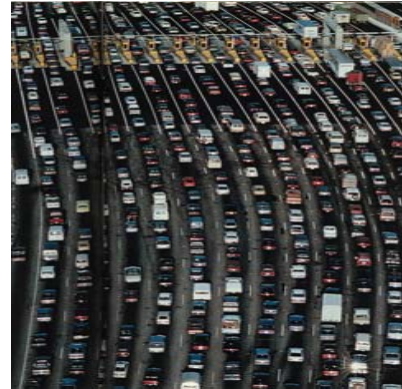


## Examples of Student Work

- Uses DC electric tools, which are quieter and more precise than pneumatic tools, place less stress and strain on the operator and use less energy.
- Just-in-time and vehicle-sequencing, eliminate wasted time and effort, while supporting the continuous improvement of quality
- A new paint shop uses water-based primer and base-coat systems to minimize harmful volatile emissions while maintaining quality.
- Install wind turbines to supplement power for production
- Use vegetable based cutting fluids that are biodegradable.
- Don't distribute the local ecosystem and create a sanctuary for the critters living around the plant.
- Special roof surfaces with plant life to drastically reduce runoff and remove carbon dioxide.

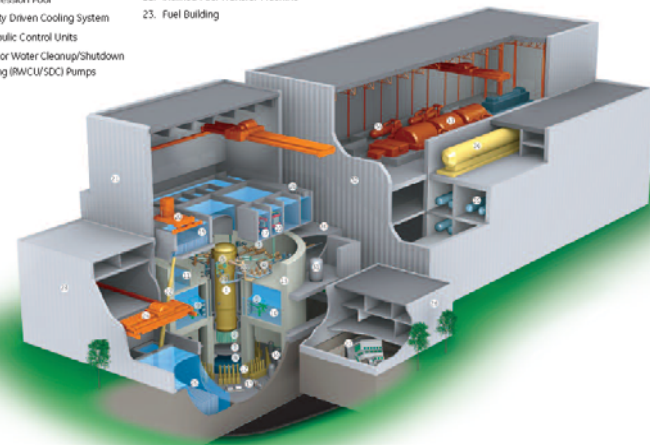
# Examples of Student work

- Every company when it comes to green manufacturing should be conserving natural resources for future generations
- One ESBWR (Economic simplified boiling water reactor) replacing the same amount of electricity generated in the U.S. through traditional sources, would reduce greenhouse gas emissions by an amount equivalent to taking 1.5 million cars off the road.



## ESBWR

- |  |  |   |  |
|--|--|---|--|
| 1. Reactor Pressure Vessel                                   | 14. RAVCU/SDC Heat Exchangers          | 24. Fuel Transfer Machine                     | 32. Turbine building                         |
| 2. Fine Motion Control Rod Drives                            | 15. Containment Vessel                 | 25. Spent Fuel Storage Pool                   | 33. Turbine-Generator                        |
| 3. Main Steam Isolation Valves                               | 16. Isolation Condensers               | 26. Control Building                          | 34. Moisture Separator Reheater              |
| 4. Safety/Relief Valves (SRV)                                | 17. Passive Containment Cooling System | 27. Main Control Room                         | 35. Feedwater Heaters                        |
| 5. SRV Quenchers   | 18. Moisture Separators                | 28. Main Steam Lines                          | 36. Direct Contact Feedwater Heater and Tank |
| 6. Depressurization Valves                                   | 19. Buffer Fuel Storage Pool           | 29. Feedwater Lines                           |  |
| 7. Lower Drywell Equipment Platform                          | 20. Refueling Machine                  | 30. Steam Tunnel                              |  |
| 8. BHM/C Core Catcher  | 21. Reactor Building                   | 31. Standby Liquid Control System Accumulator |  |
| 9. Horizontal Vents  | 22. Inclined Fuel Transfer Machine     |   |  |
| 10. Suppression Pool   | 23. Fuel Building                      |   |  |
| 11. Gravity Driven Cooling System                            |  |   |  |
| 12. Hydraulic Control Units                                  |  |   |  |
| 13. Reactor Water Cleanup/Shutdown Cooling (RAVCU/SDC) Pumps |  |   |  |





## Examples of Student Work

- It seems to me that the time and money would be better spent elsewhere.
- Storing CO<sub>2</sub> underground is transferring the problem instead of eliminating it.
- **Something that will eventually run out is not sustainable.**
  
- The Farm Security and Rural Investment Act of 2002 (Public Law 107-17), also known as the 2002 Farm Bill
  - Create Biobased Products
- The Farm Security and Rural Investment Act (FSRIA) of 2002
  - a mandate to the U.S. Department of Agriculture to develop and implement a comprehensive program for designating biobased products
  - a directive to all federal agencies to increase their purchase and use of "preferred" products
  - In my own opinion, green, sustainable, and lean manufacturing should be adopted by any manufacturing industry that will like to remain on the map by 2020.



# Summary

- Awareness through recognition, knowledge acquisition, evaluation of information and reflection
- Transforming issues into subject competencies in courses
- Adding concepts and contexts (content)
- A specific approach to interpret sustainable manufacturing
- Educational approach to global learning and one world