بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

In the name of Allah, the Beneficent, the Merciful

Identification of Co-relation between Line Balancing System and Stitching Hall Performance

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CHAPTER # 1

Today's business climate for clothing manufacturers requires low inventory and quick response systems that turn out a wide variety of products to meet customer demand. It is especially in the apparel industry that managers are trying to develop their current systems or looking for new production techniques in order to keep pace with the rapid changes in the textile industry.

In apparel manufacturing, raw material is processed in different departments before becoming a garment. There is no doubt that the sewing department is the most important department in the whole firm because there are lot of different operations which are done manually, the sewing department has to be under constant control. Consequently, all line balancing processes which determine the speed of an assembly line are done in this department but it is a big mistake not to consider the relationship of the sewing department with other departments.

1.1 Line Balancing

Line balancing is an effective tool to improve the throughput of assembly lines and reduce manpower requirements and costs. In apparel manufacturing, it is difficult to achieve line balance because the production rate of each workstation is different. This difficulty is particularly prominent in the labor-intensive assembly process.

Significance

In the apparel industry, it is essential to form a new production line for each order, and also the number of workers is changed according to the complexity of the order, the number of operations, throughput etc. The things which should be done during the installation of an assembly line are as follows;

- To define a standard time for each operation
- To balance the production line for each order
- To keep the utilization rate at a maximum for each operator
- To complete all these steps in one week before production begins

The rapid rate at which the whole process takes place, the interaction between workers and the different transition times between workers make it increasingly more difficult for a human being to make correct decisions regarding how fast each operator should work in order to continue the process, while at the same time keeping productivity high and throughput at an acceptable level.

1. Problem statement

Line un-balancing in garment`s operations is a major problem in apparel industry these days. Not only line un-balancing but we have some other challenges like, cost, quality, labor and electricity etc. besides all these, our aim is to minimize the operational time of garments manufacturing. Allocation and controlling of assembly lines can increase our profit considerably.

Our project will be a helping step towards the betterment in term of productivity and efficiency.

1.2 Project objectives

Our main objective is to identify the co-relation between line balancing system and stitching hall performance. Morever

- To highlight Importance of line balancing system in garment production halls
- To assess or estimate Impact of Line Balancing System on efficieny and effectivness of apparel industry
- Presenation of flaws in line production
- Develop a new chart by simulation method to reduce the time losses and increase productivity
- Implementation of line balancing system in garment production halls
- Evalaution in production after applying new methods

1.3 Expected Project Outcomes

After the completion of capstone project, we will be aware of:

- To analyze the presence of line balancing system in stitching halls
- Control and ease of line balancing system in apparel manufacturing

1.4 Resources Required

Our needed resource will be

- Access to the industry for the collection of data
- Digital resources
- Expert opinions

Available Resource Will Be

Internet, Library for Books, Research Papers and Research Methodology.

2 Why Do We Balance the Line?

- The step – by step method is easy to learn and help the section run more smoothly.
- Company leaders like the way balancing reduce the operating costs.
- Operators like the way balancing allow them to have steady work (people do not like to be sent home).
- Supervisors like the way balancing let the section operate smoothly with some problems.
- A big reason for balancing is that it helps keep our prices low so we keep our customers.

2.1 Line Balancing Equations

- **Cycle Time** = Production time available per day/ Units required per day
- **Minimum number of workstation** = Σ Task Time /Cycle time
- **Efficiency** = Σ Task time/ Actual no. of workstation x Cycle time

2.2 Line Balancing Steps (analysis of production lines)

- Determine Task
- Determine Sequence
- Estimate Task Time
- Calculate Cycle Time
- Calculate no of work stations
- Assign Task
- Calculate Efficiency

2.3 Three Rules of Line Balancing

- Keep at least one half hour's work for each operation.
- Fix problems before they cause trouble
- Balance the section at least every four hours

2.4 History

Overview

The assembly line concept was not "invented" at one time by one person. It has been independently redeveloped throughout history based on logic.

The transition from prototypical to the modern assembly line thus took place as creativity and logic took advantage of the opportunities that technological changes presented. The prototypical forms of assembly lines in various industries are outlined below.

2.4.1 Venetian Arsenal (1500s)

At the peak of its efficiency in the early 16th century, the Venetian Arsenal employed some 16,000 people who apparently were able to produce nearly one ship each day, and could fit out, arm, and provision a newly-built galley with standardized parts on an assembly-line basis not seen again until the Industrial Revolution.

2.4.2 Block production at Portsmouth: Brunel, Maudslay, et al. (1800-1820s)

Probably the first linear and continuous assembly line of post-Renaissance times were the Portsmouth Block Mills created in 1801 by Marc Isambard Brunel (father of Isambard Kingdom Brunel), with the help of Henry Maudslay and others, for the production of blocks for the Royal Navy. This assembly line was so successful it remained in use until the 1960s, with the workshop still visible at HM Dockyard in Portsmouth, and still containing some of the original machinery.

2.4.3 Eli Whitney (1780s-1820s)

Eli Whitney is sometimes credited with developing the armory system of manufacturing in 1801, using the ideas of division of labor, engineering tolerance, and interchangeable parts to create assemblies from parts in a repeatable manner. But Whitney's contribution was mostly as a popularizer rather than "the inventor" of repeatability. He was probably inspired by several others (including Honoré Blanc), or at least by the contemporary zeitgeist that was building around such ideas. Thomas Jefferson had tried to bring a French mechanic (who was almost certainly Blanc) and his methods to America in 1785, but the project never went anywhere.[1] A few years later, Whitney and his American contemporaries succeeded in introducing the relevant concepts (interchangeable parts, toolpath control via machine tools and jigs, transfer of skill to the equipment, allowing use of semi-skilled or unskilled machine operators) to American firearm manufacture.

2.4.4 Meatpacking industry (1860s)

The meatpacking industry of Chicago is believed to be one of the first industrial assembly lines (or dis-assembly lines) to be utilized in the United States starting in 1867. Workers would stand at fixed stations and a pulley system would bring the meat to each worker and they would complete one task. Henry Ford and others have written about the influence of this slaughterhouse practice on the later developments at Ford Motor Company (see below at Ford Motor Company (1908-1915)).

2.4.5 Firearms, clocks, et al. (1860s-1890s)

The Industrial Revolution in Western Europe and North America, but perhaps most especially in Great Britain and New England, led to a proliferation of manufacturing and invention. Many industries, notably textiles, firearms, clocks and watches,[2] buttons, horse-drawn vehicles, railroad cars and locomotives, sewing machines, and bicycles, saw expeditious improvement in materials handling, machining, and assembly during the 19th century, although modern concepts such as industrial engineering and logistics had not yet been named.

2.4.6 Ransom E. Olds (1890s-1900s)

Ransom Olds patented the assembly line concept, which he put to work in his Olds Motor Vehicle Company factory in 1901, becoming the first company in America to mass-produce automobiles.[3] This development is often overshadowed by the independent redevelopment of assembly-line work at Ford Motor Company a few years later (see below), which introduced the ramifications of the method to a wider audience.

2.4.7 Henry Ford (1900s – 1914s)

Making automobiles was a hobby for many Americans, and Henry Ford began as a hobbyist, but he brought to his hobby an unsurpassed ambition.[4]In 1899, he started his own automobile manufacturing company; he wanted to produce cars in large enough quantities to make them available to everyone. In 1908, he divided up the tasks involved in manufacturing an automobile; he broke these tasks down to the function of each autoworker, conceiving of each worker as a part of a machine that made cars. At first, he tried having chassis pulled along factory floors with towropes. Men walked alongside the chassis to stations, at each station parts were added. Manufacturing time for a single automobile decreased from twelve hours to five and one-half hours. In 1913, he installed conveyor belts in his factories. With these, workers stood at their stations, each doing the same repetitive task over and over again. Manufacturing time for one car fell to around an hour and a half. At such a pace, Ford could make a small profit on each car but could make much more money from selling the cars in the millions. By The end of 1914, his employees were the highest paid industrial workers in the world; a worker performing the simplest of tasks could, and some did, become rich.

2.4.8 World War II

When the United States entered World War II, its heavy industries were charged with manufacturing the matériel for the armed services. The assembly line was crucial to this production. In March 1941, Ford began building a factory and, by the end of 1942, was taking in raw materials at one end, processing them, and producing B-24 bombers.[5] By The end of the war, Ford's factory was producing B-17 bombers at the rate of one every sixty-three minutes.

2.5 Foundations of the Assembly Line

The idea of the assembly line has many parents. In the scientific revolution of the eighteenth century, scientists, especially mathematicians tried to quantify what made an industry productive and tried to find ways to make industries more productive. The goal was to create an industry that functioned without human labor. The most important people of the time for the development of the assembly line were the Americans **Oliver Evans** and **Eli Whitney** and the **Frenchman Gaspard Monge**.[6]

Evans is known for his invention of the first motorized amphibious vehicle, but his most influential achievement was to design a flour mill. During the late eighteenth century, he used steam engines to power mills that used belt and screw conveyors, as well as moving hoppers, to move grain through the process of becoming flour and then to move the flour to where it could be packaged. While his equipment was not exactly an assembly line, all the basic components were there.

Best known for creating the cotton gin, Eli Whitney also contributed to the development of the assembly line with his invention of interchangeable parts. Whitney created machine tools that could create parts so closely resembling each other they could be substituted for one another without harm. In 1798, the United States government ordered 10,000 muskets, and in a preview of the assembly line, Whitney set his employees to work on manufacturing parts that were assembled bit by bit into muskets. A Whitney musket could be repaired in the field with spare parts.

Gaspard Monge made his contribution while in Italy during the Napoleonic era. He took the principals of descriptive geometry and applied them to machinery. By breaking a machine down into its component parts, Monge found that he could show how each part related to the others; this would evolve into technical drawing, which allowed people to make machines they had never seen, machines that would share interchangeable parts with any other machine made with the same diagrams.

2.6 Production Parctices in Clothing Manufacturing to maintain the line balancing system in production halls

System Used

It is highly important that we use the proper system for the product and also doing it in an efficient manner. Quality of the work aids will be a major part in this scenario.

2.6.1 Apparel Production Systems

An apparel **production system** is an integration of materials handling, production processes, personnel, and equipment that directs work flow and generates finished products. Three types of production systems commonly used to mass produce apparel are: ***progressive bundle, unit production,*** **and** ***modular production***. Each system requires an appropriate management philosophy, materials handling methods, floor layout, and employee training. Firms may combine or adapt these systems to meet their specific production needs. Firms may use only one system, a combination of systems for one product line, or different systems for different product lines in the same plant.

2.6.2 Progressive Bundle System

The progressive bundle system (PBS) gets its name from the bundles of garment parts that are moved sequentially from operation to operation. This system, often referred to as the traditional production system, has been widely used by apparel manufacturers for several decades and still is today. The AAMA Technical Advisory Committee (1993) reported that 80 percent of the apparel manufacturers used the bundle system. They also predicted that use of bundle systems would decrease as firms seek more flexibility in their production systems.

Bundles consist of garment parts needed to complete a specific operation or garment component. For example, an operation bundle for pocket setting might include shirt fronts and pockets that are to be attached. Bundle sizes may range from two to a hundred parts. Some firms operate with a standard bundle size, while other firms vary bundle sizes according to cutting orders, fabric shading, size of the pieces in the bundle, and the operation that is to be completed. Some firms use a dozen or multiples of a dozen because their sales are in dozens. Bundles are assembled in the cutting room where cut parts are matched up with corresponding parts and bundle tickets.

Bundles of cut parts are transported to the sewing room and given to the operator scheduled to complete the operation. One operator is expected to perform the same operation on all the pieces in the bundle, retie the bundle, process coupon, and set it aside

The progressive bundle system may be used with a skill center or line layout depending on the order that bundles are advanced through production. Each style may have different processing requirements and thus different routing. Routing identifies the basic operations, sequence of production, and the skill centers where those operations are to be performed. Some operations are common to many styles, and at those operations, work may build up waiting to be processed.

2.6.2.1 Disadvantages

The progressive bundle system is driven by cost efficiency for individual operations. Operators perform the same operation on a continuing basis, which allows them to increase their speed and productivity. Operators who are compensated by piece rates become extremely efficient at one operation and may not be willing to learn a new operation because it reduces their efficiency and earnings. Individual operators that work in a progressive bundle system are independent of other operators and the final product.

Slow processing, absenteeism, and equipment failure may also cause major bottlenecks within the system. Large quantities of work in process are often characteristic of this type of production system. This may lead to longer throughput time, poor quality concealed by bundles, large inventory, extra handling, and difficulty in controlling inventory.

2.6.2.2 Advantages

The success of a bundle system may depend on how the system is set up and used in a plant. This system may allow better utilization of specialized machines, as output from one special purpose automated machine may be able to supply several operators for the next operation. Small bundles allow faster throughput unless there are bottlenecks and extensive waiting between operations.

2.6.3 Unit Production System

A unit production system (UPS) is a type of line layout that uses an overhead transporter system to move garment components from work station to work station for