Lean Manufacturing and TUR

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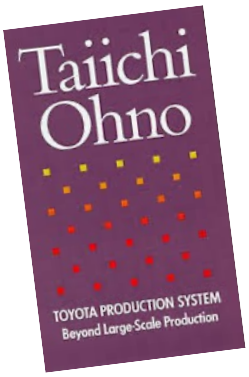
What is Lean?

Pay → Time → **Get Paid**



All we are doing is looking at the time line, from the moment the customer gives us an order to the point when we collect the cash. And we are reducing the time line by reducing the non-value adding wastes.

– Taiichi Ohno, Toyota Production System

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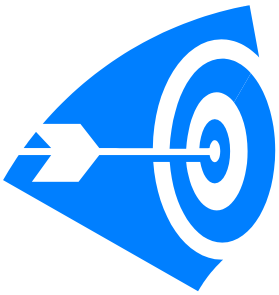
Non-value-adding Wastes

Muda

7 Wastes

- S torage
- T ransportation
- O ver-production
- P rocessing
- M otion
- D efects
- W aiting



3 M'S

Mura

Unevenness or inconsistency.

Mur_.

Strain or Over- burden

"98% of elapsed time to provide a product or services is non-value-added."

3

Concept behind flow – "Process vs. Operation"

"It is necessary to comprehend the mechanism of production function correctly in order to study Toyota Production System."

Process - flow of materials to products, which changes in accordance with course of time and space simultaneously.

Operation – Operator and machinery flow . . ., which change in accordance with time and space simultaneously.

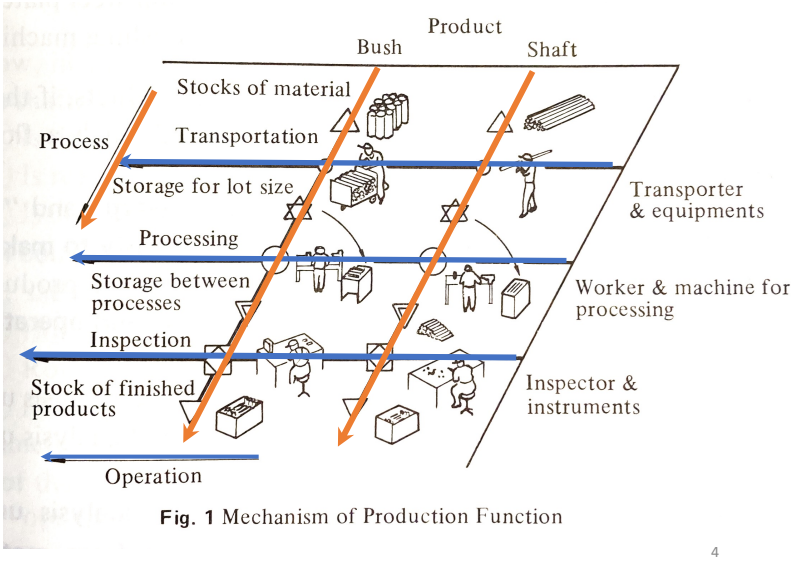


Fig. 1 Mechanism of Production Function

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Concept behind flow – ”Process vs. Operation”

Process
Material & Information

“The only way to reduce the waste of transport is layout.”
- Shigeo Shingo

Operation
People & Equipment

“Time is the shadow of motion . . . .”
- Frank & Lillian Gilbreth

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Another Critical Waste

“Lean usually helps the environment without really intending to. A Shingo Prize- winning study that EPA commissioned found that through Lean, many companies were saving money by taking steps that also benefited the environment, even when they were not consciously trying to do so. “Environmental” wastes, such as excess energy or water use, hazardous waste, or solid waste, present largely untapped opportunities to the lean practitioner.” – Mitch Kidwell, EPA

Lean Manufacturing and the Environment

Ignoring the 8th Deadly Waste' leaves money on the table.

Mitch Kidwell

Taking a break from a kaizen event, I had the rare opportunity to pick the brain of the sensei, a Japanese consultant who had been involved with lean manufacturing since before its arrival to the United States. Since I work for the Environmental Protection Agency (EPA), I asked him about the status of lean manufacturing in Japan, and in particular whether the focus of lean and efficient production had begun addressing environmental concerns. Through a few more questions and responses, his answer became clear. Environmental concerns are a part of the lean concept. Emissions to air and water, as well as the generation of solid/hazardous waste, represent a waste of production that is, no value to the customer), just as surely as the need for protective equipment (such as gloves and ear plugs) is, and that eventually lean would address them.

Lean usually helps the environment without really intending to. A Shingo Prize-winning study that EPA commissioned found that through Lean, many companies were saving money by taking steps that also benefited the environment, even when they were not consciously trying to do so. "Environmental" wastes, such as excess energy or water use, hazardous waste, or solid waste, present largely untapped opportunities to the lean practitioner. This is obvious if one steps back to consider the overall goals of lean manufacturing continually improving production efficiency. More efficient production means less energy used per unit produced. It means less material resources are used per unit produced, and materials (and energy, for that matter) are used or reused more efficiently. Aside from the obvious savings on production costs, this more efficient use means not only less energy and raw materials consumed, but also less material emitted to air and water, and less solid/hazardous waste generated. See the box for examples.

Therefore, EPA has begun to look very closely at lean as an area in which environmental and business practitioners can work together. On the one hand, lean practitioners save money finding undiscovered opportunities to eliminate the same wastes that concern environmental agencies. On the other hand, much expertise in environmental waste-minimizing opportunities already exists. It is readily available by tap-

In Brief

Lean strategies coincidentally benefit the environment, without the need for special "environmental" toolkits or a separate focus on environmental considerations, as explained by author Mitch Kidwell of the EPA.

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"Identification of waste is the problem . . ."

Process, Operation and Environmental Wastes?

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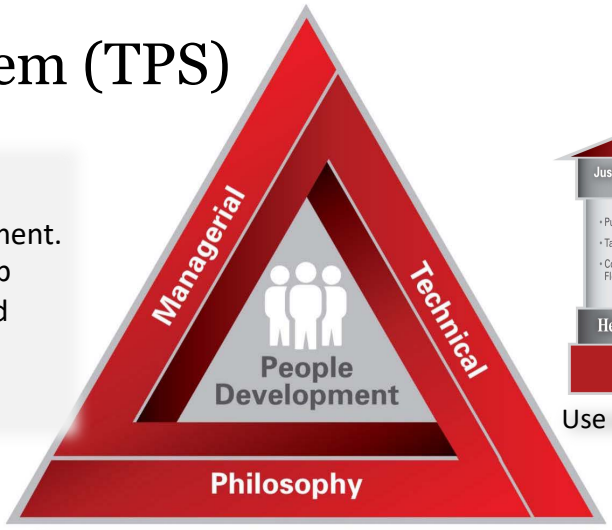
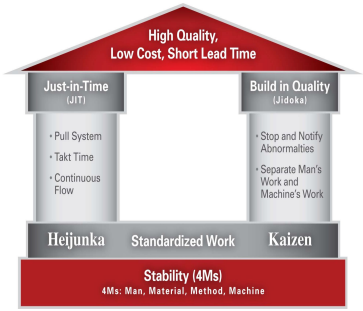
Lean System (TPS)

- Create a favorable environment for continuous improvement.
- Motivate and develop people to surface and solve problems.
- Show strong, visible commitment to TPS



Customer first thinking.
People are the most valuable resource.
Shopfloor focus – direct observation.
Kaizen.



Use TPS tools correctly.

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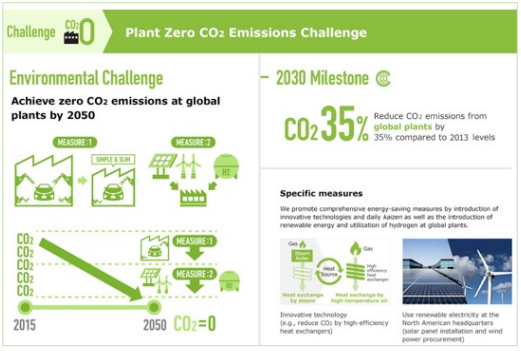
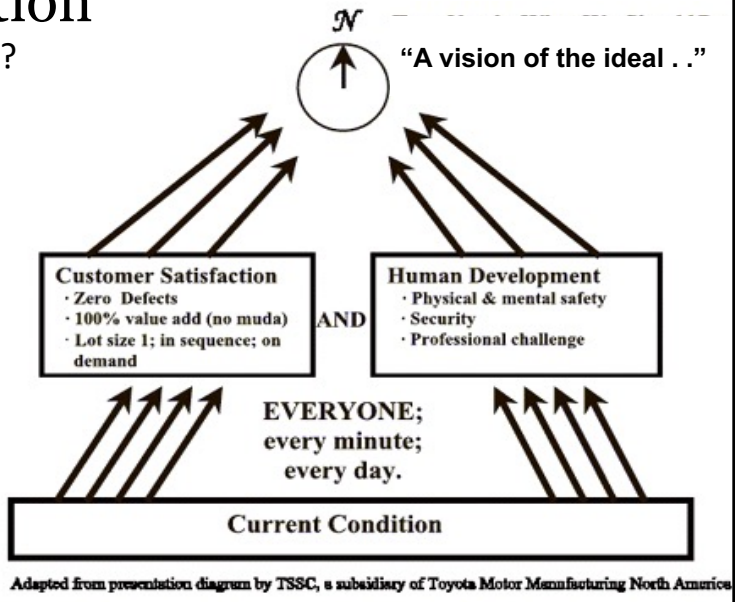
TUR Ideal Condition

What are the ideal conditions?

- Water use?
- Energy use?
- Solid waste?
- Toxic Chemicals?

What are your target conditions?





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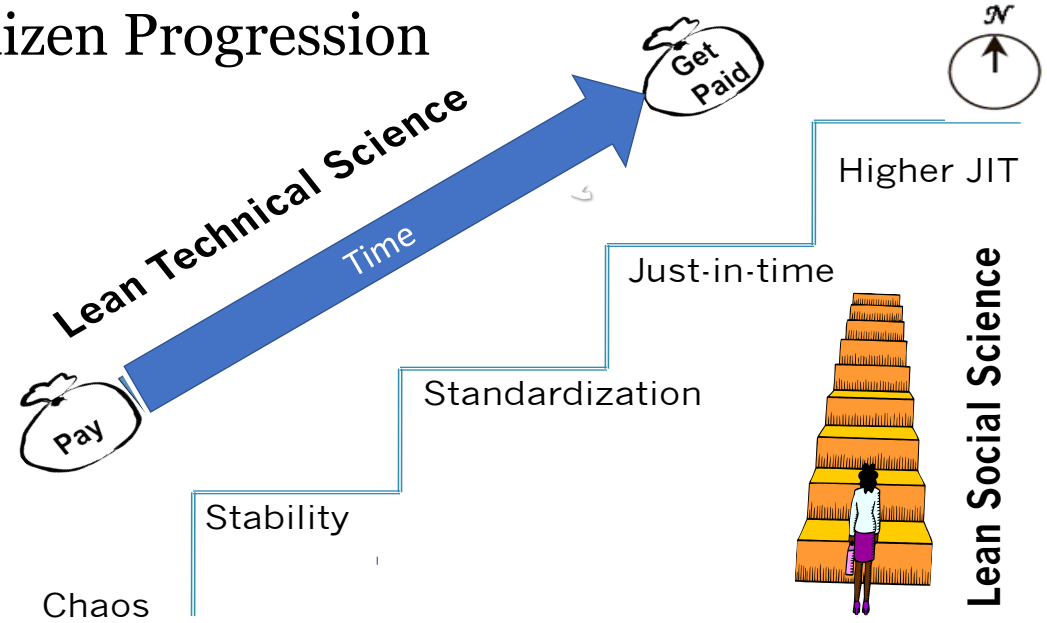
Kaizen Progression



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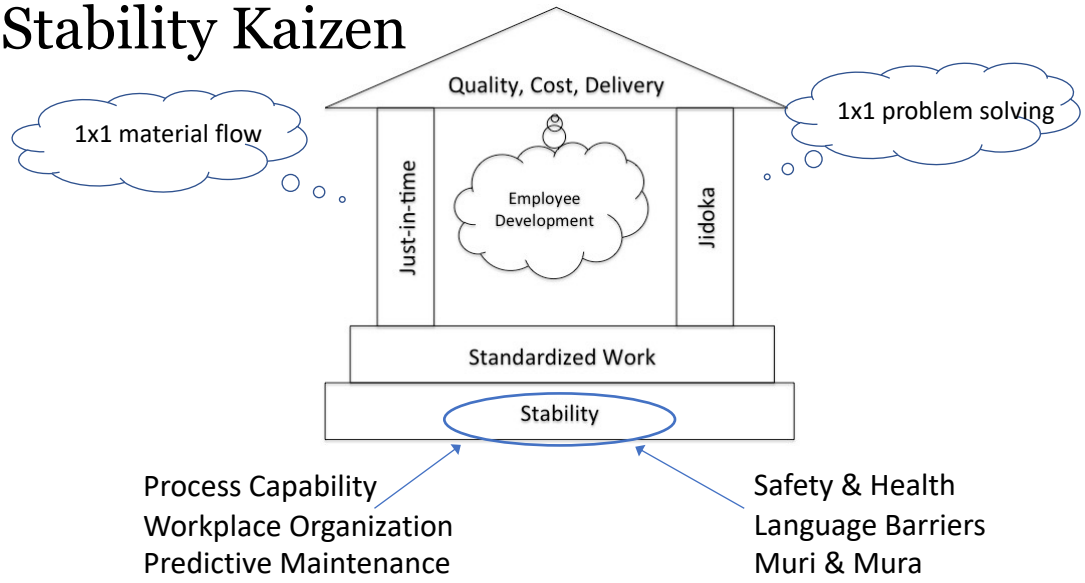
Stability Kaizen



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Stability Kaizen

5S-Workplace Organization

1) Sort out.
2) Set in order.
3) Sweep, scrub, shine
4) Standardize
5) Sustain

Good

5S Checklist in Chemical Room.

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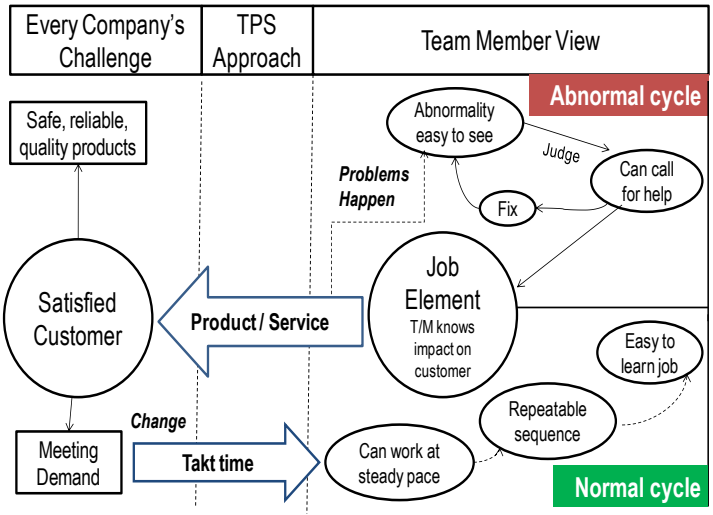
Standardization Kaizen

Standardized Work & Problem Solving



"All work shall be highly specified as to the content, sequence, timing, and outcome."
-Spear and Bowen, Decoding the DNA of TPS

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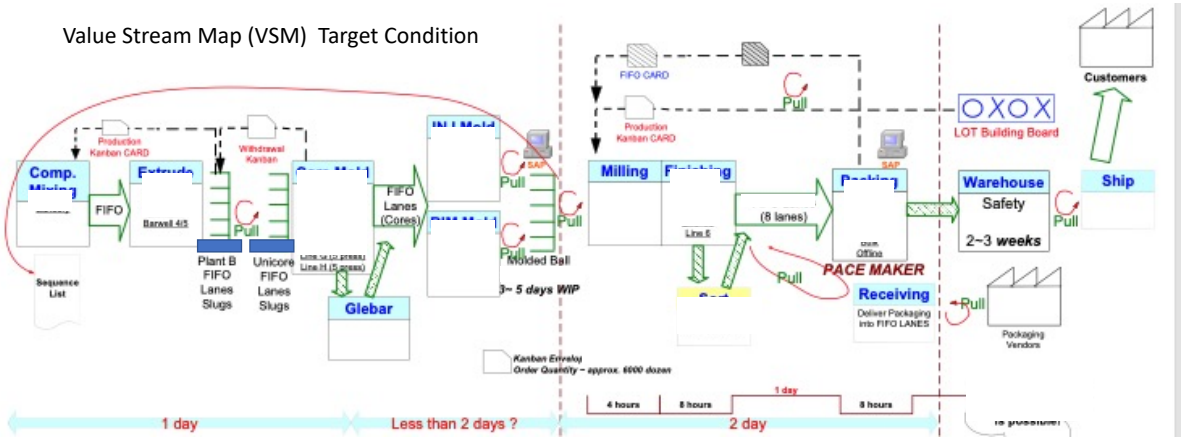
JIT Kaizen

Rapid Equipment Change and Kanban

Goal was lead-time and inventory reduction, with 'surprising' corresponding reduction in energy consumption.

Value Stream Map (VSM) Target Condition



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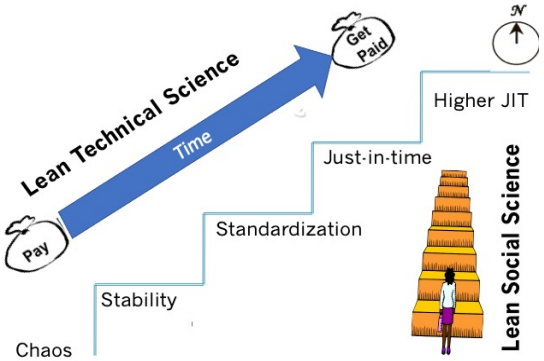
Key Roles for Top Management

1)Strong, Visible Commitment

2)Understand Lean Correctly (principles & details)

3)Make Problems Visible (build culture to expose & solve problems)

4)Go & See shop floor regularly to grasp the actual condition



"The biggest obstacle to improvement is the lack of the will to improve." -Shigeo Shingo

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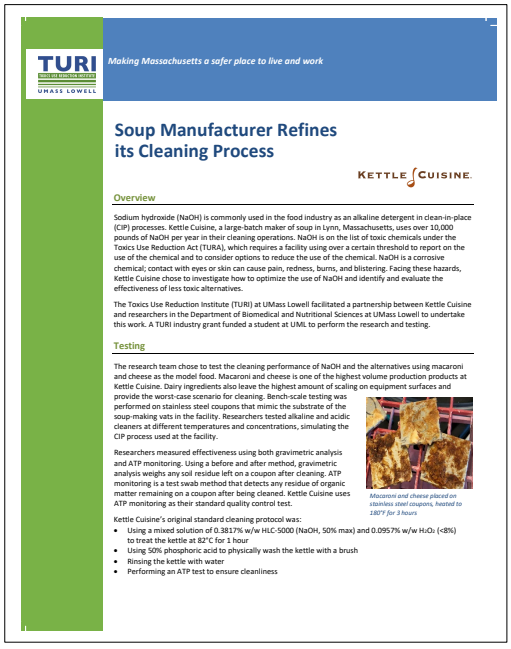
Lean and TUR Together

Ideal Condition: Zero Toxic Chemicals
Target Condition: Reduce Toxicity.
Current Condition:

- Use a mixed solution of 0.3817% w/w HLC-5000 (NaOH, 50% max) and 0.0957% w/w H_2O_2 (<8%)
- to treat the kettle at 82°C for 1 hour
- Use 50% phosphoric acid to physically wash the kettle with a brush
- Rinse the kettle with water
- Perform ATP test to ensure cleanliness

Hypothesis:
•Toxicity and temperature can be reduced with successful ATP test.
Experiment: Several alternative processes tested with H_2O_2 substitution for NaOH.
Results: CIP process can be optimized for reduced energy and toxicity.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Soup Manufacturer Refines its Cleaning Process

KETTLE CUISINE

Overview

Sodium hydroxide (NaOH) is commonly used in the food industry as an alkaline detergent in clean-in-place (CIP) processes. Kettle Cuisine, a large-batch maker of soup in Lynn, Massachusetts, uses over 10,000 pounds of NaOH per year in their cleaning operations. NaOH is on the list of toxic chemicals under the Toxics Use Reduction Act (TURA), which requires a facility using over a certain threshold to report on the use of the chemical and to consider options to reduce the use of the chemical. NaOH is a corrosive chemical; contact with eyes or skin can cause pain, redness, burns, and blistering. Facing these hazards, Kettle Cuisine chose to investigate how to optimize the use of NaOH and identify and evaluate the effectiveness of less toxic alternatives.

The Toxics Use Reduction Institute (TURI) at UMass Lowell facilitated a partnership between Kettle Cuisine and researchers in the Department of Biomedical and Nutritional Sciences at UMass Lowell to undertake this work. A TURI industry grant funded a student at UML to perform the research and testing.

Testing

The research team chose to test the cleaning performance of NaOH and the alternatives using macaroni and cheese as the model food. Macaroni and cheese is one of the highest volume production products at Kettle Cuisine. Dairy ingredients also leave the highest amount of scaling on equipment surfaces and provide the worst-case scenario for cleaning. Bench-scale testing was performed on stainless steel coupons that mimic the substrate of the soup-making vats in the facility. Researchers tested alkaline and acidic cleaners at different temperatures and concentrations, simulating the CIP process used at the facility.

Researchers measured effectiveness using both gravimetric analysis and ATP monitoring. Using a before and after method, gravimetric analysis weighs any soil residue left on a coupon after cleaning. ATP monitoring is a test swab method that detects any residue of organic matter remaining on a coupon after being cleaned. Kettle Cuisine uses ATP monitoring as their standard quality control test.

Macaroni and cheese placed on stainless steel coupons, heated to 180°F for 3 hours

Kettle Cuisine's original standard cleaning protocol was:

- Using a mixed solution of 0.3817% w/w HLC-5000 (NaOH, 50% max) and 0.0957% w/w H_2O_2 (<8%) to treat the kettle at 82°C for 1 hour
- Using 50% phosphoric acid to physically wash the kettle with a brush
- Rinsing the kettle with water
- Performing an ATP test to ensure cleanliness

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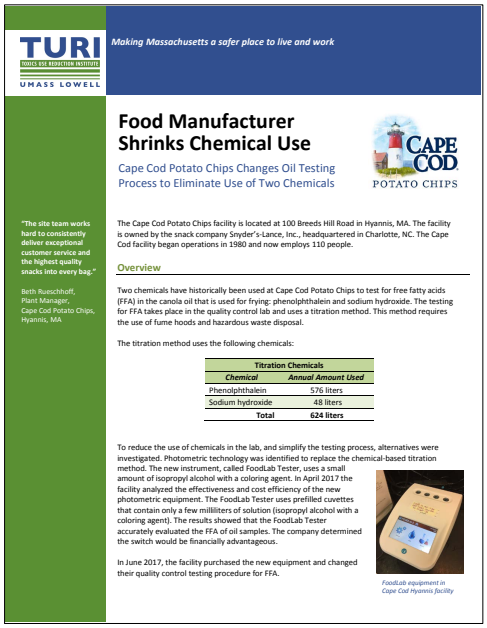
Lean and TUR Together

Ideal Condition: Zero toxic emissions from FFA Testing
Target Condition: Identify alternative test chemicals, sodium hydroxide and phenolphthalein.
Current Condition:
Titration method using above chemicals; fume hoods and hazardous waste disposal.

Hypothesis:
Alternative FFA testing method via photometric technology will be safer and reduce toxic waste stream.
Experiment: Photometric test is cheaper and faster; also safer: eliminates need for hoods
Results: Labor savings and testing time reduction, toxic waste removal eliminated. Cost savings.



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Food Manufacturer Shrinks Chemical Use

Cape Cod Potato Chips Changes Oil Testing Process to Eliminate Use of Two Chemicals

CAPE COD POTATO CHIPS

"The site team works hard to consistently deliver exceptional customer service and the highest quality snacks into every bag."

Beth Rueschhoff, Plant Manager, Cape Cod Potato Chips, Hyannis, MA

The Cape Cod Potato Chips facility is located at 100 Breeds Hill Road in Hyannis, MA. The facility is owned by the snack company Snyder's-Lance, Inc., headquartered in Charlotte, NC. The Cape Cod facility began operations in 1980 and now employs 110 people.

Overview

Two chemicals have historically been used at Cape Cod Potato Chips to test for free fatty acids (FFA) in the canola oil that is used for frying: phenolphthalein and sodium hydroxide. The testing for FFA takes place in the quality control lab and uses a titration method. This method requires the use of fume hoods and hazardous waste disposal.

The titration method uses the following chemicals:

Titration Chemicals	
Chemical	*Annual Amount Used*
Phenolphthalein	576 liters
Sodium hydroxide	48 liters
Total	**624 liters**

To reduce the use of chemicals in the lab, and simplify the testing process, alternatives were investigated. Photometric technology was identified to replace the chemical-based titration method. The new instrument, called FoodLab Tester, uses a small amount of isopropyl alcohol with a coloring agent. In April 2017 the facility analyzed the effectiveness and cost efficiency of the new photometric equipment. The FoodLab Tester uses prefilled cuvettes that contain only a few milliliters of solution (isopropyl alcohol with a coloring agent). The results showed that the FoodLab Tester accurately evaluated the FFA of oil samples. The company determined the switch would be financially advantageous.

In June 2017, the facility purchased the new equipment and changed their quality control testing procedure for FFA.

FoodLab equipment in Cape Cod Hyannis facility

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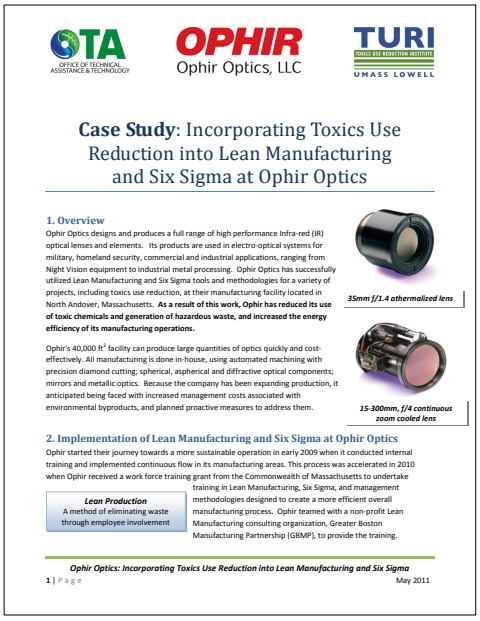
Lean and TUR Together

Ideal Condition: Zero toxic emissions from machining
Target Condition: Identify alternative to toxic mineral spirits (VOC's) from coolant.
Current Condition:
Mineral spirit consumption increase from 2008-9.
Hypothesis:
Using six sigma process, identify key factors and operating parameters for cutting machines.
Experiment: Tightly control levels to optimal per OTA.
Results: **Sh**arp decline 2010 with implementation,; also higher quality with less adjustment, lower permit costs; hazardous waste reduced by 2/3, site reclassified as a small generator.



OTA
OFFICE OF TECHNICAL ASSISTANCE & TECHNOLOGY

OPHIR
Ophir Optics, LLC

TURI
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Case Study: Incorporating Toxics Use Reduction into Lean Manufacturing and Six Sigma at Ophir Optics

1. Overview

Ophir Optics designs and produces a full range of high performance Infra-red (IR) optical lenses and elements. Its products are used in electro-optical systems for military, homeland security, commercial and industrial applications, ranging from Night Vision equipment to industrial metal processing. Ophir Optics has successfully utilized Lean Manufacturing and Six Sigma tools and methodologies for a variety of projects, including toxics use reduction, at their manufacturing facility located in North Andover, Massachusetts. **As a result of this work, Ophir has reduced its use of toxic chemicals and generation of hazardous waste, and increased the energy efficiency of its manufacturing operations.**

35mm f/1.4 athermalized lens

Ophir's 40,000 ft^2 facility can produce large quantities of optics quickly and cost-effectively. All manufacturing is done in-house, using automated machining with precision diamond cutting; spherical, aspherical and diffractive optical components; mirrors and metallic optics. Because the company has been expanding production, it anticipated being faced with increased management costs associated with environmental byproducts, and planned proactive measures to address them.

15-300mm, f/4 continuous zoom cooled lens

2. Implementation of Lean Manufacturing and Six Sigma at Ophir Optics

Ophir started their journey towards a more sustainable operation in early 2009 when it conducted internal training and implemented continuous flow in its manufacturing areas. This process was accelerated in 2010 when Ophir received a work force training grant from the Commonwealth of Massachusetts to undertake training in Lean Manufacturing, Six Sigma, and management methodologies designed to create a more efficient overall manufacturing process. Ophir teamed with a non-profit Lean Manufacturing consulting organization, Greater Boston Manufacturing Partnership (GBMP), to provide the training.

Lean Production
A method of eliminating waste through employee involvement

Ophir Optics: Incorporating Toxics Use Reduction into Lean Manufacturing and Six Sigma
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THANK YOU!
QUESTIONS?

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