# Integrating environmental sustainability into your lean and six sigma program

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**Rockwell Collins**

# Baseline

- Does your company have a sustainability department or initiative?
- Does your Environment, Safety and Health (ES&H) and Facilities team get regularly invited to improvement efforts?
- Does ES&H and Facilities conduct their own improvement efforts?
- Have you worked on a project or event to reduce environmental impacts within your organization?

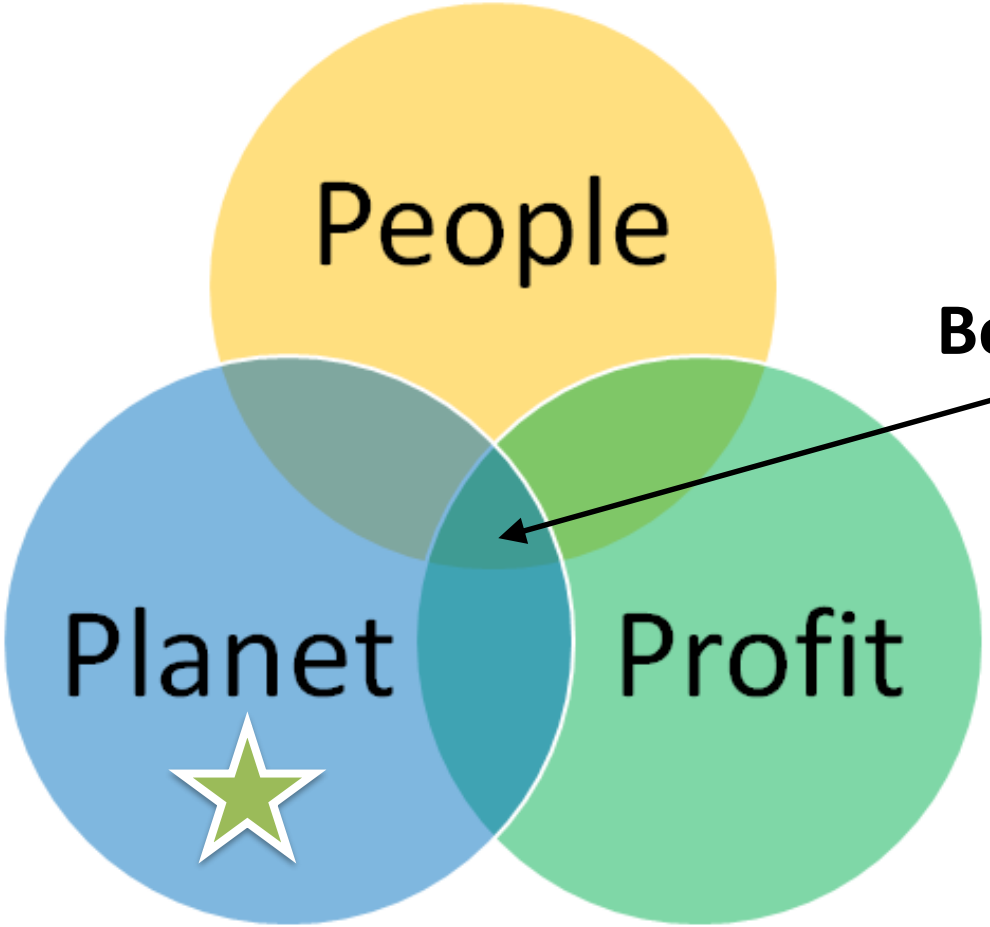
# Agenda

- About Rockwell Collins
- What is Sustainability?
- Lean → Green
- Waste
- Green → Lean
- Rockwell Collins Examples
- What LSS doesn't address
- How to address this gap
- Modified LSS Tools
- What you can do at your company
- Resources
- Summary

# About Rockwell Collins

- Provides navigation, communications and heads up and heads down display products and systems for military and commercial customers
- Operating from more than 60 locations, in 27 countries, with 19,000 employees on our team

# Sustainability




**EXAMPLE: TRANSPORTATION TO CONFERENCE**

# Sustainability Financial Benefits

1. Increased revenue
2. Reduced energy expenses
3. Reduced waste expenses
4. Reduced materials and water expenses
5. Increased employee productivity
6. Reduced employee attrition expenses
7. Avoided risk to profit

From Bob Willard http://www.sustainabilityadvantage.com

# Case Study: Lean → Green

Carts

- Created clutter
- Allowed excess inventory
- Hid problems
- Took up floor space

# Case Study: Lean → Green

- Reduced order from 54 carts to 30
- Floor markings
- Saved $10,000
- Preventing one pound of solid waste prevents 19 pounds of waste upstream[1]

[1] Washington State Department of Ecology, Beyond Waste: Waste and Material Flows in Washington (2003).

**CAPTURE ENVIRONMENTAL IMPACTS OF YOUR IMPROVEMENTS**

# Waste has Environmental Impact

| Waste Type | Environmental Impacts |
|---|---|
| Overproduction | • More raw materials consumed in making the unneeded products<br>• **Extra products may spoil or become obsolete requiring disposal**<br>• Extra hazardous materials used result in extra emissions, waste disposal, worker exposure, etc. |
| Inventory | • More packaging to store work-in-process<br>• Waste from deterioration or damage to stored WIP<br>• More materials needed to replace damaged WIP<br>• **More energy used to heat, cool, and light inventory space** |
| Transportation and Excessive Motion | • More energy use for transport<br>• Emissions from transport<br>• More space required for WIP movement, increasing lighting, heating, and cooling demand and energy consumption<br>• **More packaging required to protect components during movement**<br>• Damage and spills during transport<br>• Transportation of hazardous materials requires special shipping and packaging to prevent risk during accidents |
| Defects | • Raw materials consumed in making defective products<br>• **Defective components require recycling or disposal**<br>• More space required for rework and repair, increasing energy use for heating, cooling, and lighting |
| Over Processing | • More parts and raw materials consumed per unit of production<br>• Unnecessary processing increases wastes, energy use, and emissions |
| Waiting | • **Potential material spoilage or component damage causing waste**<br>• Wasted energy from heating, cooling, and lighting during production downtime |

HELPS IDENTIFY MORE WASTE AND HIGHLIGHTS FULL BUSINESS CASE

# Value Added vs Non-Value Added

## Value added

- ✓ Electricity to automatically place parts on a board
- ✓ Computer used to share screen with remote employees to solve a problem
- ✓ Electricity to create bid proposal
- ✓ Heat to keep employees comfortable
- ✓ Parking lot lighting at night for safety

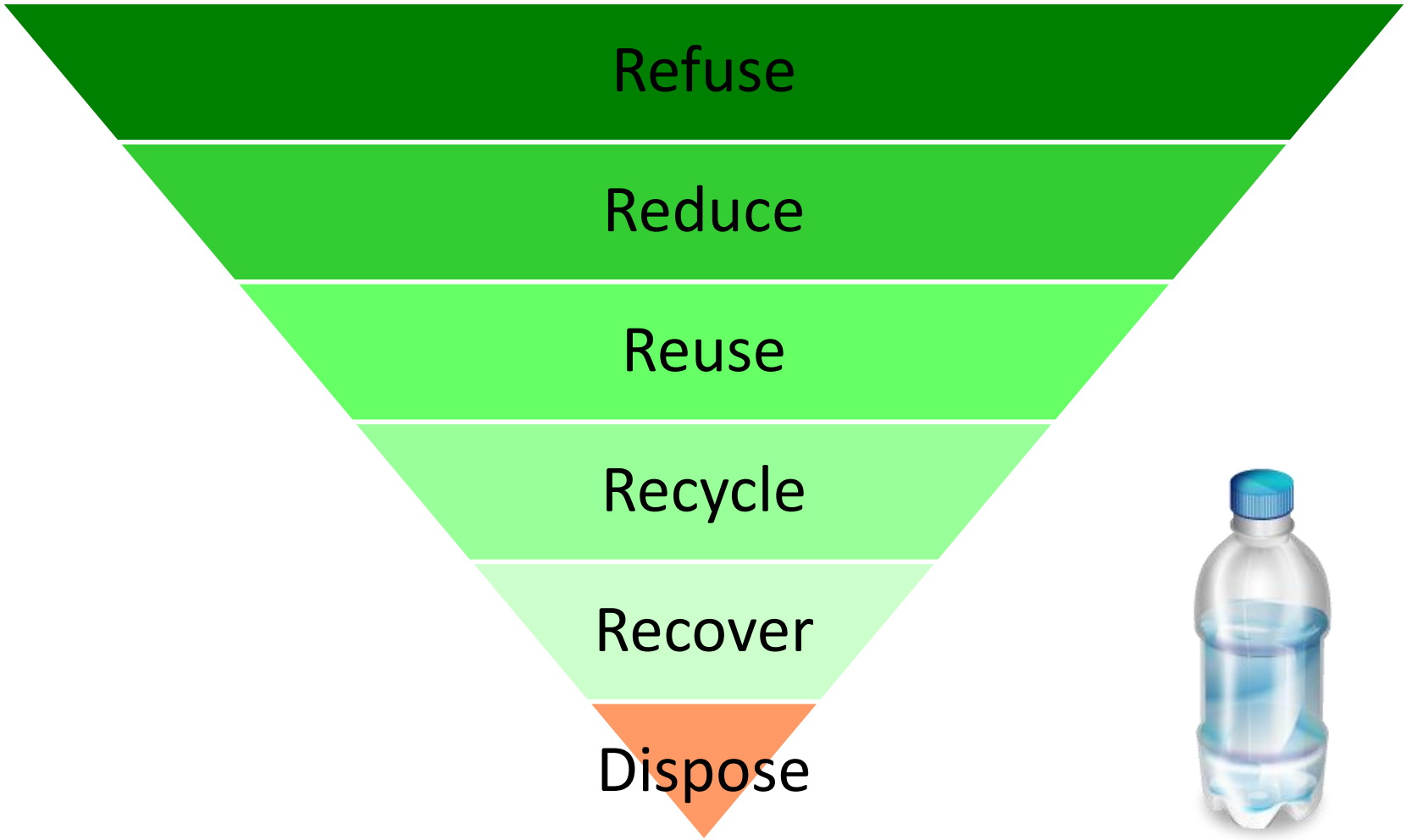
## Non-value added

- X Lighting for office area on overtime to fix a document that wasn't done right the first time
- X Air conditioner replacement due to neglect
- X Test equipment left on overnight when not being used
- X Overhead projectors left on in conference room
- X Cooling an area that is not being used

**The customer does not want to pay for non-value added waste!**

# Waste Pyramid

Zero Waste



# New way to think about W.A.S.T.E.


**WHICH W.A.S.T.E. is more important in your organization?**

# Case Study: Green → Lean

# Case Study: Green → Lean

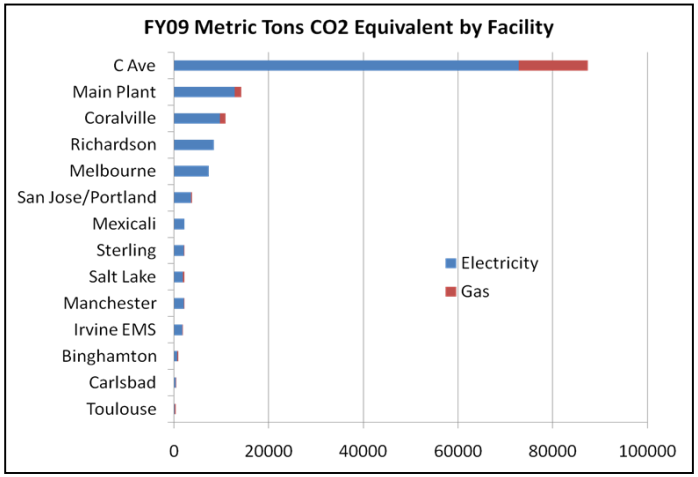
- Less unpackaging
- Easy identification
- Controls inventory (kanban)
- Breaks down for easy shipment back to supplier

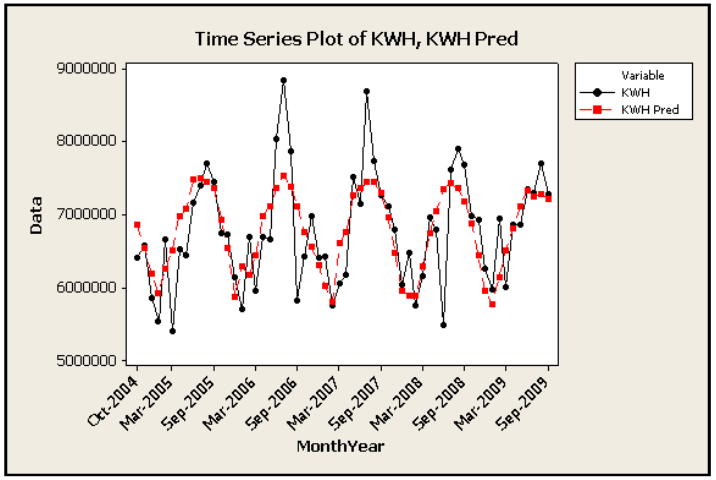
**FOCUSING ON GREEN IS A WIN-WIN FOR BUSINESS**

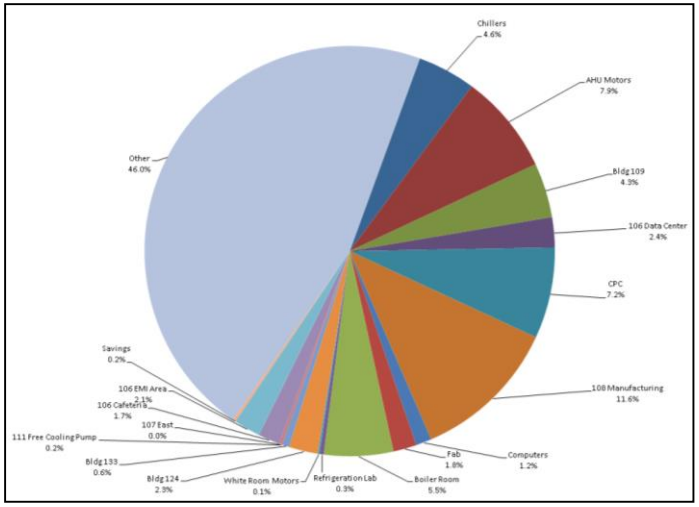
# Lean Energy "Go and See"

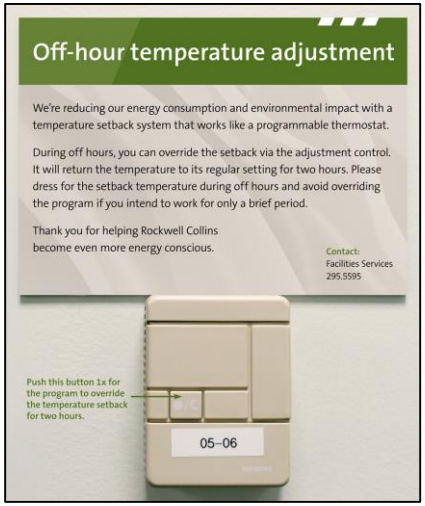
- Four "Go and See" sessions
  - Off shift
  - Start-up
  - Working time (w/breaks)
  - Shut down/Transfer
- Break into small groups
- Teams should be mix of process and technical experts, fresh set of eyes, and different levels of organization

# Six Sigma Project



# Wilsonville (Portland) Success

- Moving towards sustainability
  - Green team, 30% recycled paper, composting, “Green Bag” sessions, green cleaners
  - “Go and See” events
  - Electricity Six Sigma project
- Achieved Gold certification in Dec 2015 (getting started)
- Launched new effort at corporate level

# Others having success…

**Results from "Lean and Environment" Efforts (Box ES-2)**

- ✓ **3M** reduced volatile air emissions by 61% and toxic inventory releases by 64% from 2000 to 2005 using Lean and Six Sigma techniques in coordination with pollution prevention.
- ✓ **Columbia Paint & Coatings** recovered 49,200 lbs per year of paint solids from wash water and reduced wastewater by 36,900 gallons per year based on a few Lean and environment events.
- ✓ **Woodfold Manufacturing** reduced volatile organic compound (VOC) emissions by nearly 1,000 lbs per year and diverted 6 tons per year of solid PVC waste from the landfill through opportunities identified in a value stream mapping event.

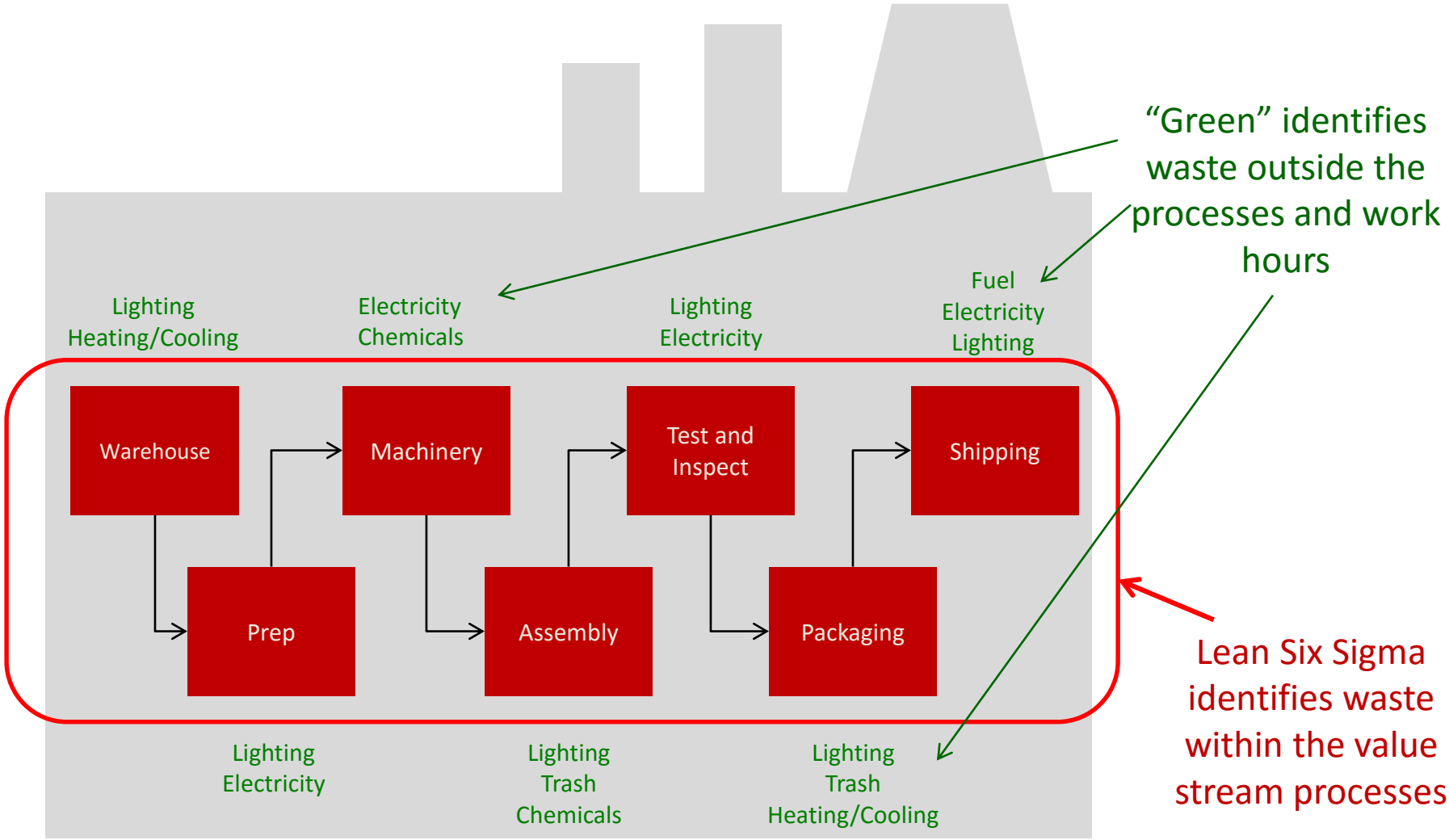
The Environmental Professional's Guide to Lean & Six Sigma

"…savings have offset the expenses by approximately 2 to 1" - IBM

# Purpose-driven Excellence

- Businesses have a responsibility to balance profits with people and planet
- Companies leading the sustainability effort are seeing positive impacts to their business (not negative impact as suspected)
- Lean Six Sigma professionals have the right skills to lead this effort
  - Do you want to help with **people** or **planet**?

# What gaps are missed with LSS?



# More gaps missed with LSS

- “Cost of doing business,” not seen as a problem
- Small impact at process or VSM level, need to view opportunities at site level
- Costs and impacts can be blanketed across many areas, hard to isolate data to biggest users
- Using recycled content, clean energy or less toxins not typically focus of improvements
- Environmental and human health risks and costs are not fully paid by businesses (externalities)
- Side benefits of efforts not known or anticipated

# What approach might work?

## ES&H

"Bottoms Up" with People

- Turn off equipment
- Recycling and composting
- Hazardous waste processes
- Water conservation
- Air leak prevention

## Facilities

"Top Down" with Infrastructure

- Renewable Energy
- Efficiency Upgrades
- Green Cafeteria
- Electric Charging Station
- LEED buildings
- Showers for bikers

# Modified LSS Tools

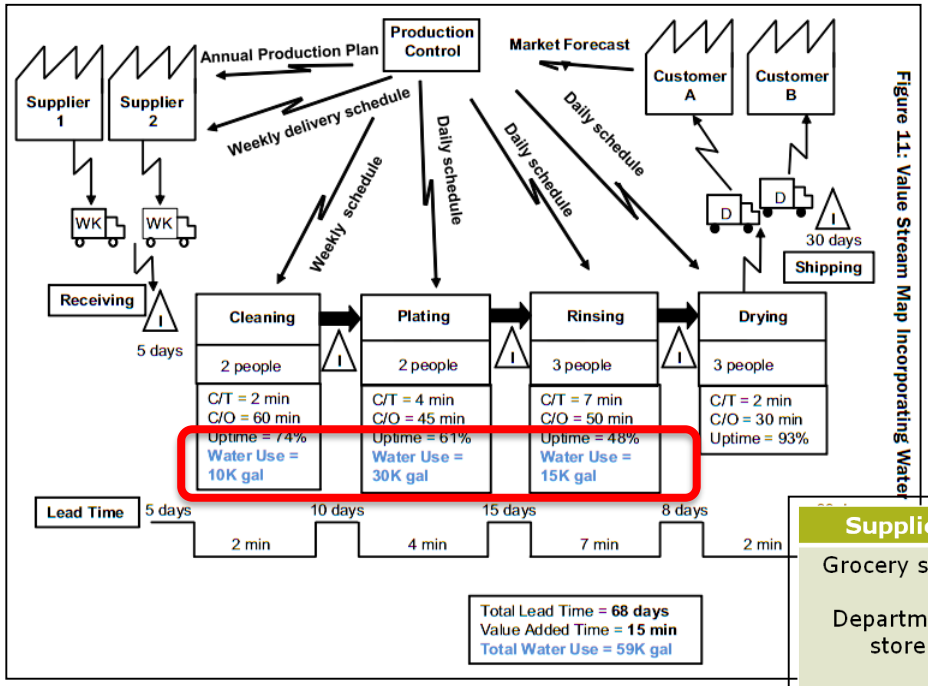
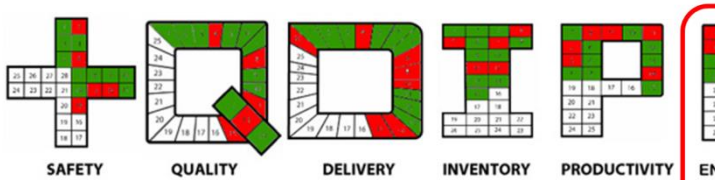



Figure 11: Value Stream Map Incorporating Water




| Safety | Quality | Delivery | Inventory | Productivity | Environment |
|---|---|---|---|---|---|
| •No missed days<br>•No injuries | •Less than 5 defects per day<br>•DPMO less than 50<br>•Test Yield greater than 95% | •100% on-time to customers, schedule, next process, etc<br>•Complete 10 units per day | •WIP less than 10 units<br>•No more than 3 pieces at each station<br>•WIP less than $10,000 | •$/hr greater than $150<br>•Less than 10 minutes of downtime<br>•Team met daily takt time goals | •All equipment shut off at end of shift<br>•No recyclables in trash<br>•100% Hazardous waste adherence |

| Supplier | Inputs | Process | Outputs | Customer |
|---|---|---|---|---|
| Grocery store | Food and drinks | Purchase Items | Trash | Landfill |
| Department store | Gifts | Remove from packaging | Recycled Materials | Residents |
| Farmer's Market | Household items | Sort out waste into bins | Compost Dirt | Community |
| Gas station | Tools | Bins collected | Greenhouse Gas Emissions | Environment |
| Department store | City website | Contents dropped off to correct location | Lechete | |
| Restaurant | | | | |
| City Officials | | | | |

# Modified LSS Tools

**SIPOC**

- Add Earth as a customer

**SQDC boards**

- Add “E” for environment

**DMAIC → DMAGIC**

- G is for “Green” impacts

**VSM**

- Add water, energy and chemicals to data box
- Show usage on timeline

**OEE**

- Add Energy Consumption to calculation

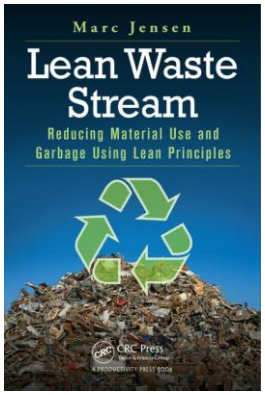
# Strategy Enhancements

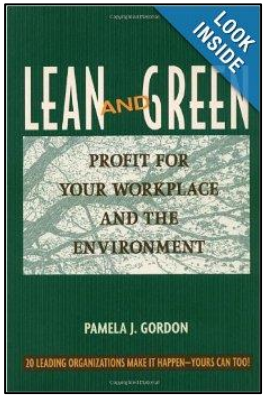
- Focus improvement efforts specifically on social and environmental metrics using Lean Six Sigma
- Relate environmental and social issues to core business needs and priorities
- All process improvements naturally reduce impact on the environment, so start capturing the benefits!
- Share this presentation with Facilities, ES&H and LSS personnel

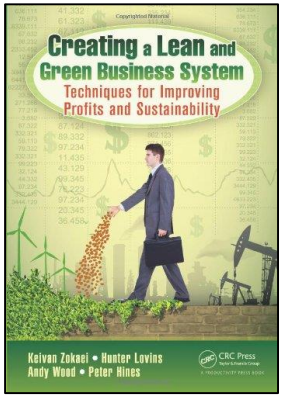
# Tactical Enhancements

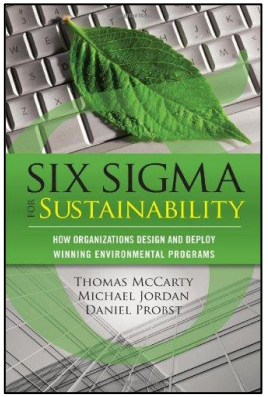
- Add Earth as a customer on your SIPOC
- Add environmental usage and costs to data boxes on VSM
- Add environmental impacts to waste definitions and training materials
- Integrate environmental checklists into event templates
- Invite ES&H and Facilities personnel to lean events and Six Sigma project teams

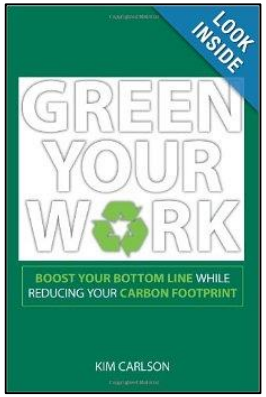
# Books

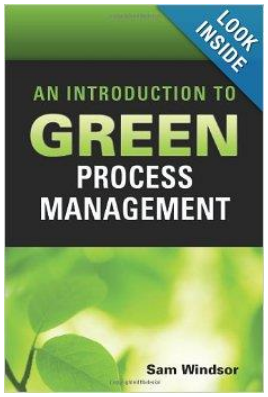

Marc Jensen
Lean Waste Stream
Reducing Material Use and Garbage Using Lean Principles
CRC Press

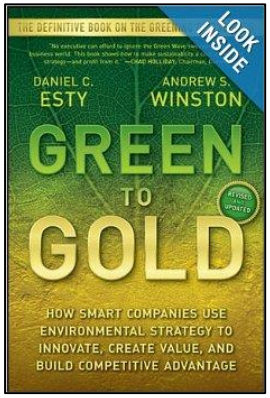

LOOK INSIDE
LEAN AND GREEN
PROFIT FOR YOUR WORKPLACE AND THE ENVIRONMENT
PAMELA J. GORDON
20 LEADING ORGANIZATIONS MAKE IT HAPPEN—YOURS CAN TOO!

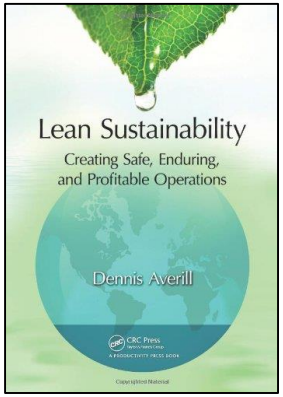

Creating a Lean and Green Business System
Techniques for Improving Profits and Sustainability
Keivan Zokaei • Hunter Lovins
Andy Wood • Peter Hines
CRC Press

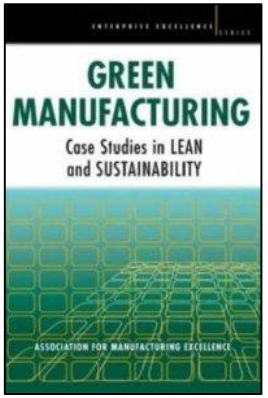

SIX SIGMA FOR SUSTAINABILITY
HOW ORGANIZATIONS DESIGN AND DEPLOY WINNING ENVIRONMENTAL PROGRAMS
THOMAS MCCARTY
MICHAEL JORDAN
DANIEL PROBST

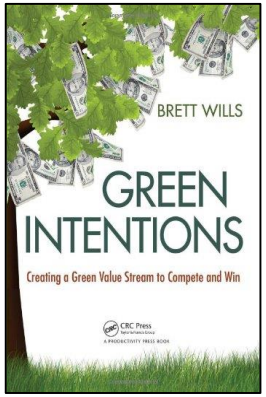

LOOK INSIDE
GREEN YOUR WORK
BOOST YOUR BOTTOM LINE WHILE REDUCING YOUR CARBON FOOTPRINT
KIM CARLSON


LOOK INSIDE
AN INTRODUCTION TO
GREEN PROCESS MANAGEMENT
Sam Windsor


LOOK INSIDE
DANIEL C. ESTY
ANDREW S. WINSTON
GREEN TO GOLD
HOW SMART COMPANIES USE ENVIRONMENTAL STRATEGY TO INNOVATE, CREATE VALUE, AND BUILD COMPETITIVE ADVANTAGE

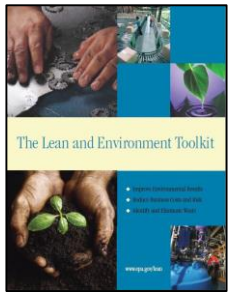

Lean Sustainability
Creating Safe, Enduring, and Profitable Operations
Dennis Averill
CRC Press

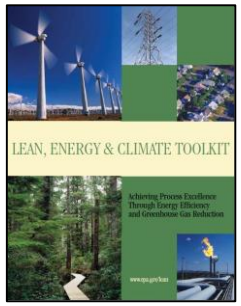

GREEN MANUFACTURING
Case Studies in LEAN and SUSTAINABILITY
ASSOCIATION FOR MANUFACTURING EXCELLENCE

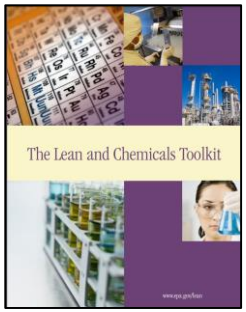

BRETT WILLS
GREEN INTENTIONS
Creating a Green Value Stream to Compete and Win
CRC Press

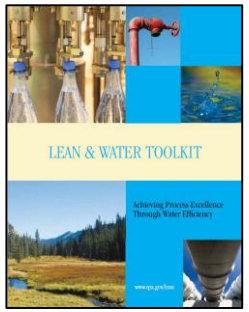
# EPA Resources

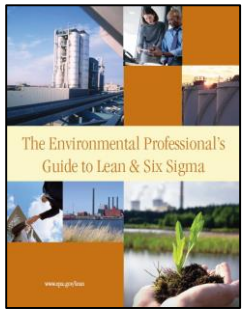
- The Lean and Environment Toolkit
- The Lean, Energy & Climate Toolkit
- The Lean and Chemicals Toolkit
- The Lean & Water Toolkit
- The Environmental Professional's Guide to Lean & Six Sigma



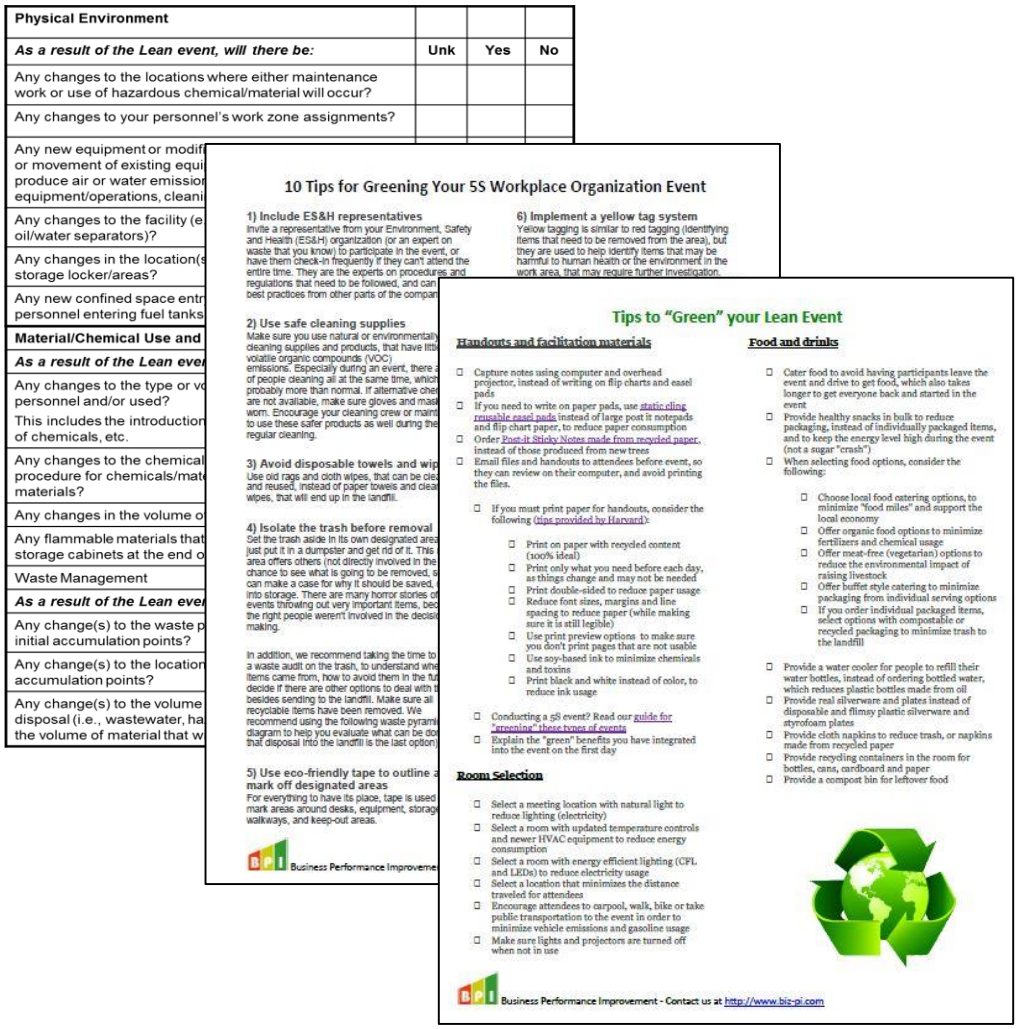



# Useful Checklists



| Physical Environment | | | |
|---|---|---|---|
| *As a result of the Lean event, will there be:* | Unk | Yes | No |
| Any changes to the locations where either maintenance work or use of hazardous chemical/material will occur? | | | |
| Any changes to your personnel's work zone assignments? | | | |
| Any new equipment or modif or movement of existing equi produce air or water emissio equipment/operations, cleani | | | |
| Any changes to the facility (e oil/water separators)? | | | |
| Any changes in the location( storage locker/areas? | | | |
| Any new confined space entr personnel entering fuel tanks | | | |
| **Material/Chemical Use and** | | | |
| ***As a result of the Lean eve*** | | | |
| Any changes to the type or v personnel and/or used? This includes the introduction of chemicals, etc. | | | |
| Any changes to the chemical procedure for chemicals/mat materials? | | | |
| Any changes in the volume o | | | |
| Any flammable materials that storage cabinets at the end o | | | |
| Waste Management | | | |
| ***As a result of the Lean eve*** | | | |
| Any change(s) to the waste p initial accumulation points? | | | |
| Any change(s) to the location accumulation points? | | | |
| Any change(s) to the volume disposal (i.e., wastewater, ha the volume of material that w | | | |

**10 Tips for Greening Your 5S Workplace Organization Event**

**1) Include ES&H representatives**
Invite a representative from your Environment, Safety and Health (ES&H) organization (or an expert on waste that you know) to participate in the event, or have them check-in frequently if they can't attend the entire time. They are the experts on procedures and regulations that need to be followed, and can best practices from other parts of the compan

**2) Use safe cleaning supplies**
Make sure you use natural or environmentally cleaning supplies and products, that have litt volatile organic compounds (VOC) emissions. Especially during an event, there of people cleaning all at the same time, which probably more than normal. If alternative che are not available, make sure gloves and mask worn. Encourage your cleaning crew or maint to use these safer products as well during the regular cleaning.

**3) Avoid disposable towels and wip**
Use old rags and cloth wipes, that can be cle and reused, instead of paper towels and clea wipes, that will end up in the landfill.

**4) Isolate the trash before removal**
Set the trash aside in its own designated area just put it in a dumpster and get rid of it. This area offers others (not directly involved in the chance to see what is going to be removed, s can make a case for why it should be saved, into storage. There are many horror stories of events throwing out very important items, bec the right people weren't involved in the decisi making.

In addition, we recommend taking the time to a waste audit on the trash, to understand whe items came from, how to avoid them in the fu decide if there are other options to deal with t besides sending to the landfill. Make sure all recyclable items have been removed. We recommend using the following waste pyrami diagram to help you evaluate what can be do that disposal into the landfill is the last option)

**5) Use eco-friendly tape to outline a mark off designated areas**
For everything to have its place, tape is used mark areas around desks, equipment, storag walkways, and keep-out areas.

Business Performance Improveme

**Tips to "Green" your Lean Event**

**Handouts and facilitation materials**

- ☐ Capture notes using computer and overhead projector, instead of writing on flip charts and easel pads
- ☐ If you need to write on paper pads, use static cling reusable easel pads instead of large post it notepads and flip chart paper, to reduce paper consumption
- ☐ Order Post-it Sticky Notes made from recycled paper, instead of those produced from new trees
- ☐ Email files and handouts to attendees before event, so they can review on their computer, and avoid printing the files.
- ☐ If you must print paper for handouts, consider the following (tips provided by Harvard):
  - ☐ Print on paper with recycled content (100% ideal)
  - ☐ Print only what you need before each day, as things change and may not be needed
  - ☐ Print double-sided to reduce paper usage
  - ☐ Reduce font sizes, margins and line spacing to reduce paper (while making sure it is still legible)
  - ☐ Use print preview options to make sure you don't print pages that are not usable
  - ☐ Use soy-based ink to minimize chemicals and toxins
  - ☐ Print black and white instead of color, to reduce ink usage
- ☐ Conducting a 5S event? Read our guide for "greening" these types of events
- ☐ Explain the "green" benefits you have integrated into the event on the first day

**Room Selection**

- ☐ Select a meeting location with natural light to reduce lighting (electricity)
- ☐ Select a room with updated temperature controls and newer HVAC equipment to reduce energy consumption
- ☐ Select a room with energy efficient lighting (CFL and LEDs) to reduce electricity usage
- ☐ Select a location that minimizes the distance traveled for attendees
- ☐ Encourage attendees to carpool, walk, bike or take public transportation to the event in order to minimize vehicle emissions and gasoline usage
- ☐ Make sure lights and projectors are turned off when not in use

**Food and drinks**

- ☐ Cater food to avoid having participants leave the event and drive to get food, which also takes longer to get everyone back and started in the event
- ☐ Provide healthy snacks in bulk to reduce packaging, instead of individually packaged items, and to keep the energy level high during the event (not a sugar "crash")
- ☐ When selecting food options, consider the following:
  - ☐ Choose local food catering options, to minimize "food miles" and support the local economy
  - ☐ Offer organic food options to minimize fertilizers and chemical usage
  - ☐ Offer meat-free (vegetarian) options to reduce the environmental impact of raising livestock
  - ☐ Offer buffet style catering to minimize packaging from individual serving options
  - ☐ If you order individual packaged items, select options with compostable or recycled packaging to minimize trash to the landfill
- ☐ Provide a water cooler for people to refill their water bottles, instead of ordering bottled water, which reduces plastic bottles made from oil
- ☐ Provide real silverware and plates instead of disposable and flimsy plastic silverware and styrofoam plates
- ☐ Provide cloth napkins to reduce trash, or napkins made from recycled paper
- ☐ Provide recycling containers in the room for bottles, cans, cardboard and paper
- ☐ Provide a compost bin for leftover food

Business Performance Improvement - Contact us at http://www.biz-pi.com

- **ES&H Lean Event Checklist**
- **10 Tips for Greening your 5S event**
- **Tips to Green your Lean Event**

# Summary

- Lean is Green
- Waste has a direct environmental impact
- Green is Lean
- Sustainability is good for business
- Leverage LSS to implement sustainability (strong alignment)
- LSS doesn't address all the issues
- Help ES&H help with bottoms up and Facilities address from top down
- Lots of great books and websites available

# Thank You!

**Your opinion is important to us!**
Please take a moment to complete the survey using the conference mobile app.

**Session:** WP/35
**Integrating environmental sustainability into your lean and six sigma program**

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Rockwell Collins
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