Global Thermoforming - Lean Manufacturing or Starvation

Are the terms Lean Manufacturing, Six Sigma, Poka-Yoke just cute catch phrases that only apply to big companies, or do they also apply to you or your thermoforming company? Do thermoforming companies have immunity from the current economic conditions and no need to worry about improvements and updates? Unfortunately, most thermoforming companies do not think that these terms apply to their businesses or are too complicated and expensive to implement. However, in today's global community and trouble economic times, thermoforming companies must make changes and implement new processes or face starvation and bankruptcy.

In the past, tthermoforming companies have tended to take the "Ostrich, head in the sand" approach to ride out the hard times. "This is the way we have always done it" is often a damaging phrase still used by many companies. The problem is that the current economic conditions are nothing like what any existing thermoforming company has ever had to face or manage. Never have we had times where oil prices are causing almost daily increases in polymer materials, as well as surge in energy cost to operate machinery and equipment. With free trade agreements, larger companies are moving manufacturing off shore, while smaller companies are contracting to have goods manufactured in more cost effective countries. Thermoformers now have to try to learn how to compete in an environment where businesses will have part of their assembly made in China, another part in Europe, and then the entire unit assembled in India, for a product to be sold in the US marketplace. In order for the thermoforming industry to stay competitive and in existence, we have to update technology, improve quality, and change our entire thermoforming manufacturing mentality.

While many companies are scared of "Lean Manufacturing, Six Sigma and Poka-Yoke", these processes in their simplest form mean using common sense and reviewing every step and aspect of your thermoforming operation. Many large businesses utilizing custom thermoforming demand that their thermoforming companies show how they are utilizing Lean Manufacturing for their products and quality control.

Lean manufacturing or lean production, which is often known simply as "Lean", is the optimal way of producing goods through the removal of waste and implementing flow, as opposed to batch and queue. Lean manufacturing is a generic process management philosophy derived almost entirely from the Toyota Production System (TPS).
"It is renowned for its focus on removing waste in order to improve overall customer value. As waste is eliminated quality improves while production time and cost are reduced. There is a second approach to Lean Manufacturing, placing the focus upon improving the "flow" or smoothness of work through the system and not upon 'waste reduction' per se. The difference between these two approaches is not the goal but the prime approach to achieving it. The implementation of smooth flow exposes quality problems which already existed and thus waste reduction naturally happens as a consequence." *Reuters.com*. Retrieved on 19 April, 2008.

Lean implementation is therefore focussed on getting the right things, to the right place, at the right time, in the right quantity to achieve perfect work flow while minimizing waste and being flexible and able to change. Poor arrangement of the workplace and doing a job inefficiently out of habit—are major forms of waste in the workplaces.

Six Sigma was originally developed as a set of practices designed to improve manufacturing processes and eliminate defects, but its application was subsequently extended to other types of business processes as well. In Six Sigma, a defect is defined as anything that could lead to customer dissatisfaction."

Six Sigma asserts that –

- Continuous efforts to achieve stable and predictable process results (i.e. reduce process variation) are of vital importance to business success.
- Manufacturing and business processes have characteristics that can be measured, analyzed, improved and controlled.
- Achieving sustained quality improvement requires commitment from the entire organization, particularly from top-level management.

Features that set Six Sigma apart from previous quality improvement initiatives include –

- A clear focus on achieving measurable and quantifiable financial returns from any Six Sigma project.
- An increased emphasis on strong and passionate management leadership and support.
- A clear commitment to making decisions on the basis of verifiable data, rather than assumptions and guesswork.

Poka-Yoke **(**pronounced "POH-kah YOH-keh") is a Japanese term that means "fail-safing" or "mistake-proofing" — avoiding inadvertent errors is a behaviour-shaping constraint, or a method of preventing errors by putting limits on how an operation can be performed in order to force the correct completion of the operation.
Thermoforming is no longer an art form. It is a repeatable science in which every variable can and has to be controlled and duplicated every time to make consistent, high quality parts. Lean manufacturing, Six Sigma and Poka-Yoke are the basic tools thermoformers need to start the process and improve quality while reducing cost. In order for thermoformers to be competitive every aspect of their companies has to be examined and evaluated for waste and areas of improvements.

Unfortunately, many thermoformers have allowed themselves to fall behind in technology, design and engineering with regards to thermoforming. The end-user, designer and thermoformer have no choice but to become and stay deeply involved in the specifications of the raw materials, as well as the finished part, quality control, and costing all the way through the operation. Many thermoforming companies tend to look at their operations with the "can't see the forest for the trees" syndrome. Self evaluation in any form is very difficult. Therefore, in todays market there are consultants and other resources dedicated to helping companies make the necessary internal improvements and modifications.

Specifically dedicated and accepted worldwide, are the "Ten Basic Fundamentals of Thermoforming". While these Ten Fundamentals may not solve all your immediate problems they are excellent guidelines and the starting point that every thermoformer needs to review, evaluate and use to examine their own company. Thermoforming consultants will use these Ten Fundamentals, along with Lean Manufacturing techniques, Six Sigma and Poka-Yoke, to evaluate your operation and conduct a "Manufacturing Analysis" outlining changes and improvements.

The Ten Fundamentals include:

1) Costing - The thermoformer must have a complete understanding and knowledge of their costing. They must know every aspect of their pricing structure - from labor, to materials, to machinery to secondary operations, to packaging.

2) Design Requirements - Thermoforming starts with the part. A company has to design their products for efficiency, forming, trimming, assembly, limitations, teamwork, and prototypes. With thermoforming, the design of the parts can either make or break the project. The wrong design of a product can cause high reject rates, poor quality products and dissatisfied customers.

3) Resins - The correct resins will help a company make better and stronger products. Polymer companies today are developing new materials almost daily. However, the almost daily increases in raw materials have to be considered and factored in to cost.

4) Sheet Material – Thermoformers have to have written material specifications for production of their extruded sheet material. Specifications have to be established and agreed upon with their sheet extruder, but more importantly have to be checked, validated and enforced.

5) Environment - A clean facility with no breezes or drafts blowing over heating ovens or forming stations is ideal. An air conditioned, humidity controlled plant is by far the best, though for most companies is impractical.

6) Heating - Outside of a top quality sheet, the single, most important factor in thermoforming is repeatable, controllable uniform (properly profiled) heat. The core of the sheet must be heated uniformity to its particular processing temperature.

7) Tooling/Molds - The use of epoxy, wood, and polyester fiberglass should be used only for special forming projects and very short runs. However, to achieve quality and consistent parts, at an economical cost, temperature-controlled aluminum molds must be used. There can be no compromise on this requirement. Molds with cast-in cooling tubes are a must. The ability to control the mold temperature throughout the thermoforming run is essential. In addition, composite and syntactic foam materials have dramatically improved and provided thermoformers with options and solutions to problems that previously did not exist.

8) Vacuum - Drape and vacuum forming are common ways of stretching polymer materials onto the surface of a mold. Vacuum is used to remove the trapped air between the mold surface and the polymer sheet material. Proper vacuum is essential to form and achieve consistent products. For most applications, the surge tank volume needs to be a

minimum of six times and preferable ten times the volume of the part being thermoformed. Lack of and improper vacuum is a major issue with most thermoforming companies.

9) Thermoforming Machines - One of the major areas of advances in thermoforming technology has been with machinery. Old ideas about process limitations are being challenged almost daily. While innovations are not restricted to just machinery, improvements in machinery include:

- Improved and more reliable ways of clamping the polymer sheet material
- Improved heaters
- Improved heat distribution patterns and controls
- Adaptation of infrared sensors for monitoring and controlling sheet residence time in ovens
- New plug assist materials (i.e. syntactic foams, etc.)
- Better control of stretching forces and pressures
- Improved trim dies
- New mold materials and mold making techniques

10) Team - The right Team and partners are essential for a successful thermoforming operation. Thermoforming companies must keep up with the latest technology and advances being made in order to be competitive. An excellent resource is the Society of Plastics Engineers Thermoforming Conference.

September 20-23, 2008, in Minneapolis, Minnesota will be the 18th annual SPE Thermoforming Conference – "***Discover Your Leading Edge" - The Competitive Advantage.*** *The* theme for the conference and Technical Program is to discuss the competitive advantages that many of the thermoforming industries use to become highly successful and profitable operations.
http://www.4spe.org/conf/thermo08/0809thermo.php

In the last decade, the thermoforming industry has tackled many very difficult problems, such as newer materials, tighter sheet and part tolerances and more critical applications. The core business has been helped greatly by improved heaters, more accurate process controls, cooperative interaction between extrusion companies and thermoformers, more easily thermoformable polymers, advance trimming techniques, and to a great degree, the acceptance of thermoforming as a process by OEM's. In addition, thermoforming has gained the attention of many universities, technical writers, consultants and software companies. However, we are now facing new global economic challenges. In order to compete and succeed, it is no longer a question of can or should a company make changes and improvements, but rather if they want to stay in business, thermoformers and the thermoforming industry have to change and improve to be competitive.

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Robert Browning, of Atlanta, Georgia, has 25 years experience in the design and engineering of single sheet, twin-sheet, and pressure thermoformed products, tooling and processes. During this time he has had the opportunity to develop, refine and patent new processes in thermoforming, and in the design of thermoforming tooling. For fifteen years, he was with one of the largest twin-sheet thermoforming companies in the U.S., as Director of Research, Development and Engineering.

Currently, an Associate/Partner consultant with the McConnell Co. Inc., Robert has also had his own consulting firm, Isosceles, Inc., since 1984. With degrees in Business Management and Industrial Design, he has successfully worked with companies such as BMW, Ford, Honda, Boeing, American Standard, and John Deere, to define problems, develop alternatives, and implement solutions. At the present, he is an active member of the Industrial Design Society of America and is a Senior Member of the Society of Plastic Engineers.