Value Stream Mapping

for HIGH-MIX, LOW-VOLUME manufacturing

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Method:

10 Questions to Reach Future State:
1. How to bring visibility to the production floor?
2. How to ensure FIFO in the production floor?
3. Where to implement continuous flow through dedicated production lines?
4. Where to implement continuous flow through flexible manufacturing cells?
5. Where to implement supermarket pull systems using Product Variety Funnel?
6. Where to implement POLCA Cards to control WIP?
7. Explore TAKT and Pacemaker at each loop.
8. How to plan and level the mix to meet the production schedule?
9. What process kaizen is needed to reach future state?
10. How to standardize new workflow?
Introduction

Value Stream Mapping, as proposed by authors Mike Rother and Dan Shook in their innovative book, *Learning to See*, was a great advancement in the knowledge of the implementation of Lean Manufacturing. By combining many different Lean Tools, with the advantages of mapping a process to see the big picture, they took great strides in simplifying the finding of improvement opportunities in manufacturing plants. Their book also diverged from previous efforts in that it was solely meant for Flow Kaizen, as opposed to Process Kaizen. Thousands of readers are now knowledgeable in seeing the obvious waste that surrounds their processes thanks to the book. Although *Learning to See*’s principles of creating flow to minimize lead time can be useful in practically any situation, the tools used in the methodology can be more biased to a particular type of process. This type of process is one where repetitive and constant components are repeated to produce a relatively low range of finished products.

**High-Mix, Low-Volume** manufacturing environments have many difficulties in their process that prevent the establishment of flow. The lack of control in the process is caused by three main types of variance:

- The variance in the products: With hundreds, or sometimes thousands of possible finished goods, the number of products causes a non-repetitive process.
- The variance in the routings: All of the products which are produced can have completely different process routings, or order of stations it has to visit. This makes the application of production lines quite difficult.
- The variance in the cycle times for each process. Each of the different products can have completely different capacity requirements at a specific machine, which limits the predictability of the process.

The variance of High-Mix Low-Volume makes using Value Stream Mapping as described in *Learning to See* a near-impossible task. In addition, some of the tools proposed in *Learning to See*, might not be the best way to eliminate waste, or to accomplish the real advantages of Value Stream Mapping, which are:

- It helps visualize more than just the single-process level.
- It helps to see more than the waste, but the source of waste.
- It creates a common language for talking about manufacturing processes.
- It makes decisions about the flow apparent, so you can discuss them.
- It ties together Lean Concepts and techniques, which avoids “cherry picking”.
- It shows the linkage between the information flow and the material flow (Rother, Shook).

The definition of Value Stream Mapping in *Learning to See*, as “a tool that helps you see and understand the flow of material and information as a product makes its way through the value stream” (Rother, Shook). The methodology in this book seeks try to create a tool which uses the same definition, to bring the same advantages, to High-Mix, Low-Volume manufacturing environments or job shops, by merging VSM with all current knowledge of High-Mix, Low-Volume best practices.
Assumptions

This paper assumes the reader has knowledge in Lean Manufacturing. It also assumes that the reader is knowledgeable in Value Stream Mapping as described in *Learning to See*, and has seen the difficulties firsthand of trying to implement the tools and methodologies in a High-Mix, Low-Volume manufacturing environments. It assumes the reader knows and values the benefits of establishing flow and reducing lead time.

Although this methodology is best used for High-Mix, Low-Volume job shops, most of the steps to improve the process are not meant for customized products, although there is some value to be extracted for the production of custom products.

Methodology

The methodology proposed for implementing Value Stream Mapping in High-Mix, Low-Volume manufacturing is the following:

![Value Stream Mapping Diagram]

Another large deviation of the proposed methodology versus the concept used in *Learning to See*, is that the adaptation is mostly a computerized tool. Although pencil and paper should be used to create the initial drafts in the Gemba, the full value of Value Stream Mapping adapted to High-Mix, Low-Volume manufacturing can be extracted only by a computerized tool.
1st Step: Analyze Mix for Opportunities
Since the product demand mix is crucial to understanding High-Mix, Low-Volume manufacturing, the first step is to have a thorough analysis of how the demand and the process behave. By analyzing the behavior of the mix, different opportunities can be inferred, especially when seeing if there can be dedicated processes. An important and crucial step is to understand that variation in job shops should be handled by isolating it. This step should include several different analyses for the production.

- **Gather Data:** Conduct time studies as detailed as possible. If possible, try to collect cycle times for all of the product numbers, in all of the processes. Although this can be a tedious task, it is a necessity to have control over the production floor. This stems from the concept proposed in Made to Order Lean by Greg Lane, in which he states that “associating a time with all work” is a crucial part of controlling High-Mix, Low-Volume manufacturing plants. By giving someone an order with no guidance as to the time that it should take, can be compared with handing someone a blank check. In addition to the cycle time, it is very relevant to collect the performance of every single station, and every worker. This should be a part of cascading the core metrics, into as small of a detail as possible. By collecting the same metrics for which the entire process is measured, for every specific operation, visibility as to where improvements need to be targeted is obtained.

- **Family Analysis:** Another analysis that should also be made is the common product family matrix proposed in Learning to See. Although this tool is quite useful, it does not take into account several factors which could impact the decision to include products in product families:
  - It does not take into account the cycle times that each product faces at each station.
  - It does not take into account the different routings, or order of stations, that the product could pass through.

For this reason, several different steps should be completed. Firstly, cycle times should be added to the product family matrix after all iterations are completed. This tool is proposed in the book Creating Mixed Model Value Stream by Jim Duggan. This will provide further insight into the possibility of having a value stream for the families. Products should not be included into a product family if their cycle times are 30% above or below the average for the proposed families.

As for the different product routings, the methodology in Value Network Mapping by authors Zahir Abbas N. Khaswala and Shahrkh A. Irani, suggests using a Modified Multi-Product Process Chart. By mapping all of the different routings for the product in an excel sheet, one can merge similar routings. All three of these analyses should provide some opportunities to identify product families. This will help when deciding what processes can be solely dedicated to the product families.
• **Pareto Analysis of Demand:** The first should be a pareto chart of the product numbers. This serves as a way to analyze how the demand is distributed. If the mix exhibits the 80/20 rule, where 80% of the demand is made up of 20% of the product numbers then there are more chances of using dedicated and pinpointed efforts for several product families. Since the variance in High-Mix, Low-Volume shops should always be handled by isolating it, the pareto chart provides as to how much potential opportunities there are. One might discover that most of the demand can be manufactured in a separate process or manufacturing lines. The pareto analysis of the demand should be made month to month, in order to see what the variation of the distribution is. If the distribution of the products remains stable throughout the year, then this would make targeting improvements, an easier task.

• **Total Lead Time Analysis:** The real lead time of the entire door to door process should be measured for every product. In many High-mix, Low-Volume environments, the lead time is only controlled for a singular product family. This type of methodology diverges away from the continuous improvement of the system and gives focus into unsustainably prioritizing orders as fast as possible. By always gathering information on the real lead time of the products in the facility, we can gather information on the variance of this process. A high variance in the lead time indicates problems with prioritization (FIFO). It also indicates a high amount of stability. By having an unstable, highly variant lead time, there is a greater need for safety stock, which causes waste. Please note that due to the variety in possible routings, there should always be a significant variability in lead time.
• **Order in/Order out Analysis:** The order in which production batches are input into the process, versus the order in which they are output by the process should be visualized and measured. This deviation could lead to several important findings. In many cases where there are batch-and-queue processes, and many operations, the order of the production schedule can be completely lost. To properly complete this step, one should input the operations into an excel spreadsheet, in the order of the production schedule, followed by a sequential number. In another column, there should be the production orders, in the order that they were output from the system. By creating a v-lookup function, and then analyzing it against its real output, we can obtain the variance for the order. For a relatively high variance, it indicates great problems with FIFO, which cause backorder costs, and customer service level issues. When an order is behind schedule, it causes backorder costs, and service level issues. When an order is ahead of schedule, it causes storage costs, and creates a bad expectation of the client, if the same level of service is not maintained. It does not provide what the customer needs, at the right time, thus it causes waste. Ex.

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**2nd Step: Create Full Line, Current-State, Value Stream Map**

Creating a current-state value stream map that can add value in a High-Mix, Low-Volume process is a difficult accomplishment. The reason for this is that the large amount of possible processes and the different routings can cause quite a chaotic diagram. Some literature suggests completing the value stream map for only one product family. Although this is certainly useful, firstly it should be found if there can be improvements that benefit the entire production process for all of the families. The author in this methodology suggest, mapping all of the product routings, for all of the products. In order to extract value from this tool, the term of demand-proportionate process boxes should be used. Demand Proportionate process boxes are icons used in Value Stream Mapping, in which their size is directly proportionate to the demand that flows through that specific process. The same concept is used, not only for process boxes, but also for the inventory icons, and the arrows indicating push. For the arrows, three kinds of arrows are used:

- ![Yellow Arrow](Image) Indicates a flow which encompasses more than 50% of all the demand.
- ![Orange Arrow](Image) Indicates a flow which encompasses 10%-50% of all demand.
- ![Light Grey Arrow](Image) Indicates a flow which encompasses less than 10% of all demand.

In addition, each process box contains a small bar chart indicating which station the product flows through next, through the use of color coding.
Another addition to the Current State Value Stream Map is the use of a **Product Variety Funnel**. The product variety funnel helps visualize where variety is added in the manufacturing process. It also helps to see where it is most possible to use Supermarket Pull Systems. By having processes with a high variety, supermarket pull systems become expensive to maintain. For that reason, they should be placed before the large expansions, in the product variety funnel.

In an example with a process which has 69 different routings, and 280 possible products, the Current State Map is the following. The map with the **demand-proportionate** process boxes makes it easy to visualize which are the main flows of the process, yet also gives the user the option to see all possible routings. In addition, by having the proportionate size inventory icons, the use can also prioritize where to attack inventory waste issues in the process more easily. In the example below, it is easy to visualize that in the Cut-to-Length station, the product variety expands from. In conclusion, by using the above method for mapping the current state value stream map, one can more easily see waste, out of a highly complex process, thus adding great value to the tool.

The current state should also include the Product Variety Funnel. The product variety funnel is a graphical representation of the product variance as it goes through the production process. While there may be a large amount of finished goods, the variance of the finished goods will probably be added at one particular stage.

**3<sup>rd</sup> Step: Create Full Line, Future-State, Value Stream Map**

**Q1) How to bring visibility to the production floor?**

In order to create flow, managers and supervisors first need to have visibility and control over the production floor. This means having the ability to know which station an order currently is in, and how long approximately it is going be out of the process. There are several ways to complete this. Firstly, a time must be associated with all work (Lane). By having a complete control of how long
a processing step should take for all of the possible products, the supervisors can more easily control the output and the flow of the operation. In order to improve upon a process, it is most important to first understand it. Many managers inside of a job shop process do not have true visibility and control of what is happening in each second inside the production floor. It is most important to implement visual management techniques to properly control the production floor. The following tools are suggested in order to gain visibility:

**Electronic Work Order Board:** The Electronic Work Order Board is an easy-to-implement tool that can be programmed by a basic level excel VBA user. It uses a bar code scanner, and the input from the operators, to constantly update the status of a production order. The operators’ tasks is simply to scan the order, and choose what the next station is in the product’s routing. This action updates a central database containing the status of all of the production orders. The statuses can then update a bar graph, which graphically shows what the WIP is at each production station. By placing the tool in a shared folder, supervisors, planners, and managers have immediate visibility of the current status of the production floor. The tool is also highly beneficial since it can easily and automatically gather useful data such as the processing time for each order in the stations. This information can be leveraged in many different ways such as more realistic capacity planning, modeling the process, etc. The tool should use visual management techniques such as separating the number of orders into colors. The red color would represent orders which have been open more than acceptable. Yellow order would be order that are getting closer to the allowed time. Green orders are orders which have not yet been inside the processing system for a long time.

The tool is an extension of the Work Order Board proposed by author Greg Lane, in his book *Made to Order Lean*. Although the Lane suggest using a visual board controlled with a pen by the operators, this complicates the use of the tool further. The use of a computer facilitates the input, and the visualization.

**Cascading Metrics at Every Level:** Using visual metrics to control the health of a production process is a great way to achieve visibility and control of the process. Normal metrics which are used by many plants are production output, efficiency, lead time, quality incidents, yield, productivity, etc. The metrics should be implemented on a “cascading” basis. This means that they should be collected for as many different parts of the production process as possible. The metrics that are reported for the production unit should be able to be traced all the way back to specific processes, and operators. In this way, improvements can be targeted towards faulty process. Using the metrics provides the following advantages:

- It allows for targeted improvements. By monitoring in a detailed way, the users can easily locate what the deficient processes are, in order to target them for process kaizen. The greater the detail, the greater the benefit there can be in terms of targeting improvements.
- It motivates employees. If the employees fully understand the implications that their actions can have, not only on their station, but also on the productivity of the entire production unit, or even plant, they can be highly motivated. Continuing with the statements proposed by Greg Lane, “What does not get measured does not get improved.” If a process is not being measured and compared, it is like handing somebody a blank check.
• It makes the process easier to control. Having metrics at every level gives an added advantage in terms of control of the production process. It will be easier for supervisors to manage their personnel.

**Visual Management:** Other visual management techniques should be used to more easily control the production floor. Using boards, some common uses can be applied such as continuous improvement boards, 5S boards, Standard Work Boards, and even Value Stream Mapping Boards (Lane).

**Q2) How to ensure FIFO?**
The nature inherent in a job shop process makes it difficult to ensure that the production schedule is being followed. The cause of this is done by the batches of product which wait before every station, and the difficulty of ensuring that the operators pick the oldest order to begin processing. If a production process has many different steps, the problem can be amplified, and the final production output can be extremely skewed compared to the initial input order. For this reason, the production team should devise a method in order to see how to ensure that FIFO is being followed at every production station. A useful and visual tool, should the operators be in charge of selection the next order, it to have simple Prioritization Unit Numbers (PUN). The PUN is placed in an easily visible space where the production orders are stored between every station. The PUN consists of four different digits. It can be indicated graphically as follows:

![PUN Diagram](image)

Ensure that orders are run according to the production schedule eliminates the variation in the cycle time which can cause waste, costs, and loss in competitive advantage.

**Q3) Where to implement continuous flow through dedicated production lines?**
The most optimal manufacturing process in terms of minimizing waste is the manufacturing line; however, due to the fact that in High-Mix, Low-Volume manufacturing, processes are rarely repeatable, it is usually not possible to implement everywhere. It should be implemented wherever possible in order to increase efficiency, cycle time, and quality. To have a production line, the process needs to be repetitive, all-inclusive, and stable. For this reason, it is a good opportunity to explore if certain resources can be dedicated to producing only a specific product family. By installing a production line for specific families, the variation of the process can be
isolated to create production lines. By creatively rethinking the production process, it is possible to implement continuous flow in many different situations. Every single possible work element should be broken down into the smallest detail, and then redistributed to make the line have a similar cycle time for all of the products.

Q4) Where to implement continuous flow through flexible manufacturing cells?

In reality, the product mix that causes the large variance in cycle times for the processes can sometimes make continuous flow through production lines a very difficult task. However, this does not mean that the process necessary will need to be run in a “batch and queue” mechanism. When it is nearly impossible to separate the processes into families that run in production lines, flexible manufacturing cells should be implemented. A flexible manufacturing cell is a group of processes which are grouped together physically, and run in a continuous flow. However, it varies from a manufacturing line in that its flow is not static, but changes depending on the product. In a production line, where mass production is made, processes can be run repetitively and consistently, which makes it easy to balance a production line. Because of different machine cycle times, and the changing proportion of products, make a high difference in cycle times between processes. Running them in a continuous flow manner would cause one machine to be constantly waiting for the other one. The difference is that flexible manufacturing cells are adaptable to many situations. The key to use flexible manufacturing cells is the cross training. By having a cross-trained work force, the manufacturing cell can adapt and change depending on the type of product that it runs.

In flexible manufacturing cells, it would be very difficult to establish no WIP between the operations. Given the variety of possible products that are run, the operators need to accumulate some WIP between two stations, and then transfer to another station to keep processing. In some cases, the operator might perform two operations with the same batch in a successive way. Although this does create some levels of WIP that prevent one-piece flow, the amount would be significantly less than if the process was run as a job shop. This is because the following situation creates a WIP that is at most, the size of a full batch, compared to the large batches of product which accumulate in job shop manufacturing.
The diagram above shows the flexibility of manufacturing cells with operators quickly moving between processes, and processes changing orders depending on the type of product which is being run.

Q5) Where to Implement Supermarket Pull Systems Using the Product Variety Funnel?

Supermarket Pull Systems have proven to be very efficient at eliminating waste caused by overproduction as well as stabilizing operations. However, supermarket pull systems are very difficult to establish in a high-mix, low-volume environment. The reason for this is that a very high amount of WIP needs to be kept to have a stock of all of the different types of product. However, the production mix as the product goes downstream should be analyzed to see where the product variety is added. This can be done by using the product variety funnel next to the Value Stream Map. In the Current State Map above, it was identified that most of the variation comes in at the Cut-to-Length process where the variety of the product increases substantially. By placing a supermarket pull system before the Cut-to-Length process, it is possible to establish a supermarket which does not require a significant amount of WIP for every single process, and it is easier to plan by aggregating the demand of the different parts, before they flow into the Cut-to-Length process.

In addition, different alternatives should be explored which push the product variety funnel as far downstream as possible. By adding the product variety as close as possible to the customer, a more stable supermarket pull system can be implemented that can assure a greater customer service level.

Q6) Where to implement POLCA Cards to reduce WIP?

Although it is quite expensive to establish supermarket pull systems everywhere, a pure push system should also be discouraged. By pushing material onto the next process regardless if the process has the capacity to process it quickly; it maximizes waste and increases cycle time. In order to control WIP, and provide a sort of pull signal, the system of POLCA Cards is used. POLCA Cards are a hybrid of push and pull systems. POLCA Cards, as opposed to Kanban Cards, do not provide a signal for replenishment of one specific product, but an unspecified signal that means it has next operation has the capacity to process an order momentarily. It uses a set amount of cards that correspond to two adjacent stations. The first station may not start producing an order, routed for the second station, until a card is returned, signaling capacity. By controlling the number of cards, the WIP is also controlled. The POLCA Card system also works with an automatized scheduling method similar to MRP. However, instead of signaling that the order should be processed, it simply gives the authorization process the order, should a POLCA card to the adjacent station be available. To read more about POLCA Cards, and its potential benefits, please read *Quick Response Manufacturing* by Rajan J. Suri.
To implement POLCA Cards into the regular Value Stream Mapping icons, they have been included as such:

Icon used to indicate the use of POLCA Cards between two hypothetical stations A and B.

Q7) Explore TAKT and Pacemaker at each Loop.

Through this question, the concept of a Loop is defined. A loop is any set of operations through which there is continuous flow. In our case, loops would indicate the dedicated production lines and the flexible manufacturing cells comprised of all of the different processes. The Pacemaker at each loop is the process which sets the pace for the entire manufacturing cell. The term may be used interchange with the term of a bottleneck; however, they are not equal. The pacemaker is usually the most upstream process in a continuous flow loop. In the use of flexible manufacturing cells, the concept of the pacemaker might be more difficult to establish due to the change in routings, or the shift in bottlenecks depending on each particular product. However, if the routing and product variety is fairly stable inside of a loop, the possibility exists to use the concept of pitchy. If the production line exhibits a fairly stable process, the concept of TAKT time should be implemented to control the different components of the production line. To read more about Takt time, please read Learning to See.

Using the concepts of Takt, Pacemaker, and Pitch might be extremely difficult to implement in a High-Mix, Low-Volume manufacturing environment due to the uncertainties, and the variance in the cycle time of the processes, however, their use should still be explored.

Q8) How to plan and level the mix to meet the production schedule?

Although a lot of High-Mix, Low-Volume manufacturing facilities may reach their goals in terms of total output, it is very difficult and rare to meet the targets for all of the different products, or even product families. For that reason, the production schedule should be made taking into account the actual time it takes to produce each product. This concept goes one step further than leveling the load in conventional Lean Manufacturing. The load should in fact be level, yet not in terms of units, but in terms of capacity. By collecting the times that each process should take for each particular unit, the planning department can have a greater visibility of how to plan each weekly production schedule given the capacity that is necessary at each particular line. By using the Work Content Graph, and the standard times for each product, at each process, the total capacity needed for the week should be calculated. By aligning the total work hours that are needed to product each unit, and leveling using a heijunka box, the flexible system should be able to realign itself in order to be able to meet the production schedule.
It is especially important in High-Mix, Low-Volume manufacturing environment to reduce the batch size as much as possible. This is because the large variation in the process commonly requires a large amount of production orders to be open on the floor at a time. By reducing the batch size, there can be significant improvement on the lead time and flow of the process. In addition, small batch sizes are the key to having flexible operations which can meet whatever product mix is necessary in the production line. Reducing the batch size is completed by making changeover time as small as possible. SMED methodology is used to complete this task. For more information on SMED, please read *A Revolution in Manufacturing: The SMED System* by Shingo Shingo.

**Q9) What improvements are necessary to reach the future state?**

Although Value Stream Mapping has long been considered as a flow kaizen tool, as opposed to a process kaizen tool, the two work together in combination. Many times, in order to reach the future state of the value stream map, there is a necessity to perform some process kaizen initiatives such as improving uptime on a machine, lowering cycle time in an operation, or improving the quality of the output. Although flow is established by eliminating the tollgates, or automatic stops between them, there is also a necessity to improve on the separate processes in order for them to rely on each other. To handle the process kaizen issues, separate tools such as six sigma, preventative maintenance, training, and root cause elimination should be practiced and researched. In case when machine cycle times cannot meet the desired takt time, it might be necessary to possibly to:

- Research a possible equipment investment.
- Analyze all of the singular components of the operations to see how the process can be split into several components to reduce cycle times.

**Q10) How to Standardize New Work Flow?**

In order to see the full potential of benefits of the new work flows that are created using Value Stream Mapping, there is a need to standardize the operation. By using the standard work tool to eliminate variability, and to properly document the right way to perform a task, all of the uncertainties that the operators have when running High-Mix, Low-Volume manufacturing lines are exposed. Standard work is defined as *any operator following a prescribed method, with a proper workstation and proper tools, should be able to perform the amount of work required in the same amount of time, with perfect quality, without risk to health or safety* (Dugan, 109). New processes can leave many people confused, especially operators. To effectively establish standard work, there needs to be a thorough cultural initiative. In order to find the best method, the standard work implementation team should work with the operators to find the best practices. The scientific method should be followed when establishing the proper standard
work sequence. The scientific method is:

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Hypothesize → Test → Analyze → Implement → Extend
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The management of the standard work should be performed through audits. The people auditing the standard work process should be all of the levels of stakeholders within the manufacturing plant in order to establish an effective and thorough standard work culture. The management audit should also include a time study to make sure that the process is being completed within the control limits of the operation, and a complete check of 5S, to make sure that the work center is properly configured.

**4th Step: If the family distribution is stable, complete VSM on separate families**

After improvement opportunities have been discovered for the entire process, it is also useful to go back to the family analysis, and perform conventional value stream mapping (as described in *Learning to See*). The usefulness of performing regular value stream mapping will depend on the distribution and variability of the demand. Should the demand have a very small amount of families which encapsulate most of the demand, there could be a lot of value from dedicating a separate value stream map for the family. Most value will be extracted by performing the Value Stream Map for the high running product families. This is because there is a bigger chance that equipment can be dedicated to that single product family, which can help create flow in the production line. When implementing Value Stream Mapping as proposed in *Learning to See*, there might be some conflicts with the improvement initiatives that were developed while Value Stream Mapping the entire line. In order to prioritize which improvements are optimal, they must each be considered on the potential monetary impact, and how much they reduce waste for the entire system. Since most improvements which affect the entire line usually have more impact than those that only affect a single family, they are usually prioritized before.

**5th Step: Form Implementation Plan**

The most important part of Value Stream Mapping is the implementation. Once the Future State has been discovered and agreed upon by all of the stakeholders, the implementation of it becomes a crucial step. Creating the Future State Value Stream map is of no use should it not be implemented in the production line. For this reason, the implementation of the improvements should be pushed from the top down by the key stakeholders in the manufacturing plant. The Value Stream Manager should oversee the implementation process through a detailed timeline with the help of the core production team consisting of Industrial Engineering, Manufacturing Engineering, Quality, and the Supervisors. Careful consideration should be exercised when implementing more difficult changes, such as supermarket pull systems, and manufacturing cells. All changes should first be pre-accompanied by lean training, and a thorough understanding of the methodology used to eliminate waste. Changes and
improvements should also be made in separate times with a validating phase after the change. This prevents the difficulties in the implementation to aggregate and create bigger problems.

As with any continuous improvement methodology, the methodology is performed in a cyclical way. After the future state has been implemented, the methodology can be reiterated to find even more dramatic improvement opportunities. In this way, the future state becomes the next current state, and the basis to attack greater improvements and enhancements to better the process.
Bibliography


