



# How Lean Manufacturing Adds Value to PCB Production

Authors: Nancy Viter, Mathew Stevenson

## Overview

*In an earlier paper, we established the importance of Design for Manufacturing (DFM) in today's PCB manufacturing environment. PCBs designed using those techniques typically experience reduced failure rates, cost less to manufacture, and minimize waste during production.*

**Lean Manufacturing:** a philosophy focused on eliminating any production component that does not deliver value to the customer.

*While DFM certainly represents a powerful tool for PCB manufacturers, it is one component of a broader Lean Manufacturing (Lean) philosophy focused on eliminating any production component that does not deliver value to the customer.*

*We will explore the impact of Lean on the PCB industry, including how it may provide competitive advantage to those organizations making Lean a key part of their culture.*

*To create a competitive edge, Lean needs to permeate every level of an organization, making it more than just a policy change or process implementation, it must become part of the culture. Manufacturers who adopt Lean must commit to it for the long haul and seek continuous improvement over time.*

*This type of commitment requires substantial investment to succeed. We will offer some best practices associated with successful Lean programs and highlight some ways to avoid some common pitfalls.*

## Assessing the Impact of Lean on PCB Manufacturing

Lean Manufacturing (Lean) philosophy increasingly drives change in the PCB industry. As demand for smaller, more complex PCBs increases, Lean's value-driven model makes even more sense to PCB manufacturers. Because Lean reduces costs of production and material use, budget concerns, green initiatives, and increased competition fuel the Lean trend.

As more PCB manufacturers make this cultural evolution, the trend toward Lean becomes self-perpetuating. Manufacturers that successfully adopt Lean make continuous process improvements. This keeps raising the bar in terms of PCB quality, driving more manufacturers toward the Lean philosophy. As we near a tipping point, PCB manufacturers choosing not to initiate Lean do so at their own peril.

PCB manufacturers have traditionally prioritized efficiency. This resulted in policies such as lot purchasing discounts or production runs focused on common board characteristics. While these initiatives had a positive impact on the bottom line, they did not necessarily increase the value of the boards to customers. In turn, efficiency efforts seldom became coordinated company-wide programs aimed at comprehensive process improvement.

Recognizing the competitive need to build better boards for their customers, more and more PCB manufacturers now seek to expand efficiency efforts into comprehensive Lean initiatives. More than a program or system, Lean is a cultural shift that defines value from the customer perspective.

As more PCB manufacturers make this cultural evolution, the trend toward Lean becomes self-perpetuating. Manufacturers that successfully adopt Lean make continuous process improvements. This keeps raising the bar in terms of PCB quality, driving more manufacturers toward the Lean philosophy. As we near a tipping point, PCB manufacturers choosing not to initiate Lean do so at their own peril.

### Value Stream Mapping: Value Drives Production

Value stream mapping is a foundational Lean practice. Its roots can be traced to Ford production in the 1920s. Though it originated on the factory floor, value stream mapping can be applied to everything from supply chain to logistics to customer support.

To create a visual representation of a work process, participants use a standardized set of symbols to connect events like steps, delays, and information flow. The result can be used to interrogate and refine the process.

By seeing global production information, materials, and design flow in the context of value, Lean PCB manufacturers can realize end-to-end improvement.

### When is a PCB Better?

The definition of a better PCB is a PCB that delivers more value. Customers must realize value or they will seek out a new manufacturer who can provide timely, cost-effective PCBs that better meet their needs. With a wide array of inexpensive DFM tools now available to designers, there are fewer opportunities for manufacturers to accelerate the schedule or reduce costs during prototyping. If you want to save a customer time and money, the best method is to eliminate waste from the production process.

Lean offers a proven method for doing so. In a Lean environment, the manufacturer works backwards from the end product to the beginning of the manufacturing process, analyzing each step and interaction along the way. Efficiency efforts that

perhaps never escaped a departmental silo now become part of a coordinated program to deliver value to the customer.

### Goals of Lean Analysis

- Minimize overbuild
- Reduce scrap
- Limit consumption of utilities such as power and water
- Improve safety on the production floor

When individual department goals transform into a company-wide commitment to value, the whole organization, not just elements of the production process, improves. Lean philosophy requires the manufacturer to constantly seek out new opportunities for improvement. As a result, businesses must discover increasingly innovative ways to deliver value. These methods may not be directly—or even obviously—correlated to the addition of value, but they can and will contribute to delivering it.

### Legend Printing Leaves Its Mark on Lean

Legend printers represent an example of equipment that can power Lean. These printers operate like massive inkjet printers, reducing waste and saving time versus traditional silk-screen printing.

The trend toward smaller, highly functional PCBs demands designers pack more circuits into less space. Legend printing makes design work easier by allowing for increased miniaturization. When designers have better tools for designing smaller boards, they spend less time on revisions during prototyping.

Legend printing also streamlines the manufacturer printing process. Instead of creating a unique silk screen for each design, the PCB manufacturer simply cues print jobs. This strengthens the value chain by:

- Reducing waste
- Accelerating turnaround
- Consuming fewer resources

Lean is a philosophy dedicated to making continuous improvements. To succeed, PCB manufacturers should seek tools to help them do so. Legend printing is one example of how the right equipment can make a difference.

## Never Stop Improving

In order to keep discovering new ways to improve, Lean manufacturers probe deeper into their production processes to find them. Questions become more challenging, consensus harder to reach, and measurement metrics less apparent. For a PCB manufacturer, a Lean process can explore and analyze the following questions:

- How far do our boards physically travel during the production process?
- What if we cross-trained more personnel?
- Is there a better way to pack our finished products?

The answers to questions like these unlock additional incremental improvement for PCB manufacturers. A PCB that travels a shorter distance during production is at reduced risk of misplacement or damage, can be completed faster, and requires less labor to transport. More cross-trained employees translate into smaller, more efficient production teams. Innovative packing solutions minimize PCB damage during transport.

True Lean focuses on improvement opportunities beyond the production floor. Lean companies invest in employees, providing healthy and safe environments to protect both personnel and our environment's future. They prioritize quality of work life and provide fair compensation. A workforce made up of well-trained, professionally satisfied personnel is more productive.

These examples of leaner decisions demonstrate the cultural shift that takes place when an organization embraces Lean from top to bottom. While some of these Lean choices may not appear related to the production process, they translate into value for the customer. The proof is in a higher quality, cost-effective, and first-to-market PCB.

Demand for smaller, high-functioning boards will continue to rise along with the level of competition for that business. PCB manufacturers face a stark truth: Go Lean or go extinct.

## Best Practices for Successful Lean Manufacturing

Lean cannot just be another program remembered for the catered kick-off breakfast and little else.

Commitment is the key to successful Lean adoption. Consider first that Lean cannot just be another program remembered for the catered kick-off breakfast and little else. Carefully evaluate the reasons for adopting Lean before beginning, taking care to assess the organization's readiness.

True Lean demands a sizable investment of time and resources to transform a company culture. That investment starts at the top.

Truly successful Lean programs leverage existing measurement methodologies to create “S.M.A.R.T.” goals (specific, measurable, attainable, relevant, and time bound). These improvement measures target everything from water usage to amounts of rigid material used during production.

## No Lean without Leadership

Lean requires dedication to never ending, continuous improvement. Once executive management commits to making the long-term investment, they must communicate this throughout the organization. Teach staff what Lean means for them and why it is important to succeed. Make it clear Lean will change the way the company operates and how personnel will perform their duties.

Leadership needs to set expectations appropriately at every level. Lean is an investment aimed at delivering value to customers, not a perk designed to make individual job tasks easier. Improvement will not happen overnight, so both staff and management must be patient. Be prepared to recognize small victories from the outset in an effort to build momentum and foster support throughout the organization.

### Kaizen: Accelerate “Good” Change

Kaizen events are quick and focused team analyses of particular processes or issues. They can produce rapid improvement in multiple areas at once. Participants pose difficult process questions that demand consideration by the group. Kaizen events challenge the status quo and force PCB manufacturers to address the validity of long engrained industry truths. The result: Leaner decision-making and PCB production delivering more value.

## Use Evangelists to Fill Communication Gaps

The standard structure of organizations generally leaves top management too far removed from the staff to provide persistent, clear direction on Lean adoption. That responsibility must then fall to leaders within the organization who possess the vision and ability to recognize Lean opportunities. While these individuals are often in managerial positions, Lean “evangelists” who adopt the philosophy early and take the initiative to improve can evolve from any level of the org chart.

Internal communication is not unlike the production line itself. We established benefits of minimizing the distance a PCB travels during production. The same can be said for communicating Lean throughout the organization. If key personnel do not take responsibility for maintaining clear, organization-wide communication, the top down Lean message will fade with time.

Not every corner of an organization speaks the same language. Lean messaging must be tailored to the departmental—or even individual—audience by these evangelists. Executive buy-in is the first step, but success or failure hinges on participation during day-to-day operations. The great ideas for process improvement come from the personnel doing the work each day. Evangelists need to convey the importance of Lean and listen carefully for opportunities to affect change.

Lean communication is two-way. When the commitment message descends from executive management and the means to improve bubble up from company personnel, Lean will begin to take hold.

## **No Second Chances**

If Lean does not transform the organization, the results are often catastrophic. Lean implementation failures are well documented. The aftermaths of these unsuccessful attempts rarely make news.

When Lean is not implemented correctly—usually because of poor education and communication—it becomes very difficult to get the momentum started again. Failure is most often avoided by strengthening the lines of communication and reacting quickly when Lean encounters resistance. As long as top management remains involved and evangelists stay persistent, speed bumps will not bring a Lean initiative to a stop.

### **KPI and Lean: Never Miss an Opportunity to Measure Success**

Key Performance Indicators (KPIs) can be applied to every aspect of production. From leading strategic measures to results-oriented measure of labor costs, KPIs help Lean manufacturers identify areas for improvement, regardless of where they are hiding.

## **Track and Record Improvement**

Metric-driven companies are better prepared to adopt Lean, because they understand how to measure success and avoid the pitfalls associated with failure. Once your organization makes the commitment to Lean, establishes strong two-way communication, and provides the tools necessary to make continuous improvement, you need to be able to measure results.

This is good news for PCB manufacturers interested in Lean. Metrics have always been a critical component of efficient manufacturing. Prior to having accurate measures of time, labor, and materials, PCB manufacturers found it hard to be competitive even before the Lean trend began.

Now, truly successful Lean programs leverage existing measurement methodologies to create “S.M.A.R.T.” goals (specific, measurable, attainable, relevant, and time bound). These improvement measures target everything from water usage to amounts of rigid material used during production. By adding metrics where they previously did not exist, a culture shift takes place for every person in the company, regardless of role.

Without the cultural evolution, long-term success will prove elusive. Beginning with top management, the entire organization must invest in Lean for it to succeed.

## Conclusions

In the competitive landscape of the future, Lean may be mandatory for the success of PCB industry players. Demand for smaller, more complex boards means PCB manufacturers must work smarter to provide value to their customers. Lean offers a path to value for those who choose it.

Lean PCB manufacturers evolve traditional efficiency measures into a new company culture that considers value first. By making Lean decisions on everything from equipment to production floor layout, PCB manufacturers find ways to improve in places they had never even looked in the past.

### Your Next Step

For those embarking on the Lean path, we recommend exploring its concepts further. Many great resources exist to help business leaders learn more about the practical components of adopting a Lean philosophy.

The Lean Enterprise Institute ([www.lean.org](http://www.lean.org)) is a great place to start. Founded in 1997, this non-profit organization offers a wide range of easily searchable content.

The success stories begin with a top down commitment, rely on clear communication throughout the organization, and do not end. Successful Lean PCB manufacturers never stop improving.

Author: Nancy Viter  
Author's title: VP of Operations  
Author's e-mail address: [nviter@sunstone.com](mailto:nviter@sunstone.com)

Mathew Stevenson  
VP of Sales & Marketing  
[mstevenson@sunstone.com](mailto:mstevenson@sunstone.com)

Sunstone Circuits  
13626 S. Freeman Road  
Mulino, OR 97042  
(503) 829-9108