INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

Optimization of Non-value Added Headcounts in Inventory Control: A Case Study in an Electronics Manufacturing Company

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DOI: https://doi.org/10.51583/IJLTEMAS.2025.1411000050

Received: 18 November 2025; Accepted: 27 November 2025; Published: 08 December 2025

ABSTRACT

Manufacturing companies are highly concerned with non-value added (NVA) activities that are unnecessary or wasteful from the customer's perspective, and the employees who are responsible for these activities are considered as NVA headcounts. Consequently, this study aims to use the Define – Measure – Analyze – Improve – Control (DMAIC) process to solve this problem for an Electronics Manufacturing Company. It showed how to analyze the data and then defined that the Inventory Control process has the most NVA headcounts to start with the improvement, the SIPOC Model Diagram (SIPOC) was brought out to measure the target process. Useful methods like Cause and Effect Diagram (CED), 5 Whys, and Time Study Snapback (TSS) were used to analyze and indicate the root causes. In the improving stage, a new Inventory Control matrix was developed to reduce 13 NVA headcounts and save approximately 78000$ per year for the company. The study also listed out the activities that would have to do to maintain the project's effectiveness.

Keywords — DMAIC process, Lean Six Sigma, Non-Value Added, SIPOC Model Diagram, Cause and Effect Diagram, Five Whys, Optimization Headcounts.

INTRODUCTION

Implementation of Lean Six Sigma in manufacturing is an effective way of allowing organizations to attain their objectives and has better competitiveness in the market.

Lean manufacturing is a management philosophy derived from the Toyota Production System (TPS). It is a systematic approach to identify and eliminate wastes (or non-value-adding activities) through continuous improvement by flowing the product at the pull of the customer in the pursuit of perfection [1]. It focused on reducing the cycle time to become more responsive to customer demand and using fewer resources, lowering costs, and increasing productivity, profit.

Six Sigma as a powerful business strategy has been well-recognized as an imperative for achieving and sustaining operational and service excellence [2]. Lean Six Sigma is the application of Lean techniques to increase speed and reduce waste, while employing Six Sigma processes to improve quality and focus on the Voice of Customer (VOC) [3]. Therefore, Lean Six Sigma together are proven methodologies that increase efficiency, effectiveness, and quality, resulting in continuous improvement to increase value for the customer as on Fig. 1.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue XI, November 2025

Fig. 1 The benefits of using Lean Six Sigma

THE DMAIC METHODOLOGY

The Lean Six Sigma process is broken down into five interconnected stages: Define, Measure, Analyse, Improve, and Control (DMAIC), as described in Fig. 2. This sequence makes the process systematic, fact-based, and data-driven. The DMAIC process is the centerpiece of the Six Sigma problem-solving methodology and it is recommended for the systematic handling of any project [4].

At the definition step, a problem is identified, and it is determined which aspect of a particular process is to be improved. Back door method is used to discover wastes. Current operating conditions are identified, where processes were done. They would be separated in detail as operations, so their purposes are determined. Operations are classified whether they add value or do not add value to the products. Actually, root causes of the wastes (no-value added operations) are determined.

At the measurement step, a baseline is developed of how that system, process, or issue is on functioning. Non-Value- Added headcounts (NVA HCs) are measured, in which they do not add any values to the products. They operate non-value- added operations such as waiting, moving, supporting, and correcting activities. The rates of NVA HCs are determined, which could help identify where should be focused on improvement. In addition, SIPOC (Supplier – Input – Process – Output – Customer) diagram is used to measure the studied process.

Fig. 2 DMAIC methodology.

At the analysis step, the root causes of the problem are analyzed by using the data gathered during the measurement phase. Cause and effect diagram (Ishikawa Diagram) and 5-Why analysis tool are used. Root causes of waste of headcounts are identified.

Step 4 is the improvement process, in which changes are defined and implemented during this phase. Improvement plan is suggested in detail. The Product-Process-Quality-Time (PPQT) matrix was used to determined standard times, where relative information such as necessary operations, demands, daily available working time, available time in the demand period, and so on is determined and calculated.

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The number of observations is determined as following equation:

$$n = \left(\frac{zs}{a\bar{x}}\right)^2 = \left(\frac{zs}{e}\right)^2 \quad (1)$$

where:

z = standard normal distribution value at the expected confidence interval (95%).

s = standard deviation

a = accepted percentage of the error

$\bar{x}$ = mean of sample

e = accepted error

Observed time (OT) is determined by equation (2)

$$OT = \frac{\sum x_i}{n} \quad (2)$$

Normal time is calculated as following:

NT = OT * PR (3)

where: PR is performance rating (%)

Finally, standard time would be determined as:

ST = NT * AF = NT * (1+ A) (4)

where:

AF: Allowance percentage based on job time

A: Allowance time

It provides required information to identify the percentage of NVA HCs.

Finally, control is the handover to the process owner who commissioned the project and makes sure the result is maintained.

Case Study

The case study is developed in an electronics manufacturing company. It demonstrates how a systematic methodology is used in carrying out the improvement processes through the Lean Six Sigma concept. A suitable process improvement methodology based on Six Sigma is needed to ensure proper and systematic process flow to achieve improvement [5]. The methodology was adopted in a phase-by-phase approach and the detailed discussion of each phase is given as follows.

Define

Demand is expected to increase in the coming years. For this reason, it is considered important to find a way to reduce the cost, provide an attractive price to customers, and increase the competitive advantage in the market.

Reducing waste is an ideal way to lower costs and the collected data indicates that the rate of non-value-added headcounts in the company in the quarter 2 of the last year was very high (Fig. 3), Therefore, this study would focus on this element to achieve the goal of reducing cost.

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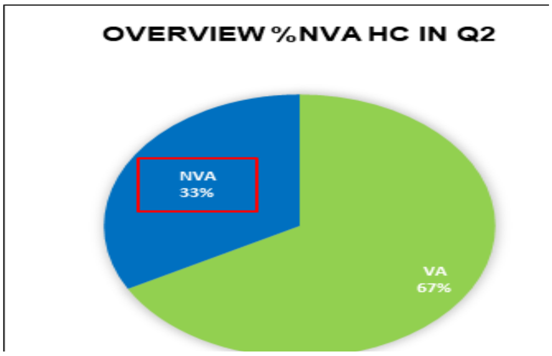
Fig. 3 Overview %NVA HC in Q2 of the last year

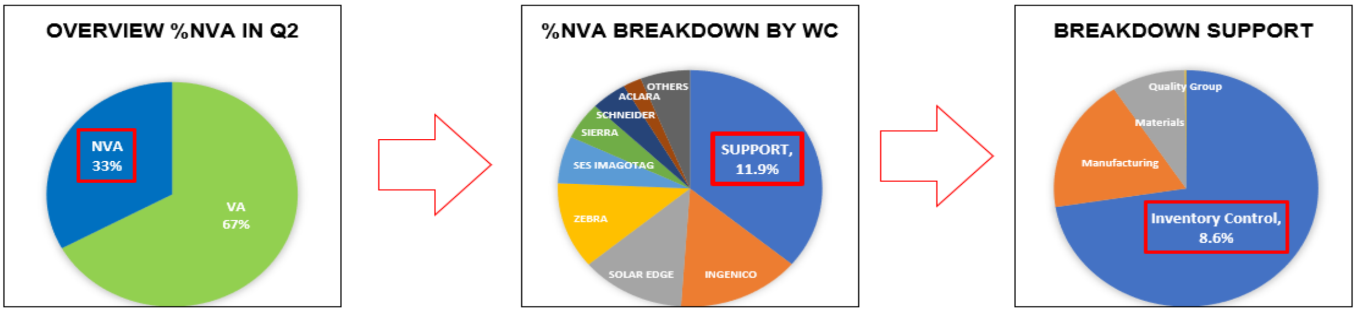


Another data collection plan was developed to break down the percentage of NVA headcounts in detail and see which department it was coming from.

Measure

A data collection plan was developed to break down the percentage of NVA headcounts in detail and see which department it was coming from and below is the result (Fig. 4).

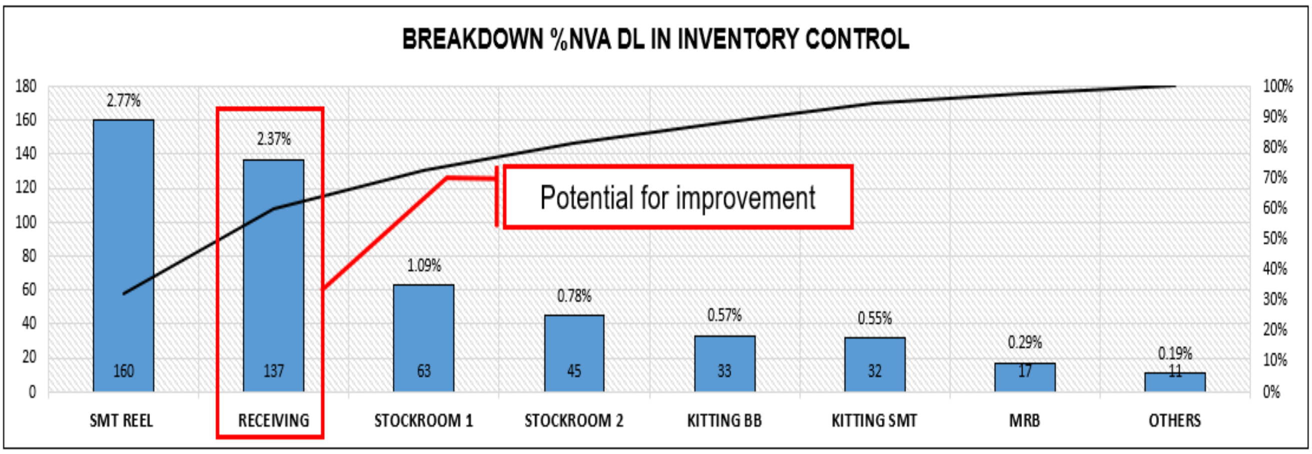
Fig. 4 %NVA HCs data breakdown



The NVA HCs rate is 33% of the total direct labor in the factory. Out of a total 33% of the NVA headcounts, 11.9% came from the Support team. For the Support team, the majority of the NVA headcounts is direct labor under Inventory Control, accounting for 8.6% of the total direct labor of the factory.

Continuously to break down the percentage of NVA headcounts in Inventory Control, Process Receiving was defined as a potential candidate for improvement as on Fig. 5. Although the AMT REEL process had highest percentage of NVA HCs, it was not managed by inventory control department. Therefore, the second highest one was focused on, which is receiving process as potential for improvement.

Fig. 5 %NVA HCs in Inventory Control



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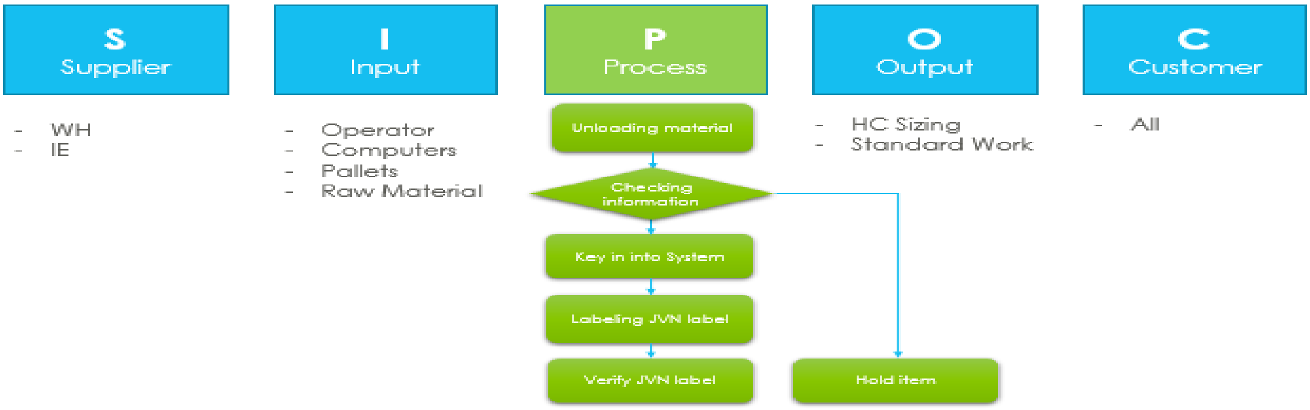
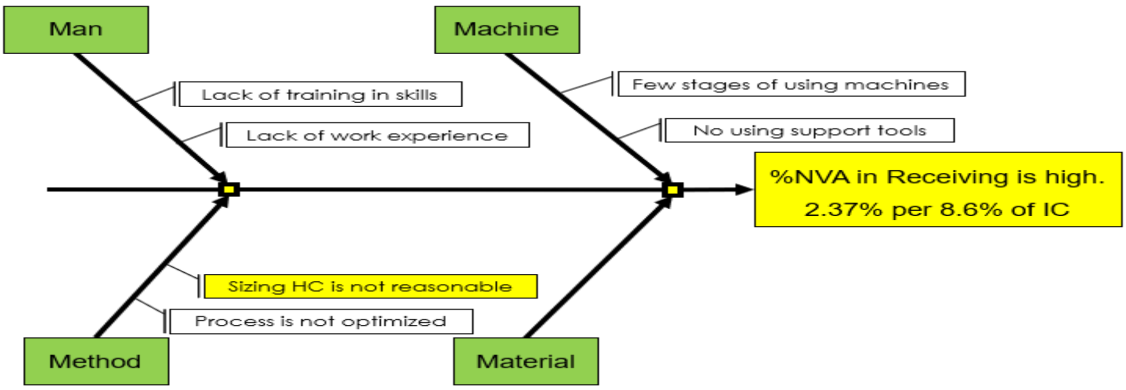
Also, SIPOC diagram was used to measure the current Receiving process as on Fig. 6. The warehouse and industrial engineering team would be responsible to improve the process as directly suppliers. SIPOC shows that the inputs such as operator, computers, pallets, and raw material directly affect the process.

Fig. 6 SIPOC diagram of Receiving process



Analyze

Fig. 7 The Cause and Effect Diagram



In this stage, the Cause and Effect Diagram and 5-Why Analysis are used to identify the root causes, resulting in Fig. 7, and Fig. 8. Because sizing headcounts is not reasonable, percentage of NVA in receiving process is unexpected high. The reasons are determined as on Fig.8.

Finally, the study concluded that the current Receiving process had no tool to do the Headcount Sizing. It led to waste a large amount of manpower and did not know how to optimize the tasks among them.

Fig. 8 Five-Why analysis

5 WHY ANALYSIS		
State the Problem: The %NVA in Receiving is high		
1	Why?	Calculating the number of HCs is not reasonable.
2	Why?	There is not enough data to make an accurate prediction of the amount of HC needed
3	Why?	No statistics on the working time of each position
4	Why?	No method to use data to calculate the number of HC
5	Why?	No tool that can use data including Product - Process - Quality - Time to HC Sizing

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Improve

After determining the root causes, a list of potential countermeasures and how to evaluate them, and the Implementation Plan was carried out as on Fig. 9. The activities for improvement of the receiving process would be assigned to relative departments, the predicted results were identified, and the time to complete them were set up.

In this stage, the Product-Process-Quality-Time (PPQT) matrix was used to calculate the standard working time of each task in the Receiving process. The suggestions to optimize the HCs to achieve the goal of reducing NVA HCs were summarized as on Fig. 10.

Fig. 9 Improvement plan

No.	Potential countermeasures	Effort	Impact
1	Apply PPQT to sizing HC in Receiving	Low	High

What	Where	Predicted Results	Who	When
Collect data needed	Receiving	Identify the workload	WH staff	1-Feb
Apply PPQT to calculator HC needed	Receiving	Calculator HC	IE eng	15-Feb
Apply new Sizing HC	Receiving	Optimize NVA HC	IE eng	15-Mar
Implementation	Receiving	Optimize NVA HC	WH head	31-Mar

Fig. 10 PPQT matrix for Receiving process

Cycle Time Source: MOST / Time Study / Estimated

USE Individual Cycle time NOT per panel

			Average Daily demand	Unload material		Checking	Labeling	Key In			Verify		Hold Item		
SAP Part Number	Job Description	Boards per panel	DEMAND	Unloading	Driver	Checking information	Labelling	Key in	Sample Handle	5S (empty box)	Hold Material	Coupa service	Cycle Count	Verify	Tracking PO
	Unloading		330	327.91											
	Driver		360		165.75										
	Checking information		7,940			26.50									
	Labelling		7,940				23.48								
	Key in		7,940					18.76							
	Sample Handle		200						184.85						
	5S (empty box)		150							120.10					
	Hold Material		70								743.10				
	Coupa service		100									58.50			
	Cycle Count		0										280.00		
	Verify		7,940											32.50	
	Tracking PO		533												35.69
	Total Demand by process=		33,503	330	360	7940	7940	7940	200	150	70	100	0	7940	533
Crew1/Shift1 (Hrs)=				10.5	10.5	10.5	10.5	10.5	10.5	10.5	7.1	7.1	10.5	10.5	10.5
Crew2/Shift2 (Hrs)=				10	10	10	10	10	10	10	10		10	10	10
Crew3/Shift3 (Hrs)=															
Crew4/Shift4 (Hrs)=															
Days in the Period of the Demand=				1	1	1	1	1	1	1	1	1	1	1	1
Qty. of Changeovers per day=				0	0	0	0	0	0	0	0	0	0	0	0
Time for Changeover (Minutes)=				15	15	15	15	15	15	15	15	15	15	15	15
Daily Available Working Time (Min)=				1230	1230	1230	1230	1230	1230	1230	1026	426	1230	1230	1230
Available Time in the demand period (Seconds)=				73,800	73,800	73,800	73,800	73,800	73,800	73,800	61,560	25,560	73,800	73,800	73,800
SUM (Demand each model X it's Cycle time) (Sec)=				108,211	59,670	210,434	186,448	148,966	36,970	18,015	52,017	5,850	40	258,083	19,025
Weighted Cycle time = SUM (Demand x CT) / Demand by process=				328	166	27	23	19	185	120	743	59	280	33	36
Takt Time= Available Working time / Demand =				224	205	9	9	9	369	492	879	256	516,600	9	138
Qty. Resources needed = Weighted Cycle Time / Takt Time=				1.47	0.81	2.85	2.53	2.02	0.50	0.24	0.84	0.23	0.00	3.50	0.26
FPY (First Pass Yield)=				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Efficiency=				85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Resources NEEDED (DLs or equipment)=				1.69	0.93	3.28	2.91	2.32	0.58	0.28	0.97	0.26	0.00	4.02	0.30
Qty. HC=				2	1	4	3	3	1		1	1		5	
No. of Crew =				3	3	3	3	3	3		3	1	3		
TOTAL HC NEEDED=				6	3	12	9	9	3		3	1	15		
HC UTILIZATION=				84.3%	93.0%	82.0%	96.8%	77.4%	57.6%		97.2%	26.3%	80.4%		

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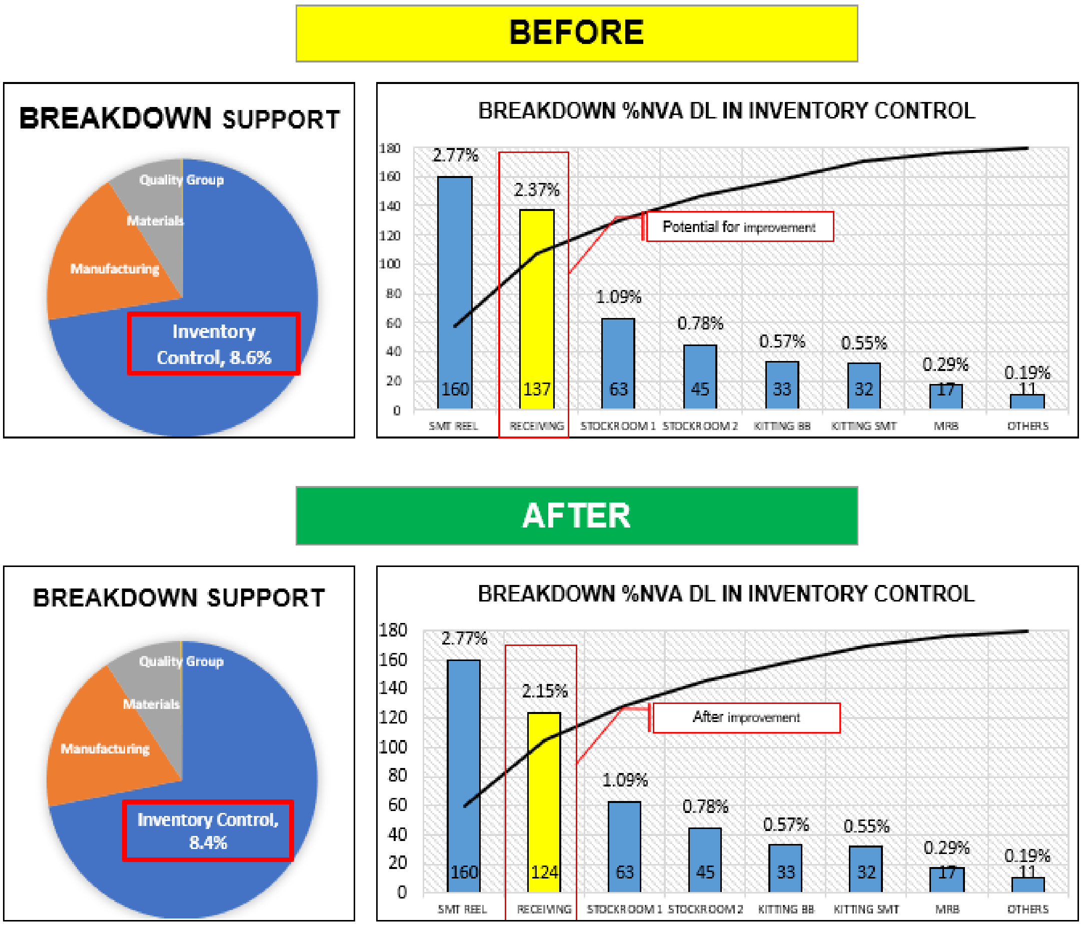
Fig. 11, and Fig. 12 show us the results after applying the PPQT matrix actions to the Receiving Process. The percentage of NVA HCs was reduced from 2.37% to 2.15%.

Fig. 11 Results after applying the PPQT matrix in the Receiving process

No.	Main Task	Job description	BEFORE		AFTER		GAIN	
			DL	%NVA	DL	%NVA	DL	%NVA
1	Flexible DL	- Supporter - MH - Line Leader	63	1.09%	63	1.09%		
2	Unload material	- Unloading - Driver	12	0.21%	9	0.16%	3	0.05%
3	Checking	- Checking information	12	0.21%	12	0.21%		
4	Labeling	- Labeling JVN label	12	0.21%	9	0.16%	3	0.05%
5	Key in	- Key in into System - 5S (empty box) - Sample Handle	18	0.31%	12	0.21%	6	0.10%
6	Verify	- Verify JVN label - Tracking PO	15	0.26%	15	0.26%		
7	Hold item	- Hold Material - Coupa service - Cycle Count	5	0.09%	4	0.07%	1	0.02%
TOTAL HC			137	2.37%	124	2.15%	13	0.22%

Fig. 12 Visualizing Results after applying the PPQT matrix in the Receiving process



With this result, 78000$ per year was saved and the cost of the factory was obviously reduced according to it as on Fig. 13.

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Fig. 13 Cost saving of this project

HARD SAVING	
Total NVA HC Before	74
Total NVA HC After	61
Total NVA HC Saving	13
Direct Labor costs per Month	$ 500
Total DL Saving Cost per Month	$ 6,500
Total DL Saving Cost per Year	**$ 78,000**

Control

This phase is the longest stage of the DMAIC cycle, which requires considerable levels of commitment and involvement by the team responsible for the project and the headcount.

The NVA HCs ratio was reached the target. Now, the responsible owner has kept following up on the daily routine. This task belongs to the Warehouse department, with help from the Industrial Engineering team to assist in monitoring the factors and improving output and yield performance through monthly reviews. Also, the PPQT HCs Sizing data cycle should be documented for future usage and reference.

CONCLUSIONS

This research expands the theoretical foundation for combining Lean and Six Sigma by studying and analyzing a practical application of the concept. Eventually, it provides a way to successfully apply Lean Six Sigma into practice. Detailing the practices of the five phases of DMAIC, the Six Sigma empirical study and describes how to reduce NVA HCs in the manufacturing company step by step. It contributes much for the company take advances in increasing the competitive ability. The same methodology can be extended to numerous other cases in the industry.

This case study emphasizes on the importance and the relevant impact that the implementation of Lean Six Sigma philosophy can have on improving the processes of a company. Thus, the implementation of this management paradigm is a way that aims to achieve considerable improvements in the effectiveness and efficiency of the processes carried out by an organization and it can be an important contribution to the company's growth and to establishing a distinguished position in the market. It was also demonstrated that the DMAIC cycle is an organized and effective methodology for defining and implementing improvement opportunities, creating at the same time a global mentality of continuous improvement.

ACKNOWLEDGEMENTS

We acknowledge Ho Chi Minh City University of Technology (HCMUT), VNU-HCM for supporting this study.

REFERENCES

1. Lim, L. R.; Tan, A. W. K., Integrating Toyota Production system for sustainability and competitive advantage in medical device software design. Green Manuf. Open 2024, 2, 14. http://dx.doi.org/10.20517/gmo.2024.051401
2. Jin Hong Kim, The adoption and implementation of Lean and Six Sigma in state governments International Journal of Lean Six Sigma and its impact on efficiency, effectiveness and equity, International Journal of Lean Six Sigma, Emerald Publishing, Volume 16, Issue 7, 2 July 2025, Pages 1521-1548
3. Emad Hashiem Abualsauod, Integrating six sigma and lean management for enhanced quality management in industrial applications, Journal of Engineering Research, Available online 13 September 2025, Elsevier.

4. Md Nazmus Sakib, Md Kawsar, and Mst Mafruha Bithee, Continuous improvement through Lean Six Sigma: a systematic literature review and bibliometric analysis, International Journal of Lean Six Sigma, Emerald Publishing, Volume 16, Issue 5, 14 January 2025, Pages 1252-1275.
5. Dana Marsetiya Utama, Millenia Abirfatin, Sustainable Lean Six-sigma: A new framework for improve sustainable manufacturing performance, Cleaner Engineering and Technology, Elsevier, Volume 17, December 2023, 100700.