THE PCB MARATHON

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By the '90s, Asia had become a great player on the electronics industry, driving companies all over the world, especially those in Europe and the Americas, to compete against its low prices. More recently, Asian manufacturers have been delivering more high-quality products to the market. These phenomena resulted in little space for mass production companies in Western countries and an increasing need for quick-turn production and prototypes of medium- to high-complexity PCBs.

Printed circuit board shops have been driven to build new business strategies that overcome the paradigm of trade-offs, in which customers had to choose between one characteristic or another, into a new way of doing business in which an equilibrium is found that meets customer needs.

Having said that, flexibility has turned into a slogan for Western companies and despite being largely spread in our culture, very few organizations handle it effectively.

Why do some companies get outstanding results while others struggle to survive? Why do some always seem to be ahead of their time, while others are always running behind? Is it all about money?

Certainly, money is a good portion of what is needed to achieve better results. Money buys new technology and helps develop highly skilled people. However, consider Toyota as an example from the '50s. They turned from a small company in a country destroyed by WWII into the most lucrative automaker in the world. They found a way to compete against economies of scale, huge amounts of money invested in new technology, skilled engineers, and low costs of production per unit, just to cite some of the challenges Toyota faced. In that scenario, reducing cycle time to produce better and faster was a live or die battle. Everything that followed those events has become part of the history that is still being written by Toyota.

The PCB market that Western companies face today has some similarities with the automotive market Toyota faced in the '50s, but a bit more challenging. All in all, the principles remain the same.

Old-Fashioned Operational Strategy				Customer Driven Strategy		
EITHER	… short delivery time	OR	… reliable PCBs … complex products	On time delivery Complexity	YET	Quick turn production
EITHER	… simple PCBs	OR	… very expensive ones	Small Batch Sizes	YET	Affordable Pricing
EITHER	… quality	OR	… delivery on time	High quality products	YET	Having flexibility to attend customers demand.
EITHER	. . .	OR	. . .	. . .	YET	. . .

Figure 1: Contrasting strategies and trade-offs.

What are Customers Willing to Pay For? (Value Stream Mapping)

First of all, managers and engineers must know exactly what is happening on the shop floor, and being told is not enough. They must take time to go to the shop floor, analyze the whole system, talk to people, encourage them to speak truthfully, get to know each area in detail, and look at the factory with the customers' eyes. They must not try to find excuses for the real state, but see opportunities in each difficulty. This is not a one-day walk, but an activity every single industrial engineer and manager should incorporate into their daily routine.

Once done, it is time to design the value stream mapping (VSM), in which the current state is contrasted with the future state—the desired one. When designing a VSM, team leaders should put themselves in the customers' shoes, including the internal customers, asking questions like: What is the customer willing to pay for? When do they want to receive their parts? What should I do to deliver parts on time? Each feature that the customer is willing to pay for is called value-added; everything else is defined as non-value added, or waste.

Developing a VSM requires team cooperation, and collecting data such as number of operators, shifts worked, working time, and cycle time are needed.

There are basically two different, but converging, concepts regarding cycle time. The first one is related to a specific process such as plating, where cycle time is defined as the production rate of the entire operation, including setup, loading and unloading.

On the other hand, there are some people who define it as the production rate of a part from the beginning to the end (e.g., from raw material preparation to final quality control). Nevertheless, it does not change the fact that working to reduce the production rate of the bottleneck will reduce the cycle time of the whole operation.

Having done this, engineers are able to have an overall look at the entire process and should start working on what most impacts the company throughput—the bottlenecks. Each company will have its own bottlenecks, and talking about PCBs, we might identify several bottlenecks depending on the PCB layout.

Eliminating or Mitigating Everything Else (Waste)

Eliminating wastes are the heart of the Toyota Production System[1].

As we see in Figure 2, most of the activities we do in a production line are non-value-added,

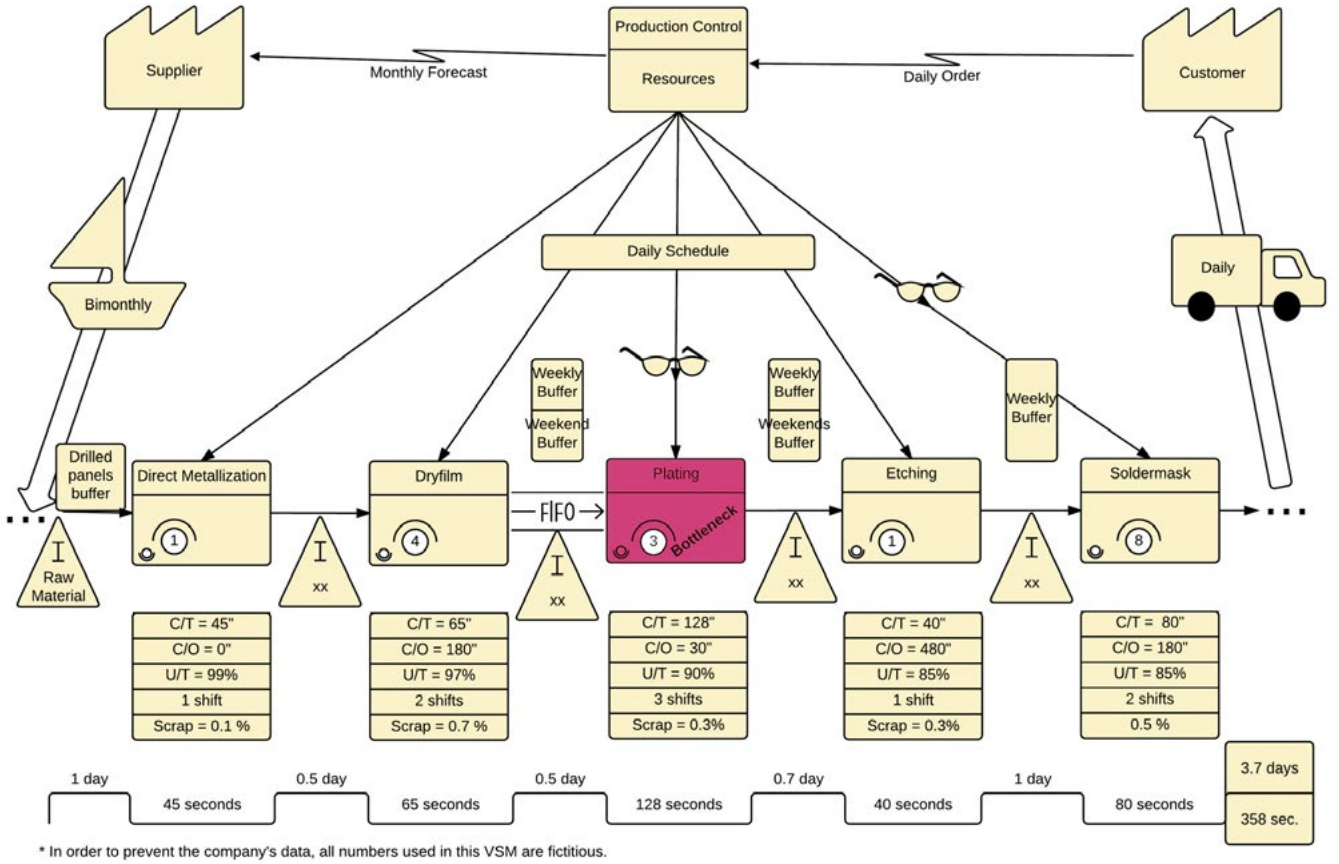

Figure 2: Example of value stream mapping.

and these are considered wastes. Some of them must be mitigated, while others should be totally eliminated.

Toyota numbered seven basic wastes on their industry: overproduction, waiting, unnecessary transport, incorrect processing, excess inventory, unnecessary movement and defects. Besides overproduction, which means producing when there are no orders, which is not applied to the PCB industry that works in a make-to-order manner, all the other categorized wastes can be found in a PCB shop.

Wastes such as incorrect processing, defects, and waiting, which result in delay to the customer, are quite common in PCB factories producing small to medium batches, including prototypes. The combination of short delivery time along with the great variety of different batches and products running at the same time can make things harder to manage, driving us to the conclusion that this is just the way our businesses run. I have heard this a lot, but I am not convinced it is true.

If we take a careful look at the factory through our customers' eyes, we will see that most of PCBs go through a similar process.

Based on that, we must drive our efforts to work hard on process stability in order to get the PCB built right the first time. Having a process-driven company will allow you to produce faster and better products as well as eliminate wastes.

Although wastes will never be totally eliminated, they can shrink significantly after you start working on them. That is why the next topic is of paramount importance.

Continuous Improvement (Long Term Results)

Nothing in this article will make such an impact on your company as the continuous improvement philosophy. I have covered a couple of management innovation tools, applying

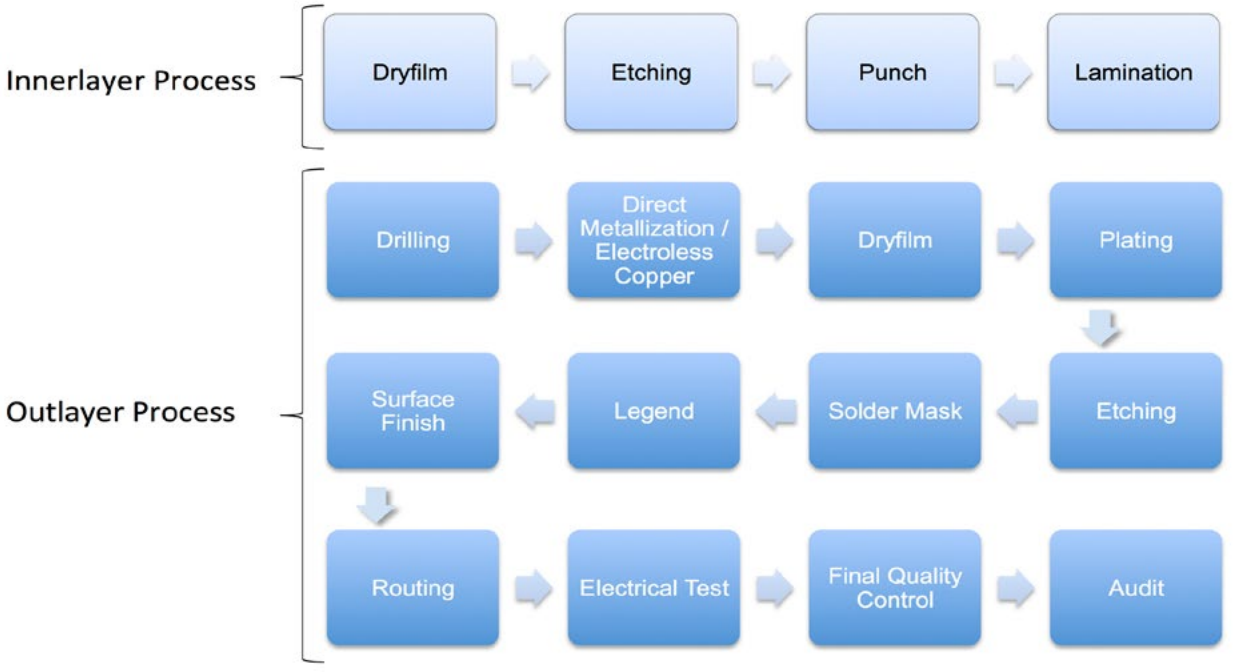

Figure 3: The PCB process.

those that were in vogue in the business administration and capable of delivering fast results, but without any consistency.

There is a principle in statistical process control (SPC) that fits perfectly with the concept of continuous improvement which says: Making improvements on an unstable process will produce random results, while making improvements in a stable process, no matter how bad it is, will produce stable results that are able to be managed and improved.

In other words, PCB shops must create and follow rigid procedures before thinking of continuous improvement, and this is totally different from saying companies must be static.

Conclusion

In order to reduce cycle time, companies must focus their efforts on identifying their bottlenecks, eliminating wastes and working hard to make the best use of their processes.

Unfortunately, especially in the PCB industry, the bottlenecks change rapidly from one PCB to another, according to its layout. So, it is not uncommon to have different bottlenecks in the same factory and managers saying that TPS (Toyota Production System) principles cannot be applied to the PCB industry due to its complexity and fast environment changes. I would rather suggest another response to that.

When working in such a complex industry, leaders must have fanatic discipline to apply everything presented in this article and go beyond it to find solutions to attend to customers' needs, one step at a time. Instead of copying every single tool Toyota has created, organizations need to understand the philosophy behind it and search for their own way of doing business.

Improvement is similar to a marathon: the running is long, not easy, and full of obstacles; you may go slow, but never stop.

I hope I have encouraged you to start a new journey in your business. What are you waiting for? Take the next step! **PCB**

References

1. Liker, Jeffrey K., 2004.

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