

Lesson Three: Create Continuous Flow to Optimize the Value Stream

© Brian Cooke, Iris Learning, 2007; All rights reserved.

A. Key Learning Points

1. Traditional batch-and-queue business processes hide vast inefficiencies.
2. Shortening the elapsed time from raw materials to finished goods or services will lead to the best quality, lowest cost and shortest delivery time.
3. Radically decreasing or eliminating inventory exposes problems that will require immediate attention; everyone will be motivated to solve the problem and minimize or eliminate the inefficiency.
4. Calculating the actual rate of customer demand (Takt Time) is the first step toward creating one-piece flow.

B. Real World Examples and Considerations for Practitioners

1. Traditional batch-and-queue business processes hide vast inefficiencies.

Despite recent breakthroughs in understanding and application of lean management methods, many businesses continue to build product or create services using a “batch-and-queue system” that was a hallmark of 20th century mass production.

In a batch-and-queue process, each stage of production or service creates more than one piece of an item and then moves those items forward to the next operation where these items wait in queue until the downstream function actually needs them.

For example, the production table below illustrates how a pizzeria uses a batch-and-queue process to prepare and bake pizza in batches of five as follows:

Production Table and Value Analysis for a “Batch-and-Queue” Pizzeria					
Step	Activity	# Items	Value Add Time	Max Wait/Queue Time	Total Time
1	Weigh, cut and stretch dough	5 Large Pizza	5 minutes	30 minutes	35 minutes
2	Spread tomato sauce and parmesan cheese	5 Large Pizza	3 minutes	5 minutes	8 minutes
3	Add mozzarella cheese and special toppings	5 Large Pizza	3 minutes	5 minutes	8 minutes
4	Bake	5 Large Pizza	15 minutes	1 minutes	16 minutes
5	Cool, Serve or Box for Take-out	5 Large Pizza	5 minutes	5 minutes	10 minutes
	Total	5 Large Pizza	31	46	77 minutes

Batch-and-queue businesses, like this pizzeria, can become surprisingly expensive to operate because:

- There are more items in various stages of unfinished production at any time – this requires additional cost to pay for (a) more parts and materials and (b) more space and more laborers to store and assemble the parts into a finished product;
 - The total time for each product while in production is increased significantly because of the interruptions and wait time between each process step;
 - There is typically at least one significant bottleneck in production where the process either becomes more complex or where capacity is limited – in a pizzeria production capacity is limited by the size of the oven;
 - The business tends to over-produce products;
 - It takes longer to discover and resolve quality problems;
 - The business tends to create more waste.
2. By contrast, successful lean businesses know that shortening the elapsed time from raw materials to finished goods or services will lead to the best quality, lowest cost and shortest delivery time.

For example, the production table below shows how a “lean” pizzeria uses one-piece flow to make and bake individual pizza’s on-demand.

Production Table and Value Analysis for a “Lean” Pizzeria					
Step	Activity	# Items	Value Add Time	Max Wait/Queue Time	Total Time
1	Weigh, cut and stretch dough	1 Large Pizzas	1 minutes	1 minutes	2 minutes
2	Spread tomato sauce and parmesan cheese	1 Large Pizzas	1 minutes	1 minutes	2 minutes
3	Add mozzarella cheese and special toppings	1 Large Pizzas	1 minutes	1 minutes	2 minutes
4	Bake	1 Large Pizzas	15 minutes	1 minutes	16 minutes
5	Cool, Serve or Box for Take-out	1 Large Pizzas	5 minutes	1 minutes	6 minutes
	Total	1 Large Pizzas	23	5	28 minutes

This lean pizza-making process has obvious advantages over the batch-and-queue method because:

- Pizza can be made and served more quickly;
- Tables in the pizzeria turnover more quickly which allows the pizzeria to serve more customers;
- Pizza are fresher;
- Pizza can be easily customized for any customer;
- Less space is required for pizza-making because storage and assembly space is minimized or eliminated;
- Pizza-makers pay more attention and take greater pride in creating high quality individual pies for each customer;
- Errors and quality problems are identified and resolved more quickly;

- The overall cost of the business is lower because there is less inventory, less waste, less scrap and smaller space required for production.
3. Radically decreasing or eliminating inventory exposes problems that will require immediate attention; everyone will be motivated to solve the problem and minimize or eliminate the inefficiency.

Some champions of mass production and batch-and-queue processes argue that it is essential to build and maintain a significant inventory to prepare the business for unexpected consumer demand and to protect the business against unpredictable interruption of materials and supplies.

For example, in July 2007 a small yet significant earthquake in Japan interrupted parts production at several Toyota suppliers. Because Toyota keeps no more than 4 hours of most parts in inventory on-site at any time, this interruption in the supply chain forced Toyota to close the factory for 3 days until stability and reliability could be restored throughout the entire lean production system. This example, however, is a rare exception in Toyota's otherwise finely-tuned, highly profitable lean enterprise.

In fact, Toyota believes decreasing or eliminating inventory forces its managers and employees to anticipate, identify, analyze and resolve all problems that may occur swiftly and permanently. By purposefully accepting occasional yet inevitable interruptions in production, Toyota has created a smart, nimble business that challenges its managers and employees to pay greater daily attention to quality and to continuous improvement. By contrast, mass producers that insist on building thirty days or more of inventory not only add cost to their business, they also tend to mask or hide inefficiencies and quality problems indefinitely.

4. Calculating the actual rate of customer demand (Takt Time) is the first step toward creating continuous one-piece flow.

To design and manage a one-piece flow process that produces goods and services reliably and profitably on-demand, it is essential that you calculate the current rate and variation in customer demand. How could you possibly run a profitable lean business if you do not know: (a) the actual number of customers you are currently serving; (b) the actual volume and mix of goods and services your customers are buying; and (c) the hourly, daily, weekly, monthly or seasonal variation in consumption that may exist in your business?

The German word for rhythm, meter or clock cycle is "takt." And Takt Time is the actual maximum rate at which customers are buying your product. Calculating customer demand or takt time is relatively easy for repetitive production of standardized goods and services.

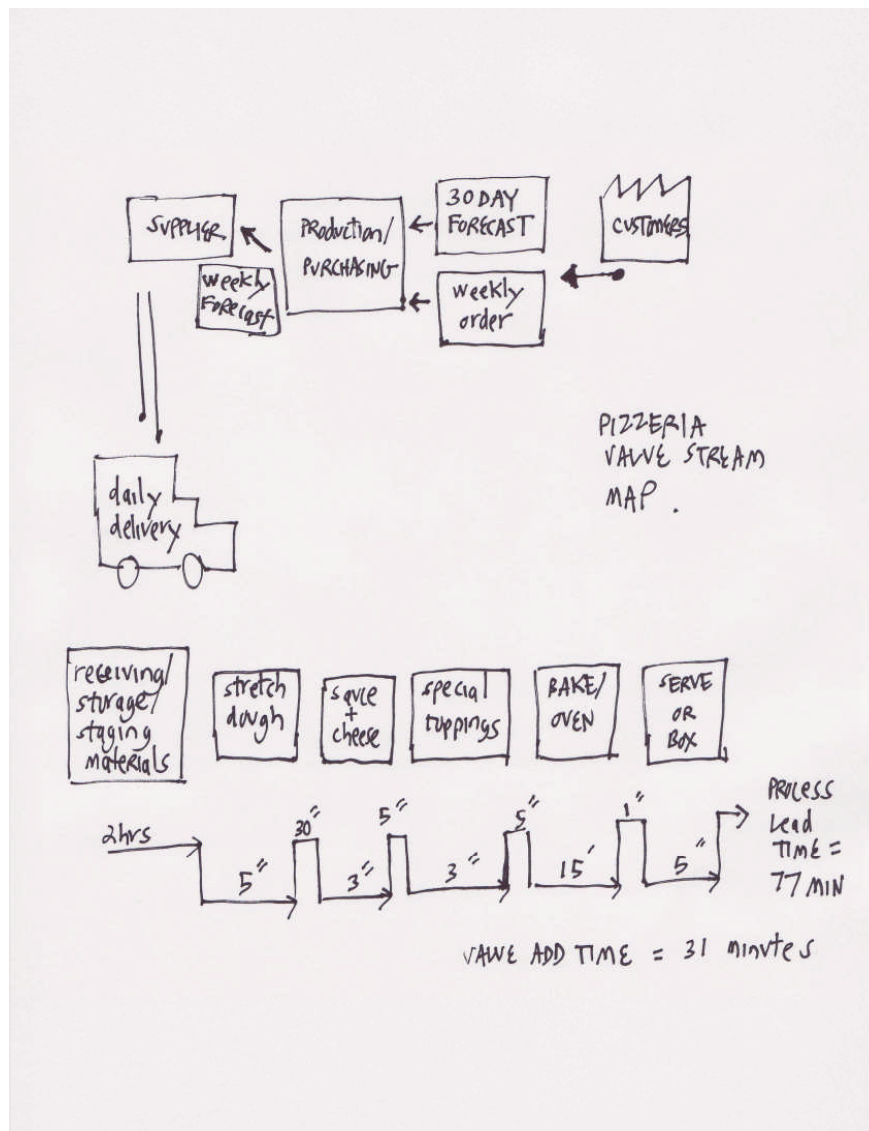
For example, if you are a small family-owned manufacturer of home-made chocolates ... who works 10 hours per day ... and sell 100 boxes of chocolates per day ... then you must produce 10 boxes of chocolates every hour/60 seconds ... or 1 box of chocolate every 6 minutes.

Calculating Takt Time becomes more complicated in businesses that have daily, hourly, weekly, monthly or seasonal variation. For example, if you are a small family-owned pizzeria ... that is open for 10 hours per day ... and sells 100 pizzas per day ... your "average" customer demand may be 1 pizza every 6 minutes But if you sell 40 pizzas in the 3 hours between 5:30 pm and 8:30 pm ... then you must design your business to respond to this peak evening capacity ... which is 40 pizzas per 3 hours/180 minutes at maximum capacity or 1 pizza every 4.5 minutes.

A lean pizzeria owner, for example, would use Takt Time to determine: how big a baking oven he needs to buy to produce pizzas at peak time of demand; how much dough, cheese, tomato sauce and specialty toppings he needs to order daily; how many employees he needs to hire at various times of the day. If the pizzeria owner buys too much, he overproduces and wastes or loses money. If he buys too little, he loses potential revenues from potential customers.

C. Lean Toolbox

The Value Stream Map below is a picture or illustration of the information listed in the “Production Table and Value Analysis for the Batch-and-Queue Pizzeria” that is described in this lesson.



For an outstanding introduction to Value Stream Mapping, please see “*Learning to See*” by Mike Rother and John Shook (Lean Enterprise Institute, 2004)

D. Recommended Reading Assignment & Highlights – All selections are from Jeffrey K. Liker, *The Toyota Way: 14 Principles from the World's Greatest Manufacturer*, Chapters 8-10, pp. 87-127

++

“If some problem occurs in one-piece flow manufacturing then the whole production line stops. In this sense it is a very bad system of manufacturing. But when production stops everyone is forced to solve the problem immediately. So team members have to think, and through thinking team members grow and become better team members and people.” – Teruyuki Minoura, former President, Toyota Motor Manufacturing, North America (p. 87)

++

“In competitive rowing, a key position is the coxswain – the little person in the back of the boat who is calling ‘row, row, row.’ He or she is coordinating the activities of all the rowers so they are rowing at the same speed. Get a maverick rower who outperforms everyone else and guess what – the boat gets out of kilter and slows down. Extra power and speed can actually slow the boat down.

A similar thing occurs in any manufacturing or service operation. Make one particular department extra efficient and it can actually bury other departments in excess inventory and paperwork and slow them down, making a mess of things. So, there is a need to coordinate activities. When you set up one-piece flow in a cell, how do you know how fast the cell should be designed to go? What should the capacity of the equipment be? How many people do you need? The answer is the takht time.” (p. 94)

++

“If you don’t confront your problems, you can’t improve your processes. One-piece flow and continuous improvement (kaizen) go hand in hand! If your competitor challenges itself to adopt the pain and ‘confusion’ of lean thinking, you’ll no longer be comfortable hiding behind your inventory – you’ll be out of business.” (p. 99)

++

“Toyota’s focus in any process is always on creating a true one-piece flow system that is waste free.... Creating flow means linking together operations that are disjointed. When operations are linked together, there is more teamwork, rapid feedback on earlier quality problems, control over the process, and direct pressure for people to solve problems and think and grow.” (p. 101)

++