

School of Mechanical Engineering
FALL Semester 2020-21
MEE -1016 Lean Enterprises and New Manufacturing Technology
Digital Assignment – 2: Application of Lean in Electronics industry
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➤ Introduction

1.1 Objective

The Purpose of this report is the usage and implementation of Lean Tools and principles in the electronics Industry. Lean is a standard practice in the majority of manufacturing companies. The electronics industry is one of the biggest manufacturing sectors in the world currently, and

therefore it follows that it would employ successful business practices. The Lean philosophy of adding value wherever possible for as little cost as possible fits perfectly with what large electronics companies would be looking for. Therefore, they would naturally implement Lean wherever they deem necessary.

This document will explore a number of Lean tools and principles that are being used in this industry and how they bring value to the product with the way they are implemented. These Lean tools will be explained with regards to how they work and in the context of electronics how they are useful. Then the success of this implementation will be discussed, if there were any failures in implementation and how the industry would have looked if there were no Lean tools and principles being used. Then there shall be a conclusion with an overview of the ways in which Lean is used which were discussed.

Literature summary

J Oliveira and A. Fernandes [1] is a company that specializes in manufacturing machinery. Throughout the production process, with the help of Value Stream Mapping (VSM), several garbage cans have been identified.

Daniela Santana Lambert & Marzagao [2] identified and understood the relationship between the critical success factors of Six Sigma programs and the performance of their projects, taking into account Six Sigma projects. This article explores that relationship via PLS (Small Square) method.

Oluwatosin Babalola and Eziyi O Ibem [3] used less proven principles and methods to gain results in the construction industry around the world. However, there is no clear understanding of the number and categories of non-core processes implemented and the associated benefits in planning, designing and constructing construction and infrastructure projects.

Ang Boon, Sin & Suhaiza Zailani [4] explain the concept of six sigma. Six Sigma is a business strategy that helps organizations improve organizational efficiency and customer satisfaction; reduces operating costs and increases profits.

Lucia Botti and Cristina Mora [5] define ideas for soft production. Lean production is a production method developed after the Japanese Toyota Production System and was rapidly developed in the global manufacturing industry. Jose Arturo

Garza-Reyes and Vikas in mar [6] describe the following in the subtleties. Evidence suggests that minimally invasive methods and tools have enabled producer organizations to achieve efficiency, and in this way meet traditional and current organizational goals such as profitability, efficiency, responsiveness, quality, and customer satisfaction.

Brain W. Jacobs [7] describes the concept of soft production. Operating Managers face the challenge of deciding when to use different management names such as Six Sigma, ISO 9000, and Lean. This study examines the effects of premature performance compared to the recent adoption of Six Sigma process improvements.

Avinash Panwar and Rakesh Jain [8] explain the concept of production technology. In the current era of intense competition, industries are using less productivity to survive. The concept of informal production is new to the Indian process industries.

Katarina Senderska and Albert Mares [9] in their work on Spaghetti graphic design work analysis workers described various aspects of how spaghetti plays an important role in the movement of industrial workers.

Nagaraj A Raikar, Prassana Katmani and Gaurish Walke [10], in their study of Using a spaghetti drawing to identify and eliminate waste in the store environment to improve OEE: Case Study described various aspects of how spaghetti plays an important role. in the transportation of waste in the industry.

Handanhal Ravinder and Ram B Misra [11] in their work on ABC asset management analysis: Closing the gap between research and class emphasized the process of detail on how ABC analysis could be used.

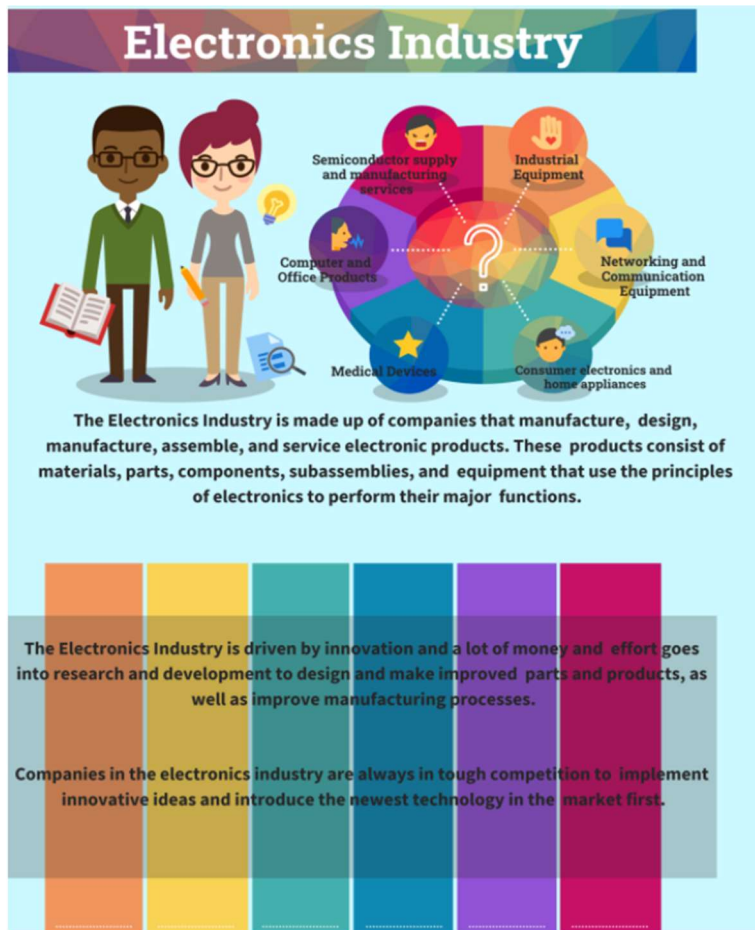
➤ Application of lean tools in Electronics market

3.1 About the industry

The electronics sector is an industry dedicated to the production of electronic devices and equipment. It is a vast and important industry with products ranging from consumer electronics to military weapons to industrial equipment. Some of the biggest segments within electronics are semiconductors, telecommunications and computer and office products. Because of its wide reach and extreme importance in the manufacturing of practically all modern devices, it has tremendous value and demand in modern economies. In India alone, the electronics industry was valued at 200 billion USD in 2019 and accounts for 10% of the whole market worldwide. In the same year, consumer electronics was the largest segment with electronic components being the fastest growing.

Two prominent companies in this field are Apple and Foxconn. Apple and Foxconn share a relationship that's common in the electronics industry, where one company designs, owns and sells a product while it outsources the manufacturing to a different company, usually one in another country where production is cheaper. Foxconn manufactures somewhere between 60-70% of Apple's iPhones. Since Apple is one of the biggest players in the electronics industry, with some of the most popular and in-demand products such as the iPhone, Mac, iPad etc,

Foxconn which is very dependent on its relationship with Apple for its revenue, must manufacture a staggering number of products annually. It needs to find the components, manage its inventory, create a supply line to build these products and do all of the steps involved extremely efficiently and with little cost whilst working on tight schedules with low margin for error. It faces huge hurdles with its manufacturing and if mismanaged would lead to a shortage of some of the most popular devices in the market, leading to a lot of lost revenue. Because of this, smart and careful planning and preparation is necessary for its manufacturing practices. Lean Manufacturing is the perfect philosophy for the job. Lean can minimise the risks involved whilst maximising throughput leading to maximum value and profits. There are plenty of places in the supply chain for Lean principles and tools to be readily applied. Foxconn is merely one example of a situation present in the whole industry. All these companies need efficient manufacturing policies to meet their ever-growing demand and therefore Lean has widespread applications across the entire sector.



3.2 Problem statement

Apple had to shut down in 1984 after spending \$20,000,000 in just two years. The main problem of apple was their failure to integrate Marketing Strategy with Manufacturing Strategy. Or, more

likely, Apple failed to even consider the issues of Manufacturing Strategy. Later, when Apple partnered with Foxconn, Apple and Foxconn did not repeat the earlier mistakes.

3.3 Lean in Electronics

Gemba walk:

Its purpose is to allow the managers and the superiors to observe the actual work process, interacting with the employees and learning the work process so they can explore opportunities in continuous growth process.

The three elements of this lean tool are;

- Go and see
- Ask why
- Respect employees

Zero quality control:

It is a method used to achieve zero defects in an organization.

Zero gives reference to objective of the zqc which is to produce the product with zero defects.

ZQC works in a way that the process does not produce defects even if a human error is made,

Continuous flow:

Continuous flow is a lean method that allows you to move a single product through every step of process instead of grouping the work into batches.

In a continuous flow system, the products go through the process individually and defects are found in time so that subsequent products can be corrected earlier in the process. Fewer products would require the rework, because the defect would be corrected before it was put into the remaining products.

Jidoka:

It is a lean method that is widely adopted in manufacturing and product development.

The main goal of jidoka is to produce free of defects. In case of a defect the manufacturing process will be paused manually or automatically.

It is worked by simple four steps:

- Detection of occurring deviation
- The production stop
- Execution of adaptations and repairs
- Investigation of the root cause of the defect.

Six big losses:

Six big losses provides a concrete and manageable framework within which the losses are categorized. This makes it easier to see where improvements can have greatest impact.

The six big losses are unplanned stops(machine failure), planned stops(changeover), small stops(jams,blocks), slow cycles(machine wear and tear), production defects(product damage), startup defects(improper assembly).

VSM

In order to provide the product or service that the customers desire, every company has a set of steps that are required. Value stream mapping enables us to better understand what these steps are, where the value is added, where it's not, and more importantly, how to improve upon the collective process.

This system takes all the people, processes, information and resources needed, and shows you on a flow chart to get a business idea.

Applications of vsm:

- Value stream mapping can be used to promote continuous growth in an organization.
- Facilitates clear communication within the branches
- It helps in recognizing wastes and its sources,

➤ Result / discussion

4.1 Implementation of lean tools

Apple's key requirements for manufacturing tasks:

Flexibility

Flexibility is the most important task for Apple. Apple's marketing strategy requires a lot of flexibility in manufacturing. This flexibility comes in several forms.

- 1. New Product Flexibility**
- 2. Volume Flexibility**
- 3. Product Mix Flexibility**

Apple's factories must be able to reconfigure for new products and modifications very quickly. The factories must be able to increase production from a test product to maximum demand quickly because of the initial promotions and short life-cycles (volume flexibility).

Things wrong with apple's manufacturing

The Effects of Automation

The facility was highly automated and designed for high production but much of this automation was unnecessary and not justified by cost savings plus, the automation had negative effects on teamwork and quality. *For e.g. the separations can create a lack of communication between departments one department may slow down due to some issue but the conveyer keeps moving this may lead to poor quality products or damaged goods this is very crucial especially in electronics industry*

<https://www.youtube.com/watch?v=NkQ58I53mjk> see this 2 min video for better understanding. *In this video, there were multiple faults in that department of the production line. Improper training led to two inexperienced operators working without a more capable colleague. The supervisor did not show them the most effective wrapping methods. There was no signs or utilisation of Visual Management to either inform the operators on how to perform their job, how to communicate to the previous sections that they were going too fast, or what to do incase they couldn't work fast enough. The unnecessary speed of operation created a bottle neck which would have to be cleared, fixed and ensured to not happen again which costs time and time is inevitably money. The supervisor and her superiors did not effectively utilise Gemba walks to realise the true situation at hand. This comedic skit would be impossible in a world with Lean.*

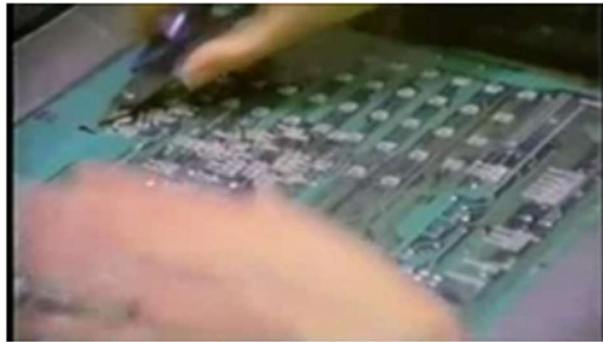
automation increases indirect and support labor costs by adding maintenance, engineering and scheduling it also increases other forms of overhead costs such as interests on the cost of space, utilities and insurance so now the problem is if the production slows, the overhead costs still remain.

Lack of proper communication and signals

Workers are separated by distance and equipment to such an extent that effective work teams would have been very improbable. The team members would not have had contact with the upstream or downstream operations but only others who were doing the same operation in vicinity. In such a scenario it would be difficult to communicate, share tasks and provide significant assistance This would cause problems and cancel the advantages of using automations.



Conveyors are everywhere. This is a symptom of poor layout, excessive handling and functional operations. These conditions, in turn, contribute to quality and communication problems. The automated conveying systems Apple employed are very difficult to change.



Manual clipping of leads on through-hole components. Appears to be done in a separate dedicated area. This mandates a lot of material movement, hence the elaborate conveyors.



Transferring circuit boards from one location on the site to another using carts and an OTR tractor-trailer. Large Batching results.

Large travel times

Travelling circuits, parts, components from one part to the other was done through conveyers or through a trailer. This increased the time required to finish the product and it also meant lagging in case of any change in the speed of any of the departments due to lack of proper signalling mechanisms and lack of visual management

Things right with Foxconn

Key Features

Lines

foxconn uses long assembly lines with little automation and very short work times. This shows similarities with Henry Ford's approach (90 years ago). Foxconn uses unskilled labor and the migrant (people often work for short times usually switching jobs) nature of this labor makes for considerable turnover. Short cycle times and repetitive tasks means that it is easier to learn(train) the task and it also becomes easy to switch.



Lots of people, short-cycles, repetitive operations and simple conveyors are the most striking features at Foxconn.

automation

Foxconn uses automation in compensation to unskilled or inexperienced workers. Manual work is done where ever it is advantageous and feasible.



NC (numerical control) machining of cases. Foxconn uses automation and technology wherever manual skills are insufficient.

Supervision & Support / Gemba

The line configuration requires considerable supervision. It looks like Foxconn uses about one supervisor for every four line-workers.



One supervisor is required for four workers on the line. similar ratio is also found in several other areas.



In this packaging area there is a lot of activity but very little inventory

Zero quality control

It means that quality is taken seriously and proactively, particularly problems related to Electrostatic Discharge (ESD). Employees can be seen wearing bunny suits with proper grounding wherever required.



Full bunny suits and ESD grounding straps indicate an effective ESD program and a concern for quality.



High level contamination control.

How to improve further

The Ford -style production lines used by Foxconn require a lot of supervision. In this case it is one supervisor for every four workers. A similar assembly line with more mature and stable American workers would require significantly less supervisors. Since the workers would comparatively be more experienced and skilled. Cellular Manufacturing would require even less supervisors. like one supervisor for every 15 - 25 workers.

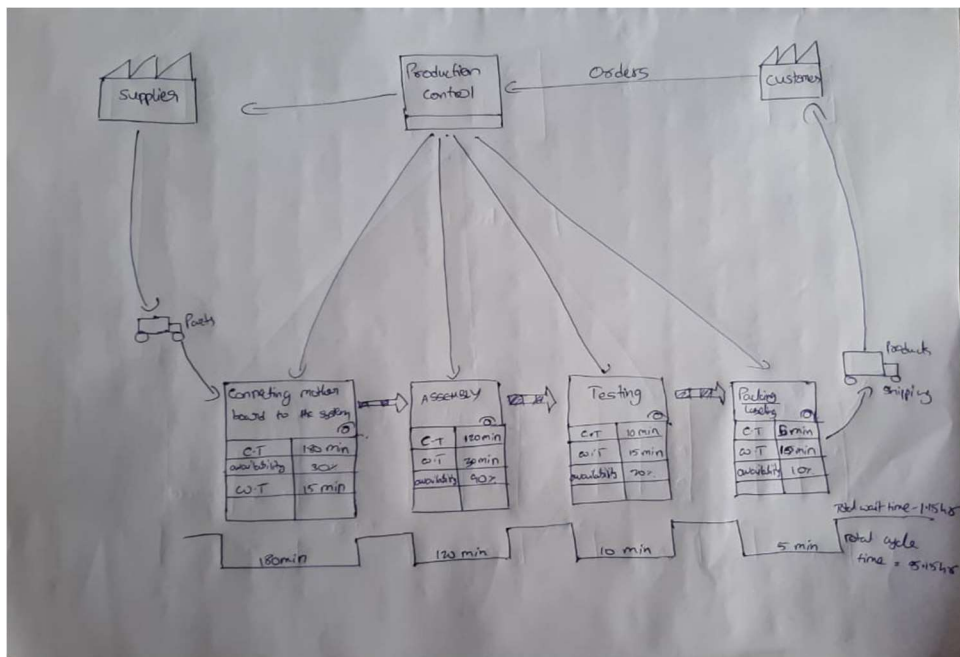
Steve Jobs once stated that 700,000 people were employed by Apple and out of that 30,000 were engineering technicians. That means that one I.E. Technician was there for every 22 workers. This is a very high ratio but it is necessary because of the unstable workforce and the production line arrangement. A factory in the U.S. making similar products could probably require about one IE Technician for every 50 workers.

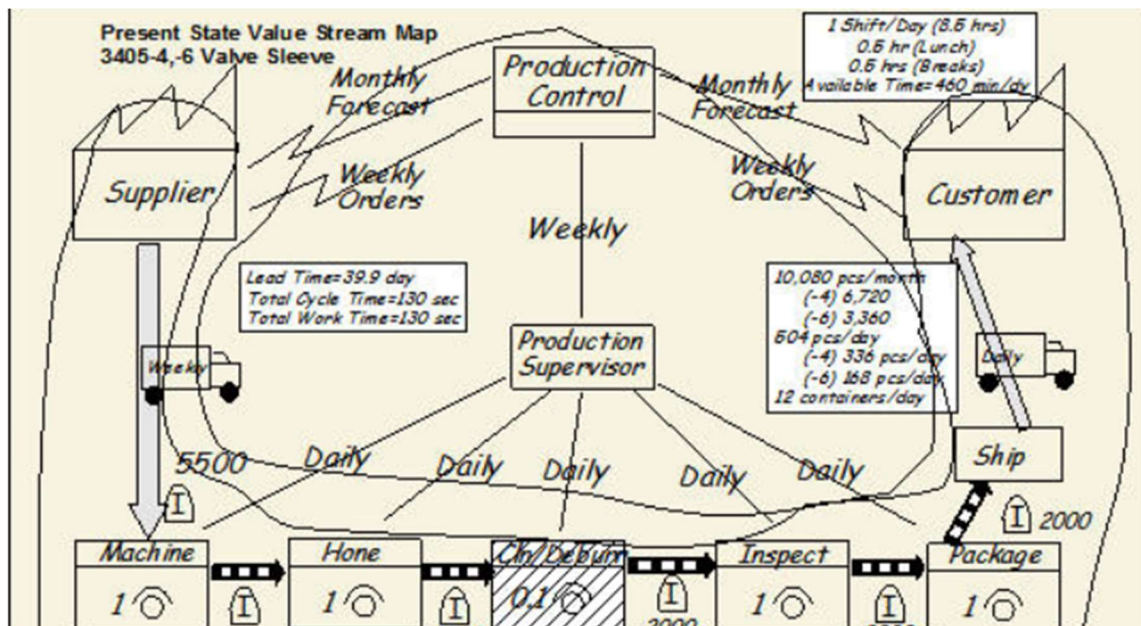
Category	Line Production China	Line Production U.S.	Cellular Production U.S.
Line Workers	1000	700	500
Supervisors	250	125	25
IE, Techs	43	20	15
Total	1293	845	540
% Baseline	100%	65%	42%

A Cellular operation would require far less engineering support because the workers are trained to perform these engineering and problem-solving tasks. A cellular operation in the U.S. would probably need one IE Technician for every 200 workers.

Using VSM and Process maps

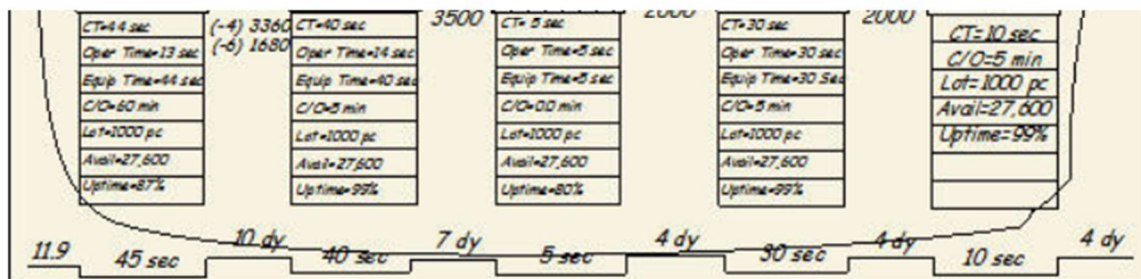
	Connecting mother board	Assembly	Testing	Labeling
C.T	180min	120min	10min	5min
W.T	15min	30min	15min	10min
Availability	30%	90%	20%	10%

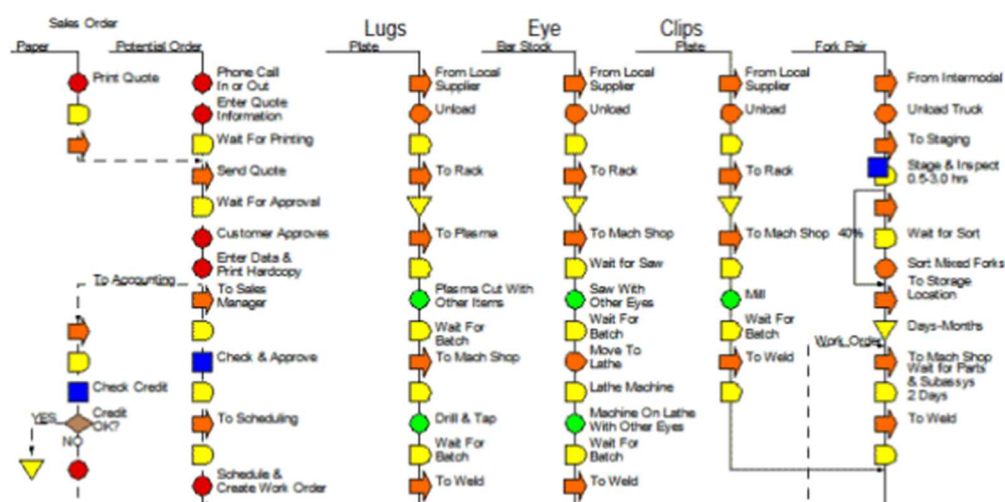




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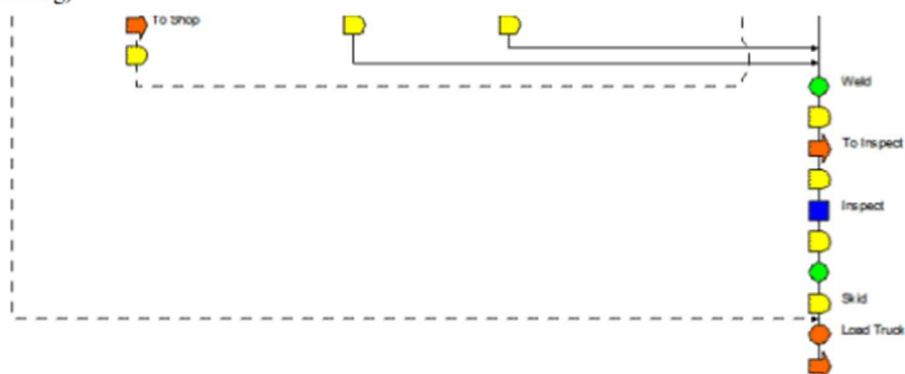
Value Stream and Proces





1/2

ping (Charting)



Which To Use?

➤ Conclusion

The electronics industry is vast and facing great demand for a large variety of products. It is difficult to cope up with the ever-rising demand without proper planning and use of proper management techniques. As we learned from apples failure that manufacturing strategies are equally important as the product designing and marketing strategies. This sheer volume in demand, low margin for error in product quality and need for high profits necessitates the usage of smart manufacturing solutions like Lean. Lean tools are widely used in the electronics sector for these reasons, an example being Foxconn producing Apple's bestselling products. But there are also areas where Lean is not applied or incorrectly applied and continuous improvement is a must.

Lean delivers value to the customer with as little cost as possible, using principles like Jidoka, Continuous flow and six big losses as examples. In an industry as massive as Electronics these strategies are a must for optimal production and Supply Chains.

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