World Journal of Advanced Engineering Technology and Sciences

eISSN: 2582-8266

Cross Ref DOI: 10.30574/wjaets

Journal homepage: https://wjaets.com/

(Research Article)

Leveraging Kanban Lean Techniques to Improve Workforce Allocation and Production Efficiency in the Apparel Industry

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World Journal of Advanced Engineering Technology and Sciences, 2025, 17(03), 060-073

Publication history: Received 26 October 2025; revised on 01 December 2025; accepted on 03 December 2025

Article DOI: https://doi.org/10.30574/wjaets.2025.17.3.1508

Abstract

This study delves into Lean manufacturing technologies, with a specific focus on the Kanban system—a pivotal tool for enhancing operational efficiency. The investigation centers on the swing line of a local Non-Kanban Ready-Made Garment (RMG) plant, scrutinizing current activities and workforce allocation. The goal is to demonstrate how implementing the Kanban system can efficiently divide the input workforce on the swing line, leading to heightened productivity, reduced idle time, and optimized working hours. The initial phase involves a comprehensive analysis of the existing non-Kanban assembly line, serving as a benchmark for evaluating the proposed Kanban paradigm. Utilizing cards or signals, the Kanban system is employed to visually optimize the process. The thesis visually represents the current non-Kanban swing line input process, highlighting operational efficiency and time utilization. Mathematical dimensions are explored to quantify the impact of the Kanban method on work efficiency. Through rigorous mathematical analysis, the thesis assesses the suggested Kanban model's potential to streamline input worker distribution, ultimately reducing working hours and elevating overall productivity. The key findings highlight the significant impact that installing the Kanban system might have on the local RMG facility's swing line. Quantitative analysis offers quantifiable data on possible enhancements in efficiency, assisting decision-makers in the industry. This thesis is a significant resource for field workers aiming to enhance their productivity, ensuring not just increased efficiency but also demonstrating the transformative impact of Lean manufacturing principles on industrial operations.

Keywords: Lean tool; Kanban System; Sewing line; Input man; Idle time; Efficiency

1. Introduction

For the Ready-Made Garments (RMG) sector to implement lean manufacturing, the Kanban system is an essential tool for improving production efficiency and optimizing operations. Kanban, derived from Japanese manufacturing concepts, is not only a visual scheduling system, but rather a philosophy that promotes a pull-based production approach, emphasizing a constant flow of work and the elimination of inefficiencies. Kanban is an essential technique for maintaining a perfect balance between supply and demand in the RMG business, where timely production and delivery are crucial. The technique employs visual cues, such as cards or boards, to show which tasks or materials are required at certain stages of the production process. The visual representation ensures that production teams concentrate only on essential commodities, so restricting overproduction and reducing excess inventory. In the realm of RMG manufacturing, a Kanban system is used, whereby every garment or production batch is represented by a Kanban card. This card has specific information such as the style, number, and manufacturing norms. Kanban cards are present alongside garments as they go through many production stages, such as cutting, sewing, and finishing. Such a high degree of visibility allows for real-time monitoring and facilitates efficient coordination across different industrial units. Moreover, the Kanban approach enables the detection of bottlenecks and regions of inefficiency in the production

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line. The technology helps teams in promptly resolving challenges by limiting work in progress and optimizing workflow, hence assuring a smooth and continuous production cycle. Implementing this efficient approach not only decreases the probability of mistakes but also enhances the adaptability of the manufacturing process to meet changing market demands. The Ready-Made Garment (RMG) business is a pillar of global manufacturing, contributing significantly to global economies and employment creation. You can get continuous growth and business success by using Lean manufacturing methods. The Kanban system, which originated from the Toyota Production System, has shown to be a powerful tool for improving production processes and minimizing inefficiencies. In order to enhance the productivity of the RMG sector, we undertook a comprehensive examination of a local industry that currently does not use the systematic advantages offered by the Kanban approach. We concentrated our efforts on a specific sector of the production line where disorganized operations were seen, resulting in inefficiencies and hampering the factory's ability to meet daily output targets. During our visit, we saw a swing line where several young boys were energetically engaged in what seemed to be a chaotic manner. Because the input technique was disorganized, swing line workers had to wait for cutting components to arrive at irregular times, which caused delay. The consequences of this dysfunction were significant, as the whole plant had difficulties in meeting its daily output goals, resulting in inefficient use of resources. The fundamental problem was the lack of an organised system to manage and control the movement of materials throughout the manufacturing process. Our suggested framework focuses on implementing the Kanban card system, a well-known Lean manufacturing technology that aims to optimize inventory levels, improve communication, and simplify production. This framework's objective is to develop a systematic approach to the input process, guaranteeing that cutting components are delivered to the swing line in a timely and orderly manner. The Kanban cards will function as visual indicators, coordinating the restocking of resources with precision at the exact moment they are required, therefore avoiding periods of inactivity and inefficiencies. By using this methodical approach, we expect a significant improvement in the industry's total productivity, enabling the achievement of daily production goals with increased efficiency and decreased workforce. The study addressed challenges within the cutting sector of the apparel industry by implementing lean tools and optimizing the facility architecture. As a consequence, cycle times were reduced, the number of required operators decreased, and rework levels were also diminished. Suggestions for enhancing performance included an Expandable Cutting table, Fabric relaxing Rack, Input rack, Box for cutting machine, marker paper stand, and an SMV data bank [1]. Value Stream Mapping assesses processes, identifies phases that do not provide value, and suggests improvements. This research paper on machining centre production looked at current and future state maps, focusing on base manufacturing and subcontracting to make things run more smoothly [2]. This research compares high-tech and semi-automatic sewing machines used in the Bangladesh RMG industry for different garment processes. The utilization of high-tech machinery results in substantial reductions in SMV, labor, and expenses, thereby emphasizing the productivity and cost-effectiveness advantages they offer apparel manufacturers [3]. In the face of intense international competition, Indian clothing producers place a premium on timely and high-quality delivery. This research examines the use of lean techniques, notably the Kanban Management System in a shirt manufacturing facility. Productivity, line efficiency, and workplace improvements are compared before and after adjustments over three months [4]. In the dynamic RMG industry of Bangladesh, quality and punctuality of production are everything. This research looks with sewing section challenges in the garment industry, providing Just-in-Time (JIT) approaches to improve productivity. Following the implementation of these tactics over a period of three months, significant enhancements were seen in production capacity, line efficiency, and overall performance. In order to make even more improvements, the research suggests looking at process integration, job sharing, and multitasking [5]. The Bangladeshi Ready-Made Garment (RMG) business has obstacles such as subpar production and lengthy lead time. Qualitative study demonstrates advancements made with the use of lean technologies such as Enterprise Resource Planning (ERP), pull production, and just-in-time emphasis. However, in order to achieve long-term development, a comprehensive strategy is necessary [6]. Although Kanban has proven successful in large corporations, its adoption is hampered in Malaysian SMEs by issues with vendor engagement, insufficient commitment, and quality development [7]. This research focuses on installing a Kanban system in a Malaysian manufacturing business, documenting the pre-implementation tasks. According to the research, Kanban improves production productivity and helps companies implement Just In Time procedures by cutting lead times, minimizing floor inventory, and optimizing storage [8]. The use of the Kanban system in a Malaysian auto-component company's Cylinder Head Cover assembly process drastically cut lead time, eliminated floor inventory, and streamlined storage, demonstrating its efficiency in attaining Just In Time procedures [9]. The Ready-Made Garment (RMG) business in Bangladesh, which has a significant position in the worldwide market, encounters obstacles as a result of fierce rivalry and evolving customer preferences. Implementing lean manufacturing is essential for achieving sustainable development via the reduction of lead times and elimination of inefficient processes [10]. The primary objective of the Bangladeshi garment industry, namely at Inters off Apparels Limited, is to improve the quality of garments by minimizing faults in knit T-shirts. The use of Pareto analysis identified seven primary areas of flaw, which in turn guided the implementation of 5S and PDCA methodologies to achieve successful improvement. Additionally, suggestions were made [11]. The case study of incorporating a milk-run business into a Kanban system for raw material flow is presented in this article. The simulation's findings demonstrate how much better it functions than the current push method, emphasizing the benefits of more effective leveling and operator utilization. The paper proposes more investigation to enhance the wider applicability [12]. An extensive Systematic Literature Review (SLR) was conducted on Agile methodologies, with a focus on Scrum and Kanban. The analysis of 38 papers provided insights into the integration of these approaches. Transition trends demonstrate a significant movement away from Scrum towards Kanban or hybrid models, frequently due to difficulties faced with Scrum, while the favorable characteristics of Kanban become apparent [13]. The research studied the influence of integrating a Kanban Coach (KC) on information system projects, finding substantial team performance improvement. The experiment showcased the effectiveness of KC in several projects, backed by Coordination Theory and Shared Mental Models, via the use of both quantitative and qualitative assessments [14]. The use of lean manufacturing (LM) techniques, particularly Value Stream Mapping (VSM) and Kanban, in the textile sector is examined in this article. The analysis confirms four assumptions, demonstrating a substantial decrease in the inventory of completed items. The results, constraints, and useful ramifications are examined, opening the door for further study in an understudied area [15].

2. Methodology

An approach used for determining the outcome of a particular problem on a certain subject or problem also known as research problems through research methodology. This methodology is founded upon the theoretical framework that was established during the literature review conducted in the preceding chapter.

The acquired knowledge from the theory and pertinent study was essential in developing the research methodology that would yield the desired results. To successfully carry out the research work, it is crucial to design a consistent methodology that encompasses data collection, analysis, data presentation, calculation, and outcomes. This chapter encompasses establishing a research technique to structure and regulate the research endeavor for the purpose of conducting the thesis. The study analyzes the steps involved and visually represents them through a flow chart to illustrate the overall research methodology. It provides a detailed explanation of the analytical process for determining the number of input men in a swing line. The chapter elucidates how the Kanban system, a proven method in lean manufacturing and project management, contributes to a more streamlined and efficient research process. It also provides a key technique to eliminate input men numbers by implementing the Kanban system for a better outcome. To facilitate a deeper comprehension of the study, the chapter incorporates relevant formulas and processes. These components serve as a guide for researchers and readers similar, offering a clear roadmap for understanding the intricacies of the study's analytical framework. The use of visual representations, such as flowcharts, aids in clarifying the complex sequence of steps involved in the study. These visual tools enhance the accessibility of the research methodology, making it easier for readers to comprehend and appreciate the systematic approach undertaken. By including these details, the methodology chapter not only underscores the rigor of the research process but also provides a valuable resource for future scholars and practitioners in the field.

The following steps were followed to determine the number of input men in a swing line and analyze the data to generate calculative suggestion for reducing the number of input men:

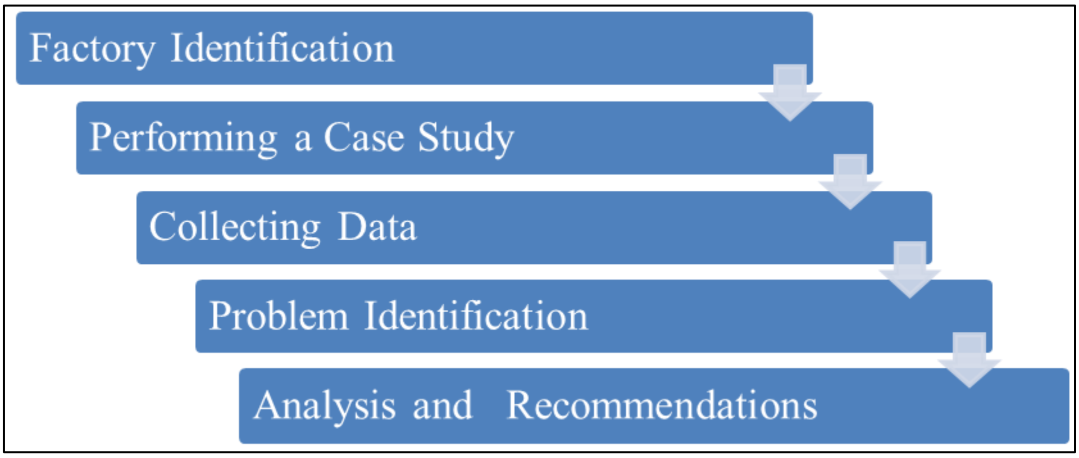

Figure 1 Flow chart of Research Methodology

Ultimately, this research is carried out within a specific garments factory called “Ha Meem Garments” This document provides an overview of the demographic characteristics of the organization.

Table 1 Basic Overview of the Selected Garment Factory

Name of The Company	**Ha Meem Garments**
Location	Kaliganj, Gazipur, Dhaka
Product Type	Knit / Woven garments
Working Hours per Day	Hours (Maximum)
Total Number of Workers	Male: 1500 **|** Female: 500 Total: 2000

Data had been gathered regarding the number of input workers at the chosen garment factory in this phase. Through interviews and visualizations with the supervisor, input personnel, and other management, we have gathered the information presented here. They give us both qualitative and quantitative data, which is used for the analysis of the study**.**

Choosing a nearby textile industry that had not yet implemented the Kanban system. Here, input staff members were mostly tasked with delivering material from the cutting section to a swing line. However, a significant delay in the loading process of the swing line was detected. It is important to note that the input man would not begin the bin-loading procedure until the bins were fully empty. Two individuals were designated to operate a swing line. At their maximum idle time, the loading pressure does not occur continuously throughout the day. After providing the input, which typically takes 2 to 3 hours, they typically have nothing remaining tasks. Their idleness results in decreased efficiency on the assembly line. There are two input men per swing line, thus a lot of labor is required. Due to an overabundance of labor, companies must pay higher wages, which raises operating expenses.

Upon identification of the prevailing issue, focus shifted towards mitigating the challenge by implementing the Kanban card system. This strategic intervention aimed to alleviate the workload and pressure on the input man. The Kanban system employs three distinct types of cards—red, green, and white—to signal the status of the swing line's readiness for production. A red card denotes that the bin is empty, signaling that input from the cutting section is required urgently. Witnessing this indicator, the input man promptly proceeded to the cutting section to provide the necessary input for the swing line.

Conversely, a white card signifies that pattern pieces are in a work-in-process condition, indicating that the required input is still in the cutting section and not yet ready for deployment in the swing line. Finally, the green card signals that the input from the cutting section is prepared for the swing line. Upon observing this signal, the input man moves to the cutting section to collect the input and place it on the swing line.

A proposal was put in suggesting that one input man could effectively manage responsibilities for two swing lines. This proposition was based on the assumption that the cutting section's pattern cutting could sustain two hours of production for a swing line. Following the delivery of input to the bin within the swing line, the input man attached a Kanban card to the bin. Subsequently, as production progresses, nearing the two-hour mark, the input man, observing the bin, changes the Kanban card, signaling the cutting section to initiate the production of additional pattern pieces for the swing line.

This iterative process serves as an alert to the cutting section, effectively communicating the need for more pattern pieces to sustain production. The visual cues provided by the Kanban cards enable easy observation of which production line requires input. Through the implementation of the Kanban methodology, the number of required inputs man can be significantly diminished. The proposed idea that one input man can effectively manage two swing lines is substantiated by the systematic and visual signaling mechanism of the Kanban system. As a result, there is a potential reduction in wages, contributing to decreased annual labor costs.

2.1. Idle Time

Idle time refers to the period during which a machine, equipment, or workforce remains inactive or unproductive. It represents the duration when resources are not engaged in any productive activity, leading to a temporary cessation or slowdown of work. Idle time can occur for various reasons, including equipment breakdowns, maintenance activities, lack of materials, or waiting for the next task in a production process.

In manufacturing, idle time can result in reduced overall efficiency and productivity, as it represents time that could have been utilized for value-added activities. It is a significant concern for businesses aiming to optimize their operations and minimize downtime. Efficient management of idle time is crucial for maximizing resource utilization and ensuring that production processes run smoothly.

By providing a systematic and visual signaling mechanism, the Kanban system helps reduce delays and ensures a continuous flow of materials, thereby contributing to the reduction of idle time and improving overall efficiency.

The formula for measuring Idle Time:

Idle Time = Total Working hour – Actual Working hour

2.2. Efficiency

Efficiency refers to the ability to accomplish a task or produce output with the least number of wasted resources, time, or effort. Efficiency is a key indicator of how well a system, process, or individual can generate desired results while minimizing inefficiencies

Efficiency = (Actual Working hour / Total Working hour) × 100%

2.3. Data collection and calculation

In order to assess the effects of kanban, we gathered daily data from a nearby garments industry that does not use kanban. We discovered several opportunities for improvement. There were two linemen providing input for each of the twenty sewing lines on the floor. It took 140 minutes for each lineman to prepare the input. Furthermore, when completing the stitching in a single row, they proceeded to input. During that period, the sewing operators were idle. The whole duration of the line was 140 minutes of inactivity. Implementing a kanban card system may effectively address the issue of 140 minutes of idle time, which is a significant area for improvement.

2.4. In Ha Meem Garments

Determining the Number of Input Man:
Given that,
Number of lines = 20
Input man for a Single Line = 2

Now,
Number of total line man = Number of lines * Input man for Single Line
Number of total line man= 20×2 = 40
By using this formula and calculation method, we determined the required input man for Ha Meem garments.

Table 2 Line and Line-man data of Ha-Meem Garments

Line-man Data of Ha meem Garments				
Serial No.	Days	Numer of line	Line man for single line	Total Line Man
1	1	20	2	40
2	2	20	2	40
3	3	20	2	40
4	4	20	2	40
5	5	20	2	40
6	6	20	2	40
7	7	20	2	40
8	8	20	2	40
9	9	20	2	40
10	10	20	2	40
11	11	20	2	40
12	12	20	2	40
13	13	20	2	40
14	14	20	2	40
15	15	20	2	40
16	16	20	2	40
17	17	20	2	40
18	18	20	2	40
19	19	20	2	40
20	20	20	2	40
21	21	20	2	40
22	22	20	2	40
23	23	20	2	40
24	24	20	2	40
25	25	20	2	40
26	26	20	2	40
27	27	20	2	40
28	28	20	2	40
29	29	20	2	40
30	30	20	2	40
31	31	20	2	40
32	32	20	2	40
33	33	20	2	40
34	34	20	2	40
35	35	20	2	40
36	36	20	2	40
37	37	20	2	40
38	38	20	2	40
39	39	20	2	40
40	40	20	2	40
41	41	20	2	40
42	42	20	2	40
43	43	20	2	40
44	44	20	2	40
45	45	20	2	40
46	46	20	2	40
47	47	20	2	40
48	48	20	2	40
49	49	20	2	40
50	50	20	2	40

2.4.1. Determining Idle Time

Where,
Total Working Hour = 480 min
Actual Working Hour = 305 min

Now,
Idle Time = Total Working Hour (min) – Actual Working Hour (min)

Idle Time = 480-305 = 175

Determining Efficiency:
Actual Working Hour = 305 min
Total Working Hour = 480 min

$$\textbf{Efficiency} = \frac{\textbf{Actual Working Hour (min)}}{\textbf{Total Working Hour (min)}} \times 100\%$$

Efficiency = 63.54%
By using this formula and calculation method, we determined the required input man for a local garments industry.

Table 3 Line wise (Working time and Idle time) data of Ha Meem Garments

Efficiency Data of Ha meem Garments					
Serial No.	Days	Working hour	Idle Time	Actual Working time	Ha meem current Efficiency
1	1	480	175	305	64%
2	2	480	165	315	66%
3	3	480	180	300	63%
4	4	480	150	330	69%
5	5	480	170	310	65%
6	6	480	150	330	69%
7	7	480	150	330	69%
8	8	480	150	330	69%
9	9	480	150	330	69%
10	10	480	160	320	67%
11	11	480	160	320	67%
12	12	480	160	320	67%
13	13	480	155	325	68%
14	14	480	150	330	69%
15	15	480	160	320	67%
16	16	480	150	330	69%
17	17	480	150	330	69%
18	18	480	175	305	64%
19	19	480	160	320	67%
20	20	480	150	330	69%
21	21	480	155	325	68%
22	22	480	150	330	69%
23	23	480	180	300	63%
24	24	480	150	330	69%
25	25	480	185	295	61%
26	26	480	145	335	70%
27	27	480	180	300	63%
28	28	480	165	315	66%
29	29	480	140	340	71%
30	30	480	175	305	64%
31	31	480	155	325	68%
32	32	480	185	295	61%
33	33	480	170	310	65%
34	34	480	160	320	67%
35	35	480	175	305	64%
36	36	480	160	320	67%
37	37	480	160	320	67%
38	38	480	185	295	61%
39	39	480	150	330	69%
40	40	480	145	335	70%
41	41	480	160	320	67%
42	42	480	170	310	65%
43	43	480	180	300	63%
44	44	480	170	310	65%
45	45	480	165	315	66%
46	46	480	160	320	67%
47	47	480	175	305	64%
48	48	480	175	305	64%
49	49	480	155	325	68%
50	50	480	165	315	66%

2.5. In proposed Kanban industry

Determining the Number of Input Man:

Where,
Number of lines = 20
Number of lines operated by Single Input Man = 02

Now,
Number of total line man = (Number of lines / Number of lines operated by Single Input Man)
Number of total line man= 20/2 = 10

By using this formula and calculation method, we determined the required input man for a Proposed Kanban-Implemented garments industry.

After analyzing those data, we proposed them a plan with kanban card system and we hope that after following this plan there sewing line will have minimum idle time and efficiency.

Table 4 Proposed plan for Input line-man

Proposed Line-man Plan for Ha meem Garments				
Serial No.	Days	Numer of line	Line man for Two line	Total Line Man
1	1	20	1	10
2	2	20	1	10
3	3	20	1	10
4	4	20	1	10
5	5	20	1	10
6	6	20	1	10
7	7	20	1	10
8	8	20	1	10
9	9	20	1	10
10	10	20	1	10
11	11	20	1	10
12	12	20	1	10
13	13	20	1	10
14	14	20	1	10
15	15	20	1	10
16	16	20	1	10
17	17	20	1	10
18	18	20	1	10
19	19	20	1	10
20	20	20	1	10
21	21	20	1	10
22	22	20	1	10
23	23	20	1	10
24	24	20	1	10
25	25	20	1	10
26	26	20	1	10
27	27	20	1	10
28	28	20	1	10
29	29	20	1	10
30	30	20	1	10
31	31	20	1	10
32	32	20	1	10
33	33	20	1	10
34	34	20	1	10
35	35	20	1	10
36	36	20	1	10
37	37	20	1	10
38	38	20	1	10
39	39	20	1	10
40	40	20	1	10
41	41	20	1	10
42	42	20	1	10
43	43	20	1	10
44	44	20	1	10
45	45	20	1	10
46	46	20	1	10
47	47	20	1	10
48	48	20	1	10
49	49	20	1	10
50	50	20	1	10

2.5.1. Determining Idle Time

Where,
Total Working Hour = 480 min
Actual Working Hour =390 min
Idle Time = 480 -390 = 175 min

So,

Efficiency is, 81%
Accordingly, we determined the required input man for a Proposed Kanban garments industry.

Table 5 Efficiency calculation Table for the proposed plan

Proposed Efficiency Plan for Ha meem Garments					
Serial No.	Days	Working hour	Idle Time	Actual Working time	Efficiency of our Proposed plan
1	1	480	90	390	81%
2	2	480	90	390	81%
3	3	480	90	390	81%
4	4	480	90	390	81%
5	5	480	90	390	81%
6	6	480	90	390	81%
7	7	480	90	390	81%
8	8	480	90	390	81%
9	9	480	90	390	81%
10	10	480	90	390	81%
11	11	480	90	390	81%
12	12	480	90	390	81%
13	13	480	90	390	81%
14	14	480	90	390	81%
15	15	480	90	390	81%
16	16	480	90	390	81%
17	17	480	90	390	81%
18	18	480	90	390	81%
19	19	480	90	390	81%
20	20	480	90	390	81%
21	21	480	90	390	81%
22	22	480	90	390	81%
23	23	480	90	390	81%
24	24	480	90	390	81%
25	25	480	90	390	81%
26	26	480	90	390	81%
27	27	480	90	390	81%
28	28	480	90	390	81%
29	29	480	90	390	81%
30	30	480	90	390	81%
31	31	480	90	390	81%
32	32	480	90	390	81%
33	33	480	90	390	81%
34	34	480	90	390	81%
35	35	480	90	390	81%
36	36	480	90	390	81%
37	37	480	90	390	81%
38	38	480	90	390	81%
39	39	480	90	390	81%
40	40	480	90	390	81%
41	41	480	90	390	81%
42	42	480	90	390	81%
43	43	480	90	390	81%
44	44	480	90	390	81%
45	45	480	90	390	81%
46	46	480	90	390	81%
47	47	480	90	390	81%
48	48	480	90	390	81%
49	49	480	90	390	81%
50	50	480	90	390	81%

3. Result and discussion

This analysis of Ha Meem Garments manufacturing factory reveals a clear inefficiency in the use of labor. Even though there are only twenty production lines on the floor, more than forty linesmen are in charge of a swing line, which is managed by two input personnel. There is an urgent need for operational improvement as this mismatch leads to a significant loss of labor and an increase in idle time.

According to the suggested theory, applying the Kanban method in this context has the potential to be revolutionary. The implementation of Kanban concepts at the plant can result in decreased labor needs, decreased idle time, and an overall improvement in operational effectiveness. Addressing the identified difficulties is in line with the Kanban system's emphasis on visualizing workflow, reducing idle time and maximizing efficiency.

This thesis emphasizes how the use of Kanban techniques can result in a garment production process that is more effective and streamlined in terms of resources. The proposed modifications seek to address existing inefficiencies while also positioning the facility for enhanced flexibility and responsiveness to the ever-changing demands of the industry. The thesis proposes the implementation of the Kanban system to address this issue, anticipating benefits such as reduced manpower requirements, minimized idle time, and improved overall efficiency in garment production. This highlights the potential positive impact of adopting Kanban principles in the utilization man power, reducing idle time and streamlining the production process.

In Ha Meem Garments, 40 input individuals are required to manage 20 production lines. This configuration suggests a one-to-two ratio of input men to production lines.

Contrastingly, with the proposed implementation of Kanban in the garments, a remarkable efficiency emerges. A mere 10 input individuals are capable of overseeing the operation of 20 production lines. This reflects a streamlined one-to-two ratio, demonstrating a significant reduction in required manpower.

In summary, the Kanban system, when applied to garment production, showcases a notable improvement in resource optimization. The reduction from 20 to 10 input individuals for the same number of production lines not only signifies increased efficiency but also underscores the potential benefits of adopting Kanban methodologies in enhancing workforce productivity and minimizing labor overhead.

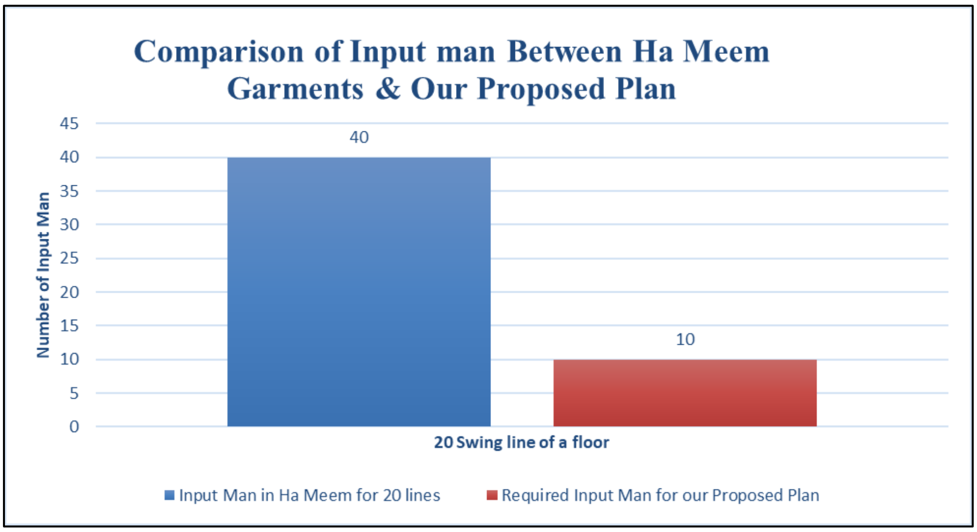

Figure 2 Comparison of Input man Between Ha Meem Garments and our Proposed Plan

Efficiency is a metric for how successfully resources are used to generate outputs or reach a goal. It's commonly represented as the ratio of usable output to total input, which shows how well a process transforms inputs into worthwhile outcomes.

Efficiency is effective for Ha Meem Garments productions because it may maximize resources, cut expenses, increase productivity, satisfies customer demands, and improve the overall quality of the manufacturing process. In a fast-paced and demanding industry, it acts as a cornerstone for resilience and competitiveness.

The efficiency in the garments sector that isn't Kanban ranges from 63% to 69%. This implies that the degree of resource utilization and workflow management is not at its best.

On the other hand, the suggested use of Kanban in the apparel sector leads to a notable enhancement in productivity, attaining 81%. This noticeable improvement shows how implementing Kanban methods can result in a more efficient and productive production process.

As a whole, the comparison highlights the substantial efficiency increases that can be attained by applying Kanban principles in the apparel business, providing a noteworthy improvement over the lower efficiency range seen in Ha Meem Garments.

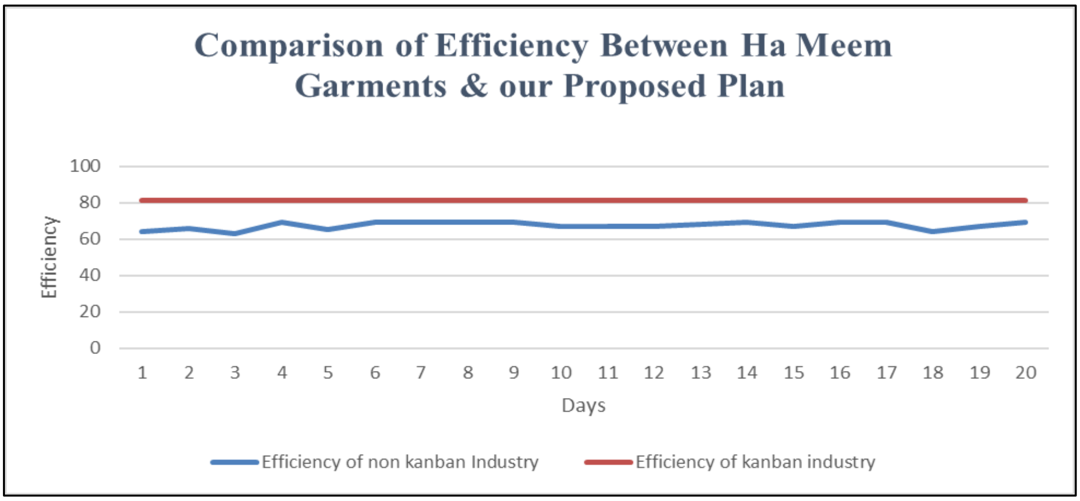

Figure 3 Comparison of Efficiency between Ha Meem Garments & our Proposed Plan

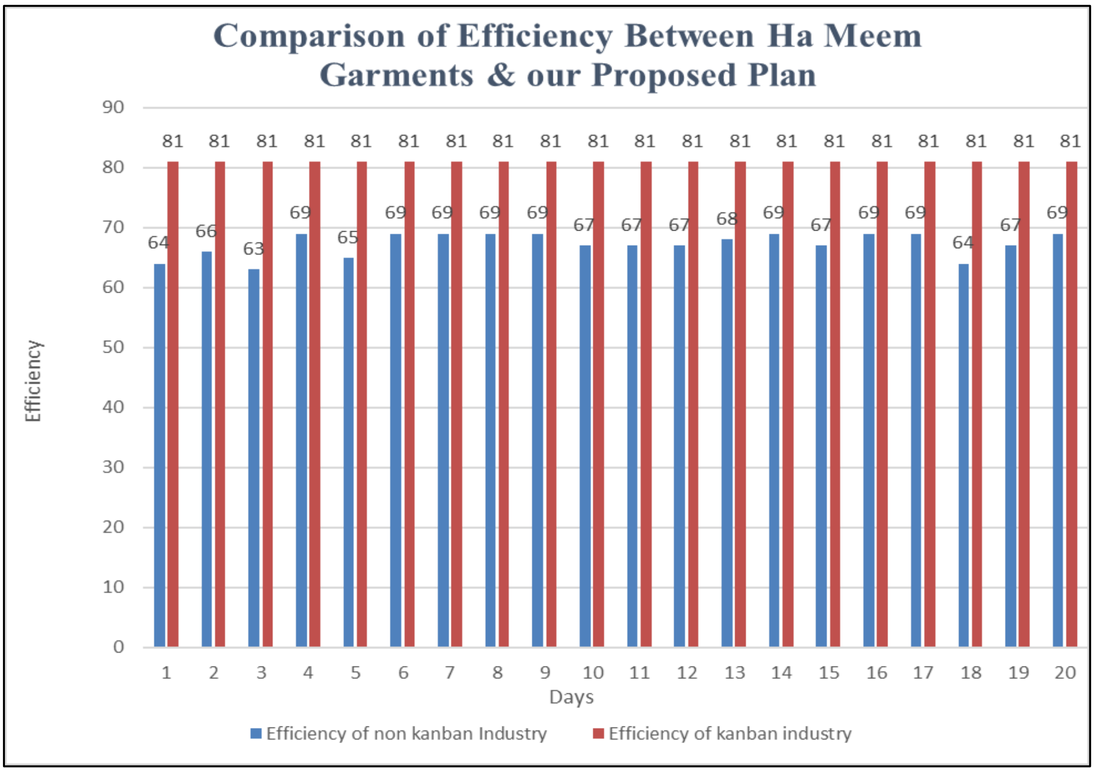

Figure 4 Comparison of Efficiency between Ha Meem Garments & our Proposed Plan

Idle time, when resources are unused, occurs in Ha Meem Garments production due to factors like waiting for materials or machine setup. Effectively managing this idle time is crucial for optimizing resource efficiency, reducing costs, and enhancing operational efficiency. Proactive measures to minimize idle time are essential for efficient production processes, ensuring both the workforce and machinery operate at their best. Ha Meem garment factories can align production with targets, actively engage workers, and foster a responsive manufacturing environment. Efficient idle time utilization is pivotal in improving flexibility, output, and consumer appeal in non-Kanban apparel production.

Effectively managing idle time is pivotal for improving flexibility, output, and consumer appeal in Ha Meem Garments apparel production. There is a significant difference in efficiency between the Ha Meem Garments and the suggested Kanban implementation when comparing idle time. Idle time in the current non-Kanban apparel production is between 145 and 180 minutes, which might indicate resource underuse and inadequate workflow management. But with the new Kanban plan, idle time is drastically cut down to just ninety minutes. This notable enhancement highlights the productivity increases that can be attained by applying Kanban techniques. The suggested Kanban nearly improves the overall responsiveness and adaptability of the clothing production process in addition to reducing periods of inefficiency. This thesis's findings demonstrate the revolutionary effects that implementing Kanban principles may have on idle time management, which will ultimately help the apparel industry's manufacturing operations become more efficient, responsive, and streamlined.

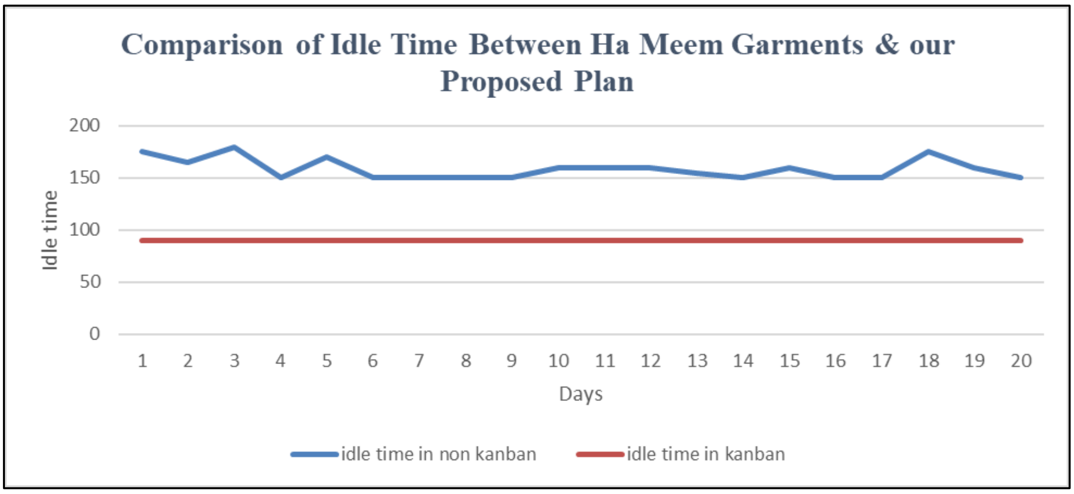

Figure 5 Comparison of Idle Time Between Ha Meem Garments & our Proposed Plan

4. Conclusion

The research of Lean manufacturing technologies, particularly the Kanban system, within the framework of a non-Kanban Ready-Made Garment (RMG) plant's swing line has yielded substantial insights and highlighted critical difficulties regarding the current operational structure. The research questions focused on the effectiveness of the present non-Kanban system, the causes leading to the lack of Kanban acceptability, and the potential benefits of implementing Kanban principles. The primary objective was to evaluate the present state of the swing line, with a focus on the imbalanced allocation of work, periods of idleness, and overall efficiency. The research conducted a thorough analysis and found that there was a substantial decrease in workforce, ineffective allocation of tasks, and communication obstacles within the centralized management system. The investigation's lessons highlight how the Kanban method may revolutionize swing line optimization. The visual depiction and quantitative examination revealed the major disparities between the existing condition and the suggested Kanban model. A more balanced job distribution and a decentralized strategy are required to improve productivity in light of efficiency problems, which include the observed staff redundancy and idle time. Implementing Kanban principles may effectively resolve these challenges by facilitating a streamlined allocation of jobs, minimizing downtime, and enhancing overall responsiveness to production requirements. The research acts as a guide for implementing the Kanban system in non-Kanban local RMG enterprises, offering stakeholders a clear comprehension of potential improvements. To explore possible sources of idle time and obstacles to effective job allocation, it is advisable to do more study in order to identify future possibilities. This may need a thorough analysis of the responsibilities of the two persons providing information, the precise duties carried out by the linesmen, and the general framework of communication. Furthermore, investigating the flexibility of the existing system in accommodating fluctuations in demand or production specifications would provide a more comprehensive understanding of the intricacies of the distinctive production arrangement.

The results of this thesis not only add to the existing academic knowledge but also provide practical consequences for industry executives and workers who want to improve efficiency in garment manufacturing facilities. By adopting and implementing Kanban concepts, there is a great opportunity for substantial improvements in productivity and resource allocation. Consequently, this study establishes the foundation for future research efforts focused on improving and broadening the use of Lean manufacturing principles in various industrial environments

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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