Produce Perfect Products

Preventive error proofing plays into the lean approach to create dynamic synergy.

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Is there synergy between preventive error proofing and lean? What is synergy, and how is it created?

Synergy occurs when the overall effect of two or more elements combined is greater than their independent effects. Certainly then, the potential synergy when preventive error proofing and lean are effectively combined is considerable.

Fundamentally, lean focuses on efficiency improvements while error proofing's focus is effectiveness. The result of incorporating error-proofed product and process solutions within a waste-free operating system might be the ultimate combination. With the current constraints on budgets and resources experienced by most organizations, initiatives must be restricted to those that maximize the benefit for the effort required. Therefore, complementing lean implementation with robust error proofing can be a high-leverage approach.

The focus on leaning out entire enterprises, in addition to the preexisting focus on lean manufacturing, continues to gain momentum. The primary objectives of lean—to increase efficiency and eliminate waste—are fundamental and applicable to most industries and business processes. Though relatively simple, successful implementation of these concepts has proven to be more elusive than originally predicted for many industry enthusiasts. The powerful one-two punch from lean implementation coupled with preventive error proofing may provide the recipe required for optimization.

In their effort to demonstrate rapid progress in the implementation of lean philosophies, many companies are improving efficiency—sometimes dramatically. But if these efficiency gains are not implemented correctly, then an operation can merely become increasingly adept at pumping out defective products in a more efficient manner.

A manual sticklead assembly of through-hole components on automotive electronic products requires a variety of parts to be placed by the operator. *Source: Delphi Corp.*

Consider an inefficient manufacturing operation that is producing product with a first-time quality (FTQ) of 60%. This would mean that for every 100 products produced, 40 of them would not pass all test-and-inspection processes the first time through. Now further suppose that the poor FTQ is not because of manufacturing inefficiency, but perhaps to product or process design, or even the quality of incoming components. If significant efficiency improvement is realized through lean implementation, then this operation has become more efficient at producing defective product.

This example may not be overly concerning because quality was not harmed during lean implementation. Certainly efficiency improvements are desirable and can have a dramatic impact on the bottom line for most companies. A more concerning scenario is one in which quality did not remain stagnant during lean implementation, but actually deteriorated. In an effort to improve efficiency, the significant change that typically results can sometimes have disastrous consequences for product quality.

SWITCHING THE FOCUS

Frequently on the journey to lean manufacturing, inventories are being slashed, floor space is rapidly disappearing, changeovers have skyrocketed and fully automated manufacturing lines have been relegated to the scrap heap. Although in some situations these actions are directionally correct, they cannot be instituted in a vacuum. These results can, and often do, negatively affect quality if the organization takes its eye off the ball during lean implementation. Unfortunately, all too often the focus is on floor space reduction, cycle time reduction and dramatically increasing agility.

A robotic cover replacement and automated screw driving for assembly of electronic powertrain controllers takes place. Lean initiatives sometimes replace automation with manual processes. *Source: Delphi Corp.*

Introducing significantly more human intervention where automation once existed, as well as changing processes over every few minutes compared to daily or weekly, may require innovative counter measures to maintain current product quality levels.

In addition, when the cushion of product buffers and finished goods inventories are eliminated, any small hiccup in manufacturing can now have a widespread ripple effect. In the past when an occasional defective product was created, or equipment downtime occurred, these issues were considered a nuisance for manufacturing. In a lean environment what was previously a nuisance can become catastrophic and prevent shipment to a key customer.

Some interpret lean thinking as supporting the transfer of the maximum number of tasks and responsibilities to the manufacturing operator. Simple, repetitive tasks may be replaced with complex, multistep, sophisticated activities in an effort to empower the operator and reduce automation. It is not difficult to imagine the potential impact to quality when the effects of frequent changeovers, increased manual labor and other critical lean results are combined. The combined impact of these efficiency improvements, if not off-set with complementary product and process enhancements, can be disastrous to quality performance.

Ideally products, processes and the other manufacturing system elements such as materials, methods and tools, are developed in parallel to ensure the optimization of the whole. Even when developed sequentially, the objective is to ensure that each complements and facilitates the other. A particular product-design configuration that was optimized based on minimal changeovers, automated manufacturing, buffers of defect-free products and significant inventories of finished goods may have a radically different design than one where these options have been eliminated.

Too often a manufacturing operation has undergone a lean transformation while the product design has remained relatively constant. Potentially this oversight of the critical optimization of product, process and manufacturing system in parallel has been the biggest roadblock to reaping the maximum benefits of lean manufacturing.

What is the key to implementing efficiency improvements using lean principles without jeopardizing product quality and customer delivery? Perhaps preventive error proofing of the product design and the manufacturing process design is the key. Optimization of product and process design, while allowing the flexibility demanded by lean, may require a radically different error-proofing strategy.

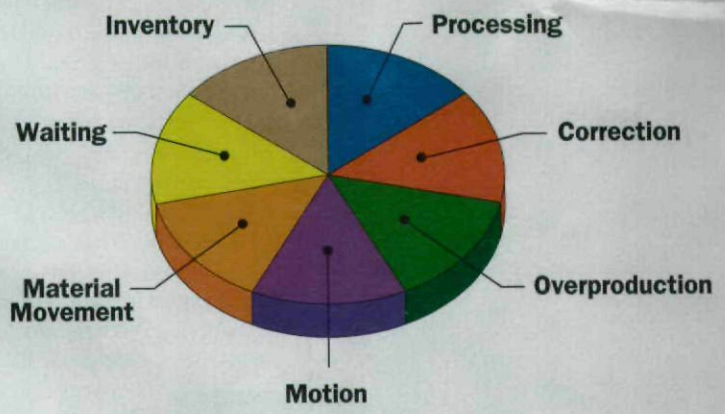
ERROR PROOFING

Consider again the frequent result of lean implementation is the reduction of

TECH TIPS

- The potential synergy when preventive error proofing and lean are effectively combined is considerable.
- If the efficiency gains realized by lean are not implemented correctly, then an operation can merely become increasingly adept at pumping out defective products in an ever more efficient manner.
- Lean principles and preventive error-proofing principles have a number of objectives and applications in common including the elimination of waste, the pursuit of perfection, efficiency improvements and a focus on the entire value stream.

TYPES OF WASTE



automation and a corresponding increase in manual labor. Typically, for some processes and products, automation is viewed as less flexible than an operator performing a variety of tasks.

Success in significantly reducing automation and increasing manual labor is critically dependent on standard work. Standard work is documenting and adhering to a specific method of performing tasks with little room for deviation or operator personal preference. But, it is not enough to just standardize the work and ensure it is repeatable. It is imperative that the standard work be error proofed.

Ideally, this error proofing would eliminate the opportunity for the operator to make an error resulting in a defective product. If the standard work is not the best way of performing the task without the opportunity for errors and defects—significant issues—waste will develop.

Consider a fully automated final assembly process that involves numerous types and sizes of fasteners, rotation of the product around multiple axes, and requires tight tolerances on torque and pitch. Now, imagine that through lean implementation automation has been eliminated and the final assembly activity is now performed in a cell, by an operator or as volumes fluctuate, numerous operators.

Although the automated process would not be without failure modes, it is predictable that the number of potential failure modes involving operators would be significantly higher. In addition, the probability of occurrence, or frequency, of some of these failure modes could be significant, such as, the specified torque and the correct pitch.

Consider the standard work required for these final assembly tasks. Is it conceivable that preventive error proofing of the product and processes could be the ticket to ensure product quality does

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not deteriorate when this manufacturing system undergoes such dramatic changes? Simple training and documentation will probably not be sufficient to achieve superior quality levels.

DEFECT-FREE PRODUCTS

Lean principles and preventive error-proofing principles have a number of objectives and applications in common. These include the elimination of waste, the pursuit of perfection, efficiency improvements and a focus on the entire value stream. In addition, both lean and error proofing have broad application and can be applied beyond manufacturing and across an entire enterprise.

When combined correctly, lean implementation can provide gains in efficiency while preventive error proofing can provide complementary gains in effectiveness. The result is the ability to not only increase the speed of producing products, but also to ensure that only defect-free products are created.

One of the fundamental cornerstones to lean thinking is waste elimination. In fact, depending on the reference source, a number of different types of waste have been identified and should be eradicated when optimizing lean implementation. Effective error proofing, particularly preventive error proofing, can positively impact many, if not all, of the seven forms of waste—processing, correction, overproduction, motion, material movement, waiting and inventory.

When defective products are created, consider the impact to some of the forms of waste. If defective products are repaired this represents correction waste. If this repair is a satellite process outside of the normal value stream, then this requires additional material movement and motion, two other forms of waste. Because a repair process is dependent on the quantity of defects created, it is difficult to staff and schedule. As a result, typically either the product ends up waiting for an available repairman, or the repairman ends up waiting for a defective product.

Waiting is an additional form of waste. If defective products are scrapped instead of repaired, then this may be the ultimate form of waste.

Scrap can certainly impact inventory, require additional processing and may require overproduction. Creating defective products can have a significant impact on the quantity of waste that a facility generates.

The leanest flow in product manufacturing, as well as development activities such as software or hardware design, require that each process hand off a perfect product to the next downstream process and that every process would be value added.

As a result, prevention of errors and defects would be required. Inspection and test processes would have to be eliminated, and every value added process would have to be incapable of creating a defect. Although this is idealistic, it supports the lean philosophy of an unending pursuit of perfection. In their book, "Lean Thinking," James Womack and Daniel Jones refer to test and inspection as type one muda (waste). Type one muda is described as a step that creates no value but is unavoidable with current technologies and production assets.

Sure, test and inspection will be required as long as defects are tolerated. When preventive solutions are implemented, test and inspection—an unacceptable form of muda—can be eliminated. Preventive error proofing may be the ultimate lean approach. Q

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