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# Applying Lean Six Sigma at Nordson EFD

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# Lean Six Sigma

## Introduction

Lean Six Sigma (LSS) gives a company a competitive advantage over its competitors. On average, LSS cuts down on unwanted waste and cost by 25% ("What Is Lean Six Sigma?"). Additionally, LSS allows businesses to move beyond fixing defects or perfecting their processes to focus on the quality of their products. It also fosters a continuous improvement culture within companies' operations and administrative offices. LSS is a proven methodology used to reduce all types of waste in businesses. Although lean six sigma started in the manufacturing industry, it has been adapted for use across all industries, public and private ("Six Sigma Not Just for Big Companies," 11).

Lean Six Sigma works by combining the ideas of "lean" management with Six Sigma quality measures. Lean is about doing more with less by eliminating each of the seven "deadly wastes": Overproduction, waiting, transportation, extra processing, inventory, motion and defects (Seven Types of Deadly Waste).

Each of the seven deadly wastes causes extra costs beyond what is necessary to make the product or deliver the service. Three things tend to happen when these sources of waste have been eliminated. First, managers discover the virtues of a simple process or system design. A process does not have to be twenty steps to make a high quality product. In fact under the lean philosophy the fewer the steps the better. The main idea is that the process should only be long enough to make the product and nothing more. The second result of eliminating waste is that managers realize that there is always room for improvement. This realization leads to the final result of using lean: the emergence of a "continuous improvement" culture throughout the

company. The ideology of continuous improvement encourages managers to remain alert to areas of weaknesses that cause waste or can be made more efficient. The important aspect to remember with continuous improvement is that it does not only apply to the factory floor or the service process. It applies to all aspect of the business. It could be used to develop a more efficient way to schedule lunch breaks or change the way that a memo is distributed. By following this concept, lean practices will be successful (Thinking of Lean Manufacturing Systems).

The other aspect of LSS is Six Sigma. Six Sigma is a variation of quality measurement. This rule states that a high quality production system produces less than 3.4 defects per million units or opportunities. ("Six Sigma.")This measurement has been adapted to represent three different things: a philosophy, a set of tools, and a methodology. Six Sigma is a philosophy that breaks all things down into processes. This means that all issues or problems can be defined by each input combined to produce an output. It also means that the process can be broken down using a methodology called D.M.A.I.C (Define, Measure, Analyze, Improve, and Control.). This method will be explained later in the paper. (George)

As a set of tools, Six Sigma refers to the mechanisms that are used to drive process improvement. Each of these tools is used during different phases of D.M.A.I.C. For example, a common tool used for Six Sigma is called a process flow chart. This chart allows managers to map out each process, isolating where processes are being slowed down or where there is a missed step. This tool is often used during the measurement phase of D.M.A.I.C. (George)

Six Sigma as a methodology is the process of applying D.M.A.I.C to solve a problem. This methodology looks at the problem or issue and systematically breaks it down into the following steps; define, measure, analyze, improve, and control (George).

Many corporate leaders found that lean manufacturing and Six Sigma philosophies complemented each other. Their discovery began a trend of combining lean manufacturing and Six Sigma practices for different projects. People began to refer to this method as Lean Six Sigma or LSS. The greatest difference between LSS and Six Sigma is the way in which projects are prioritized, data is collected, and projects are analyzed ("History of Lean Six Sigma").

There are four key elements that LSS focuses on. The first focus is to delight the customer. This means understanding their expectations and perception of value. The company meets these expectations and delivers value through quality and speed of delivery. The second focus is improving processes. In doing this the company will eliminate defects and any unnecessary waste. The company achieves this by focusing on process flow and by looking for any type of variation in the process. The third focus, teamwork, is necessary to achieve the previous two elements. Supervisors are able to develop the best possible solution by working with machine operators and workers from other departments. Finally, factual data should be the basis for all the other decisions that are made. Without such data, effective conclusions or decisions cannot be made. The more data and facts analysts have to work with, the more informed decisions can be made (George, Rowlands, Kastle).

# Case Study: Nordson EFD

## Company Background

EFD is a company that has been making electronic fluid dispensing products since John Carter founded company in 1963. Carter originally started the company with a welding device that could be used on very small pieces of metal, such as earrings. He made most of his profits from the jewelry district for which Rhode Island is famous. As the company became increasingly successful, he diversified into producing different types of valves and dispensing devices. Carter also developed a very strict culture in his factory. He had a philosophy that the customer is king and that the customer should never see a defect. If the customer did, that meant that his employees were not doing their job. In an effort to prevent defects, employees would create their own quality checks that would prevent such errors (Sarza).

Nordson Corporation inherited this corporate culture and all the quality checks when they purchased the company from John Carter in 2000. Nordson Corporation was founded by Eric and Evan Nord in 1954. EFD became formally known as Nordson EFD or as NDSN on the NASDAQ Exchange, operating specifically in the diversified machinery industry ("NDSN: Summary for Nordson Corporation- Yahoo! Finance."). Although Nordson Corporation headquarter is located in Ohio, Nordson EFD operates out of East Providence and Lincoln, Rhode Island. Nordson's locations focus on manufacturing devices, such as manual dispensers, dispensing valves and tips, syringe barrels, and dispensing robots. ("Nordson EFD Products.")

Soon after Nordson took over EFD they decided to make some major changes. First, they empowered their labor force and focused on developing a decentralized organizational structure. In doing this, they wanted to make sure employees felt free to make suggestions. After all they

were the people that saw the products being made every day and fully understood each step in making the product.

Second, they gave support to the lean implementation department. This department focused on getting the factory running as smoothly and efficiently as possible. With the support of upper management and the empowered labor force they were able to be more effective. Nordson felt it was important to support lean thinking and implemented the use of Six Sigma tools. Nordson's other factories operated with the same thinking and they proved to be successful. Corporate also felt it was important for EFD to be operating as efficiently and effectively as possible because they were working from two different locations, and they did not immediately have the means to combine the factories into one. (Sarza)

The biggest change for EFD came in 2008, when the company finally decided that they needed to combine the factories because they were putting themselves at a disadvantage by operating from two different cities. They moved into a new building, which meant starting from scratch, setting up the production floor in the most efficient way possible and allowing room for growth. The lean department was deeply involved in this process and, as a result, the move was well planned out with limited interruption to production. (Sarza)

After the move, production operated smoothly and it seemed as though all the planning paid off. However, in 2009 the recession began to take its toll on the demand for EFD products. Demand dropped and, as a result, it was not possible for the company to operate at full capacity. This completely changed the focus of EFD's lean implementation department. Instead of shutting down the factory completely, corporate leaders decided to cut down production from

three shifts to one shift. They laid off all temporary workers and cut back on employees' hours. Their last effort to stay above the red was to reduce unnecessary inventory.

Just as fast as demand dropped off it came back for Nordson EFD. Although this was great for profits, the factory wasn't ready to respond to that type of demand. Their biggest issue was being able to build back inventory levels after letting them drop off so drastically. The Lean department had to work on how to get production back up to normal capacity and how to make sure it is running as efficiently as possible.

Nordson EFD successfully navigated these hard times and was able to get their production running smoothly. They achieved this by always observing production adapting to any issues that may come up and running different Lean Six Sigma events. Since the department was developed it has implemented a new business system, reorganized their electromechanical and packaging departments and adapted there solder and paste department to operate more efficiently.

After all these changes the company had lost focus of something very important to EFD: their focus on the customer. In 2010 Nordson EFD decided to do this by working on their on-time delivery. This meant getting the product to the customer the same day the order was processed or up to a week later (Sarza). As a result EFD had to have the product in inventory before the product is ordered.

## On-Time Delivery

In 2004 EFD had implemented a lean concept to improve their on-time delivery and improve scheduling of production across the factory. This system was called Kanban and will be described shortly. However, in 2010 the company's on-time delivery was at 56%. This meant that the customer was getting their product on time only 56% of the time. This percentage was not acceptable by Nordson EFD's standards. The Lean implementation department was tasked with improving this number (Sarza).

The department's first step was to determine the source of the delays .The first cause they discovered was in their business information system that had been implemented in 2007. This system controls orders. It takes the order from the customer, tells production when to have the order ready by and measures if the orders were being shipped on time. After looking at the system it was clear that people were incorrectly entering data into the system. This caused the system to register a shipment going out late when in reality it was going out on time. After addressing this problem, the on-time percentages increased to 76% in November of 2010. (Sarza)

Although 76% was a great improvement from 56% the lean implementation department wanted to get that number even higher. Their goal was for 95% by the end of the 2012 fiscal year. They did this by focusing on the factory and looking at where delays were happening. They found that the biggest cause of delays were from unexpected demand. EFD forecast demand based on demand levels from the previous year. This does not take into account any types of variables that may cause demand levels to increase or decrease. (Sarza)

This past year EFD found that there was an increase in demand. As a result they were required to outsource some of the products that they usually make in the factory because it would

be more cost effective and East Providence's factory could not operate at that capacity. By outsourcing parts of their operations, EFD put all the power in the hands of the supplier. As a result, many of the outsourced components were not coming in on time. The product could not be assembled and shipped on time, causing the on time percentage to go down.

Another delay found was from quality checks. In order for Nordson EFD to ensure quality to their customer they must either make all components of the product themselves or conduct quality inspections on 100% of their outsourced components. This was time consuming and required a lot of effort. However, the company felt this was a fair trade off because of the competitive advantage they gain by making quality products.

The delays from outsourcing and quality checks are issues that are hard to fix. The company can work on finding other supplier. This makes it so that the supplier does not have as much power over delivery time**.** However, the quality checks are a tradeoff that they have decided to make and must deal with the consequences. Another alternative is to focus on the factory operations to ensure that they are running smoothly and efficiently. They are doing this by keeping the morale and loyalty of the workers high and getting everyone involved with improvements.

By focusing on the factory and making minor adjustments, EFD was able to increase their on-time delivery to 90% in 2011 and was at 92% as of October 2012. Although it seems they will fall short of their goal of 95% by the end of 2012, they have made great improvements. In order to reach their goal, EFD can return focus to their lean processes they originally used to schedule production and control their on-time delivery; their Kanban system. (Sarza)

## Kanban system

Kanban is a “pull system” or a system where production is initiated by the department that will be using the product. Kanban uses a signal, such as a card, a light, or some kind of sound that lets workers know when a process needs to be started and the quantity that needs to be made ("Kanban System for Lean Manufacturing."). For example, if product “A” is taken out of inventory to be shipped then a card will be sent to assembly indicating that product “A” needs to be put together and replace the one removed from inventory. Once product “A” is assembled a card will be sent to the raw materials department indicating that material “B” and “X” were used to make product “A” and that replacement material needs to be ordered. This system is useful when your demand is relatively steady and you don’t want to hold a lot of inventory. This system can be very effective. However, it can also be hard to implement. It requires a great deal of cooperation between departments on the manufacturing floor. When used correctly, a Kanban system can reduce cost, minimize lead times, and reduce inventory levels and cost. ("Kanban System for Lean Manufacturing.")

At Nordson EFD a card signal is used. It indicates the product that needs to be made, the quantity of units that needs to be produced, and the total number of cards that are in each process. The Kanban system was one of the first lean tools to be implemented into the factory in May of 2004. Over the years they have adjusted and added to the system to meet the needs of each process and other changes in the factory. However, they are still encountering issues.

Two areas of the factory that use the Kanban system regularly are the plastics department and the electromechanical department. The plastics department focuses on making the plastic tips and barrels for the factory. The electromechanical department assembles valves and dispensers. (Sarza)

# DMAIC

DMAIC is the methodology behind Six Sigma. It outlines the steps that most Six Sigma organizations follow to understand and develop solutions for a business problem or run a rapid improvement event. DMAIC is a valuable tool for organizations to use. It provides a solid and structured framework to solve problems and improve an organization's operations. (George)

The first step is to define. In this step the organization looks at the problem at hand and clearly states the problem, its scope, and its potential causes if they are able to be determined at this point. The second step is to measure. The organization maps out the process and collects data. In this step it is important to develop a true understanding for the process and establish a baseline or benchmark for outcomes. The next step is to analyze. In this step the organization or team looks at all the measurements and data as well as the process and the steps that are taken to make the product. By the end of this step the team should be able to identify the true root cause of the problem (O'Connell).

The last two steps develop ways to fix the problem. The fourth step is to improve. It is used to develop a solution and implement it. It is important in the step to look at all the data and information collected. Many times the organization will have the employees that work with the process on a daily basis involved because they are able to give a perspective that many other team members would not be able to give, and that perspective is very valuable at this point in the process. The fifth and last step in the DMAIC process is to control. This step is really about controlling the solution put in place. This allows the teams to make sure their solution is being implemented correctly and maintain that they implemented the best solution for the issue and

that the improvement will be followed in the future. ("DMAIC The 5 Phases of Lean Six Sigma.")

This is the methodology that will be used to analyze Nordson EFD's Kanban system. The Kanban system was implemented eight years ago. In that time many aspects of the factory have changed and adapted to new demands. Using DMAIC, this case study will be able to determine if the Kanban system implemented in 2004 is still being use efficiently in Nordson EFD's plastics and electromechanical department (O'Connell).

## Step 1: Define

Nordson EFD's Plastics department makes all size of barrels and dispensing tips. In this process plastic pellets are melted down and placed in a mold to produce the desired product. The plastics department receives a signal from the packaging department when more products are needed. The Kanban system is very efficient in this stage of production. However, they are currently experiencing issues with the system. The plastics department often does not produce the correct number or type of unit for the assembly department.

Nordson EFD's electromechanical department makes valves and dispensers. The process this department uses to make products is much longer and more complex than the plastics department. This department requires more assembly time and skilled workforce. The major issue for this department is being able to keep up with demand and as a result the Kanban system is not being as effective as possible.

This project will look at the current Kanban system in place for each department. It will then determine the source of the problems. Finally it will develop solutions to these problems, as well as ways to control and monitor the success of the proposed solutions.

## Step 2: Measure

- Each exhibit outlines the department's Kanban system. The demand created activates an activity that will satisfy the demand. That activity will trigger the Kanban system to signal the following department's demand.

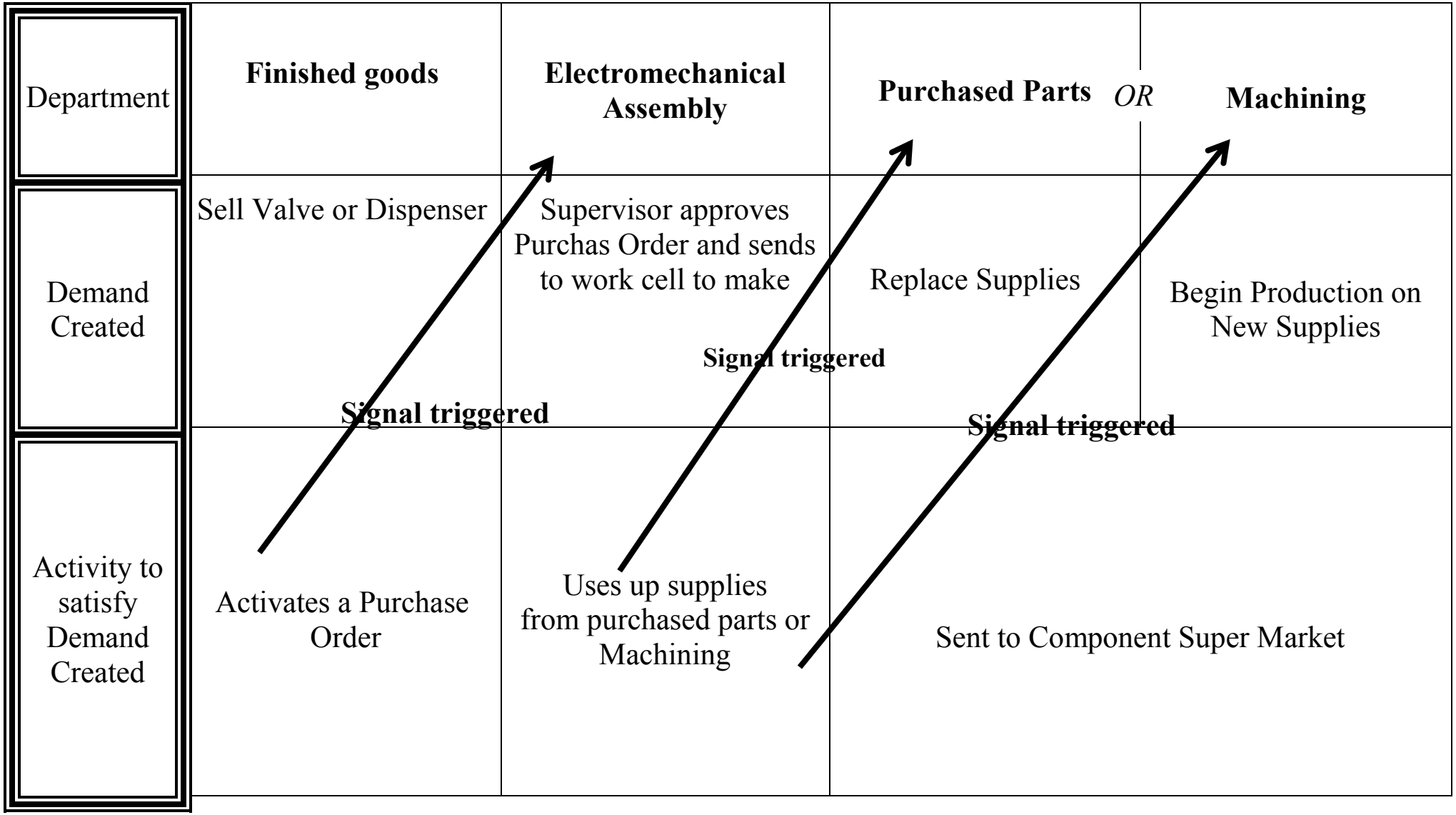
### Plastics *(exhibit a)*

| Department | **Finished goods** | **Packaging** | **Molding** |
|---|---|---|---|
| Demand Created | Send out Orders | Fill the Purchase Order | Replace Material for Packaging |
| Activity to satisfy Demand Created | Activates a Purchase Order to Package more | Uses up all Material | Molding Process Started |

**Signal triggered**

**Signal triggered**

Electromechanical Assembly *(exhibit b)*



## Step 3: Analyze

*Plastics*

After mapping out the plastics department Kanban process as outlined in exhibit a, it appeared that the areas where the problem was showing up was in the Finished Goods department. There wouldn't be enough of a product to fill an order. After following the problem back and looking at where the delay in production was the plastics department still couldn't find anything.

Following the product though production it was clear that the product was being made on time. However, a deeper look showed that the amount of product being made was the core problem. The Kanban cards ask for fewer units than the actual amounts needed. These issues tend to happen when there is an increase in demand for different products or if there was a high volume of a certain product.

Another ripple effect could be seen in the molding department. With unexpected changes in demand, the molding department depleted the raw materials before it had a chance to order more. This results in a halt in production simply because the department has to wait for more raw materials to be delivered.

The plastics department also offers some unique aspects that are important to take into consideration when analyzing the Kanban process. First of all, production in this area is very flexible. The machines in this department have the ability to make many different types of products by simply switching out molds. The second important observation is that the products that come from the plastics department are quickly assembled because there are not many

components involved and assembly is not complex. As a result of these two unique aspects, the department is able to quickly adapt to a problem or a shortage of product (Sarza).

*Electromechanical*

The electromechanical Kanban process is mapped in exhibit b. After studying the process it was apparent that there was a delay between the electromechanical assembly and the purchased parts or machining. This delay was being caused by a shortage of parts. The electromechanical assembly had to wait for both downstream departments to have the materials they needed to assemble the product.

The root cause of the shortage in the machining department was determined after taking an in-depth look at the department. The department was having problems being able to make the amount of components in the amount of time that the electromechanical assembly demanded (Sarza). The machining department was originally designed for a different level of demand. They were also being delayed by necessary machine servicing, conducted by sub-contractors.

The shortage from the purchased parts department was originally caused by suppliers. The purchased parts department gets many of their supplies from the same supplier. This give the supplier a lot of power and the purchased parts department has no other choice but to wait for the parts to be delivered when the supplier is able to deliver it. This issue is also a result of unexpected change in demand for these parts.

This department also offered unique aspects to take into account when analyzing the Kanban process. The products that are made in the electromechanical department are very complex and have many different components. As a result, product has a long production lead

time. Any type of delay or shortage of a component will usually result in the finished product being unable to be delivered on time.

## Step 4: Improve

*Plastics*

The root cause of plastics department delays is that the Kanban process does not ask for a sufficient number of units. The actual demand exceeds the expected demand that is used for the Kanban cards. After analyzing this process and brain storming possible solutions with Lean Implementation manager at Nordson EFD, Holly Sarza, we determined that the following are the three best possible solutions:

1.) Stop using the Kanban cards in the plastics department. In replacement of the Kanban cards, create a reorder point for the products. That way the number of units they have will never get below a certain number. In addition to a re-order point they will also require a max point. That way it will control the amount of inventory on hand and the production department won't create more then needed.
2.) Much of the influx in demand is caused by orders from China. In fact, overseas orders account for over 60% of the company's sales (Sarza). An option to cut down on the ripple effect that is caused by increased demand from China is to make this part of the products make-to-order. This means that the department would schedule a separate time, apart from their day-to-day operations, to meet the demand from China without taking away from regular day-to-day orders.
3.) Another option is to use an electronic Kanban system. This system can be very expensive and complex to implement and use. However, it would allow the different

departments to adjust the levels as needed. This would eliminate the issue that is being caused by the Kanban unit levels registering below the unexpected demand.

Each of these options would require greater communication between departments. They would also require a high degree of effort and training to implement. Option 2 would require the least amount of hassle to implement. Option 1 and 3 would require a great deal of training and some trial and error to determine the best possible levels and new rules to put in place. However, neither would be disruptive once they are in place and running smoothly.

After a complete understanding of the problem and possible solutions, the best option for Nordson EFD plastics department is option 3. This option puts in place a very sophisticated system. This will give supervisors and managers greater control over the Kanban system. Once the system is implemented the electronic Kanban system will allow greater organization of the entire process, from when finished goods triggers the signal for the packaging departments to signal the molding department. Although it will be expensive and complicated to implement, the expected tradeoff of having sophisticated and organized system will be worth it. However, an in-depth cost-benefit analysis will have to be conducted in order to confirm this expectation. This analysis should be conducted during the control step of D.M.A.I.C.

*Electromechanical*

Electromechanical department's biggest issue is with capacity. There is a delay in the delivery of raw material from both their purchased parts and from the machining department. The delay from their purchased parts department is being caused by the suppliers and the delay

from the machining department is being caused because the department is unable to keep up with the demand from electromechanical assembly.

Solutions for Purchased Parts:

1.) This department will order more components than demanded. This means that the department will have a safety stock of components and there should never be a delay to deliver them to electromechanical assembly. However, that will mean that the department will require the room to store this extra stock, increasing the cost of the purchased part.
2.) Another option is to have multiple suppliers for different components. This allows the purchased parts department to have a second option of which supplier they would like to buy from. By doing this they put the power in their own hands. In doing this, the department will be able to get the components when they need them and they can get the lowest price for the component. However, this will require forming new relationships with these suppliers and taking the risk that their products aren't up to the same quality standards of Nordson EFD.

Solutions for the Machining department;

1.) This department needs to increase the amount of the products they are able to make or add more capacity to their production. There are two ways to do this:
    a. Add more machines. This option is expensive and will mean the reorganization of the department in order to fit another machine. However, it would also mean that they would be able to increase their production levels and no longer cause delays for electromechanical assembly.

b. Add more labor. The department has the option to increase the number of shifts that the machine runs. This means that the company would have to pay for an extra shift of labor hours; however, they would be able to make enough components that they wouldn't cause delays for electromechanical assembly. This option also increases the risk of a machine breaking or needing maintenance more often with no time for that to be done without interrupting production.

The best solution for the purchased parts department is to set up multiple suppliers. Under these circumstances it is bad to have a single supplier because this gives them all the power. The supplier is able to set the price, the delivery rate, and the quality of the product because they know that you have no other options. In Nordson EFD, having one supplier has caused delays in production. When they set up a second and third supplier they will have the option of which one to go with depending on price, if it can be delivered on time and if it is up to the quality standards of Nordson EFD. However, it will take some time and effort to set up new suppliers and at first workers at EFD will have to conduct in-depth quality inspections of these new products which will add lead time to production. However, this is an expected tradeoff for the advantages mentioned above.

The machining department's best option is the more expensive option; to purchase a new machine. Although it will have a large fixed cost in the beginning, that cost will decrease over time and eventually pay for itself because the company will be able to make more components and completely cut out the delays caused by the machining department (Sarza). The company also has the room for the machine. The burden of reorganizing the floor space is mitigated

because the company took into account room for growth when moving into the new factory space.

## Step 6: Control

*Plastics*

In order to be sure that the option to implement an electric Kanban system is working efficiently and effectively supervisors must keep a close eye on the system. In addition to this they must be able to clearly understand if the system is performing correctly or not. This means setting levels for acceptable defects or delays. If the system ever goes outside of these levels then they must be able to observe and identify where the problem is and how to fix it. Without these steps the new system will prove ineffective.

*Electromechanical*

In the Electromechanical department the number of delays must be monitored as they move forward with their changes. In order to be sure that lining up multiple suppliers has proven to be successful for the purchased parts department there must be a record kept. This record must compare current prices and delivery rates to past prices and delivery rates to be sure that they are in fact getting better result.

To be sure that purchasing a new machine was the best choice for the machining department, managers and supervisors must set maximum and minimum levels of output. If the machine operates within these levels, that means that it does not have too little downtime, thus making it impractical. It also means that the machine is not running too much without being able to meet demand.

# Conclusion

Using a lean six sigma analysis, this paper has been able to clearly define, measure, analyze, improve, and control the plastics and electromechanical department at Nordson EFD. This methodology has provided a systematic way to assess and respond to issues arising in these departments. Because of this, Nordson EFD can now implement the solutions developed during the improve stage of DMAIC and then monitor the issues by using the methods developed in the control stage.

This methodology can also be adapted for use throughout other factory departments. Many companies have done this after using lean six sigma. They are impressed with the results after using LSS on the factory floor and look for other areas to apply it. This is where lean six sigma becomes relevant in other areas of the business and how it has expanded from the manufacturing industry to the service industry.

Lean six sigma is an important methodology, philosophy, and set of tools that provides a company with a competitive advantage over the competition. This allows the company to be able to compete with other companies that are able to produce products quickly with a low overhead. For example, many factories in Asian countries are able to produce products at a low overhead because wages are much less. This is why many factories outsourced their operations to Asian markets. However, many U.S. companies that use LSS practices are able to compete with these markets and keep their operations local. In the case of Nordson EFD they will be able to produce their products quickly and efficiently. This means that EFD will have a competitive advantage of quick delivery and high quality products, allowing them to maintain and grow their market share thanks to their use of Lean Six Sigma product.

Works Cited

"DMAIC The 5 Phases of Lean Six Sigma." *The Basics of Lean Six Sigma*. Go Lean Six Sigma, n.d. Web. 20 Aug. 2012.

George, Michael L., Dave Rowlands, and Bill Kastle. *What Is Lean Six Sigma?* New York: McGraw-Hill, 2004. Print.

George, Michael L. *The Lean Six Sigma Pocket Toolbook: A Quick Reference Guide to Nearly 100 Tools for Improving Process Quality, Speed, and Complexity*. New York: McGraw-Hill, 2005. Print.

"History of Lean Six Sigma." *HubPages*. NING, n.d. Web. 7 Oct. 2012.

"Kanban System for Lean Manufacturing." *Logistics Management*. Global Logistics, n.d. Web. 20 Aug. 2012.

"NDSN: Summary for Nordson Corporation- Yahoo! Finance." *Yahoo! Finance*. Yahoo!, n.d. Web. 20 Aug. 2012.

"Nordson EFD Products." *Nordson EFD*. Nordson Corporation, n.d. Web. 20 Aug. 2012.

O'Connell, Scott. "Interview with Nordson EFD Facilities Manager." Personal interview. 27 May 2012.

Sarza, Holly. "Interview with Nordson EFD Lean Implementation Manager." Personal interview. 19 Oct. 2012.

*Seven Types of Deadly Waste*. LEAN Innovations, n.d. Web. 7 Oct. 2012.

"Six Sigma." *ASQ*. American Society for Quality, n.d. Web. 7 Oct. 2012.

"Six Sigma Not Just for Big Companies." *Insights*. Schneider Downs, n.d. Web. 20 Aug. 2012.

*Thinking of Lean Manufacturing Systems*. SAE International, n.d. Web. 7 Oct. 2012.

"What Is Lean Six Sigma?" *Strong America Now*. Idea Den, n.d. Web. 7 Oct. 2012.