IMPLEMENTING LEAN IN A MEDIUM SCALE INDUSTRY

A CASE STUDY AT COUNTRY CONE ENTERPRISES LIMITED- GHANA

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SEPTEMBER, 2011
ABSTRACT

Lean manufacturing is a known principle used in today’s industries to eliminate various hidden wastes that do not add value to the finish product. Lean concept has many advantages which have helped many companies over the years to stay more competitive in global and national business.

With the help of value stream mapping as a main tool, the current state of the company can be analyze so to detect any non-value adding processes termed as waste. Future state of the company is then planned to make sure all non-value processes are eliminated from the entire production line.

Many companies are currently choosing lean production with the ultimate aim of bringing overall operating cost to barely minimum. Choosing lean production means continues improvement within the company to be able to achieve the benefits of lean production.

This thesis aim at studying the production lines, how information are distributed across the entire company from suppliers to the customers. Interviews will be conducted with various distribution centre managers, suppliers, and also technicians to familiarize with how things are done currently and the way forward to achieve the aim of operating on lean. Operators and other staffs will be trained to understand how lean works and also the need for continuous improvement and not just a one-time improvement.

Recommendations will be made to enable the company to reach the ultimate aim of operating on lean principle which has been known to be helpful.

Key words: lean manufacturing, value stream mapping, continues improvement, hidden waste
ACKNOWLEDGEMENTS

My greatest thanks go to The Lord Almighty Father by whose blessings and guidance I have come to this far in life.

I am also grateful to my dear uncle, Mr. Alex Owusu Asirifi and his family for their uncountable supports both in prayers and in kind. They have been my only source of financial support throughout my educational life. To them I say “May Almighty God keeps blessing you above imaginations”.

Again, I want to say a big thank you to Mr. Alex Adusei, the Managing Director of Country Cone Enterprises Limited, Mr. Simon Sarfo and the entire staffs of Country Cone Enterprises Limited for the friendly atmosphere granted to me when I was with the Company studying and collecting data. I appreciate your times and knowledge towards this thesis work.

My deepest appreciation goes to Mr. Ove Bayard, my supervisor and also a coordinator at the Production Engineering and Management program at the Royal Institute of Technology (KTH) Stockholm for his immerse contribution during the planning, take off and finalizing of this thesis. I greatly appreciate your effort towards this work.

Finally, I wish to say thank you to my friend Osman Chaudhary for taking the pains to give suggestions towards this work and also to all my program mates at Royal Institute of Technology to whom I have learnt a lot as far as international cultures are concern. I say God bless you all in whatever you guys will be doing in life.
LIST OF ABBREVIATION

TPS - Toyota Production System
JIT - Just-In-Time
WIP - Work in Progress
POUS - Point-of -Use-Storage
VSM - Value Stream Mapping
TPM - Total Productive Maintenance
5S - Sort, Straighten, Shine, Standardize, Sustain
SMED - Single Minute Exchange of Die
TQM - Total Quality Management
C/T - Cycle Time
OP - Operator
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1.0 INTRODUCTION

The rapid growth of industrial competition throughout the world has brought about the needs to stay focus on how best a company can be producing to the customer’s requirement at a minimum cost.

This has also generated the needs of numerous researches which can help achieve the necessary requirement to stay ahead of the competition. Lean manufacturing is one of these principles which have over the years been used by many companies to be able to stay more flexible in business which is the backbone of meeting customer’s needs.

Again, these days, companies do not compete internationally but also locally as there are always struggles over who captures the immediate markets simply by how well the company’s products are able to fulfill the customer’s expectations. This is because; customers are always ready to pay for only what they consider as satisfies their needs. This has brought about companies always investing on how to operate to take control of the immediate markets. One important principle which has been identified by many successful organizations all over the world is what is called lean production.

The history of lean manufacturing is traced back to an American automobile owner Henry Ford who was able to turnover inventory but did not provide varieties in the system. After the Second World War, leaders at Toyota Company in Japan considered the shortcomings with Henry Ford’s type of manufacturing which was very good at flow and spent intense researches to come up with a system which is capable of providing varieties in the production system while also considering the flow techniques. They were successful and that gave birth to Toyota Production System which is now known in production world as Lean manufacturing. (Womack and Jones 1996)

1.1 Problem Statement

In both manufacturing industries and service sectors, there are considerable amount of waste which are not easily identified but they form part of the daily processes. This has generated the need for analyzing the processes within a company to identify these hidden wastes and find means to eliminate them.

Country cones enterprises limited as manufacturing company which produces ice cream cones and ice creams and have been in business for the past decade and has grown from various stages in business and still has aim of expanding their production systems needs to be flexible to meet the challenging expectations of customers.
To meet customer’s requirement on time and also provide high quality product at a minimum cost requires operating on lean principles. Country cones enterprises limited starts it process of production from taking deliveries from various suppliers such as Takoradi flour mill and other companies who supply the ingredients, then to the processing department to produce the cones and ice creams, followed by transporting the packaged cones and ice creams to carefully located distribution centers where the sales people come in to sell to consumers almost around the country.

As the company has two different production lines (one for ice cream production and the other for the production of cones) it requires a planned schedule of the lines to prevent one of the lines from over production or under production. This issue calls for continuous improvement of the system to be able to meet customer’s expectations always.

1.2 Objectives of This Thesis

The objectives of this thesis work are to analysis country cones enterprise limited manufacturing system, try to find out if there are any non-value-adding processes and then suggest which lean principles are best suited for country cones enterprises limited. It is therefore divided into three main points as follows;

- Analysis the current processes at the company by working in the company for some time.
- Find out any hidden wastes (non-value-adding processes) in the company’s production system
- Determine the best lean principles for the company by discussing it with management

1.3 Limitations of this Thesis

Considering the time frame available for studying the company’s processes, only the processes from supplies through production processes to the distribution centers will be considered. This is also due to the numerous customers and again sales agents available to the company. Much attention is also given to the cones and ice cream production lines as far as this thesis work is concern because country cones enterprises limited produces more ice cream cones for its own distribution centers to be sold with their own ice creams but also have other customers who take only cones and not ice cream because those customers produce their own ice creams.

The study is also limited to country cones enterprises limited only and any recommendation may not be necessary be helpful to any other company as it has been established that lean principles helpful to companies differ from one another.


2.0 LITERATURE REVIEW

Lean production is known to be originated from Toyota Production System (TPS). Toyota production system also known as Just-In-Time (JIT) system was introduced to produce only what and also when the customer needs their products. Taiichai Ohno and his right hand man Dr. Shiego Shingo are known to be the originators of Toyota Production system (TPS) or Just-In-Time (JIT) when they needed to compete with other giants like Ford in the automobile industries (Badurdeen, 2009).

With lean production, the value of a product or service is defined by the customer’s point of view. Customers accept your products by looking at how well they are going to satisfy their sets of requirements. Customers are not ready to pay for any quality defects created by your facility and therefore need to be corrected and also any overheads brought about during production but they are only ready to pay for what meet their expectations as far as your product is concerned.

Lean manufacturing sets priorities to simple, small and continuous improvement rather than big innovations.

2.1 Manufacturing Wastes

In manufacturing, wastes are inevitable and therefore form part of the daily processes during production. Wastes in manufacturing are any process that does not add value to the final product and therefore costing the organization a lot of time and resources. Wastes are normally hidden among the production processes and need critical analysis of the system to unearth them and also find means to eliminate from the processes. Many organizations spent a lot of their resources without noticing any waste in the system but there are wastes too and this is because the wastes are usually hidden and cannot be seen easily as people thinks. It has also been established that elimination of wastes is central to lean approaches. Wastes in manufacturing are over production, waiting, work in progress (WIP), and transportation during the process, excess inventory, defects, non-value-added process, under utilization of human resources etc.

2.1.1 Over Production

Along the production lines, one stage producing more than what the immediately needed by the proceeding stage is over production. According to Toyota production system, this is the greatest known form of waste in production system. It is also known as producing something or a product before it actually needed. This is why lean techniques recommend pulled system of production than the pushed system which produces as far as it can produce without thinking
about the next stage. Pull system means you only produce when the next stage after you is in need of the product but not just producing because you have the capacity to do it. This means the next station is termed your customer as far as production is considered and therefore it is only that station that can trigger you production. Pull system eliminates unnecessary inventory which is also a cost to the organization from the production lines. Many loses in a form of cost are caused by over production in the system. Over production creates low quality products which becomes difficult to detect because of the high number of products and brings about higher work-in-progress (WIP).

2.1.2 Waiting

Waiting along the production lines is also a major waste in production. Studies show that 90% of the time, goods is waiting to be worked on. A minute lost in waiting can never be retrieved from the process afterwards. More waiting translate into higher lead times and that is a negative effect on the organization so why keep your customers waiting? Removal of waiting time along the production lines means it takes a shorter time to deliver your products to your cherished customers. One thing wealthy to know is that, customers are never ready to pay extra cost just because of waiting along the production line and therefore waiting must be removed always along the processes.

To avoid waiting along the processes, all stations and also workers must be trained to understand the effects of it so that they will work as a team in eliminating it. If this is not done, it will be difficult to entirely eliminate waiting from the processes. Also elimination of waiting means your company is in the position to compete with other competitors within the market because you will have a system to produce at a lower cost which is important in production competition. Main factors identified as those that bring about waiting in production according to Badurdeen 2009, are high volume machinery, conventional thinking of the workers and unawareness of the people at the working environment.

2.1.3 Work-In-Progress (WIP)

Work-In-Progress (WIP) according to lean manufacturing is defined as a form of inventory which is usually found within steps or sub-processes of the production process, sometimes in one bin or two bin system. The present of unnecessary Work-In-Progress (WIP) is an indicator that an unreliable supply chain or process or production bottlenecks. Work-in-progress is also considered as a waste just as inventory is also a waste because it ties up the company’s capital for a certain amount of time which could have generated high returns elsewhere within the company. For some companies, work-in-progress is used as a buffer to take care of unnecessary peak demand or volatile demand patterns. But if this is not the case, then work-in-progress
indicates that there is a bottleneck somewhere within the production causing it and needs to be thoroughly investigated to entirely remove it.

Work-in-progress reduces the flexibility of the entire production facility by increasing the change over time between different products. It makes quality defects difficult to notice and therefore increases the number of quality defects in the system which is only noticed after a considerable amount of defects have occurred. Another negative effect of work-in-progress is that, it takes a lot of working space and makes the working environment looks very bad.

2.1.4 Transportation

From Taylor and Martichenko 2006, transportation is not always a waste and transportation can be used as a differentiator. However, transportation in excess of what is actually required is a waste and it should be eliminated. Materials should always be delivered to its point of use. It is a waste to move or transport raw material from supplier to a receiving bay processed and then takes it to warehouse followed by moving to an assembly line. In lean principles, materials should always be shipped straight from supply to an area close to the area needed for work to start. This is what is termed point-of-use-storage (POUS) (Kilpatrick, 2003).

A lot of transportation of goods or materials in production causes congestion, higher cost of production and higher work-in-progress. Lean implementation in manufacturing is rightly centered on the implementation of small batch manufacturing, one-piece flow and the reduction of inventories. This means smaller quantities will be moved by transportation more frequently for both inbound and outbound shipments which are opposite to the traditional style of moving large lot sizes based on cost efficiency assumptions. But using lean effectively will reduce inventories, shipment sizes and also reduce transportation costs in the process. Lean transportation minimizes the time it takes to get products to reach customers which means you create a good business image between yourself and your customers.

Taylor and Martichenko again argue that transportation strategy and execution should support inventory strategy designed to support customer’s expectations. Inventory and customer strategies should not be a result of transportation strategies based on silo optimization of the transportation function. The above shows how customer’s expectations are paramount in choosing transportation for the organization. Customer’s expectations should always be considered when planning transportation because when you transport more goods than what the customer needed at a time and then another time round you are not able to transport anything to the customer when he/she needs the product because full truck load is not ready, then it becomes a waste and you may lose your customer to a competitor. Customer experience is always important when planning your transportation system.
2.1.5 Excess Inventory

Any inventory above what is exactly needed to meet customer’s demand will negatively affect the company in a form of cash flow and again takes up workshop floor space. When there is inventory at any stage of production, it means cash is being hold up in the system until it is sold or delivered to the customer. Holding up money in a form of inventory is very bad practices of doing business since the company’s turnover rate will be very low as far as you hold more inventory in the system. All what lean principle does mostly is to eliminate excess inventory throughout the whole organization. The use of value stream mapping also known as end-to-end system mapping is to highlight such processes which do not add value to the product such as excess inventory and eliminate them. It is because of excess inventory which lean seek to eliminate that is why it suggest pull system instead of push system which creates a lot of inventory always on the following workstation. With the pull system, production is always triggered when customers request for the products.

It is also important to note that inventory is also sometimes necessary to be able to meet unexpected demand coming from loyal customers and therefore becomes necessary to a required minimum inventory as far as unstable demand is concerned. Managing inventory requires thoroughly knowledge of the market by keeping regular contacts with your customers and also study the demand trends. You also need good skills in forecasting to meet future demand with less cost by taking into account minimum inventory.

2.1.6 Defects

Defects in products during production are a major waste which all organizations wish to eliminate from their systems. When error occurs during production, materials are wasted; labor is also wasted during production and also needs reworking to correct it. A lot of time is also lost in doing the work and rework and again handling customer complains. Defects which are a type of waste that cost a lot to the company and therefore needs to be handled accurately to prevent it re-occurring. When defects get to the customer, they send bad image from the company to the customer which can cost the company very much. Because of this, many or even all manufacturing companies are frequently trying to improve their system to eliminate defects from their systems. Cost of correcting defects is very high to the extent that allocation of resources to those effects is on the rise these days among companies. Quality department within an organization should always make sure that the system works perfectly to avoid and eliminate defects. Removing defects from the system is a long time task and therefore should be plan as such. A known best method in doing this is to educate workers, high quality raw material and a fool proof system.
2.1.7 Non-Value-Added-Process

Non-value-added-process is a waste that is normally hidden and can only be seen by analyzing the entire production system. To identify this type of waste usually value-stream-mapping (VSM) is used which has been successful over sometimes now. It is also known as excess motion and it main causes are poor layout, poor workflow, bad housekeeping and bad work methods. During production of products, motion is a non-value-added process and it must be minimized if not completely removed from the processes. A detail study of the processes is necessary to overcome this problem of non-value-added processes. All the above wastes such as overproduction, waiting, excess inventory, unnecessary transportation and so on are all non-value-added processes. A simple change of workshop floor or the production lines can add a significant amount of value to the entire system.

2.1.8 Underutilization of Human Resources

This type of waste is normally not considered by many lean experts but it has been a great waste in the production organization and it value is known to be having substantial effects. This includes underutilization of the mental faculty of your employees, creative and physical skills and abilities. Non-lean environments only recognize the ability of workers to contribute their physical attributes but lean goes beyond that to consider the skills and mental abilities of their workers to improve the system. Causes of underutilization of people include poor workflow, organizational culture, inadequate hiring practices, poor or non-existent training and high employee turnover. (Kilpatrick, 2003)

Workers are usually ignored when planning works for the organization because top management thinks they know all what are to be done without the workshop floor people. When this happens, the outcome of the planning become very little and some workers will feel neglected and may not put up with their best doing the work for the expected growth of the company to be realized. Considering lean manufacturing, means everybody within the company from top managers to the last person below the organizational structure is important as far as the growth of the company comes to mind. This means, managers should source for ideals from all workers and used them for the betterment of the company. It is therefore a waste for not tapping the knowledge of all workers from top to lower level. Motivation and rewarding of workers for their talents is a major means of pushing workers to come out with their full potentials to help the entire organization to grow continuously. (Burdeeden, 2009)
2.2 Lean Manufacturing Tools

Many tools are used in reducing or eliminating wastes in the production lines or organizations. It has been established that when any of the lean tools is used as stand alone, it doesn’t give the required effect and most of the time these tools are together to have the needed effects. The sequences of implementing lean affect the overall impact of the system. Also using some of these lean tools wrongly affects the system negatively and therefore needs to be studied very well before choosing the correct lean tools for your organization.

2.2.1 Kanban

Kanban is a very important lean tool which informs when to replenish or place an order to the next work station and even exactly where those materials or order must be sent to. It also indicates how much is actually needed at a time and therefore it is seen as a method for maintaining an orderly flow of material within and even outside the organization (Kilpatrick, 2002). Kanban also serve as a tool to eliminate overproduction as it indicates when to start producing or start moving in material between two work stations depending on information from the customer. It is used to reduce cost in production by smoothing and balancing material flows by controlling inventories. It main functions have been the following:

- Reduces cost by eliminating waste by smoothing and balancing material flows
- Creates work environment that can react to changes in the system due to demand
- Helps methods of achieving and assuring quality control
- Helps workers to reach their maximum potentials

According to Aza Bedurdeen 2009, there are two types of Kanban, the withdrawal and the production Kanban. Withdrawal Kanban sends work order or authorization of movement of parts between stages. A withdrawal Kanban indicates the following information such as:

- Part name and number
- Lot size
- Rooting process
- Name, and location of the next process
- Name, and location of the preceding process
The production Kanban has a function of releasing an order to the preceding stage to build the lot size indicated on the card. It contains the following information:

- Type and capacity of container
- Number of containers released
- Materials needed at the preceding stage
- Parts required at the preceding stage
- And also all the information on the withdrawal Kanban

Because of the importance of Kanban at the workplace, there is a preconditions which has been established to guide Kanban system implementation. These preconditions are:

- No withdrawal of parts without a Kanban
- The subsequent process comes to withdraw only what is needed
- Do not send any defective part to the subsequent process
- The preceding process should produce only the exact quantity withdrawn by the subsequent process
- Smoothing of production always
- Fine tuning of production using Kanban

For special circumstances, there are also special Kanban currently in use and they are:

- Express Kanban – used when there is shortage of parts and needs to be replenish to continue production
- Emergency Kanban – applied when there is a machine failure or there is changes in production
- Through Kanban – used when two stations are closed to each other and therefore can use one production and withdrawal Kanban instead of separate ones.

Kanban can be seen as a simple card normally placed at a well selected position so that all the information on it can be read by those who need them during production or it can also be on a computer screen where operator and staffs can log in to the necessary information for next production. (Schonberger, 1984)
2.2.2 Just-In-Time (JIT)

Just-In-Time is a term referred to the production of goods to meet customer demand exactly, in time, quality and quantity, whether the customer is the final consumer of the product or another process further along the production line. Just-In-Time in its totality consist of continuous improvement, eliminating of wastes, good housekeeping, reduction of set-up times etc. Just-in-time principle which was developed in Japan by one Taiichai Ohno who worked for Toyota Company in the fifties is used to eliminate waste by only producing goods when needed by the customer. It is based on pull system of production because it is the customer who place order to trigger the production of goods. Just-in-time shows how and when to place order for materials needed for production by depending solely on the next customer’s needs. It allows eliminating unnecessary stocks of raw materials by ordering materials in small batches continuously which means smooth running of production. Burdeeden 2009 noted that doing so helps reduce cost of storage, and also minimize degrading of goods at storage. Just-in-time when implemented well will improve profits, lower turnover cost, reduce variability, and improve product quality and increase employee’s loyalty. (Schonberger, 1984)

2.2.3 Work Cells

Work cells sometimes known as cellular manufacturing is a technique where machines and workstations are arranged in an efficient sequence that allows a continuous and smooth movement of parts and materials to produce products from start to finish in a single process flow, while minimizing transportation, waiting time etc. (silicon, 2005)

From Kilpatrick’s lean principles, work cell is a technique of arranging operations and/or people in a cell rather than in the traditional straight assembly line. Among other things, the work cell enables better utilization of people and also improves communication between workers.

A single process flow set-up makes the transfer of products between equipment along the same production line a free-flowing manner, avoiding transportation and batching delays. This is what is termed as work cell. Work cell is a collection of equipment and workstations arranged in a single area that allows a product or group of similar products to be processed completely from start to finish. Normally many work cells are created within a company to take care of the single process flow desired. Work cell is faster and efficient in production than the traditional method of batch and queue type of production.

Cellular manufacturing helps to achieve just-in-time and again eliminates build up of inventory as it depends on pull system where products made by a workstation are immediately pulled by the preceding work station. The end customer can also create the pull where products are manufactured straight to the customer therefore removing a build up inventory. From silicon
2005, advantages of cellular manufacturing includes removal of waste, elimination or reduced inventory, higher production efficiency, higher cycle times, optimized used of floor space, effective use of production capacity and improved customer response time.

2.2.4 Total Productive Maintenance (TPM)

Total productive maintenance (TPM) is a productive maintenance carried out by all employees through small group activities. It is equipment maintenance performed on a companywide basis. The ultimate goals of total productive maintenance are zero breakdowns and zero defects. When breakdowns and defects are removed, then improvement takes centre stage in equipment operations, cost of production reduces and basic inventory can also be minimized. Total productive maintenance (TPM) suggests that operators carry out routine maintenance of equipment while only vital maintenance is carried out by maintenance personals. Many companies fail to achieve the numerous benefits of total productive maintenance because the operators and maintenance personals that are meant to deliver TPM to the equipment are ignored during its implementation. It capitalizes on proactive and progressive maintenance methodologies and calls upon the knowledge and cooperation of operators, equipment vendors, engineers and support personnel to optimize machine performance. This leads to improved utilization, elimination of breakdowns, higher throughput, reduction of unscheduled and schedule downtime and better quality products. It lowers operating costs, longer equipment life and lower overall maintenance costs. (Kilpatrick, 2003)

Also according to Sondalini’s article on total productive maintenance define it as an equipment program that emphasis operator involvement and ownership of equipment performance. It is also sometimes called total production maintenance. The goals of total production maintenance program are to maximize equipment productivity, maximum equipment availability and make quality product by eliminating causes of equipment defects, loses and wastes through expanding and engaging the knowledge, skills and abilities of the front line people running the processes.

2.2.5 The 5S

The 5S terminology which originated from Japan stands for five terms which are good housekeeping in an organization. It is one of the simplest lean tools which create a discipline, clean and well-ordered work environment. Lack of a robust 5S system makes other lean tools ineffective. (Chapman, 2005)

The term 5S stands for sort, straighten, shine, standardize and sustain.
• **Sort**- is to eliminate what is not needed and keep what is needed. Anything or substance that is not needed in any way should not be allowed to take up space on the working area and therefore need to be discarded.

• **Straighten**- is to position things in their rightful places so that they can be easily be located when needed and again prevent causing obstructions during movement within the workplace. Everything has its place including files, tools etc.

• **Shine**- keeping things clean and tidy. Dirt must not be seen in the working area. Normally cleaning is specified to determine who should clean at a particular time and how it should be done. Cleaning includes all areas, machines, furniture and so on.

• **Standardize**- means to maintain cleanliness and order. Perpetual neatness is what is required by standardize. This requires that the above three of the 5S should be standard and become clearly outlined for all employees to note them.

• **Sustain**- is to develop a commitment and pride in keeping to standards. Sustain makes sure that all the 5S housekeeping practices becomes part of the organization. It also makes sure that all levels of employees are involved in this housekeeping norms within the company that is from shop floor personnel to the top managers are involved. (Slack, Chambers and Johnston, 2010)

According to Chapman 2005, to successfully implement other lean tools, organization needs to adopt the 5Ss terminology so that it can get the full benefits of the other lean tools. By implementing 5Ss, equipment set-up times can be reduced drastically, and it is a crucial part of total productive maintenance (TPM). This is because while operators are taking cleaning chores, they inspect equipment by listening to sounds and watching parts for any defects and take actions before a breakdown occurs.

### 2.2.6 Single Minute Exchange of Die (SMED)

Single minute exchange of die abbreviated as SMED is a technique used to reduce machine set-up time by the use of modern engineering technology, simplicity and standardization of the processes of production. Single minute exchange of die makes production lines flexible by easily changing over from one product to another. It can easily be achieved by carefully planning and coordination of the processes so that all complications that are normally associated with changeover are removed and therefore becomes easier to changeover. SMED differs from organization to organization depending on what the organization produce which can result that doing so can be easily done or with a bit of difficulties. One issue wealth mention is that single minute exchange of die demands strategic planning, choosing the right machinery, correct layouts, well trained people and the best mindset of people. Some useful techniques that may be used in implementing SMED are process analysis and mapping, shadow board,
standardization of tools and tasks, use of automation and feedbacks, efficient use of labor and skills. The main purpose of reducing changeover times is not necessarily increasing production capacity, but to allow for more frequent changeovers in order to increase production flexibility and allow smaller batch sizes. (Kilpatrick, 2003)

2.2.7 Total Quality Management (TQM)

From Kilpatrick 2003, total quality management is a management system used to continuously improve all areas of a company’s operation. TQM is applicable to every operation in the company and recognizes the strength of employees’ involvement.

Also from Slack, Chambers and Johnston 2010, total quality management is an effective system for integrating the quality development, quality maintenance and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allows for full customer satisfaction.

It also defined as an integrated organizational effort designed to improve quality at every level. It is all about customer-defined quality which is what the customer defined as quality. Quality has been defined by many experts in many ways such as

- Conformance to specification which is how well a product or service meets the targets and tolerances determined by its designers.
- Fitness for use defined as quality that evaluates how well the product performs for its intended use.
- Value for price paid which is the product or service usefulness for the price paid.
- Support services also defined in terms of the support provided after the product or service is purchased.

From Slack, Chambers and Johnston 2010, total quality comprises of all the following

- Meeting the needs and expectations of customers
- Covering all parts of the organization
- Including every person in the organization
- Examining all cost which are related to quality, especially failure costs and getting things right the first time.
- Developing the system and procedures which support quality and improvement
- Developing a continuous process of improvement
Total quality management seeks to identify the root cause of any quality problem that occurs and immediately rectifies them at the main source of the problem so as to reduce defects in finished goods. It is a philosophy that stresses that quality is customers driven and therefore strive to go ahead to meet customers’ expectations or even go beyond those expectations and this is the main reason why total quality management involves the entire organization and not only quality department.

2.2.8 Batch Size Reduction

Batch size reduction is one of the lean principle tools that need to practice in a continuous manner to achieve the best minimum batch size. Reducing batch size leads to reduced work-in-progress (WIP) which then leads to reduce inventory cost. Smaller batch sizes shorten the overall production cycle to achieve shorter time to take products to the market. Increase batch size on the other hand affects set-up times by putting pressure on employees not to cause error during set-ups or it will affects all the items that will go through production after the error has taken place. When this happen it cost the company severely because then they need to rework all the affected products or even sometimes need to discard all products because they don’t meet specification. (Schonberger, 1982)
3.0 CURRENT OPERATING STATE

The current operating state at Country Cone Enterprise Limited is the traditional form of production right from suppliers to the final customer. Almost all the departments within the company try to reach their own targets without considering the next department or the entire company’s targets. The ice cream production section tries to meet their own separate target without usually considering how much the cone production section is actually producing or even the market needs. Even within the cone section, the baking part always tries to finish what they will produce within the shift without considering how things are going for the packaging part of that section. Considering the layout at the production facility within the company, it will make it easily to share information about production as both production sections are close to each other within the same building. Even sharing information without electronic means will not be much difficult when one consider the nature of the production facility.

3.1 Current Inventory

Raw materials or ingredients for the production of both ice cream and the cones are stored in a room as inventory. There is also finished cone inventory in another room waiting for customers or one of the company’s distribution centers to place order for delivery. For the ice cream, after production, they are kept in different refrigerators for further freezing so that they can be hard enough to be transported to various delivery centers without melting due to the heat from the environment.

The ingredients used for making the ice cream, once they get into the inventory room for raw materials, they are measured into plastic bags by a supervisor who knows the required quantities of each ingredient such as milk powder, sugar, salt and other and kept to make sure that the operators always use the right quantities to be able to realize the correct taste will be maintained all the time. Once any quantity is changed either increased or reduced, it affects the taste of the final product which affects the company’s image badly because then consumers complain a lot about the taste. It then goes on to affect sales extremely for sometime before consumers are brought back to patronize the product again when the original taste is realized again. In a way to double check this situation to avoid it happening, when operators are going for the bagged ingredients, they also weigh again all the various quantities used for the production to check that the right amount was measured by the supervisor before using them. Ingredients for the cone production are not bagged like those of the ice cream. They are rather stored and when operator needs them, he just goes for the required quantities by weighing them and then straight away goes to the mixing room to start production.
Inventory for the finished cone is kept in a separate room design for that purpose. As far as there is space or empty shelves, production continuous because supervisors think when they have space for storage, workers should be working without anticipating how much customers need in their next order. This is also because supervisors have not taken the pain to analysis customers order patterns in any way. This has resulted in sometimes finished cones staying on the shelves in the inventory room for days before transporting them to customers and even sometimes run out of stock and therefore customers have to wait in a queue to be served the next day or two.

3.2 Suppliers

There are various suppliers to the company with each one supplying one or two of the ingredients used by the company, country cone enterprise limited. The main supplier is Takoradi flour mill limited which the company has done business with since it was established. Takoradi flour mill is a known producer of flour within the country and they are known for their quality level. Country cone enterprise limited has established a good business relationship with Takoradi flour mill limited to the extent that they are given credit for goods and pay later which both companies have done well to perform their part of the contract. Country cone enterprise limited also get other ingredients from various nestle Ghana limited whole sale outlets within the operation vicinity of the company. Due to the diversity of the wholesale outlets, country cone enterprise limited makes sure that those who provide better business relationship to the company are the ones that they deal with. There are other petty stuffs that they also buy from the open market by just going on window shopping around the market considering quality of those products and also the prices of those stuffs. Again of course, there are some stands that country cone enterprise limited buy from due to good relationship accorded them by those market stands.

Again there are other items imported from America on periodic bases by considering how long it takes it receive them after an order has been placed. Due to time between order and supply, this particular order handling is done by the manager who has enough knowledge about such orders with consultation with supervisors to acquaint himself with production rate and available inventory.

3.3 Information Flow

Information flow within the company does not take any formal form. Between the major supplier and the company, information is transfer normally between the supplier’s sales persons and the manager of country cones or sometimes through the driver of country cone enterprise
limited to the manager or by through telephone calls. Within the production section, information is passed from co-worker to another verbally and vice versa.

Sometimes the supervisor is the one who carries most of this information either from operators to the manager or sometimes from manager to operators. Also manager communicates straight to the worker when needed and he is also open to all workers who want to communicate with him concerning the company, co-worker or even person issues. Communication between the company and its distribution centers is done through telephone. This means when a distribution center want to place order, the center manager makes a call to the supervisor, the company’s driver or the manager. The one who receives the call makes all the necessary checks to be well informed about inventory, production and availability of transport to confirm when the order can be delivered. Sometimes, it takes two or three days before an order is delivered especially when the order is not full truck load. When this happens, the company’s driver tries to negotiate with other distribution centers to see if he can add other orders from those centers along the same route to save cost of transporting.

Then the driver informs the center manager when he will get there so that the center manager will also arrange for the workers to be available to help the driver in off loading the orders. Due to the use of the telephone to place order, sometimes if one does not listen well, there can be shortcoming somewhere such as misquoting of the order quantity and so on. Also when passing information about an order from one person to another or before it get to the final person who process the order who is usually the inventory leader and the driver, a very important part of the information in the order get lost creating misunderstanding when the order is finally delivered.

### 3.4 Ice Cream Production

Current ice cream production at country cone is running on two shifts with operators operating all the machines for the production. The production rate is also quite able to meet current market demand as it is not all customers who order cones from country cone enterprise limited also order ice cream from them also. Most of their customers produce their own ice cream and then order cone from the company and therefore only need cones to sell their ice cream with it. Therefore the ice cream production facility only supply few external customers and the rest of the ice cream produced by them are used to serve the company’s own distribution centers. This has make it easy for the company to meet customer demands without much pressure from the external customer even though of course there are sometimes short coming but it is not frequent. Production of ice cream has processes such as cooking, pasteurizing, cooling, ageing, freezing, and final packaging and freezing.
3.4.1 Cooking and Pasteurizing

Cooking is the first process of the ice cream production where all the needed ingredients are measured and mixed together thoroughly and then cooked for thirty minutes in a kitchen located just behind the room where the other processes are located. Only one person takes care of the cooking as it does not demand a lot and also takes half an hour to complete one batch of cooking. Within one shift, two cooking are done and it serves all what a shift will be able to produce before the end that particular shift. Since this process does not take all the shift time during production, the same person moves to the next process to handle that process which is pasteurizing. Here the cooked substance is poured into the pasteurizer which has a motor mounted on it to do the stirring of the mixture for a well mixed mixture after cooking. This process takes five minutes and then it is then ready to be pumped from the pasteurizer through a tube to the next process with the help of a pump and a switch to help close and open the tube during pumping so that it does not overflow the cooler. Again, this process does not demand much attention and time and that is what makes it possible for one person to handle cooking together with it.

3.4.2 Cooling and Ageing

From the pasteurizing process, the liquid is pumped to a cooling system to start taking the heat which was introduced during the cooking process from it. Here a tank that contains cooled water usually at freezing point with tubes passed through it and also a condensing element installed just behind it to help in cooling the liquid cooked porridge. The freezing process actually starts right from here. It is then proceeds to the ageing tank when it stays for some time preparing it for turning into cream from the liquid state but it is semi creamy or porridge like. There is also a motor installed on the ageing tank to make sure the whole substance freezes at the same rate and not that maybe beneath freezes while the top part is still liquid. Also this ageing process does not need constant supervision as it only requires intermittent opening of tap to fill a container placed beneath when the next operation is ready to take it to start the real creaming process.

3.4.3 Freezing or Ice Creaming

After the ageing process, the porridge which has started freezing already, is transferred to the main ice cream machines where real freezing takes place. There are three (3) main machines which handles this because it where the amount of production along the production takes
place. The volume of the compartment that holds the ice cream is not much to handle more ice cream at a time.

During running of these machines, the operator has to keep an eye on it to avoid caking of the ice cream in the machines because when it does, this will cause blocking of the outlet tubes and the nostrils and the machine to stop from running. When it happens, then much time is needed to wash all the blocked tubes and other part to free the machine meaning much valuable production time is lost. When this happens, it can cause damage to some of the bearing which then means extra cost to replace it and extra labor which is undesirable in lean production. The operator therefore tries as much as possible to check the nature of the cream and release it when it is ready. From these machines, the ice cream is moved into a deep freezer located just close to the machines for further freezing before filling them into their final containers where they will be before delivering them to the customers. When they have been almost solid in the freezer, they are removed and filled in the containers without considering the weight but just use his own judgment to see that the volume of the container is full and then rapped with plastic bags and then send to the final freezing before transporting to distribution centers and external customers or other vendors who come and buy from the production centre directly and sell them by moving from house to house. The final freezing takes almost twelve hours to make the ice cream hard as required before transporting them from the production facility to distribution centers to avoid melting during transportation because of the heat of the environment.

3.4.4 Current Value Stream Mapping for Ice Cream

The value stream mapping of the current ice cream production within the company is illustrated below showing how the product move during production. The processes start by delivery of raw materials on weekly basis to the raw material inventory. At the raw material inventory, materials are stored to cater for weekly production. The first main process is the cooking of the raw materials before going to pasteurizing process. The cooking process takes thirty minutes before it is ready to be moved to the next process.

The pasteurizing process requires averagely five minutes as normally it is allowed to continue to work when the next process is not ready to take new product to process. This has been because the more pasteurizing process goes on, the better mixing of the cooked product. The next process is the cooling stage where the hot porridge caused by the cooking process is cooled by cooling system which takes two minutes to cool the porridge to the needed temperature before moving to the ageing stage.

The ageing process which is also a form of cooling also needs five minutes before going to the batch freezing where real creaming of the porridge takes place. When the porridge stays long at the ageing stage, then creaming starts from there and therefore the need to stir it constantly for
perfect product before batch freezing. Batch freezing takes fifteen minutes to complete it process and currently has three machines operating at this stage. Batch freezing is the only process along the ice cream production line that uses three operators because of the number machines at this station. Deep freezing which is the next process is where freezing of the ice cream to a stage when it can be packed into containers due to the nature of the packed ice cream occurs. It takes almost one hundred and twenty minutes (120min) for this process. Packaging is the last process before moving to buffer stock for it to be transported to the company’s customers. This process which is packaging requires fifteen minutes (15min) to finish one container as the operator has to dress the top well before covering the whole container with polythene and then placed in the buffer stock which also continue to freeze to make the product hard enough to be transported long enough without melting.

The buffer stock currently stores product for half day before delivery to costumer’s order. This has been working quiet well as demand for the ice cream is not high compared to the cone because of the number of customers served with the ice cream. Delivery to customers is currently done on daily basis with two small vans with carefully selected route by considering which customers to serve by that particular delivery.

Production planning and control department currently communicates to customers, distribution centers and also suppliers through the use of mobile phone. From the planning and control section to the suppliers, most of the time it is only from the company who initiates the communication by checking on whether there are stocks for raw materials which they need but not from the suppliers. It is two ways communication between customers and the company to place order and also check on stock and again negotiate for when an order can be delivered. Information from planning and control section to the shop floor is manually done at the beginning of each shift through a supervisor on the shop floor.
3.5 Cone Production

Currently production of cones forms the major part of the company as it has the most customers and also have a high demand with the number of customers also increasing on monthly basis. The cone production line was the first facility to be ran by country cone enterprises limited when the company entered into business before introducing the ice cream production later to make sure that it captures the market hence it name. This production line has gone through so many changes with the aim to stay in business and this has help the company to grow in size from when it was operating on only one shift for many years and currently running on two shifts with each shift operating for eight hours a day.

Because the company’s number of customers and also the company’s own distribution centers keeps on increasing creating problem of unstable production or sometimes having a high level of inventory at the company’s own cost and also running out of stock when customers need
goods. Currently, country cone enterprise limited produces ice cream cones for its’ own distribution centers for vendors to go for them from the distribution centers on daily basis and also produces for external customers who produce their own ice creams but do not have their own cone production facilities. Currently these external customers are increasing and the company is also opening more distribution centers as many competitors have fold out from doing business. The cone production also has the following process such as mixing, baking, packaging, sealing and then to inventory before transporting to customers.

For production data for the cone for the years 2009, 2010 and 2011 including their various graphs can be found at appendices.

### 3.5.1 Mixing of Ingredients

The mixing machine which mix all the ingredients together with water is located in a small room located just next to the machines which handles the proceeding process to avoid long travel time from the mixing room to the next process. The raw materials or the ingredients are placed in a location easily reachable from the mixing room to speed up the process. For health reasons, management make sure that before any worker enters the mixing room, he/she must wash his/her hands and also have all the necessary dresses on to avoid contamination of the food. It is also boldly written on the entering door to the room that all cleanliness rules must be observed before entering. Some of these rules states that hands must be washed thoroughly, one must have head gear or head cover on before entering and also the room and all tools must be cleaned after used.

Here a motor is mounted on top of the mixing container and it does the mixing by stirring to make sure they are well mixed by just adding the correct amount of water to it. The right quantity of each ingredient is necessary to obtain the correct taste after finishing. Too much or less of any ingredient would affect the final taste of the product. This has made it a routine practice that always experience workers who can be trusted does the measuring either alone or with a less experience colleague so that he too can learn from the experience one. This is because country cone enterprise limited is not ready to compromise as far as taste is concern as it is the unique taste that has made them a leader competitor on the market today.

### 3.5.2 Baking into Cone

After the mixing process, the next process is baking process where there are three machines which handle this process at the same time. Before starting the baking of the cones, these machines must be switched on several minutes for them to be heated to the required temperature necessary for the baking. Because of this issue, the machines are preheated immediately the mixing process starts from measuring of ingredients before it is ready at the
baking point making the machines ready to start the baking process straight away. Since there are three machines for this process, there are also three operators at this point with each operator handling one machine.

During a shift, these operators most often try to finish their task before the total time for the shift ends without considering what is happening at the next process therefore creating a lot of inventory between them the next station which is packaging. This reason has created the issue of some of the operators trying to select particular staffs to work on shifts with a known aim of finishing earlier than other workers within the same shift.

Another issue with the current situation is that operators fail to inspect the heating element which is made up of a thin wire waved on top of the heating block and the under part too. This wire usually becomes weak after some time and therefore needs to be inspected before work commence so that it can be changed when it is weak to avoid any preventable stops during production. When any machine at this point of the production breakdown, it takes a longer time to restore it back as it needs to be allowed to cooled down, dismantle before fixing a new wire, reassemble it and again reheat the machine to the required temperature for the baking.

3.5.3 Packaging and Sealing

Packaging and sealing of the cones are the last processes before the sealed cones are sent to the finished cone inventory room to be transported to both internal and external customers using the first-in-first-out (FIFO) principles. Most of the workers here are ladies due to the nature of the work here as compared to all the other processes within the production line where workers have to be standing most of the time during shift period.

Currently workers at these two processes work together as a team as they help each other when there are piles of goods for the other process to work on. Normally during the start of a shift, the sealing process will be free while there will be work at the packaging section and therefore helps the packaging section to handle that whiles waiting for packed cones to get to the sealing section. As the work progresses, a lot of packed cones get to the sealing section creating queue and therefore either one or two people offer a helping hand to the sealing section which is a very good team work. This is what is absent between the baking and the packaging sections thereby creating a lot of inventory between them almost all the time when production is in section.

3.5.4 Current Value Stream Mapping for Cone Production

The figure below shows the current value stream mapping of the cone production. The first thing that happens is supply from suppliers to the raw materials inventory which keeps
inventory for weekly production needs. The next process which is mixing pulls raw materials from the inventory to start its own process whenever needed during shifts. The mixing process takes twenty minutes (20min) to be ready for the next process. After the operator has moved the mixed substance to the next station, he comes back to wash the mixer and also clean the place waiting for when the next mixing will be needed before he re-starts again. The baking process which follows the mixing process possesses three machines for the baking with three operators. It takes three minutes to finish baking one set of cones and then released into containers placed below each machine until someone comes from the next station to pick them up to the next station for packaging. Between these two processes the cones stay for about one hour twenty minutes before they are picked up to the packaging station. At the packaging station, it takes averagely sixty minutes for a set of cones brought from the baking section to be completely packed and then moved to the sealing table for them to be sealed into packages containing fifty pieces of cones in each package.

At the sealing section, fifteen minutes to fix including all what goes in before finally sealing it and moved to finished cone inventory. Transportation of cones to customers is also done on daily basis by considering various customers’ orders. The first-in-first-out (FIFO) principle is practice here to make sure that old cones are sold first before the latest ones in inventory are sold out. Here too, communication is done the same way as it is done for the ice cream production line. From the planning and control section to the suppliers, most of the time it is only from the company who initiates the communication by checking on whether there are stocks for raw materials which they need but not from the suppliers. It is two ways communication between customers and the company to place order and also check on stock and again negotiate for when an order can be delivered. Information from planning and control section to the shop floor is manually done at the beginning of each shift through a supervisor on the shop floor.
Figure 2 Current Value Stream Mapping for Cone Production
4.0 ANALYSIS OF THE CURRENT STATE

The current practices within the company is analysis to find out where improvement can be done to achieved lean in the company’s production system. Both ice cream and cone production lines are analysis and also the data available from the current operation is studied to know what can be done to improve the system considering lean principles.

4.1 Analysis of Current Ice Cream Production

- The production orders and planning is being done traditionally by paper and introduction of a production order that will be displayed on screen will be beneficial.
- The orders are received from the customer using normal communication devices rather than a standardized system, introduction of online order, receipt and communication may improve this process.
- The delivery from the suppliers is received on a weekly basis creating a lot of inventory for the raw materials, if the delivery is standardized and planned on a daily basis; inventory and waste can be prevented also the lead time for production can be reduced.
- Rather than have a huge weekly inventory, it is better to have safety stock for a few days as buffer between supply and production.
- Cooking is a standalone process with a minimum cooking time and lot of machine availability and is positioned ideally to the next process, so it is suggested not to change anything at this stage.
- The next three processes can be grouped in to a production cell with resource (workers) sharing because they are not labor intensive and don’t need a lot of supervision. This is where the cone section will get extra workers to handle the bottleneck there. The cell formation will reduce production time and inventory. In the next stage the batch freezing combined with a sensor technology and weight scale, a standardized packaging can be achieved; then final stage can be just freezing directly in to a standard pack.
- The delivery can benefit from a refrigerated truck; will help the ice cream to be transported to far distances without melting and again provide more space for packing more ice creams as compared to the current practices.

4.2 Analysis of Current Cone Production

- The production orders and planning is being done traditionally by paper and introduction of a production order that will be displayed on a screen will be beneficial.
• The orders are received from the customer using normal communication devices rather than a standardized system and therefore introduction of online order, receipt and communication may improve this process.
• The delivery from the suppliers is received on a weekly basis creating a lot of inventory for the raw materials, if the delivery is standardized and planned on a daily basis, inventory and waste can be prevented and again also the lead time to production can be reduced.
• Rather than have a huge weekly inventory, it is better to have safety stock for a few days as buffer between supply and production.
• Mixing is a standalone process with a lot of machine availability and is positioned ideally to the next process so it is suggested not to change anything at this stage.
• In the next process which is baking, the workers try to finish their task for the day without considering the next process which leads to lack of teamwork, there is a lot of inventory generated between these two processes, baking and packaging. It is possible to move and share workers between these two and a signal communication from packaging to baking, a pull signal, will be beneficial. This will reduce production time and inventory. Packaging can also benefit from worker sharing from the ice cream section.
• This is a time intensive process along the line will benefit from the workers who will be moved from the ice cream production line.
• The delivery goes out every day but a high inventory is kept as finished goods. Having a safety stock of one 1 day is feasible (after doing inspection of demand).
5.0 FUTURE STATE

After thoroughly studying the current state of operating and also coming out with where there should be improvement by the analysis of the current state in other to operate according to lean principles, a proposed future state of operating has been developed. Most of the processes that can be grouped into cell have been done and also where there are more workers, some of them have been moved to where they are in need of workers to reduce cycle time at those processes. Inventory along the production lines have been either removed or replaced with a safety stock to help avoid delay in delivery of customer’s orders.

5.1 Suggested Future Value Stream Map for Cone Production

The raw material inventory which takes an average of seven days has been redesigned to have a safety stock. The safety stock is to avoid any unforeseen disruptions that can occur to prevent supply of raw material. This has become possible because of effective discussions that took place between major suppliers and the company. Suppliers are ready to deliver on daily basis and if by any reason delivery can’t be done on a particular day, the company will be notice before close of midday for the company to pick the goods up to avoid stops of productions. The various processes along the ice cream production have been reduced to only three processes with some process from the current processes grouped into cell manufacturing and others which can be remove entirely has been done to increase the efficiency of the production system.

As shown in figure 3 below, the future state value stream mapping shows all the suggested processes with the cooking process pulling raw materials from the safety stock applying first-in-first-out principles. The next process after cooking is a cell manufacturing housing three similar processes (pasteurizing, cooling and ageing) with only one operator running all this three processes. This has been successful because these three processes are interrelated and they do not require much supervision also. Grouping them also helps to reduce the total cycle time for the three processes to five (5) minutes which is the maximum required among them. This has contributed to reduce the total value adding time by seven (7) minutes which is very significant.

Batch freezing process has been improved by attaching an automated weight scale under the container that takes the ice cream after freezing to make sure that all the containers will have the same amount of ice cream and also help to eliminate other proceeding processes which will then be unnecessary. This also provides extra two workers that can be moved to the other production line where more staffs are needed. Effect of removing these two processes from the production line is that the total value adding time will be reduced by one hundred and thirty-five minutes which much in considering the total value added time. This is also possible because the use of refrigerated trucks to transport the ice cream to customers will help prevent them from melting while transporting for long distances. The buffer for the finished ice cream is now
turned into a safety stock which will only carry one full truck load to take care for any short coming along the production line.

A refrigerated truck which is normally used to transport ice cream has been suggested to replace the current truck so that the company can also meet its plans of extending market to other part of the country far from the location of the production facility. This refrigerated truck is a required asset to help the company to be more efficient as far as expanding the business is concern. Also information between distribution centers and the company and placing of orders is advised to be done through email which is cheaper and reliable to avoid error in processing orders. Production information is written on a notice board placed at a place for everybody to be able to read so that operators will all know how much they are to produce within a shift and work according to that information.
5.2 Suggested Future Value Stream Map for Cone Production

Current raw material inventory which carries seven days inventory is turned into a safety stock of one day needs of raw material. This has been possible because of arrangement made between suppliers and the company where the supplier delivers goods on daily basis.

The first process which is mixing pulls raw material from the safety stock applying first-in-first-out principle to make sure that old stocks are used before new ones are used. The mixing process is maintained as it is in the current state. Baking process which follows the mixing process and also have three (3) machines operated by three (3) operators is positioned in a cell form so that one
operator can operate them without difficulties. This will again free two (2) workers for them to be used at where is more queuing of product during production. The inventory or in other terms queuing between baking and packaging processes is removed entirely so that the baking process is activated when packaging process signal that they are in need of baked cones, reducing the total lead time by 0.05 day.

Packaging process where the major queuing takes place have benefited from the freed workers from other processes such as baking and also from the ice cream production line too. Four (4) more workers have been added to this process which has reduced the cycle time by 30 minutes.

The queuing between packaging and sealing is eliminated by increasing the number of workers operating at the sealing stage from one to three. This does not cost the company any money as they have extra sealing machines already. This has reduced the cycle time here to five minutes with no queuing waiting to be worked on. The finished cone inventory is now turned into a one day safety stock. The total lead time now becomes two (2) days as illustrated in figure 4 below. Daily delivery of goods from the company to customers and distribution centers is still done on daily basis but with much improvement on how orders can be placed so that the delivery can be done as expected by customers. Production information is written on a notice board placed at a place for everybody to be able to read so that operators will know how much they are to produce within a shift and work according to that information.
Figure 4 Future Value Stream Mapping for Cone Production
6.0 RECOMMENDATION AND CONCLUSION

6.1 Recommendation

After studying the current operating states of the various production lines and also the analysis done on those production lines have made it very necessary to make the following recommendations below:

6.2 On the Ice Cream Production Line

Before the commencement of a shift, an updated production requirement for that particular shift should be well communicated to the operators and make sure that everybody is well informed and prepared to deliver to meet that requirement.

Having a daily supply of raw materials from suppliers will require regular communication between suppliers and the company to enhance an effective delivery of goods without delay to avoid disruption of production. Management should therefore keep a good business relationship with their suppliers all the time.

To be able to eliminate the deep freezing and the packaging processes from the production line, it is highly recommended that a simple automated shut off system with an attached weight scale should be installed on the batch freezing machines to enable the containers to be filled with the same amount of ice cream during filling. This can lead to the company not losing in a form of over filling some containers.

It is also recommended that, management plan and acquires a refrigerated truck that is capable of transporting the ice creams to its customers considering the increasing number of customers for the product.

6.3 On the Cone Production

Again the production requirement for a shift should be well communicated to the workers before the beginning of the shift. This can be done on the notice board placed at a point where all employees can read from or it can also be on a screen throughout the production shift so it could be accessed by all.

Along the production line, the pull system of production should be adhered to all the time to avoid build-up of queues at a point along the line. This then requires effective communication
between stages along the production line. Production should always be activated by the customer’s order so that production can be in-line with demand from the customer.

The waste that comes out after baking the cone is currently thrown into garbage but it should be used as organic manure that could be sold to generate some revenue which can be plough back into the company’s welfare coffers.

6.4 General Recommendation

Employee should be educated on regular intervals on lean principles and its benefits to help them to always appreciate the issues of lean implementation. During these meetings, employees should be allowed to express their views for Management to consider them on how best the company can benefit from those views. This will make employees feel that they are part of the business.

The former practice of setting aside a particular day on monthly basis for general maintenance is highly recommended to be re-institute to replace the current practice of waiting until a breakdown occurs before it is fixed. Alongside this maintenance, total production maintenance where operators check and lubricate parts and even replace parts during cleaning after work should be encouraged to help prevent breakdowns.

6.5 Conclusion

In conclusion, this thesis has been able to unearth some of the major manufacturing waste within the company’s production system such as large inventory, over production, inadequate maintenance and so on. All the same with the above mentioned wastes, Country Cone Enterprise Limited has been able to grow in size and market. In spite of these achievements customers always have to negotiate on when their orders can be delivered due to lack of communication and teamwork on the part of employees. This issue can be solved by the cooperation of all parties within the business cycle. Suppliers, employees and customers have to agree on how to perform their respective tasks to avoid delay and other manufacturing wastes for the benefit of all parties.

Management should also strive to use the results of this research to improve the system keeping in mind that lean implementation is a continuous and gradual process.

Future studies should be considered when expanding the system from its current size to know which kind of lean principle to be adopted.
7.0 REFERENCES


8.0 APPENDICE

8.1 Cone Production Data

Table 1: Cone Production Data for the year 2009

<table>
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<th>Month</th>
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Figure 7: Graph for Cone Production Data 2011

Table 4: Demand Comparison for the Years 2009, 2010 and 2011

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Figure 6.2: Graph for Demand Comparison for Cone Production Data for the Year 2011

8.2 PICTURES FROM THE PRODUCTION LINES

Figure 8 Packaging of Cones
Figure 9 Packaging and Sealing of Ice Cream

Figure 10 Baking of Cones in Progress
Figure 11 Repairing a Broken Down Batch Freezer

Figure 12 Ice Cream filled into it Container ready for final freezing