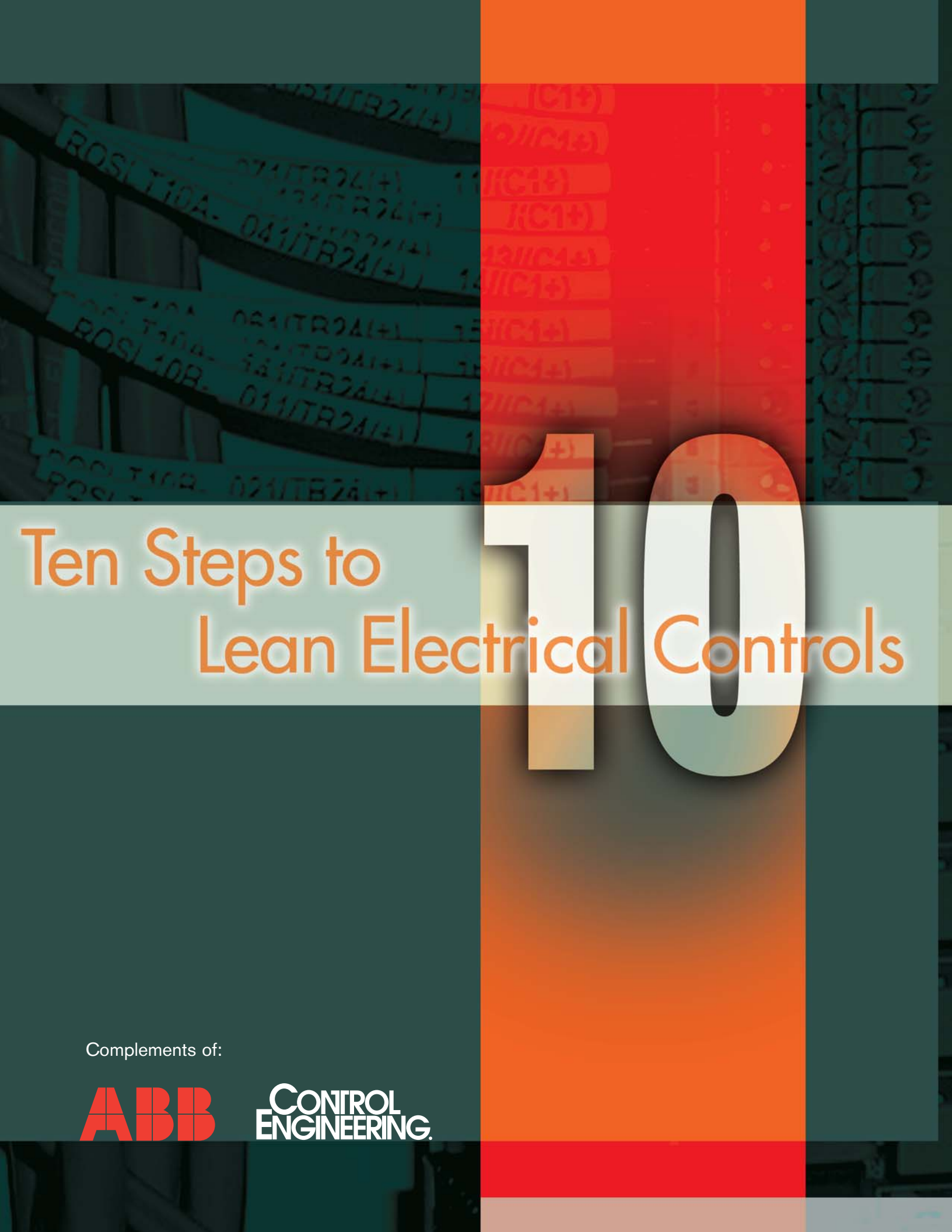

Ten Steps to Lean Electrical Controls

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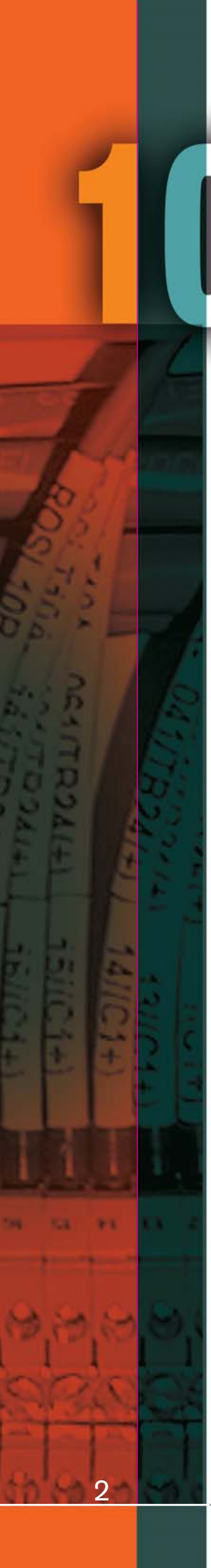


10 TEN STEPS to Lean Electrical Controls

EXECUTIVE SUMMARY

Globalization is forcing companies to constantly become more efficient. To drive efficiencies, many companies are implementing Lean Manufacturing to stay competitive in this ever shrinking world.

This paper will discuss how you can leverage Lean Operations, A Lean Supply Chain, and Lean Design of your electrical panels to meet the key goals from James P. Womack and Daniel T. Jones book "Lean Thinking":

- *Determine what the customer is willing to pay for … this is value.*
- *Identify the processes required to provide value … this is the value stream.*
- *Physically arrange the required resources in a "flow".*
- *Implement "pull systems".*
- *Eliminate waste from the flow.*

We will expand these thoughts into ten distinct areas companies building electrical panels should address if looking to lower their costs and improving the value you bring to the customer.

OBJECTIVE

The major objective of lean manufacturing as stated in the book "Lean Thinking" is to "banish waste and create wealth in your corporation". This is an objective that any company would likely see as a good thing to do. However, waste is not banished by a silver bullet and wealth is not created by applying one simple formula. Rather, hard work and the persistence of applying proven practices and methods over a period of time yields positive results. This is the pragmatic approach that has allowed many companies to experience the benefits of lean manufacturing in varying degrees of success.

The objective of this paper is to share ten specific lean manufacturing strategies a manufacturer who uses electrical controls can deploy to help reduce waste in the total supply chain. If applied properly and completely, the result will be lower overall costs, faster throughput speed, higher levels of quality, and a simpler business experience for the supplier, the customer, and the customer's customer. You may have heard some of these ideas before. The difference here is the identification of ten specific things that any company can do right now.

UNDERSTANDING WASTE

The fundamental opportunity in eliminating waste is to first recognize it! In the big picture, waste is any activity that does not add value to the company's product or service. These non-value adding activities do not add form, fit, or function, and are things that the customer would not be willing to pay for if they knew they existed.

These activities should be eliminated, simplified, reduced, or improved. Value adding activities, on the other hand, are things that do add form, fit, or function, and are things that the customer is willing to pay for.

Consider the simple example of a product going through the manufacturing process. If the time associated with all of the value adding operations is added up (i.e. fabrication, machining, assembly) and compared to the time of the non-value adding operations (i.e. moving, staging, stocking, transacting, testing, waiting), the ratio of non-value to value would likely be very large – 500:1 or more. An electrical component that has 10 minutes of total work done on it could be "in the flow" for about 10 days! Not uncommon. One of the goals of lean is to reduce this ratio by having fewer non-value adding activities.

To help understand the difference between value and non-value, decide in which category the following belong:

- Starting/stopping a motor.
- Marking the customer's part number on a box.
- Surge protecting a circuit.
- Moving a component to an inventory location.
- Stripping insulation from a wire to be terminated.
- Wiring the electrical components in a panel.
- Testing the machine before it ships.
- Detecting the proximity of a machine component.

When thinking about these from the final customer's point of view, there are items that really do not add value to the operation of the machine. For example, if a wire could be terminated without being stripped, it could save a lot of time and still have the machine operate appropriately. Better yet, if there was a pre-wired cable system you could snap into place, there would be no need to cut, mark, and bundle all of the individual wires. Finally, what if you could reduce the amount of wires required and still perform the electrical functions the machine needs to operate?

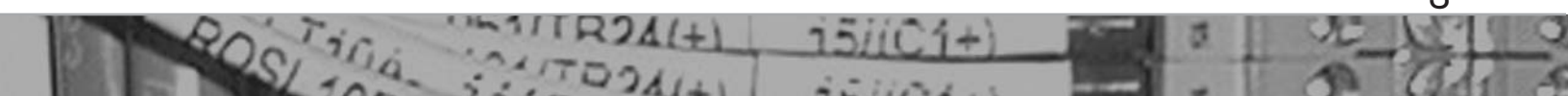
In the supply chain, some believe that the cost of non-value adding activities is up to 40% of the price paid for the item. To better understand these economics, consider the following example of a customer buying an electrical component from a supplier and the costs incurred to do this:

Price paid for an electrical component:	$22.00
Ordering/PO cost (on a 100 item order):	$0.75
Inventory carrying cost:	$2.20
De-trashing and transacting:	$2.20
Inspecting and testing:	$0.50
Total cost:	$27.65
Total non-value activities:	$5.65
Total price of the component:	$22.00
Percentage of cost adding activities:	**26%**

Three key questions here follow from the price vs. cost thought process:

- Are you looking for the lowest cost or the lowest price?
- Have you tried to really understand the difference?
- Can you articulate the difference as a competitive advantage to your customers?

The high performance electrical controls supplier uses lean manufacturing to address the unnecessary motion, overproduction, defects, inventory, transportation, waiting, inspecting/testing, extra processing, and other non-value adding activities in the supply chain to



TEN STEPS to Lean Electrical Controls

lower the total cost and increase throughput speed. The following three sections of this paper outline ten specific tactics in terms of lean operations, lean supply chain, and lean design.

LEAN OPERATIONS

Lean operations concentrate on reducing waste within the four walls of the supplier's business.

Step 1
Functional vs. Flow/Cellular Manufacturing

The traditional way to organize a factory is to group all like processes together. The result is many isolated departments: the milling department, the welding department, the punching department, the drilling department, and so on. Characteristics are generally long distances traveled, large batch sizes, single-skill employees, huge work-in-process, long throughput time, numerous transactions, slow detection of quality problems, and "bury the next department" as a primary performance measure. A functional factory flow is depicted in Figure 1.

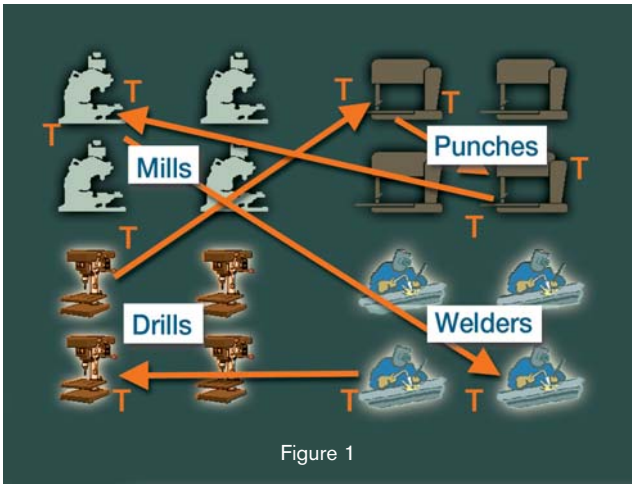


Figure 1

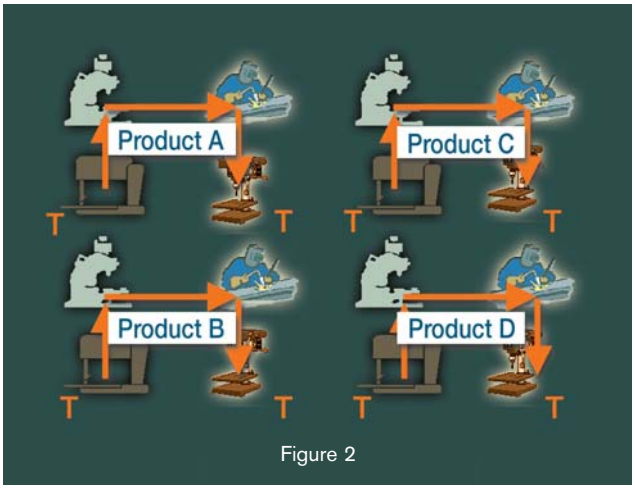


Figure 2

Lean operations re-lay out the facility to co-locate all (or most) of the processes required to produce a product or group of similar products. The result is many "factories within a factory". Performance is significantly improved by 90+% reductions in throughput time and work-in-process, immediately visible quality problems, multi-skilled workers, an opportunity to shrink lot sizes, and faster response to customer needs. The performance measures become: safety, quality, rate, and schedule on a daily or hourly basis. A cellular factory flow is depicted in Figure 2.

Step 2
5S Housekeeping and Workplace Organization

The objective of 5S is to have a highly effective and well organized workplace. Lean practitioners agree that productivity improves, quality

improves, and employee moral improves when the workplace has a world-class look and feel. The basics of 5S are:

Sort – remove all unnecessary items from the workplace.
Shine – clean the workplace and eliminate sources of dirt/oil.
Set-In-Order – engineer a proper place for all tool, materials, and supplies.
Standardize – mark and label all locations.
Sustain – Implement checklists, training, and audits to ensure 5S is maintained.

Many companies start lean implementation with 5S because it is relatively easy to do, results are highly visible, many people can become involved quickly, and the results are almost immediate.

Step 3 Setup Reduction

In many operations, the key to faster customer response and smaller lot sizes is to make changeover a non-issue. This is accomplished by reducing the setup time of machine tools, assembly workstations, and other processes. Setup time is defined as all of the time that expires between the last good piece of the current job to the first good piece of the next job.

Normally, a 50% reduction can be made simply by becoming more organized, moving inside activities to outside activities, and measuring performance. Some companies have reduced four-hour setups to four-minute (or less) setups. The result is reclaimed capacity that can be used in one of two ways: 1) produce more product in the same amount of time, or 2) produce a wider variety of items each day in smaller lots. Either way, customer needs are met in a more timely manner and costs are lower.

LEAN SUPPLY CHAIN

The lean supply chain extends waste elimination upstream to suppliers and downstream to customers.

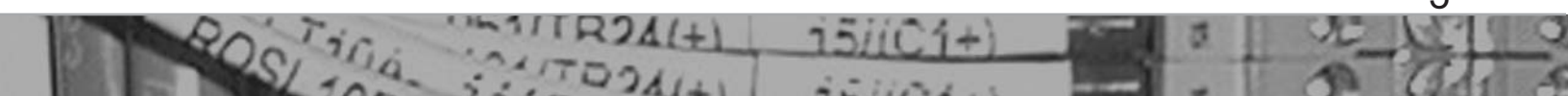
Step 4 Pull Systems

A pull system is a method for triggering production/replenishment based on the needs of the consumer. For example, when an assembly line needs components for panel assembly, a "pull signal" is sent to the supply source and parts are delivered. The supply source could be a feeder line, a warehouse, or the outside supplier. When the signal arrives, the precise amount of the product is delivered to the user at exactly the right time. Material is only moved when a "pull" occurs. In a "push" system (which lean operations are attempting to eliminate), material movement may based on availability at the supplier, not the need of the user.

Pull systems have been quite successful in helping to reduce inventory, reduce throughput times, and synchronize the supply chain. This is a very simple practice, but implementation requires precise engineering of part identification, placement, quantity sizing, and trigger mechanism.

Step 5 Kanban

The trigger mechanism for a pull system is often a visual or electronic kanban. Kanban is the Japanese word for signal, and it is an execution technique. The kanban signal could be an empty container, a card, a vacant space on the floor, an empty shelf, a yellow light, an electronic display board, a white board, a computer report, or a variety of other techniques. The objective is to communicate the need to pull material, and to do it in a way that the people directly involved in the process can see the signal and take the appropriate action immediately. A two-bin kanban pull system is shown in Figure 3.



TEN STEPS to Lean Electrical Controls

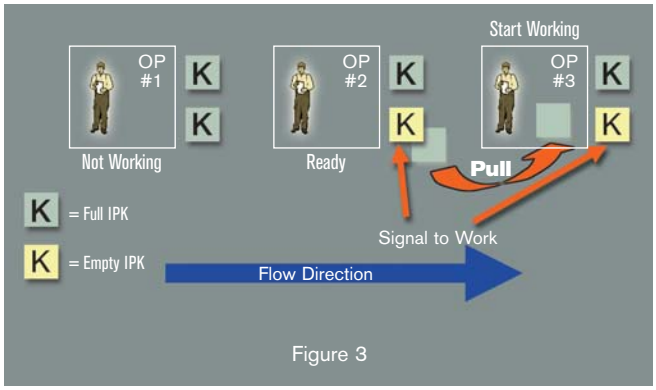


Figure 3

Step 6 Kitting

Kitting is an extension of kanban pull systems, and involves combining a set of parts that satisfies the need for an entire assembly. For example, when building a panel, the manufacturer could order, receive, transact, inventory, inspect, issue, handle, and administer each of the dozens of components independently. Or the manufacturer could specify all of the components as a kit and have only one part number and one set of administration. The supply chain complexity is significantly reduced and cost adding activities are minimized. The electrical components supplier can add value to the supply chain by performing kitting as a value adding service for the manufacturer.

An extension of kitting is to provide components in a kit tray that presents components in a fit-for-use condition to the user. Fit-for-use means that the components are positioned correctly for the assembler, organized logically, and do not require un-boxing and/or de-trashing. The tray is designed to integrate into the customer's assembly area, and can form the basis of a visual kanban pull system. For example, when a tray is empty, it becomes the kanban (or the signal) for the supplier to ship another tray. Obviously, there are many details to engineer for this to work effectively. But once it is all set up, the simplicity facilitates speed and lowers supply chain cost.

LEAN DESIGN

Lean design focuses on reducing cost and increasing speed in the engineering, estimating, and quoting of an electrical product or service.

Step 7 Parallel Design

The traditional way to do new product introduction (NPI) and development is called sequential design. The steps are: idea -> design -> prototype -> tooling -> materials -> production. Essentially, one phase is not started until the previous phase is complete. Quite often, the design time is cut short so other activities can begin. The result of this approach is a long throughput time and many costly ECO's (engineering change orders) that originate in production and require design revisions. The electrical component supplier formally enters this process when material is procured … long after the design, prototype, and tooling are complete. Sequential design is shown in Figure 4.

The lean approach is to do several activities in parallel. Once the decision has been made to

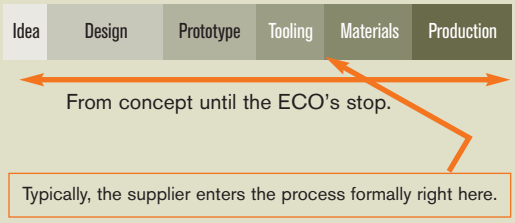


Figure 4

commit design resources to an idea or request, a team is formed to do the detailed design. The team includes engineering, material, manufacturing, tooling, suppliers, and the customer! It may take longer to finalize the design, but several of the handoffs have been eliminated. Material sourcing, tooling, and prototyping are all integrated into the design process and are accomplished simultaneously. In this scenario, the electrical component supplier is included near the start of the design process which allows supplier know-how and technology to be included in the product. The result is a less costly, better engineered product that more completely satisfies the customer's needs, and utilizes the best supplier technology. Plus, the number of ECO's when production commences is significantly reduced. Parallel design is shown in Figure 5.

Step 8 Fast Quoting

In general, customers want quotes right away … not tomorrow or in a few days. We find that slow quotes are the result of a high wait-to-work ratio in the quoting process. In other words, much of the time the request for quote is sitting on someone's desk! Just like the functional factory, slow quoting is often the result of a functional office … engineers here, scheduling over there, accounting in the next building, and order entry down the hall. The secret to fast quoting is to co-locate the people required to do the job, which significantly improves communications and raises the sense of urgency. When people are co-located, the opportunities for waiting, queuing, moving, and stopping are minimized. When a "quoting cell" is created and complemented with the appropriate tools, most quotes can be done the same day. Granted, there will be some that take some time … the really unique and special jobs. But an objective should be to get 95+% of all quotes out the same day.

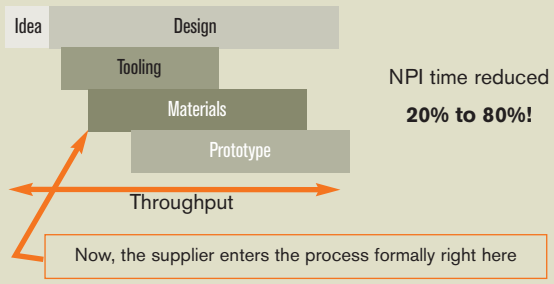


Figure 5

Here are some steps to help get fast quoting started:

- Map the entire process end-to-end.
- Eliminate the "wait" by asking "why" five times.
- Build computer models to deal with numerous variations of standard designs.
- Use standard components whenever possible.
- Co-locate people to improve communication.
- Measure performance.

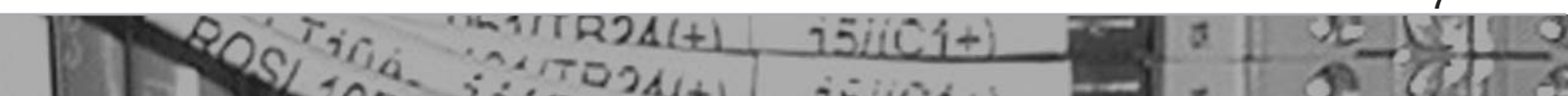
Step 9 Standard Components

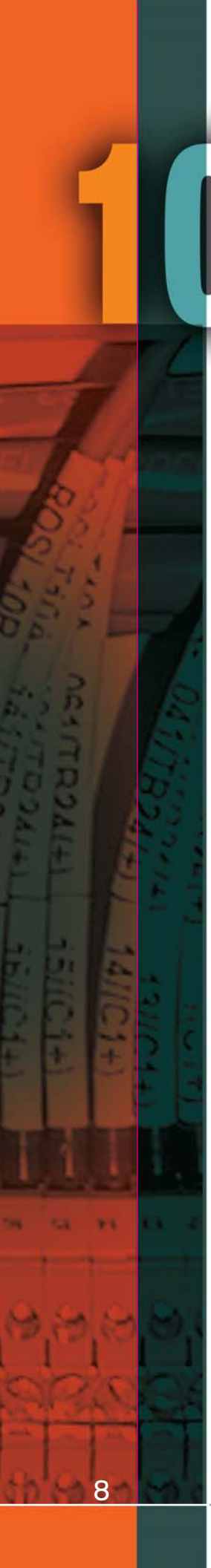
In engineering school, many of us were taught to be creative … design new things … more is better! But in the lean world, many times less is better. Use something that we already have. Don't reinvent the wheel! So for some designers, the new standardization paradigm is in order. Here are some of the key points:

- Fewer components.
- Use standard components whenever possible.
- Use something that we already have in an existing design.
- Eliminate, simplify, combine, improve.

Using standard components benefits helps reduce waste and speed throughput time in several ways:

- Inventory costs are lower since there are fewer part numbers.
- Transaction/ordering costs are lower.





10 TEN STEPS to Lean Electrical Controls

- Service parts are simplified.
- Quoting and design times are faster.
- Interchangeability is enabled.

Step 10 Focus on Value in Your Design

As an engineer designs a machine, he/she must continually ask, "What is my customer willing to pay for, and how do I reduce the items they are not?" Early in this paper we asked about value and non-value add activities. The engineer needs to keep in mind the customer just wants the machine to perform its function and do it safely. Finding ways to meet this task with new technology, methods, or processes is critically important. One electrical supplier, ABB, has helped its customers reduce the total cost of a panel by over 20% with new methods, or by building the panel or a subassembly in the panel for the manufacturer. As a panel is designed, it is critical to utilize an expert to help find ways to reduce the non-value add activities, before they are designed in.

SUMMARY

To gain the competitive advantage, the aggressive and knowledgeable electrical controls company will be on a relentless quest to eliminate waste and speed throughput times in all aspects of the supply chain. The ten points outlined here can form the basis for a lean initiative that will result in reduced costs, faster throughput, and ultimately benefit your customer. The main point is to get started … do as much as the organization has time and resources to handle. Be in it for the long haul … avoid looking for the "silver-bullet". Over time, persistence will prevail and your lean electrical controls business will come out on top!

J. E. Boyer Company, Inc. integrates lean manufacturing with enterprise resource planning to create world-class manufacturing environments where these two improvement strategies work together. For the past 20 years, clients from a wide variety of industries have improved their operations in terms of cost management, on-time shipments, inventory investment, people development, operational speed, and overall business performance.

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www.jeboyer.com
Please direct your comments and questions to:
John E. Boyer, President
J. E. Boyer Company, Inc.
3347 North 900 East
North Ogden, Utah 84414
Phone: (801) 721-5284
Fax: (801) 737-0799
e-mail: jeb@jeboyer.com