Introduction

The American Society for Quality defines lean manufacturing as a set of management practices that improve efficiency and effectiveness by eliminating waste. Lean manufacturing does this by first breaking activities down into two types; value added and non-value added. Value added activities create customer value (i.e. things the customer is willing to pay for) while non-value added activities add costs that customers would rather not pay for. As a manufacturing principle, lean's focus is to continuously improve productivity by reducing non-value added activities. These approaches can be applied to sustainability.

Lean Manufacturing and Water Use

The U.S. Environmental Protection Agency (EPA) recommends using lean manufacturing strategies to address water usage and waste. The benefits of doing so include cost savings, operational improvements, reduced water-related business risks, and increased value for customers and employees. Below are a few ways to incorporate lean methods into a facility's water reduction program:

- Develop a resource efficiency team
- Complete a water bill analysis
- Identify water entering the facility, where it is used, and where it exits
- Hold facility walk-throughs
- Create a facility level water balance
- Develop a sustainable value stream map and include water use
- Conduct a rapid process improvement event

Need Help...
- establishing lean practices,
- training a team,
- or educating employees about resource efficiency?

Contact the Kentucky Pollution Prevention Center!
Website: www.kppc.org
Email: info@kppc.org
Phone: 502-852-0965
Developing a Team

A resource efficiency team is responsible for planning, implementing, benchmarking, monitoring, and evaluating the water reduction program. The team’s duties also include delivering training, communicating results, and providing recognition. This effort requires internal resources and employees’ time, however the cost to implement such an effort is small compared to the potential savings.

Ensure that the team is multidisciplinary with a representative from as many departments as feasible. Not only does this help to integrate the team into the organization; a diverse, cross-functional team can find more opportunities for reducing water use, and evaluate the benefits better than a team that is not cross functional.

Water Bill Analysis

An important place to start facility level water reduction efforts is with the water and wastewater bills. Analyzing these bills will help one learn the total water delivered to the facility and the amount leaving the facility as wastewater, with the associated costs.

Depending upon location, a facility's water bill can come bundled among other municipal bills. A water bill is typically measured in gallons. Also check to see how you are billed for wastewater, as often the utility assumes the amount of wastewater equals the amount of water used. The total cost of water should include both water and wastewater charges.

Facility Walk-through

Walk the grounds and the building to see where water is being used. This will help both employees and managers acquire a complete understanding of water use in the process and the facility (e.g. restrooms, landscaping, etc.). Develop a map of the process and identify where water enters/ exits each step of the process. Ask operators questions about how water is used and how much is consumed. Walk the floor while operations are active and during shutdown periods. Doing so will help identify any operations that are not properly shut down or leaking. Signs of leaks can be dirty water, low water pressure, and unaccounted water usage. Identify and fix any noted leaks. Repairing leaks is a good low cost solution to improving water efficiency. Follow up to ensure that identified leaks are fixed. A leak-detection checklist can be used on a regular basis to determine possible hot spots or areas where leaks can occur.

Water Balance

By using recent water and sewer bills together with any sub-metering data, a water balance can be developed. A water balance is a tool that provides an overall assessment of the amount of water entering the facility and the amount leaving the facility as product water, wastewater, or other forms of water waste (such as stillage). Based on the water balance, the amount of water lost in the facility through evaporation and leaks, can be determined by subtracting the amount leaving the facility from the amount entering. The water balance data should be monitored monthly to understand trends in water use, wastewater, and water losses. Therefore, enter the facility’s water data into a spreadsheet on a monthly basis. This data would include the amount of water entering the facility, the amount of product water, wastewater, and other water leaving. Monthly accounting will also help evaluate the benefits of water efficiency projects.
**Items to Consider** - There are usually some quick fixes for facilities just starting water reduction programs. The costs of even minor leakages are often overlooked or underestimated. Water reduction projects have been difficult to justify based on the cost of water; however, if the full cost of water is calculated, some projects may become more attractive, especially if future price increases are taken into account and value is put on business continuity and water reliability. When calculating the potential savings from a particular measure, there may be savings from; water use, onsite water pumping and associated maintenance, water treatment (chemicals, filter backwash, etc.), water heating or cooling, effluent pumping, effluent treatment, effluent discharge, etc.

**The Real Cost of Water**

![Image of cost calculation]

Total Costs Associated with Water Use = Price of Incoming Water + Sewer Service Charge + Cost of Energy and Chemicals Needed to Process Water + Labor, Regulatory Fees, and Other Costs Associated with Water Processing and Treatment

The "Price" of the Water Bill

The cost of water used at a facility can be much more than the amount on the water bill!

**Sustainable Value Stream Mapping**

Value Stream Mapping (VSM) is a tool used in lean manufacturing to identify waste. Initially created to evaluate productivity, VSMs can be adapted to also help identify the environmental sustainability impacts of production like water usage and water waste. Start by drawing each major step of the production process along with material inputs/outputs at each step and the time spent associated with each step. The result is a map of the entire manufacturing process for a single batch of production, or a time period (i.e. shift or day). Next, collect information on which process steps use water and in what quantity. Identify water wastes at each step as well. Then add this information to your value stream map to create what is called a sustainable value stream map.

**Kaizen Events**

A kaizen event (i.e. a rapid process improvement event) is a 2–5 day period when a cross-functional team examines a process and makes rapid changes to improve it. Consider conducting kaizen events that are specifically designed to find and implement water efficiency opportunities. Good places to target include processes or areas of facility operations that use significant amounts of water. Another option is to hold kaizen events that look for water-efficiency opportunities across a single facility. Water balances and value stream maps with water data can provide good ideas for where to focus water kaizen implementation activities. Even if the main objective of a kaizen event is not water efficiency, it is helpful to keep an eye out for water-efficiency opportunities. There may be opportunities to reduce water use, such as by adjusting equipment or reusing water, while also improving other aspects of the process.
Data Analysis

To facilitate data driven decision-making, analyze your data by looking for trends. Common improvement opportunities found while doing this include:

- Broken and incorrectly set valves.
- Leaks.
- Excessive, unnecessary and unknown use.
- Clean water discharges directly to effluent.
- Unauthorized discharges to effluent.

Action Planning

After analyzing your data, develop an action plan. When doing this, consider all alternatives. A few items to remember while developing your action plan include:

- **Leaks** - Schedule periodic facility evaluations for water leaks. Fixing leaks can be a good low cost solution to improving water efficiency, especially if the fix only includes tightening or replacing a fitting.
- **Reduction** - Look for ways to reduce water usage by asking if water is needed to be used or if water flow could be reduced.
- **Reuse** - Identify any steps in the process that do not need treated water and see if it is possible to reuse water from a different step.

Implementing Change

Focus on creating a culture of lean within the facility. This can be achieved by using a team approach, establishing goals, communicating results and recognizing achievements. Set goals that are measurable and realistic to achieve. Internally recognize the contributions of teams and individuals to maintain motivation and encourage greater improvement. External recognition from a third party will provide additional validation and enhance public image. For continuous improvement, repeat the cycle of performance assessment, action planning and implementing change.

Additional Resources

**U.S. Environmental Protection Agency**

**Lean and Water Toolkit**

**Beverage Industry Environmental Roundtable**

**True Cost of Water Toolkit**

**Brewers Association**

**Water and Wastewater Sustainability Manual**

**Kentucky Pollution Prevention Center**

**Sustainable Spirits and Brewing Initiative**
- [http://kppc.org/ksmi/ssf/](http://kppc.org/ksmi/ssf/)
- info@kppc.org
- 502-852-0965

**Kentucky Division of Compliance Assistance**

**Kentucky’s Sustainable Spirits Initiative**
- [https://eec.ky.gov/Environmental-Protection/Compliance-Assistance/Pages/sustainable-spirits.aspx](https://eec.ky.gov/Environmental-Protection/Compliance-Assistance/Pages/sustainable-spirits.aspx)
- envhelp@ky.gov
- 502-782-6189

Recognition Opportunity...

Kentucky Excellence in Environmental Leadership (KY EXCEL) is a program that recognizes environmental achievements throughout Kentucky.

For details, contact **KY EXCEL**!

Email: envhelp@ky.gov
Phone: 502-782-6189

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Kentucky Division of Compliance Assistance

Produced by the Kentucky Pollution Prevention Partnership (KP3) thanks to US EPA Pollution Prevention Grant Funding
Keys to Team Success

A team approach improves buy-in from all levels of the organization, which in turn helps to ensure greater resource efficiency and cost savings. Below are seven keys to ensuring team success.

1. Support
   Support from the top senior management is key for funding and empowerment of a team or a network of teams.

2. Members
   The team should have a diversity of cross-functional members that have good communication skills, are able to work independently, and have the ability to adapt.

3. Size
   The most effective teams have fewer than 10 members. Larger teams allow for members to reduce effort because they feel less responsible for output.

4. Communication
   For good communication, make sure the team has developed a communication plan, established a communication schedule and is using the right tool.

5. Leadership
   Team leaders should serve as coordinators that rely on specific team member expertise (as needed), foster a sense of balanced contribution, and provide/request regular status updates.

6. Shared Vision
   Establish a common purpose or vision with clear and detailed deliverables. Give the team freedom and set up a reward system to keep the team motivated.

7. Trust
   Trust is key for a team to effectively work together and with others. Three ways of building trust include uniting around a common cause, developing interpersonal relationships and face-to-face touchpoints at key points in their work.
# Water Use Assessments

Organize a facility walk-through using the checklist below to assess water use and find water saving opportunities. Assessments are powerful tools for involving facilities and encouraging buy-in.

## Process and Equipment Use
- **Cleaning, Rinsing, Washing**
- **Process Water Reuse**
- **RO Water Process**
- **Water Pumps**
- **Water Use in Products**

## Heating and Cooling
- **Cooling Towers**
- **Boilers, Hot Water, Steam Systems**

## Other Facilities
- **Toilets and Urinals**
- **Faucets and Wash-up Basins**
- **Floor Cleaning/Mopping**
- **Laboratories**
- **Landscaping and Irrigation**

## Kitchens and Breakrooms
- **Dishwashers**
- **Faucets and Sinks**
- **Ice Machines**
- **Food Disposals**
- **Water Use in Products**

**NOTE:** Facility walk-throughs are also hands-on learning opportunities because team members may see best practices in action. After an assessment, an in-depth report should be written and a summary circulated internally.