When you hear the word “sustainability,” it is generally in the context of environmentally friendly concepts used in the design and construction of new or renovated facilities. The term can have different meanings to different groups: Governments, corporations, environmental organizations and ordinary households will all have their particular view of the topic.

While the same is true for manufacturing operations, very little sustainability data is available to those who work in the field. However, manufacturers can improve the sustainability of their operations without the need to spend capital on bricks and mortar.

A list of attainable sustainability goals for the typical manufacturer might include:

- Reduce energy use
- Improve efficiency and productivity
- Eliminate waste and scrap
- Reduce hazardous waste
- Foster a culture of Sustainability

To achieve these goals, it is useful to consider seven key areas for sustainability in manufacturing operations:

1. Equipment
2. Operations
3. Cleaning
4. Storage and Transport
5. Utilities
6. Third-Party Certification Resources
7. Culture

Key Area 1: Improving Sustainability through Equipment

Some techniques for realizing your organization’s sustainability goals when dealing with equipment are:

- Specify equipment designed and built with sustainability in mind. When requesting a proposal from an equipment vendor, inquire about the sustainable design aspects of the equipment. This may include:
  - Variable Speed Drives
  - Energy Efficient Motors
  - Sustainable fabrication and finish techniques

- Encourage vendors to describe the sustainable aspects of their equipment designs and their fabrication and finish techniques. Let them know that sustainability is important to you and should be important to them.

- Reduce the resources required to support equipment by combining unit operations wherever possible. For example, many manufacturers use three separate pieces of equipment to perform case erecting, case packing and case sealing functions. These operations can often be combined into one erector/packer/sealer, thereby saving on floor space, utility requirements, maintenance, spare parts, lubrication, etc. Additionally, the conveyors needed to join the individual units, and the maintenance and utilities needed for those conveyors, are eliminated.
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- Rebuild/refurbish existing equipment. Where possible, rebuild or refurbish used equipment rather than purchasing new equipment. This approach requires far less material resources and can result in a savings in both capital and schedule time. If your business is spread over multiple sites, consider establishing a surplus equipment database to list components that are no longer needed in one facility but might be of value in another facility.

- Commission equipment to minimize resources and maximize output. As equipment grows more sophisticated, it is harder to achieve a sustainable manufacturing environment using procurement, installation and start up methods that were developed in the last century. To make the most of equipment investments, many manufacturers have embraced the concept of commissioning. Commissioning is a systematic process that governs the equipment procurement process from concept to operation and will typically include the following principles:
  - Equipment does not leave the vendor’s shop until testing has determined that all operational parameters function as intended.
  - When construction is complete, the installation is mechanically and electrically checked. Motors are “bumped” to check proper rotation and the equipment goes through a dry run for at least four hours to uncover problems.
  - At start-up, testing ascertains that the control program has been completely debugged. All product variations are run and design and quality rates are achieved for each variation.
  - Under normal operating conditions, ongoing checks are made to verify that product is running at the expected rates and quality levels and that scrap is within specified limits.

- Along the way, commissioning provides the proper infrastructure so that the equipment can be operated and maintained over time:
  - Operators and maintenance people receive methodical training by qualified, knowledgeable personnel instead of learning “on-the-fly.”
  - Equipment documentation on operations and maintenance is available and accessible to operators and maintenance personnel.
  - Critical spares are on hand if needed.

- Use laser vs. inkjet. Inkjet coding requires not only a constant supply of ink, but often involves the use of solvents for clean-up purposes. To eliminate the use, storage, and transport of these potentially hazardous materials, consider using laser coding where possible. Modern lasers are fast, programmable, and use no consumables, making them ideal candidates to operate in a sustainable manufacturing environment.

- Donate instead of scrap. No equipment lasts forever. When a component no longer meets your needs, consider donating it to an industry-related association, educational institution, research center or trade school. These organizations may welcome the addition of the equipment to their operations and you will have found a way to re-use rather than discard - a prime tenet of sustainability.

Key Area 2: Improving Sustainability through Operations

The following suggestions offer ways to improve sustainability within the operations area:

- Improve utilization by reducing changeover time. The time required to changeover a piece of equipment can create waste: Line components may be idle, environmental equipment runs, lights burn and operators are not productive. Sustainable manufacturing involves minimizing the impact of changeovers by reducing the time needed to perform them. To speed changeovers, first requires studying them. Define all of the elements that make up a changeover, such as material supply, machine adjustment, clean up, removal/installation of change parts, etc. Chart the time and effort needed for each element to establish a baseline.
You also need to understand why each element takes as long as it does:
- Are materials and change parts readily available or must they be located and retrieved?
- Can operators make changes using tool-free adjustments?
- Are adjustments made using programmable servo drives or manually?
- Are devices such as scales and dial indicators available to speed positioning?
- Can elevation and position changes be made by using manual or automated gearbox systems?

Concentrate your efforts on reducing changeover elements that take the most time. Identify those items that are beyond your immediate control and work with others in the organization to eliminate those items or minimize their impact.

Standardize to reduce parts inventories. Manufacturing operations are complex ventures that require hundreds of parts to operate. Unfortunately, the large parts inventories needed to support these activities represent significant resources in material and capital and are not compatible with sustainable manufacturing principles.

While it is not possible to eliminate parts inventories, it is possible to reduce their size by standardization. Standardization can take two forms:
- Component standardization involves the use of the same types of motors, switches, photo eyes, rollers, heaters, etc. on all of the equipment in a given operation. Adopt component standards that are suitable to your situation and insist that vendors supply equipment with components that meets these standards. You will need to stock fewer components and the space for, and cost of, your inventories will be reduced.
- Equipment standardization involves using the same equipment for a given task instead of using multiple suppliers. For example, if you routinely use Case Erectors, adopt a reliable equipment supplier who can provide the same, or similar, erectors for all of your needs. You will find that parts inventories will shrink while the ability to cover equipment outages will remain the same. Additionally, maintenance will be streamlined with less need for specialization.

Use computer databases. Operation and maintenance manuals, drawings, forms, records, and other documentation require a lot of paper and significant space for storage. By converting these items to computer databases, the use of paper and storage space can be greatly reduced. An added benefit of converting from paper to computer storage is that the information usually becomes more accessible to a variety of users.

Key Area 3: Improving Sustainability through Cleaning

Sustainability in manufacturing operations can be improved by taking some alternate approaches to cleaning:

- Reduce water use. Because most clean-up operations are repetitive in nature, daily water usage should be about the same for a given operation. Yet it often varies widely. By providing local monitoring (instead of site or department monitoring), variations in water usage can be detected for a given area or cleaning operation. When variations are noticed, determine the reason for the change. Is the cleaning operation being done correctly? Was too much - or too little - water used? Why? Remember that having the capability to monitor is only half of the equation. Someone must read the monitored flows and follow up when variations occur. Put water usage on the agenda of every operations meeting.
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- Reduce the need for cleaning water and chemicals on equipment. Specify equipment that lends itself to easy/minimal clean up, which will require less time, effort, chemicals, water and resources to meet the desired level of cleanliness. Both the International Fresh-Cut Produce Association (IFPA) and the American Meat Institute (AMI) offer guidelines and practical tips on evaluating equipment from a cleanliness/cleanability perspective.

Key Area 4: Improving Sustainability through Storage and Transport

The fourth area of importance when attempting to improve sustainability is storage and transport. The following tips can help in this effort:

- Reduce storage space (and associated utilities). The simplest way to reduce the space needed for storage is to minimize the width of the fork truck aisle. This can be done safely and without damage to products by using fork trucks that have smaller turning radii than the ones currently in use. For example, if using conventional sit-down, counter-balanced fork trucks that require a 12 ft. wide aisle, consider switching to an outrigger-type fork truck that can operate in an 8 ft. wide aisle. The space savings can be used to make the storage smaller or to increase the storage capacity of a given space. In either case, the space and utilities needed to support the storage function can be reduced. This is especially attractive if refrigerated storage space is used.

- Save fuel, reduce emissions using the EPA’s “SmartWay Transport Partnership.” Investigate the “SmartWay Transport Partnership” from the EPA to determine if your operation can take advantage of the potential to save fuel and reduce emissions. Information is available on the web at http://www.epa.gov/otaq/smartway/index.htm. This site has information about creating partnerships, innovative financing methods, idle-free corridors, fuel/emissions-reducing tractors and trailers and other data. Determine if any of these areas apply to your manufacturing operation.

- Reduce the solid waste stream with recycled pallets. Each day, manufacturers handle millions of loads of goods stacked on wooden and plastic pallets. These pallets represent a tremendous volume of material that, under normal circumstances, would ultimately be destined for the solid waste stream. One way to reduce the solid waste stream, while still tending to your material handling needs, is to use pallets made of recycled materials. A web search for “recycled pallets” turns up numerous producers of both wood and plastic pallets that are made from materials that were removed from the solid waste stream. Typically, pallets made of recycled materials are comparable in duty rating and overall quality to those made from virgin materials.

- Improve material handling productivity. A Warehouse Management System (WMS) provides a method to efficiently handle materials in a large manufacturing operation. By installing or upgrading a WMS, the operation will improve productivity through better tracking of materials and optimizing all pallet, forklift and truck loading/unloading activities.

Key Area 5: Improving Sustainability through Utilities

Utilities are another area where improvements in sustainability can be made, such as:

- Eliminate compressed air leaks. Because compressed air leaks can account for a large percentage of wasted utilities, they are not compatible with sustainable manufacturing objectives. Anyone can identify a compressed air leak by the characteristic sound the escaping air makes. Once a leak is found, it is usually easy to repair. However, with all of the background noise in a typical manufacturing facility, it can be difficult to hear leaks. Instead, try using the “silent treatment.” Walk through the operation on a weekend or evening when there is no production in progress and the area is relatively quiet. With the air compressors running, leaks in and around the non-functioning production equipment should be easier to identify. The table below provides examples of the costs of compressed air leakage.
### Equivalent Hole Diameter

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Air Volume Lost</th>
<th>Energy Waste - kWh/Yr</th>
<th>$/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/16 in.</td>
<td>0.84 gal / sec</td>
<td>2128</td>
<td>$213</td>
</tr>
<tr>
<td>1/8 in.</td>
<td>3.38 gal / sec</td>
<td>8512</td>
<td>$851</td>
</tr>
<tr>
<td>1/4 in.</td>
<td>13.5 gal / sec</td>
<td>34040</td>
<td>$3,404</td>
</tr>
</tbody>
</table>

If you are in the habit of monitoring compressed air usage, note the difference in total flow before and after employing the “silent treatment.” You may be surprised at how much costly compressed air is wasted in your operation.

- Reduce utility consumption by de-powering equipment when not in use. In many cases, the utilities consumed during idle time is tremendous and can be avoided. Conveyors that continue to run when no packages are available are a prime example of equipment that waste energy when idle. Utility consumption can be reduced by determining if equipment in your operation can be de-energized when idle. While most manufacturing equipment is not designed to power down when not in use, all that may be needed is a change to the control program and manually switching the equipment off may be an option.

- Cut electric usage in motors and drives. Electric motor-driven equipment used in manufacturing operations can account for up to 60% of the electricity used by the manufacturer, according to the U. S. Department of Energy (DOE). The DOE’s Office of Energy Efficiency and Renewable Energy (EERE) suggests that savings of 30% or more are possible by installing Energy Efficient Motors (EEMs) and Variable Speed Drives (VSDs).

  EEMs will generally cost 25–30% more than standard motors. However, in most cases, the energy savings over the life of the motor more than compensates for this premium. For example, an EEM rated at 55 kW will cost $960 more than a standard motor, but will save $770 annually in energy costs. Improvements in power factor can also be achieved, resulting in less loading, and therefore heating, on supply switchgear, cabling and transformer systems. In addition, EEMs will reduce the amount of capacitance needed for power factor correction.

  VSDs can trim energy costs and extend the life of equipment by adjusting motor speed to meet load requirements. For example, by reducing fan or pump speed by 15% to 20%, shaft power can be decreased by as much as 30%.

- Minimize power needed for lighting. Did you know that lighting accounts for 8 - 30% of an energy bill and operating costs for lighting are divided as 88% electricity, 8% lamp and ballast and 4% labor? Most manufacturers have already converted over to energy-efficient lighting to reduce power consumption. If you haven’t, or if you would like more information, check out “Environmental Defense” on the web at www.environmentaldefense.org for a reference on energy efficient bulb types and other useful data. Also, consider installing skylights as an energy-saving alternative. Skylights can increase the level of lighting in a given area, even on a gloomy day, and are ideal in large storage areas where the level of lighting is usually low.

#### Key Area 6: Improving Sustainability through Third-Party Certification Resources

Consult with independent third parties to source products and services and to develop operational methods that have been tested and certified as being environmentally responsible. These products, services and methods may include:
### Sustainability in Manufacturing Operations

- Paints
- Cleaners
- Vacuums
- Pallets
- Indoor air
- Adhesives
- Paper products
- Cleaning Svc.
- Signage
- Plastic fencing
- Chillers
- Floor care
- Training
- Drums
- Strapping

A sampling of environmentally-based, third-party certification resources include:

- U. S. EPA (Procurement Guidelines) - www.epa.gov/epaoswer/non-hw/procure
- Greenguard Environmental Institute - www.greenguard.org
- Green Seal - www.greenseal.org

### Key Area 7: Improving Sustainability through Culture

For sustainability to become a reality in your organization, it must be planned, discussed and promoted by management as being a key component of the operation. Managers and individual workers should be made aware of the organization’s objectives toward sustainability. In addition to raising awareness of the sustainability program, you should also make sustainability a part of the training of all employees, set sustainability goals and reward sustainability achievements to ensure sustainability is ingrained throughout the organization.

### Sustainability and Your Manufacturing Operation

Besides helping us to be responsible stewards of the environment and our resources, sustainability makes good business and economic sense. Because many companies today consider sustainability to be a competitive weapon – your competitors perhaps? – following the tips described above may help your manufacturing operation gain a competitive advantage while saving on operational costs, labor and more.

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