Graduation Project

Facility planning

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Acknowledgment

It's a great opportunity for me to write about Facility layout designs. At the time of preparing this term I have gone through different books and websites which help me to get acquainted with new topics. I am actually focusing on those topics which are important for us to understand about this subject easily.

I acknowledge with gratitude to assistant doctor Omar Arayda my respective teacher, who has always been sincere and helpful in making me understanding the different system of legal research and conceptual problems in my term paper, and special thanks for the Committee doctor Mohmmad Obidat and doctor Hazem Smadi which are always support me in my university lifetime in different subjects.

And I would like to thank the company that helped me, supporting and providing necessary guidance concerning project implementation .

Apart from me this term paper will certainly be of immense importance for those who are interested to know about this subject. I hope they will find it comprehensible.

I have tried hard and soul to gather all relevant documents regarding this subject. I don't know how far I am able to do that. Furthermore I don't claim all the information in this term paper is included perfectly. There may be shortcoming, factual errors and mistaken opinions which are all mine and I alone am responsible for those but I will try to give a better volume in future.

Team Members Contributions

The work was divided equally among the team members who are 2 people.

Chapter 1

Introduction

1.1 Facility management

Facilities management services FM is a relatively new discipline. It has developed around 1978, when the Herman Miller Corporation, the world's leading furniture manufacturer, staged a conference on "Facilities Impact on Productivity" (facilities are understood as plots, buildings, mechanisms, equipment, technical supporting devices and infrastructure). This might be seen as the beginning of FM. In Northern Europe the field of facilities management has evolved as a new profession and academic subject over the last 15-20 years; the growth of this sector represents the increased awareness of importance of the physical surroundings for the development of organizations. As a discipline FM emerged out of practice, just as the great established professions did. It emerged with the integration of three main strands of activity: property management, property operations and maintenance and office administration. According to a common definition, FM is the "integrated management of the workplace to enhance the performance of the organization". More specifically, FM can be defined as the management of premises and services required to accommodate and support the core business activities of a client organization, while constantly adding value to the stakeholders. FM is therefore a key function in managing facility resources, support services and the working environment to support the core business of an organization in both the long and short term or, as the International Facility Management Association (IFMA) says, FM is "a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology" (International Facility Management Association, 2011). In other words it is the practice of coordinating the physical workplace with the people and work of an organization: it integrates the principles of business administration, architecture, behavior and engineering science. Facility maintenance is often seen as an annoyance or as a "necessary evil."

General types of facility layouts

Production processes can be divided into 5 categories in aspect of continuity, product variety and production volume:

1- Project production (production is a complex process, low volume, high customization, the sequence of operations is unique to each project/product, fixed position layout).
2- Job-shop production (manufacturing of one or few quantity of products, low volume and high variety of products, general-purpose machines arranged into different departments, each job requires unique technological requirements and machines, requiring highly skilled operators and high inventories).
3- Batch production (shorter production runs, plant and machinery are flexible, manufacturing lead time and cost are lower compared to job-shop production).
4- Mass production (manufacturing of a small variety (mostly only one) and huge volume of products, machines are arranged in a line or product layout, product and process sequence are standardized, the cycle time of the production is short, low inventory, balanced production lines, high productivity).
5- Flow/Process production (manufacturing of small variety (mostly only one) and huge volume of products, special purpose machines in a fix sequence, manufacturing cycle time is zero).

1.2 Facility Layout and Design

Facility layout and design is an important component of a business's overall operations, both in terms of maximizing the effectiveness of the production process and meeting the needs of employees. The basic objective of layout is to ensure a smooth flow of work, material, and information through a system. The basic meaning of facility is the space in which a business's activities take place. The layout and design of that space impact greatly how the work is done—the flow of work, materials, and information through the system. The key to good facility layout and design is the integration of the needs of people (personnel and customers), materials (raw, finishes, and in process), and machinery in such a way that they create a single, well-functioning system.

Facility layout design objectives

Small business owners need to consider many operational factors when building or renovating a facility for maximum layout effectiveness. These criteria include the following:

1- Ease of future expansion or change

Facilities should be designed so that they can be easily expanded or adjusted to meet changing production needs. "Although redesigning a facility is a major, expensive undertaking not to be done lightly, there is always the possibility that a redesign will be necessary. Therefore, any design should be flexible manufacturing systems most often are highly automated facilities having intermediate-volume production of a variety of products. Their goal is to minimize changeover or setup times for producing the different products while still achieving close to assembly line (single-product) production rates."

2- Flow of movement

The facility design should reflect a recognition of the importance of smooth process flow. In the case of factory facilities, the plan will show the raw materials entering your plant at one end and the finished product emerging at the other. The flow need not be a straight line. Parallel flows, U-shaped patterns, or even a zig-zag that ends up with the finished product back at the shipping and receiving bays can be functional. However, backtracking is to be avoided in whatever pattern is chosen. When parts and materials move against or across the overall flow, personnel and paperwork become confused, parts become lost, and the attainment of coordination becomes complicated."

3- Materials handling

Small business owners should make certain that the facility layout makes it possible to handle materials (products, equipment, containers, etc.) in an orderly, efficient—and preferably simple—manner.

4- Output needs

The facility should be laid out in a way that is conducive to helping the business meet its production needs.

5- Space utilization

This aspect of facility design includes everything from making sure that traffic lanes are wide enough to making certain that inventory storage warehouses or rooms utilize as much vertical space as possible.

6- Shipping and receiving

The J. K. Lasser Institute counseled small business owners to leave ample room for this aspect of operations. "While space does tend to fill itself up, receiving and shipping rarely get enough space for the work to be done effectively.

7- Ease of communication and support

Facilities should be laid out so that communication within various areas of the business and interactions with vendors and customers can be done in an easy and effective manner. Similarly, support areas should be stationed in areas that help them to serve operating areas.

8- Promotional value

If the business commonly receives visitors in the form of customers, vendors, investors, etc., the small business owner may want to make sure that the facility layout is an attractive one that further burnishes the company's reputation. Design factors that can influence the degree of attractiveness of a facility include not only the design of the production area itself, but the impact that it has on, for instance, ease of fulfilling maintenance/cleaning tasks.

9- Safety

The facility layout should enable the business to effectively operate in accordance with Occupational Safety and Health Administration guidelines and other legal restrictions.

"Facility layout must be considered very carefully because we do not want to constantly redesign the facility, some of the goals in designing the facility are to ensure a minimum amount of materials handling, to avoid bottlenecks, to minimize machine interference, to ensure safety, and to ensure flexibility. Essentially, there are two distinct types of layout. *Product layout* is synonymous with assembly line and is oriented toward the products that are being made. *Process layout* is oriented around the processes that are used to make the products. Generally, product layout is applicable for high-volume repetitive operations, while process layout is applicable for low-volume custom-made goods."

1.3 customer satisfaction

Manufacturers that can't deliver on time won't keep their customers happy—or keep them at all. This reality is all the more reason why small and mid-sized manufacturers need to get their products into customers' hands as quickly as possible. Often, however, bottlenecks in the production process make this impossible. The following scenarios of lost productivity should be familiar to anyone managing manufacturing operations.

- The company can't meet delivery dates, no matter how much it tinkers with lead times.
- Operators always have a backlog, regardless of the production schedule.
- One rush order from a major customer throws the whole week's production schedule out of kilter.

Each scenario takes a bite out of a company's productivity. The sum of these productivity losses adds up to a major waste of resources that could otherwise be used to improve customer service, increase revenues, or enhance the company's competitiveness.

1.4 Problem statement

The type of layout utilized will largely depend on the nature of the manufacturing activities, including the volume and variety of the products being produced. The plant layout generation is challenging, especially for the process-oriented layout.

The case study has been developed in (……company) that is the (……..). In the course of time and development, the company began to diversify its production by customizing its products for old\new customers. In this scenario, the company maintained its layout whatever the customer is asking for, but sometime you need to justified your process to reach the objectives of layout design which is explain before in this chapter.

In this case many problems appear *(will discuss later)* but the main problem in the company is the existence of a large movement of materials in process whatever they are (raw materials, WIP, finished goods) because of poor design and complex routs at work floor, which leads more redundant movements, and as we all know the motion and transpirations are non-added value for my product or service (lean concept), so we have to eliminate or reduce them.

1.5 Research objectives

This study aims to increase the efficiency and effectiveness of the company productivity initiatives, by identifying alternative layout designs, and merge processes to reduce number of stations and reduce motions, based on their capacity and space available to use, in a practical and applicable way in order to meet the customer demand and reduce the cost. In addition, to increase sales and increase the value and appreciation what the company is giving to its customers.

So the objectives presented have been:

1- To obtain a better use of space and cost reduction offsets and the flow of employees.

2- To enhance material handling system.

3- To reduce the movements and improve the flow of items.
4- To improve the flow of information.
5- To meet customer orders and avoid backlogs and backorders, so enhance customer satisfaction.
6- To generate increased productivity, thereby optimizing the processes conducted in area.

1.6 Company profile

The Hashemite Kingdom of Jordan is one of the region's main sources for natural stone for the construction industry.

Chapter 2

Literature Review

2.1 Value stream mapping

Value stream mapping is a visual means to depict and improve the flow of manufacturing and production process, as well as the information that controls the flow of materials through the process.

It is the preferred methodology for identifying the inherent waste and losses within an operation.

As a management tool, value stream mapping (VSM) is used to:

- Graphically illustrate, analyze and understand the flow of materials and the information needed to process them. Unlike process maps that are limited to mapping the sequence of tasks that are performed to complete a procedure or process, value-stream mapping provides the means to:
- Display the interaction between multiple functions within the manufacturing process as well as ancillary functions such as production planning, scheduling, and materials management, etc.
- The flow of information (communications) and materials throughout the complete manufacturing or production process. Coordination and in-process materials are common sources of significant loss in far too many plants. Value-stream mapping provides the means to visualize and recognize these limiting factors.
- Highlight problems, inefficiencies and losses within complex systems. Since the value stream map integrates information and materials flow, as well as the sequence of tasks-

including cycle time and lag between tasks -- the ability to identify restrictions, bottlenecks and all other factors that limit effectiveness and efficiency is greatly enhanced.

- Develop and implement countermeasures in a highly visual way that facilitates culture change within the organization. The entire value-stream mapping process utilizes graphical depictions of limiting factors that all stakeholders can easily visualize. The process is also designed to actively involve all stakeholders in each stage.
- Focus direction for the lean transformation teams, front-line supervision and upper management towards continuous improvement.
- Serve as a dashboard to monitor and continuously improve the process

First Pass: Understand the Current State

- Train your value stream mapping (VSM) team: Select a cross-functional team that includes all stakeholders of the process or area to be mapped. These teams must include the operators and maintenance personnel with first-hand knowledge of the process or area as well as those who must support them.
- Physically walk the path of the material flow, beginning from each source of primary and secondary materials required to support the operation as well as the actual manufacturing or production process that is being mapped.
- Document each step observed or discovered as part of the walk-down. Identify the communication points and how communication occurs.
- Create your “current state” VSM and include all pertinent data and information. Now is not the time to skimp on detail or short-cut the process. Dig until you are sure that the VSM accurately and completely describes the current process.

Second Pass: Analyze and Reflect

- Analyze and gain consensus for your value stream analysis. Socialize the current state VSM with all stakeholders. Gain their consensus that the map truly reflects how the process is currently performed.
- Identify limiting factors, deficiencies and losses associated with the current process. Think outside the box and do not be constrained by perceptions or artificial boundaries. Quantify the impact on performance and cost for each of the limitations identified. Care must be taken to assure the true root causes, not the symptoms, of each limiting factor are identified.
- Develop cost-effective solutions for each of the factors, deficiencies and losses that are limiting the effectiveness and efficiency of the current process. Solutions must directly address the root cause of the identified issues and be affordable.
- Change the VSM to reflect the proposed changes that will eliminate or mitigate the limiting factors associated with the initial process map. Make sure that all recommended changes are clearly identified and included in the “Future State” VSM.

Third Pass: Improve

- Socialize the future-state value stream map with all stakeholders. It is imperative that you gain their consensus and buy-in before proceeding to the implementation stage. Assure that all stakeholders are given the opportunity to review and comment on the new process.
- Modify all affected procedures, bills of material and training materials to reflect the changes to be implemented. This step cannot be omitted or minimized without incurring serious restrictions in any real benefits derived from the proposed changes.
- Train all affected personnel on the new procedures. Assure that all are trained and can apply them before attempting to implement.
- Implement the changes identified through the VSM process. These changes should be implemented based on descending priority—greatest benefit first and thoroughly documented. The preferred approach is to implement the changes in discrete increments

with sufficient time between changes to determine the resultant benefit derived from each discrete change.

Fourth Pass: Sustain

- Establish effective key performance indicators (KPIs) that will accurately measure performance and cost change within and for the applicable process. These KPIs, in conjunction with a verified baseline of the current-state process, will be used to verify and validate change.
- Monitor and reinforce compliance with the new standard procedures and practices established as part of the improvement process. One cannot assume that all stakeholders will immediately and voluntarily adhere to the changes that are being implemented.
- Verified and validated improvements should be institutionalized across the manufacturing site.
- VSM is a highly effective continuous improvement tool, but it must be used effectively. Any and all short-cuts will limit the value of the tool, and too many will assure that little gain will be achieved. Use it properly and completely and it will provide a direct path to process optimization and an operation that is assured long-term survival.

2.2 Bottleneck detection

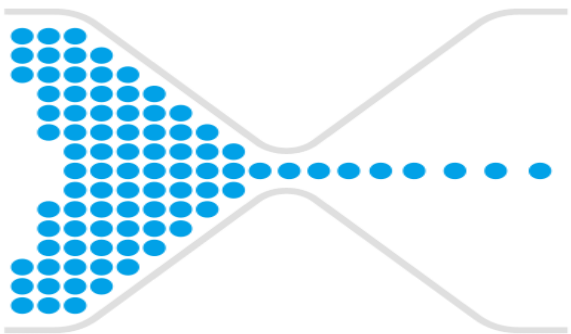


Figure 2.2.1

If we can identify the bottlenecks that are slowing down your production line, you can speed up manufacturing and increase productivity. In manufacturing, there is always one part of the process that is the slowest, and it may change as the production line adapts. The bottlenecks you're looking for are more serious. In one place and continuously slow down the whole line. Identifying these bottlenecks will result in major performance improvements.

Before we can fix the bottleneck, we must identify where it begins. Bottlenecks can result from a cumulative effect or entirely from one station. If it is cumulative, several stations are producing slightly more than the following station can keep up with, leaving a small overflow at each station until a station is totally overwhelmed.

This is very important as we analyze process capacity and look for ways to improve the output capabilities of a process – improving the bottleneck improves the system capacity, improving the non-bottlenecks will have no effect in system capacity. The focus is on either improving the capacity of the bottleneck activity or in maintaining the bottleneck activity operating at all times. While there are several methods to increase the capacity of an activity (discussed later in the text), this is sometimes infeasible due to physical, spatial, cost, or other requirements/limitations. For example, the machine cannot speed quicker, and the space cannot be expanded. The only way to add capacity then is to buy another machine, but this may be financially infeasible due to cash flow or facility space. Thus the capacity is fixed. The question is then, how to maintain the Trimming station operating to its fullest capacity.

A powerful approach to address bottlenecks (and system improvement) is the Theory of Constraints developed by Eliyahu Goldratt (1980). The TOC basics are:

1. Identify the system constraints. (No improvement is possible unless the constraint or weakest link is found.)
2. Decide how to exploit the system constraint. (Make the constraints as effective as possible.)
3. Subordinate everything else to that decision. (Align every other part of the system to support the constraints even if this reduces the efficiency of non-constraint resources.)
4. Elevate the system constraints. (If output is still inadequate, acquire more of this resource so it no longer becomes a constraint.)
5. If, in the previous steps, the constraints have been broken, go back to step 1, but do not let the inertia become the system constraint. (After this constraint problem is solved, go back to the beginning and start over.)

In our case the bottleneck is easier to fix by increasing the resource (workers) for this station; in this case, we will not have to revamp our entire operation.

2.3 Cycle time Vs Lead time

Cycle Time

Cycle time describes how long it takes to complete a specific task from start to finish. This task may be to assemble a widget or answer a customer service phone call.

Now, you can get fancy and segregate value added cycle time from non-value added cycle time if you'd like.

Cycle time can be measured with a stop watch, and simply it's the sum of real added value for a certain unit.

Manufacturing Lead Time

I actually prefer to call this Production Lead Time or PLT for short.

The PLT represents the total time – value added and non-value added, it takes a product to make it through an entire value stream.

This is often called the "call to cash" time since it helps us understand the time between taking the order and receiving payment for the delivered goods.

Value stream maps are excellent tools for determining the Production Lead Time, as we did in this project did.

Cycle time reduction is an ongoing process that takes strong management commitment. Change can be difficult, but manufacturers that keep doing the same things will keep getting the same results—for better or for worse, so we will to reduce the lead time and cycle time by several methods, such as:

1- Perform activities in parallel. Most of the steps in a business process are often performed in sequence. A serial approach results in the cycle time for the entire process being the sum of the individual steps, not to mention transport and waiting time between steps. When using a parallel approach, the cycle time can be reduced by as much as 80% and produces a better result.

2- Change the sequence of activities. Documents and products are often transported back and forth between machines (Downstream and upstream), departments. For instance, a document might be transferred between two offices a number of times for inspection and signing. If the sequence of some of these activities can be altered, it may be possible to perform much of the document's processing when it comes to the first time.

3- Reduce interruptions. Any issue that causes long delays and increases the cycle time for a critical business process is an interruption. The production of an important order can, for example, waiting raw material, maintenance...act

4- Improve timing. Many processes are performed with relatively large time intervals between each activity. For example, a purchasing order may only be issued every other day. Individuals using such reports should be aware of deadlines to avoid missing them, as improved timing in these processes can save many days of cycle time.

2.4 Operation Process Chart

The manufacturing process is divided into separate operations with the help of the operation process chart. It shows the points at which materials are introduced into the process and the sequence of various operations and inspections other than material handling.

The operation process chart is meant for new plant which is to be laid out. This chart represents the basic activities required for producing a product. Since it presents the overall visualization of the process, basis for studying possibilities for the improvement of operations by elimination, combination, rearrangement or simplification is available.

2.5 Spaghetti plot

A spaghetti diagram is a visual representation using a continuous flow line tracing the path of an item or activity through a process. The continuous flow line enables process teams to identify redundancies in the work flow and opportunities to expedite process flow. And we used this chart to show the path of the product and raw materials.

Chapter 3

Methodology

3.1 Current process flow

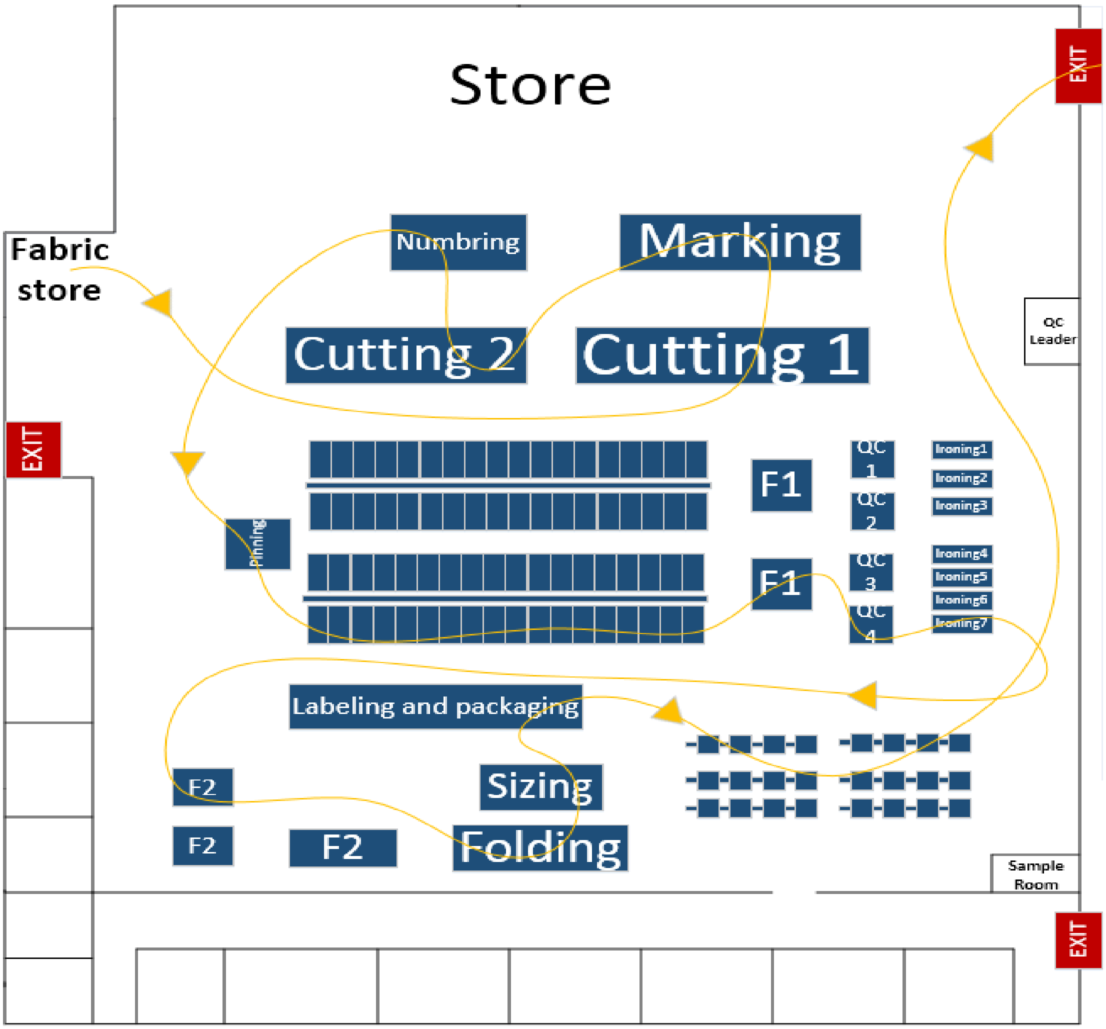


Figure 3.1.1

As shown in the current state, the Spaghetti line shows how motion between stations intersected and unsmoothed.

It had been noticed that marking do their job of 45 minutes and wait until cutting 1 finishes its cycle time of 3 hours and a half to reproduce their desired output that means most of the times marking workers only wait.

There is a buffer zone between numbering and pinning, because numbering process does not take much time per hour to be finished as pinning.

Process	# of workers	Output	Column1
Cutting 1	4	200 layer/3.33 hr	60 unit/ hr
Marking	2	200 layer/45 min	267 unit/hr

Table 3.1.1

Process	# of workers	Output	Column1
Numbering	2	1500 piece/hr	
Pinning	2	400 piece/hr	

Table 3.1.2

Sewing process is the bottleneck. It is shown below trimming process produces the least output, because it is the hardest of them all that tend to take much time doing it, because of so many threads need to be trimmed.

Finishing 1 will surely work on a scrap part because QC is located after finishing 1.

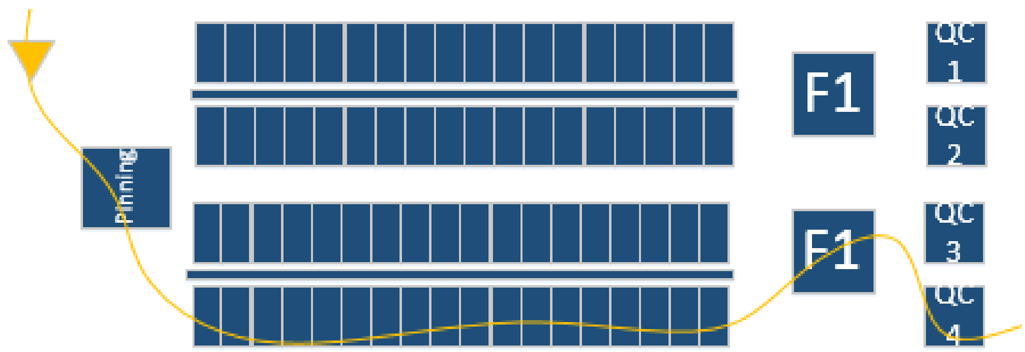


Figure 3.1.2

There is a long distance for handling units from ironing to finishing 2.

Ironing buffer units because they only do this process for the ease of finishing 2 to discover if there is any failure appeared.

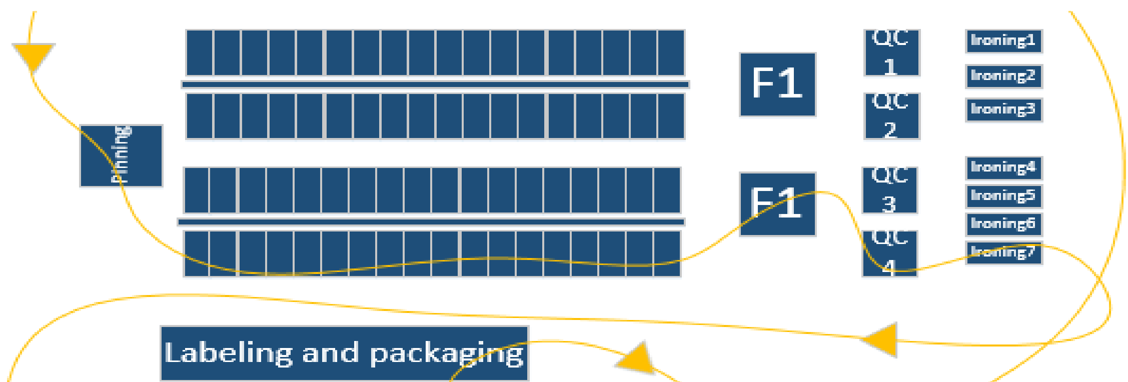


Figure 3.1.3

In labeling and packaging process workers refold for the cause of packaging, on the other hand folding process seems to be an added process that is useless.

This a flow chart for the work floor in the company, let me first introduce the process on each:

1- **Cutting 1:** 4 operators cut the fabric of 10 meters long through pressing cutting machine, by one press 200 layers of fabric are produced.

2- **Marking:** 2 operators mark the desired shape (depends on the order) on the top of the fabric using soap marker.

3- **Cutting 2:** 2 operators cut the 200 layers with a fixed base machine, this machine is flexible, it moves with the move of the hand and that's how the worker cut the fabric with the desired shape.

4- **Numbering:** 2 operators use a loading gun labels machine to put a sticker that contains the size of the piece. (just to know the size of the item, and it's not the final label)

5- **Pinning:** 2 operators make a longitudinal opening for purpose of buttons placed in sewing process.

6- **Sewing:** 72 operators for both production line, each line has 18 workstation.

7- **Finishing 1:** two stations, each one has one operators cut the extra strings with a pair of scissors and fix the piece if there was any damages.

8- **QC 1, 2, 3 and 4:** 4 operators are distributed on 4 stations to inspect the parts from damages and if the part is within standards.

9- **Ironing**: 7 operators are distributed on 7 ironing stations (Diesel).

10- **Finishing 2:** 3 operators, this an extra check for parts if they are within specifications and standards, in order not to reach loss.

11- **Folding:** 2 operators do the folding process.

12- **Sizing:** 1 person separates the sizes (S, M, L, XL) each size on a side.

13- **Labeling:** 5 operators provide the price label on each part.

14- **Packaging:** cartoons packaging this process consists of 3 steps:

a. Polybag: 1 operator covers each part with a plastic bag.

b. <u>Polyclose:</u> 1 operator close each plastic bag with a transparent tape.
c. <u>Polysticker:</u> 1 operator sticks the code of the part and the name of the customer on the cartoon box.

The flow goes in this way:

1- First the raw materials are existing in the fabric store near to exist so they can unload there.
2- Then the fabric moves to **Marking** station which is located in the opposite side the warehouse, this transfer is long since they are carried the fabric along the workshop using manual cart.
3- The marked batch will be shear in **Cutting 1** and **Cutting 2** per patch.
4- The sheared off batches will be **Numbering** in the next station per items.
5- The output from **Numbering** will pinning per item also.
6- The numbered item will goes to **Pining**.
7- The output from the **Pining** station will be collect in dedicated place before enter the production lines.
8- At the end of the lines there is a buffer zone, all the produced items are pile up in that zone waiting the first **Finishing**.
9- Two **Finishing** stations and two operators are trim and cut the extra fabrics and strings to facilitate the **Quality Control** process.
10- The pass items from QC will pile up waiting the **Ironing** process.
11- **Ironing** reveals more defects on items, so 7 operators are spreader on 7 ironing stations to feed up the final **Quality Control** station.
12- The final pass items are going to be folded in **Folding** station which has two operators.
13- After all the above processes the sizes are mixed up, so we need to separate each size separately, this process is made by one operator **(Sizing).**
14- After the sizing and aggregate the items per their sizes, 5 operators but the labels, and supply the packaging stage.
15- Finally the finished product is collected in cartoons and put them in ballets, to make them ready to deliver.

Process	No. of workers	Output per 1 hour
Cutting 1	4	60 unit/ hr
Marking	2	267 unit/hr
Cutting 2	2	1120 unit/hr
Numbering	2	1500 piece/hr
Pinning	2	400 piece/hr
Sewing line 1 + line 2	72	180/hr

Finishing 1,2	2	240/hr
QC 1,2,3,4	4	600/hr
Ironing	7	700/hr
Finishing 3,4,5	3	590/hr
Folding	2	400/hr
Sizing	1	200/hr
Labeling	5	350/hr
Packaging	3	300/hr

Table 3.1.3

Packaging:

Packaging	No. of workers	Output/hr
Polybag	**1**	**299**
Polyclose	**1**	**301**
Polysticker	**1**	**300**

Table 3.1.4

The main 2 production lines:

72 workers are working in these lines, 4 workers are doing the same job in parallel, the sequence of processes are as follow:

1- Soldering the front piece with the back piece.
2- Stitching the shoulder shape.
3- Sewing ribs for the dome.
4- Joining the ribs by stitching them on the part.
5- Piping make: this process produces a feature for accessories cause. The output of this process is a ribbon that in the next step will be implemented on the part.
6- Sewing the piping on the part.
7- Sewing the sleeves of the part.
8- Tuck the end of the sleeves and stitch it.
9- Join sleeves on the part by soldering the sleeves on the part.
10- Sewing two sides (front & back) of the part together.
11- Produce labels that contain the sizes (S, M, L, and XL) of the part.
12- Join the label on the part by stitching it on the internal back of the part.
13- Sewing buttons for the dome and the end of the sleeves on the part.
14- Hemming the end of the part and sew it.
15- Hemming the end of the arm sleeves and sew it.
16- Produce labels contain the name of the company.
17- Sewing the label on the side of the internal part.
18- Trimming the extra fabric strings that ruins the standards of the part.

Sewing internal connected processes (current):

	Internal process name:	Output/hr:	# of workers
1	Back & front soldering	400	4
2	Shoulder stitching	325	4
3	Neck rib sewing	370	4
4	Neck rib joint	420	4
5	Piping make	412	4
6	Piping joint	399	4
7	Sleeve sewing	389	4
8	Sleeve tuck with body part	299	4
9	Sleeve joint with the body part	415	4
10	Side seam	310	4
11	Size label	372	4
12	Size label joint	401	4
13	Button hand & neck	490	4
14	Bottom hem sewing	357	4
15	Arm bottom hem joint	393	4
16	Label sewing	378	4
17	Label joint	503	4
18	Trimming	180	4

Table 3.1.5

While reviewing the internal processes for the sewing lines and collecting the data on the floor, last process (Trimming) has the lowest output per hour, so we will consider it as a bottleneck process and we will take it into consideration in our alternative solution on the next chapter.

3.2 Data collection

Observation, particularly participant observation, has been used in a variety of disciplines as a tool for collecting data about people, processes, and cultures in qualitative research. This paper provides a look at various definitions of participant observation, the history of its use, the purposes for which it is used, the stances of the observer, and when, what, and how to observe. Information on keeping field notes and writing them up is also discussed, along with some exercises for teaching observation techniques to researchers-in-training.

2 people are go down to the stream and start collect the data as the follow sample:

Daily production report

Operation name: Ironing

DATE: 10-April-2017

Total target #: 1,100

ID: 26

Hours	Column 1	Column 2	Column 3	Column4	Column5	To. pcs
8:30	100					100
9:30	90	10				100
10:30	100					100
11:30	100					100
12:30	100					100
2:00	25	75				100
3:00	10	19	54	5	12	100
4:00	20	50	30			100
5:00	100					100
6:00	12	88				100
7:00	71	25				96
8:00	43	40				83

Table 3.2.1

3.3 Current value stream mapping

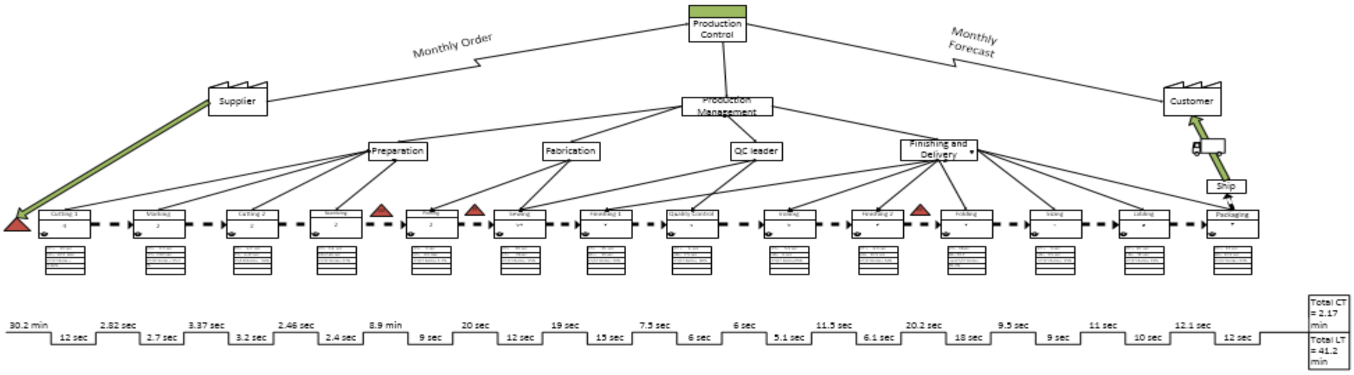


Figure 3.2.1

Here are four common factors that can stretch the current value stream mapping:

1- Too many non-value-added activities. The time an order is actually being worked on in our company averages less than five percent of the order-to-delivery cycle

(Cycle time\Lead time) which is 2.17\41.2 = 0.052.

Inventory and transportation thus spends 95 percent of the time between order entry and shipment waiting for the next step in the process. Complicated paperwork and long waits during the work process can add days to the cycle, but no value to the product.

2- Measuring the wrong parameters. Many times companies measure their performance against criteria such as equipment utilization, productivity, or order completion date and think they're doing fine if they get high scores. But a company can excel by these criteria and still lose out to the competition if it can't get its product to the customer when promised. Employees perform to what's being measured.

3- Capacity management. Balancing customer demand and available capacity is essential to success. This is not to say a company should refuse orders, but rather that it realizes it must meet delivery commitments that satisfy customers.

4- Corporate culture. Employee attitudes toward work can have an adverse effect on performance.

5- Use poor material handling system which leads to more non-added value to the product.

In this case, the employees don't understand what they are doing, thy just received the planning and schedules and start work, but I think if they have more awareness about what they are produce, the productivity will be increase without any single changes.

3.3 Problems and Constraint for the Current layout:

The current design for the process is annoying regarding the flow of materials, but it has some constraints that will impede changes and we will discuss these constraints in this section:

1- Ironing stations: Seven operators are working on these stations, one by each, these ironing stations are fuel consumption, and there position will stay close to the exhausts.
   Other alternative for the consumption type is electrical ironing stations, but the top management reject this option because the running cost is higher than fuel one.

2- The exits and entrances are fixed because of the factory design and the difficulty of changing its location.
3- The initial finishing process must be in place before the first QC process because the finished parts of the production lines contain large undesirable buildup that may impede the process of the Ironing.
4- Also, the ironing process shows small defects that may affect the quality of the goods and reputation of the factory that passed the initial inspection, so there is an additional finishing process after it.
5- After the second finishing process, some of the pieces that have been finished from this process will be chewy and need to be ironed again.
6- Because the nature of the work, all sizes will mixed and messed together so we need to separate each size according to the order requirements.

Chapter 4
Optimal layout selection

4.1 Alternatives

Choosing the right layout and processes in the most efficient manner can increase production output, decrease operational costs and enhance product quality, the ultimate goals of operations management. Operations managers continually re-evaluate their production setups to look for opportunities to save money or boost production effectiveness.

So we spread a check list to the management to produce the possible alternatives and select the optimal solution as per their problem.

Here is a sample of the check list that we made and it's a sample of their selection.

1	Is it possible to move any operation from its place to another place freely?		
2	Are you restricted with the ironing process place and can't be changed?		✖
3	Can ironing process be moved outdoor for safety issues?		✖
4	Is it possible adding the folding procedure to labeling workers? After labeling they direct fold.		
5	Are you agreed to combine marking and cutting 2 processes into one workstation?		
6	Are you with the idea of providing four baskets or cartoons that each one specifies the size of the part (S, M, L, XL), that will help the sizing process?		
7	Is it okay that there will be a small buffer between numbering process and pinning process?		✖
8	Are you satisfied with dividing the pinning process into two stations instead of one station, each station responsible for each line?		
9	Can you afford extra resources?		✖
10	Can store leader office be moved freely?		
11	Is it easier for handling fabric to change the fabric store location near the cutting 1 process?		

12	Can you afford four new stations for trimming process?		
13	Are you satisfied to add four new stations of trimming process for the cause of increasing the sewing output?		
14	Do you prefer to expand the area of goods warehouse?		
15	Can QC leader office be moved into another place within the facility?		
16	Are you with the recommendation of moving one station of finishing 2 next to finishing 1 to enhance line balancing?		
17	Are you restricted with exit point's locations?		
18	Are you satisfied to move the cutting 1 near to sample room?		
19	Is it one of your goals to make finished goods area nearby the exit buyer point?		
20	Are you committed in keeping finishing 1 processes before QC process for some special reasons?		✖
21	Is the use of fuel for ironing instead of electricity a constraint that can't be changed?		✖

Table 4.1.1

In this chapter we will review all the possible alternatives about redesigning the floor and they will be as follow:

- Alternative No. 1

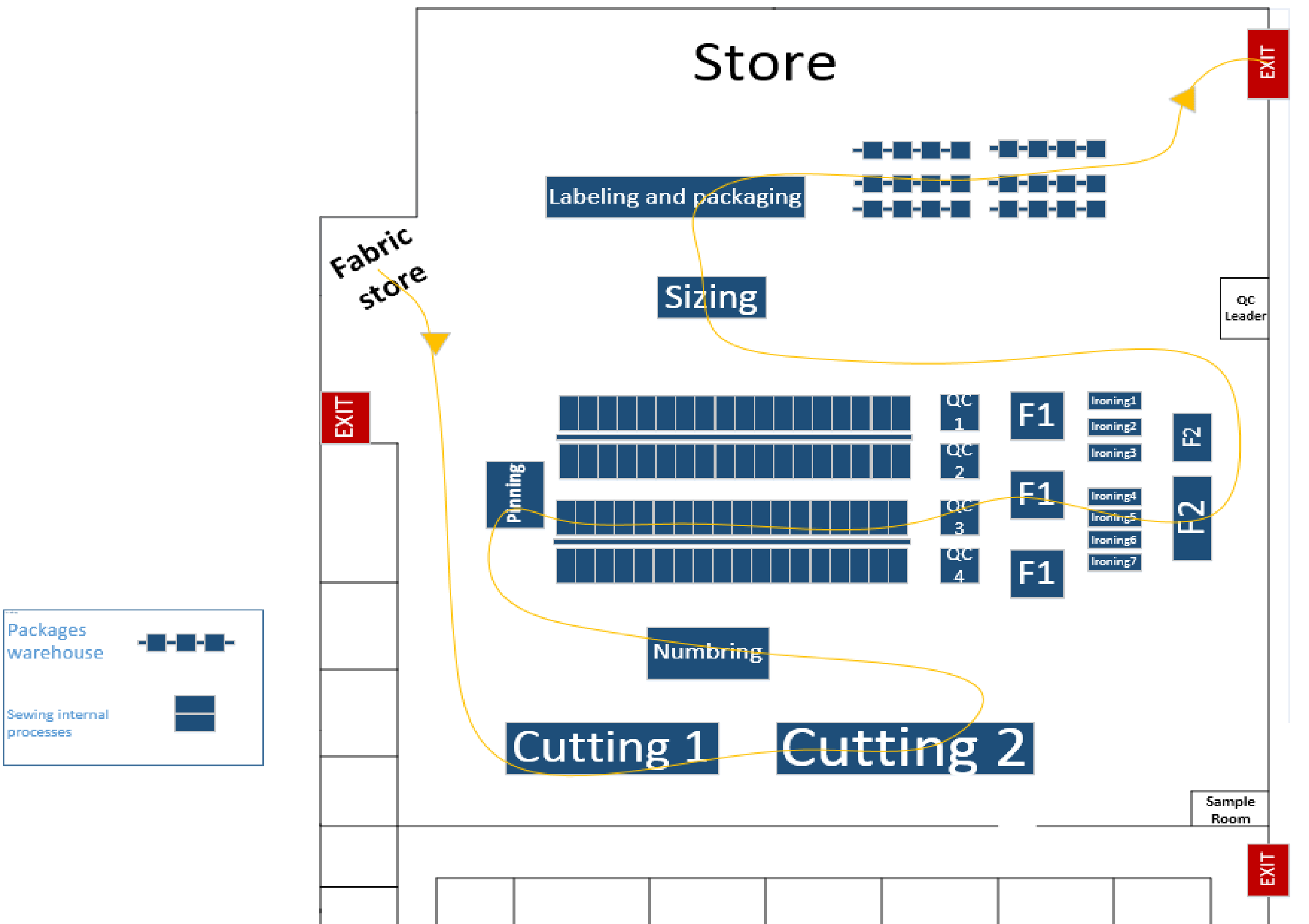


Figure 4.1.1

- Marking process will locate before cutting 2 process at the same workstation of cutting 2, combination is done at cutting 2.
- Fabric store is far from cutting 1 process, but no problem because 2 to 3 times a day fabric will be handled from the fabric store to cutting 1 process.
- QC and finishing 1 switched places to avoid finishing 1 working on a scrap part.
- One station from finishing 2 has been moved next to finishing 1 and does the same work of finishing 1 because there will be more work load at finishing 1, finishing 2 work the same work of finishing 1 but takes less time.
- Packaging area is near the exit buyer point.
- Packaging area is near the store that contains cartoons.

- Alternative No. 2

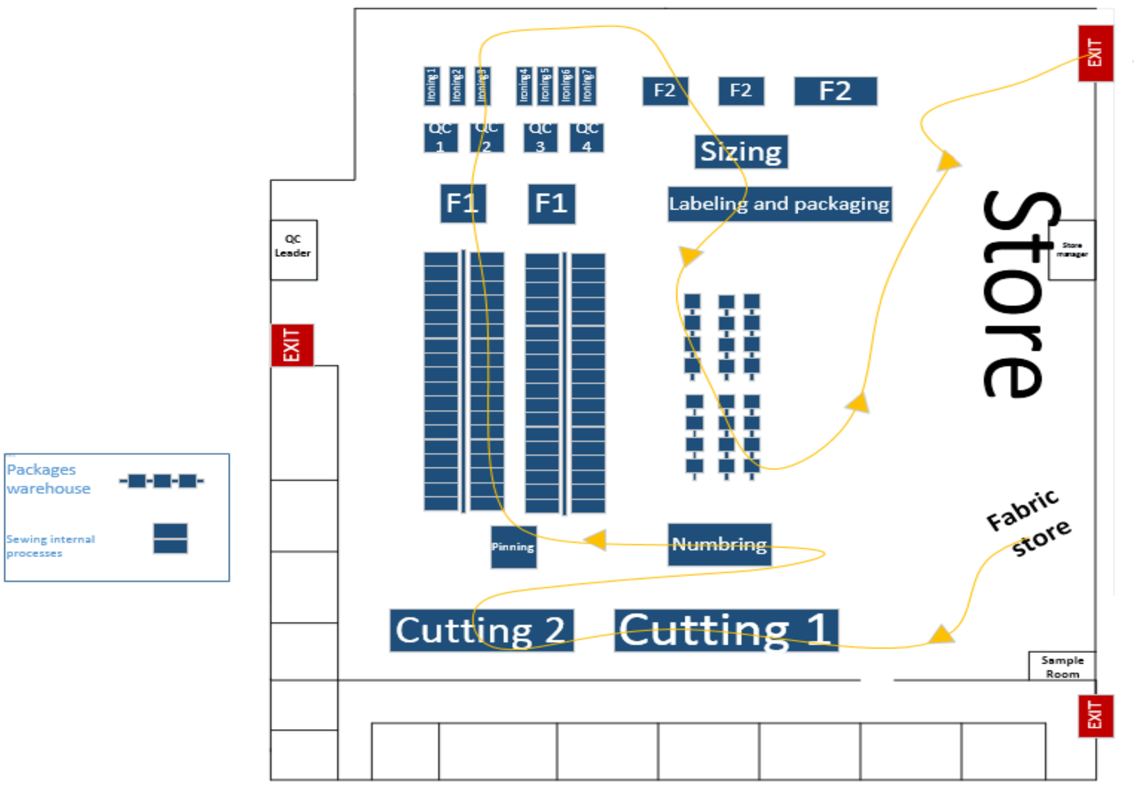


Figure 4.1.2

- Marking process is done before cutting 2 process at the same workstation of cutting 2, combination is done at cutting 2.
- Store is moved near the buyer and supplier exit point, distance reduced to help while material handling.
- Fabric store is also moved near the exit point.
- Fabric store near cutting 1 process.
- QC leader office has been changed into store manager and new QC leader office is made near the QC processes for the cause of the information exchange.
- Packaging area is near the store that contains cartoons.

 Alternative No.3

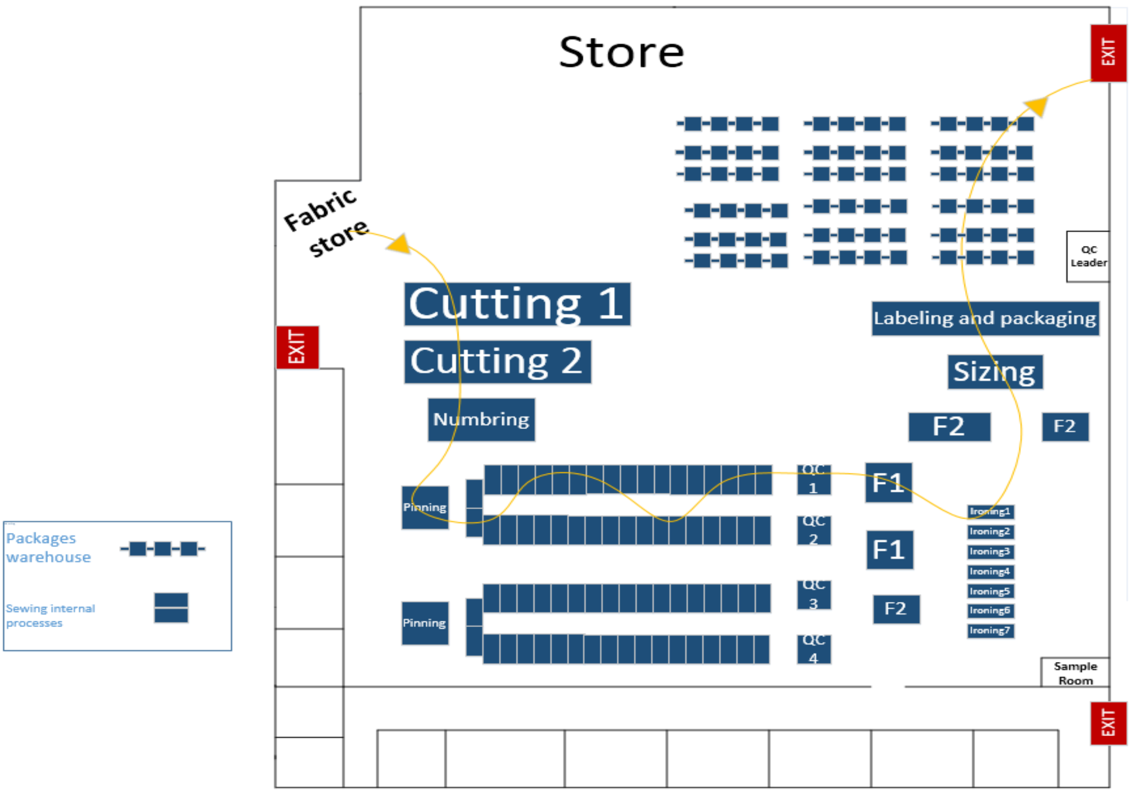
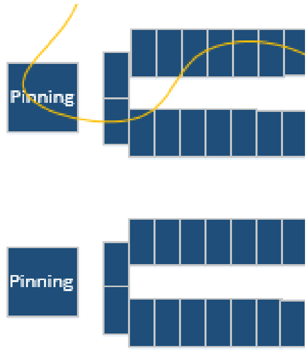


Figure 4.1.3

- Marking process is done before cutting 2 process at the same workstation of cutting 2, combination is done at cutting 2.
- Folding process is eliminated.
- Distance between fabric store and cutting 1 process has been reduced.
- Pinning process includes two workers, separating it into two workstations as shown for each line will increase smoothness.
- Finishing 1 moved and located after QC to avoid working on a scrap part.
- Packaging area is near the exit buyer point.
- Packaging area is near the store that contains cartoons.



- Alternative No.4

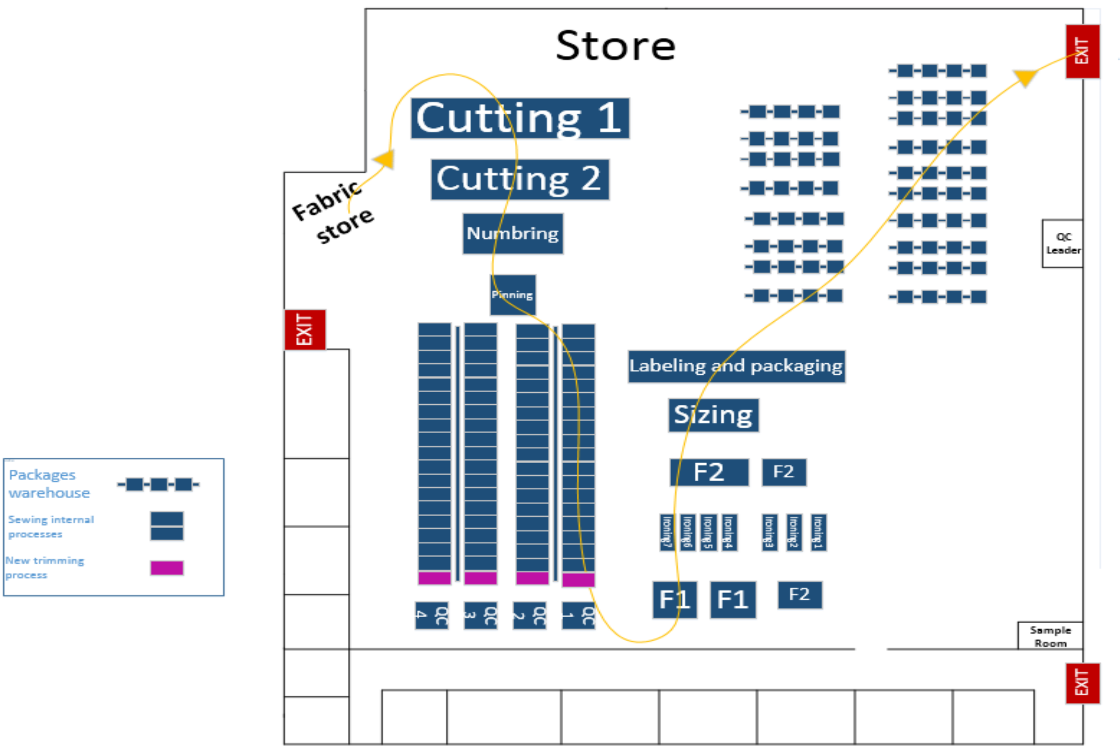


Figure 4.1.4

- Marking process is done before cutting 2 process at the same workstation of cutting 2, combination is done at cutting 2.
- Folding has been eliminated.
- A new trimming row with 4 operators has been added to the sewing line process as shown, in order to eliminate the bottleneck. Now instead of producing 180 unit/hr, 360 unit/hr is produced after the new row is added.
- Packaging area is near the exit buyer point, distance has been reduced.
- One finishing 2 process has been moved next to finishing 1 and by that finishing 1 includes three processes in a row that produces 360 instead of 240 and finishing 2 process produce 393 instead of 590 part this is called line balancing for the overview processes.
- Packaging area is near the store that contains cartoons.

Internal process name	Output/hr	#of workers
Button hand & neck	490	4
Bottom hem sewing	356	4
Arm bottom hem joint	393	4
Label sewing	376	4
Label joint	503	4
Trimming	180	4

Table 4.1.1

Internal process name	Output/hr	#of workers
Button hand & neck	376	3
Bottom hem sewing	356	4
Arm bottom hem joint	393	4
Label sewing	376	4
Label joint	377	3
Trimming	360	6

Table 4.1.2

Compare between the current state and this alternative

As we can see from the previous comparison, the processes are getting consistence and synchronized regarding the Label joint and Trimming processes, by increase the sources in the Trimming process.

A survey is creating and was given to the company to choose the best alternatives according to their needs, here is the survey:

So they choose the following one:

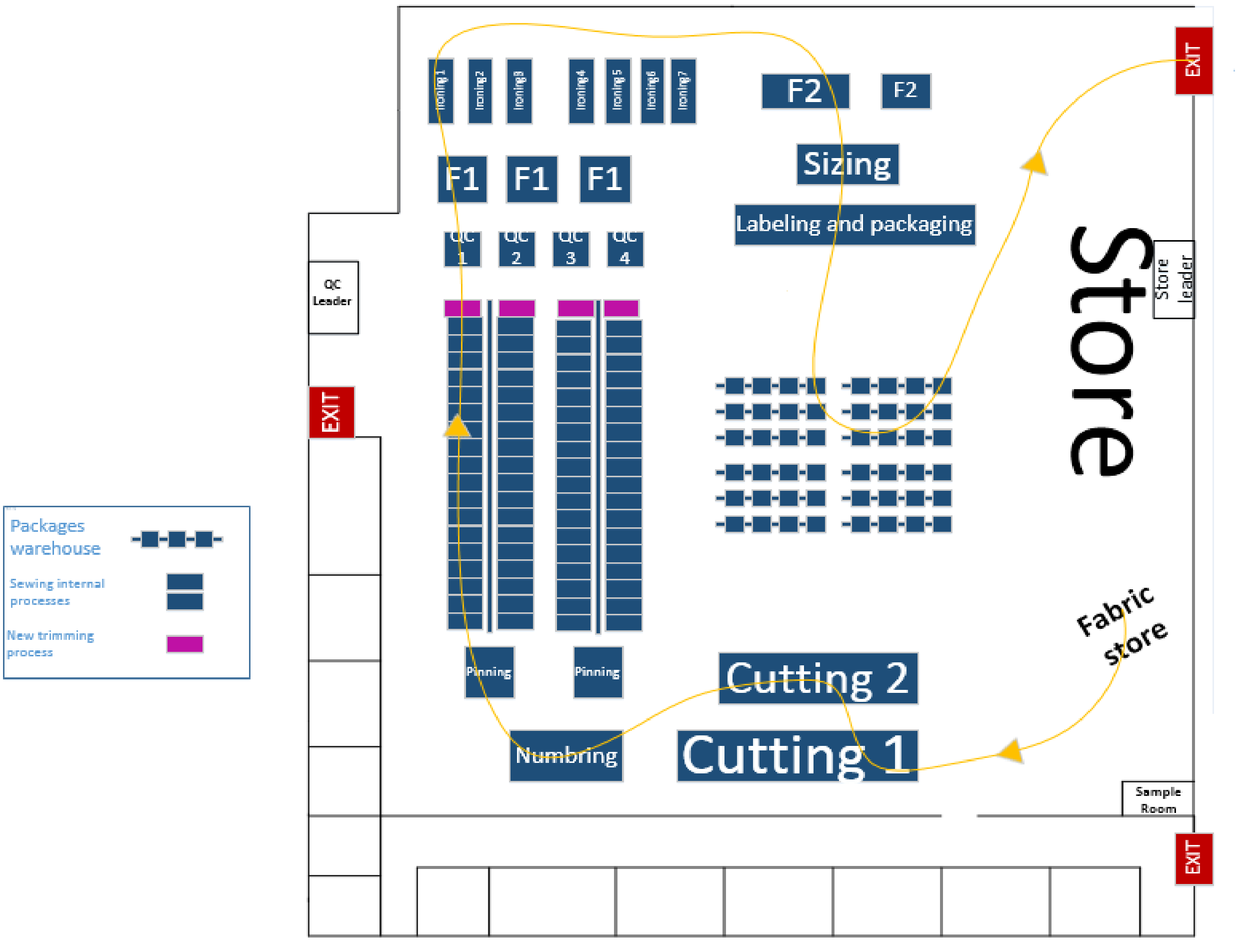


Figure 4.1.5

Advantages for the optimal selection:

- Distance is reduced between supplier exit point and fabric store.
- Cycle time reduce from 2.17 to 1.77 min, and lead time from 41.2 to 28.8 min
- Distance is reduced between fabric store and cutting 1 for the ease of handling raw material.
- Marking process is done before cutting 2 process at the same workstation of cutting 2, combination is done at cutting 2 and will not effect on production flow.
- Pinning process includes two workers, separating it into two processes as shown for each line will increase smoothness.
- A new trimming row with 4 operators has been added to the sewing line process as shown, in order to eliminate the bottleneck. Now instead of producing 180 unit/hr, 360 unit/hr is produced after the new row is added.
- Switch between QC and Finishing 1 to avoid finishing 1 from working on a scrap part.
- One finishing 2 process has been moved next to finishing 1 and by that finishing 1 includes three processes in a row that produces 360 instead of 240 and finishing 2 process produce 393 instead of 590 part this is called line balancing for the overview processes.
- Distance between ironing and finishing 2 has been reduced.
- Folding process has been removed because of folding is already done while workers do the labeling process.

- Packaging process is now near the customer entrance and that's better because the transportation distance of finished goods is reduced.

- Packaging area is near the store that contains cartoons.

- One worker from marking process is added to the sizing process and by that, the output of sizing process will be increase to 400 instead of 200 per hour.
- QC leader office has been changed into store manager and new QC leader office is made near the QC processes for the cause of the information exchange.

Value stream mapping for the best selection:

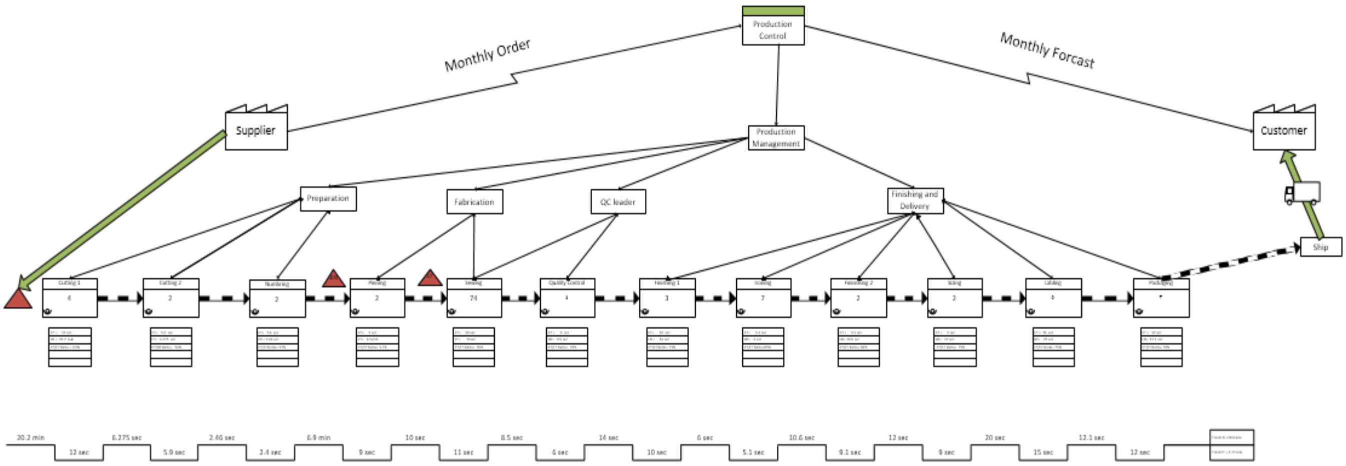


Figure 4.1.6

4.2 Conclusion

In conclusion, it is found that analysis of facility design such as layout and material handling system is very important in a manufacturing industry. Proper analysis of existing layout design could improve the performance of production line. It could decrease bottleneck rate, minimize material handling cost, reduces idle time, raise the efficiency and utilization of labour, equipment and space.

The proposed research that will be conducted by us (Lubna and Namaa) is evaluating existing layout arrangement using combination of heuristic methods and alternative's selection. Basic heuristic analysis technique will be used to find a new proper layout configuration. Then, select the best and efficient layout.

This paper presents the discussion on the objectives of facility layout design, flow pattern and material handling systems and finally discusses the different type of layout.

The current trends are to integrate the different aspects of the manufacturing system design problem. Also present an idea for solving point location and material handling flowpath problem.