

Improve HTS and Schedule B Classification Process to Reduce the Turnaround Time in a Commodity Shipments Compliance Project

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Abstract — *The HTS and Schedule B classification process adds two days to the turnaround time of the standard process of the Commodity Shipments Compliance team. Throughout 2021, 108 of 326 requests approvals, requiring HTS and Schedule B classification took longer than three days. A process improvement has been made using the Lean-Kaizen methodology. As Lean-Kaizen tools, DMAIC (Define, Measure, Analyze, Improve, and Control) and Value Streaming Mapping (VSM) were worked together to obtain efficient results. As a result, one delay, three waiting times, and seven kaizen bursts were identified. Twelve corrective actions were proposed for process improvement. The future VSM results reflect that the maximum lead and waiting times are reduced from almost 11 days to one day. These time reductions will help with the 50% goal of time reduction proposed for the classification process and the 33% reduction goal for the total turnaround time in the request approval process.*

Key Terms — *Classification process, Lean-Kaizen, Time reduction, Turnaround time.*

PROBLEM STATEMENT

An engineering team requests approved export invoices of commodities for international export shipment compliance. These requests are verified and should be completed, inspected, and delivered to the requestor no later than one day (24 hours) if the information provided is complete and the request is urgent; if the request is not urgent, the turnaround time is two days (48 hours). When any commodity of the invoice requested requires Harmonized Tariff Schedule (HTS) and Schedule B classification, an additional process is required prior to the approval to comply with the process.

A document with the necessary information of the commodity that requires HTS and Schedule B

classification is requested to the engineering team and then provided to the HTS and Schedule B classification team to complete the commodity classification. This team verifies the information provided, and the HTS and Schedule B classification is performed, inspected, completed, and sent back to the shipment compliance team. After receiving an email from the HTS and Schedule B classification team with the HTS and Schedule B classification, the shipment compliance team can work on the request for approval completion and inspection; then deliver it to the requestor.

In the actual process, the HTS and Schedule B classification adds two days to the turnaround time of the standard process. If not performed with urgency, this process affects the delivery date of the requests. In one year, from January 2021 to December 2021, a total of 108 requests requiring HTS and Schedule B classification took longer than three days, and this study finds the root cause of this delay.

Research Description

It has been made a process improvement to the HTS and Schedule B classification process using Lean-Kaizen, to comply with the turnaround time and on-time delivery of the requests that require HTS and Schedule B classification in the Commodity Shipments Compliance project. The Lean-Kaizen method consists of the integration of the DMAIC strategy and the Value Stream Mapping (VSP) method.

This study is essential to avoid late deliveries and comply with the turnaround time and on-time delivery established for the Commodity Shipments Compliance project, which has been affected when the request requires HTS and Schedule B classification. Therefore, finding the root cause and implementing a robust process that helps to reduce

the waste, defects, and turnbacks in the HTS and Schedule B classification process is vital to reaching this study goal.

Research Objectives

The main objective of this research is to use the DMAIC strategy and VSM methodology to reach this study goal by implementing a robust classification process and analyzing the actual and future processes to reduce waste and turnbacks. The goal of this study is to comply with the Commodity Shipments Compliance project quality metrics and be able to reduce the completion time of the HTS and Schedule B classification process from two (2) days to one (1) day, which represents a 50% reduction in the HTS and Schedule B classification turnaround time and reduce the turnaround time of the requests that required HTS & Schedule B classification from three (3) days to two (2) days, which represents a 33.3% turnaround time reduction.

Research Contributions

The main contribution of this study is to achieve and implement a more robust and organized process, by improving the actual HTS and Schedule B classification process. Improving the actual HTS and Schedule B classification process implies verifying and updating the standard work, the work instructions, and the employee's database access, and reducing the defects and time caused by rework by having limited access to necessary information. As a result, comply with the turnaround time and on-time delivery of the Global Trade commodity shipment's compliance project, and provide a stable process that meets the requestor's needs and the project requirements.

LITERATURE REVIEW

HTS stands for Harmonized Tariff Schedule, a 10-digit classification system used in the United States to determine customs duties to be paid on exports or imports and identify products that are being imported or exported through a country's borders [1]. They classify and categorize products in a worldwide system used for customs clearance

purposes. HTS and Schedule B classification is an essential process because this classification needs to be provided in all export or import invoices for any item to be exported or imported to comply with the regulations of the United States International Trade Commission (USITC) and the Bureau of Customs and Border Protection (CBP, formerly the U.S. Customs Service) of the Department of Homeland Security. The HTS and Schedule B classification helps the Bureau of Customs and Border Protection in the mission of "Protecting our borders from the illegal movement of weapons, drugs, contraband, and people while promoting lawful entry and exit by classifying and categorizing products" [2].



Figure 1
DMAIC Methodology

DMAIC methodology is a five-phase approach to addressing a process that needs improvement [3]. With the DMAIC Methodology, it is easier to understand the formal requirements for the process and helps to establish the project as a priority. In addition, this methodology allows the use of actual data, helps to select the right tool for the situation, and communicates the project goals and accomplishments. DMAIC is a structured problem-solving methodology where all steps are outlined [3].

Lean is a set of techniques that allows for reducing and eliminating waste. Lean Thinking: Banish Waste and Create Wealth in Your Corporation summarizes lean thinking in five principles: specify the value, identify the value stream, create the flow, pull the value, and pursue perfection. Lean is ideal for improving this process since the HTS and Schedule B classification is a global trade process that involves several steps and employees with different expertise and backgrounds. Kaizen is a Japanese concept for "continuous improvement" [4]. This continuous improvement

concept commonly combines with Lean manufacturing tools to find and eliminate waste in production methods by improving quality, processes, company culture, and productivity. Due to the aggressive turnaround time of this project, all the stoppages in the process will represent a late deliverable. The Lean-Kaizen system will create a more flexible, leaner, and more responsive process by creating a better flow and providing immediate feedback on the process's efforts, reducing time and waste, and converting it into value [5].

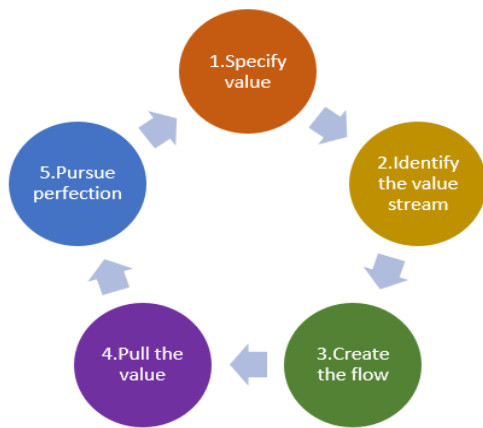


Figure 2
Lean Principles

None of the methodologies developed to date is a complete one that can solve all the problems of the process. Therefore, integrating methodologies that complement each other and use the advantages of each one will obtain better results. For example, the HTS and Schedule B classification process can be improved by reducing waste and generating a better flow using Lean Six Sigma methodologies and tools (DMAIC and VSM). Using the lean principle tool VSM will help the team visualize the whole process and identify opportunity areas. Value Stream Map is a tool that foments a continuous improvement structure in the team, involves the employee to create a stable and smooth process, and provides better visualization of the overall process flow [6].

After the VSM improves the process, identify the areas of opportunity and steps that do not add

value, reduce the waste, and implement the corresponding corrective actions.

METHODOLOGY

Values Stream Mapping methodology and DMAIC strategy will execute to achieve the objectives and goals of this project since it is a capable approach to managing a process that needs improvement. A series of actions develop before starting the first DMAIC phase, Pre-Work, to organize how to proceed with this case study and to collect the necessary data to complete the study.

First, explain the case study rules. Then, explain the SIPOC diagram, Workflow, and time study template. The team used the SIPOC (suppliers, inputs, process, outputs, customers) Diagram to identify the appropriate steps in the project process before the case study began. The supplier provides the inputs. The input is all the resources needed to complete a process. The process is a series of steps used to convert inputs into outputs. The outputs are the results from the process, which can be products or services. The customer is the recipient of the output. [7]. With the Workflow, visualize the order that tasks and process steps occur, and with the Time Study template, collect the time people take to carry out each process step.

The first phase of the DMAIC methodology is the Define phase. This stage will validate the problem statement and goal by creating a Project Charter. Next, customer satisfaction will analyze by a Customer's Feedback Analysis to understand how satisfied the customer is with the current process. Then, a team that does not pertain to the HTS and Classification process will validate the current process using the Workflow and a SIPOC diagram, and finally, a schedule will develop.

In the Measure phase, a current Value Stream Map will be developed along with a Time Study to frame and visualize the whole process, including inputs and outputs. Company tools collect information from January 2021 thru December 2021 related to stoppage reported in the process, defects found during inspections, and delivery dates. Also, it

will analyze turnbacks, defects, late deliveries, process flow steps, and lost time.

In the analysis phase, the time study's results will analyze and indicate where the value-add and non-value-add, defects, constraints, and rework occurs. In addition, analysis using a Pareto chart to identify the most significant defects to focus on and "5-Whys," to search for the root causes of the most significant defects. Finally, verify the root causes affecting the critical input and outputs.

The following step is the Improve phase, where potential solutions are evaluated and selected. First, use the root cause test to identify a range of potential solutions to the problem. Next, evaluate and prioritize solutions using a Solution Selection Matrix and develop a future Value Stream Map contemplating applying the process improvements.

In the final phase, Control develops procedures to maintain the improvements in the process. After implementing the improvements, monitored the inspection and delivery data by generating a delivery due date report to confirm if the new turnaround time has complied and generated turnbacks and defects report confirming if there are no defect recurrences. The tool used to generate these reports will also be used to monitor the process monthly. Implementing this methodology will provide a stable, enhanced process that meets customer needs.

RESULTS AND DISCUSSIONS

SIPOC diagram for the HTS and Schedule B classification process was presented in Figure 3. The supplier and customer were the Commodity Shipments Compliance team. This team provided the input and received the improved output of the process. The input is the list of the commodities that need HTS and Schedule B classification with the product description form for each commodity, and this form contains the necessary data to complete the classification process. Next, the HTS and Classification team performed the classification with a rationale to support the decision. The outputs were the HTS and Schedule B classification with the

rationale. The output was sent by email to the Commodity Shipments Compliance team.

Suppliers		Commodity shipment's compliance team
Inputs	<i>Description</i>	Request for HTS & Schedule B classification via email
	<i>Quantified measure</i>	List of commodities that need classification with the Product description form for each commodity
Process		Perform HTS & Schedule B classification and rationale
Outputs	<i>Description</i>	HTS & Schedule B classification and rationale send via email to Commodity shipment's compliance team
	<i>Quantified measure Delivery</i>	Complete HTS & Schedule B classification and rationale within 2 days of request arrival
	<i>Quantified measure Quality</i>	100% accurate completion of the required HTS & Schedule B classification and rationale
Customers		Commodity shipment's compliance team

Figure 3
HTS and Schedule B classification process
SIPOC Diagram

The workflow map visualized and validated the sequence of events in the current HTS and Schedule B classification process. The sequence of events: received request, part research, look up the possible chapter's titles, look up in the HTS index, read and analyze applicable section and chapter notes, apply correct GRI, check the headings, investigate explanatory notes, investigate the customs rulings, search for the sub-headings, select HTS and Schedule B classification, write a rationale and send to customer.

Employees of each role were selected to provide the minimum and maximum time in minutes it takes to complete each step in the process. They worked with the same three (3) commodities based on complexity levels: level 1 is the less complex and level 3 is the more complex. Divided the data by the level of complexity to consider the best and worst scenario, with the data obtained, performed the time

study. The purpose of the time study was to measure the time of each step when executing HTS Classifications to find a way to minimize the execution time of tasks. The minimum waiting time of level 1 commodity and the maximum waiting time of level 3 commodity provided by the employees were selected to generate the time information for the current VSM for each step in the HTS and Schedule B classification process. The minimum time was considered the best-case scenario of providing the classification of one simple (level 1) commodity, while the maximum time provided was considered a worst-case scenario of providing the classification of one complex (level 3) commodity.

HTS & Schedule B Classification VSM Time Study									
Process Time/Cycle Time = Time it takes you to perform task without interruption									
Practitioner	LEVEL 1	LEVEL 2		LEVEL 3		Overall			
		Min	Max	Min	Max	Min	Max	Min	Max
Part Research Steps	4.5	37	8.5	46	12	61	4.5	61	
Look up to the possible chapters titles related to the item being analyzed and list the options.	1	4	3	6	2	10	1	10	
Look up in the HTS index for the noun or synonyms of the being analyzed.	1	3	1	6	1	8	1	8	
Read and analyze applicable section and chapter notes.	1	5	2	6	4	8	1	8	
Apply correct GRI by following an order of elimination (2-6).	0.1	6	0.1	8	0.1	6	0.1	8	
Check the heading of the selected chapters.	0.1	5	2	8	1	6	0.1	8	
Look into Explanatory notes for confirmation of your selection and/or guidance.	2	6	3	6	3	8	6	8	
Look into the Customs Ratings to verify if there any decision or precedent.	2	3	2	8	1	10	1	10	
Search for the sub-heading and sub-sub-heading of the part being analyzed	0.1	4	3	6	1	6	0.1	6	
Select HTS & Schedule B Classification.	0.1	3	1	6	1	8	0.1	8	
Write a Rationale.	3	6.75	3	10	6	15	3	15	

Figure 4
Time Study Results Summary

Table 1 represented the delay of the requestors in providing the necessary information on the commodity that needs classification. This delay occurs next to the part research step.

Table 1
Time Study Delay

HTS - Delay		
Practitioner	Time [min]	Waiting Response.
Process	Min	0
	Max	14400
Overall	Min	0
	Max	14400

Table 2
Time Study Waiting times

HTS - Waiting Time				
Practitioner	Time [min]	1# Loading pages and tools issues	2# Network or Internet Issue	3# Mentoring or peer review
Process	Min	0	0	0
	Max	240	240	480
Overall	Min	0	0	0
	Max	240	240	480

Table 2 represented the waiting times during the process. Waiting time #1 occurs between step 7 and 8, waiting time #2 occurs between step 1 and 2 and waiting time #3 occurs before write the rationale step between step 10 & 11.

Table 3
Defects summary

Defect by Process Step	Total Defects	Defect Classification
Incorrect HTS number selection	275	CRITICAL
Missing information necessary for classification	373	MAJOR
Information not related to item	57	MAJOR
Missing HTS classification code	39	MAJOR
Missing Schedule B	3	MAJOR
Missing Syntax	148	MINOR
Missing information source	30	MINOR
Incorrect Schedule B Selection	15	MINOR
Incorrect HTS sub-heading selection	30	MINOR
Incorrect Schedule B sub-heading	30	MINOR
Incorrect Spelling	47	INCIDENTAL

Value Stream Mapping includes the defects found during inspections (Table 3) and turnbacks reported by practitioners from January 2021 to December 2021 (Table 4). Most of the defects were classification related, 852 of 1047, the remain 195 defects were missing, or incorrect information related.

The data reported on turnback during 2021 was collected from the company's internal databases. The turnback data were identified per step to select with a Pareto Chart the steps with the more turnbacks. Grouping the turnbacks by steps made it easier to identify in what steps of the process the most turnbacks occur with the Pareto Chart.

Table 4
Turn backs Summary

Turn backs Categories	Total	Turnback related step
Missing Syntax	163	Rationale
Incomplete information received	41	Input
Info. to sustain a class. not avail	40	Part search
Incorrect Spelling	17	Rationale
Missing "NMI Yes or No" field	17	Part Search
Info. to sustain a class. not found	16	Part search
Request cancelation	15	Cancelation
Incorrect input	11	Input
Issues with work related tools	8	System Issues
Information not related to the item	7	Rationale
Missing info. in delivered file	6	Part search

Table 5
Turnbacks by process step

Turnback related step	Total Turnbacks	Total %	Cumulative %
Rationale	187	55%	55%
Part Search	79	23%	78%
Input	52	15%	93%
Cancelation	15	4%	98%
System Issues	8	2%	100%
Total turnbacks	341		

Table 4 contained all turnbacks reported in 2021, and Table 5 summarized the reported turnback reported per process step. In addition, Pareto Chart (Figure 5) was developed to identify the steps with the most quantities of turnback reported during 2021.

The Pareto Chart in Figure 5 shows that 78% of the turnback were reported in two process steps. These steps are where to write the rationale to validate the classification selection and look for the necessary information to complete the classification.

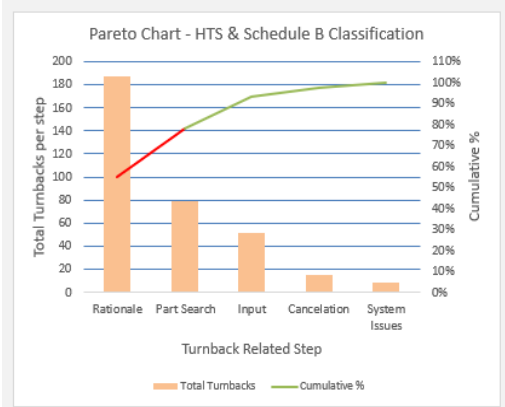


Figure 5
Pareto Chart

As a result of the analysis of the data collected (Defects, Turnbacks, and Time Study) and Pareto Chart analysis, the following Kaizen Burst (Table 6) were identified. 5Why methodology was performed on each Kaizen Burst to identify the root causes for the defects, turnbacks, waiting times, and delays.

Table 6
Kaizen Burst identified

Kaizen Burst	Description
1	Delay and Waiting Times – selected due to amount of time.
2	Write a Rationale Step– selected due to number of defects.
3	Write a Rationale Step– selected due to amount of turnback.
4	HTS Classification & Schedule B Selection Step– selected due to number of defects.
5	Part Research Step – selected due to amount of turnback.
6	HTS Classification & Schedule B Selection Step– selected due to number of critical defects.
7	Sub-heading and sub-sub-heading of the part Step– selected due to number of defects.

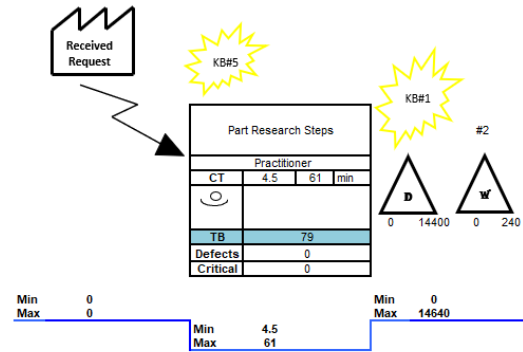


Figure 1
Current Value Stream Map section 1

Figure 6 represented step one, part research, with 79 turnbacks reported. Then the delay due to the requestor responding 14400 minutes, and a waiting time due to network or internet issues 240 minutes. From steps 2 to 7, Figures 7, 8, and 9, no defects, turnbacks, or waiting times were reported; therefore, no action was needed in those process steps.

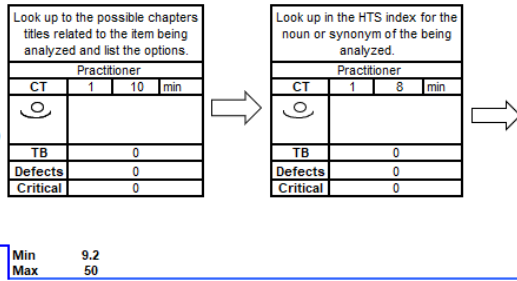


Figure 7
Current Value Stream Map section 2

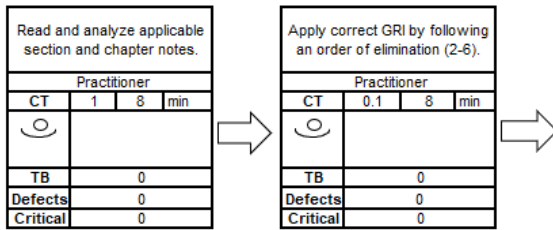


Figure 8
Current Value Stream Map section 3

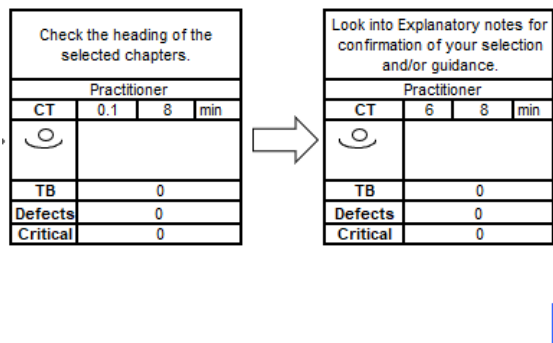


Figure 9
Current Value Stream Map section 4

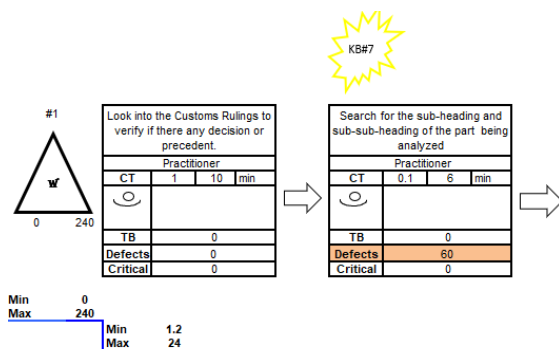


Figure 10
Current Value Stream Map section 5

Figure 10 represented steps 8 and 9. Before step 8, a waiting time of 240 minutes passed, due to loading pages and tools issues. In step 9, search the Sub-heading and sub-sub-heading with 60 defects found.

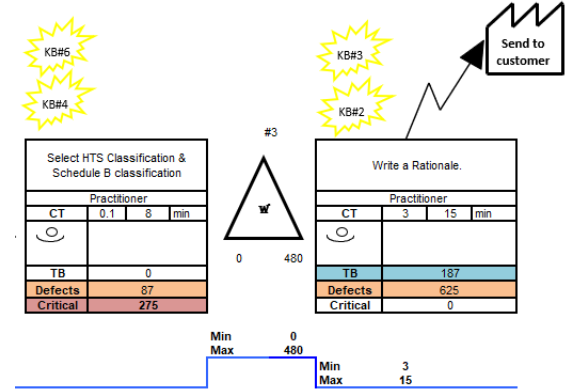


Figure 11
Current Value Stream Map section 6

Figure 11 represented steps 10 and 11. In step 10, select the HTS and Schedule B classification. Three hundred sixty-two (362) defects were found, and 275 of those defects were critical. After step 10, a waiting time of 480 minutes passed, due to mentoring or peer review. In step 11, write a rationale with 625 defects, and 187 turnbacks with 625 defects reported.

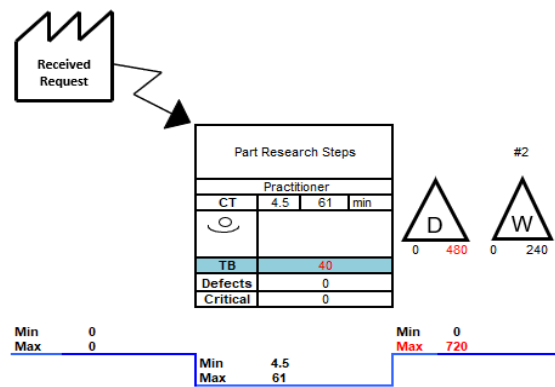


Figure 12
Future Value Stream Map section 1

Figure 12, after having access to the databases and the corrective actions, suggested to avoid the delay; time was reduced considerably, from 14400 to 480 minutes.

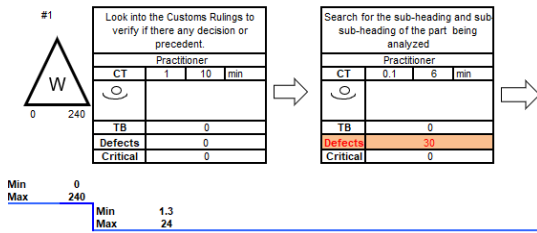


Figure 13
Future Value Stream Map section 5

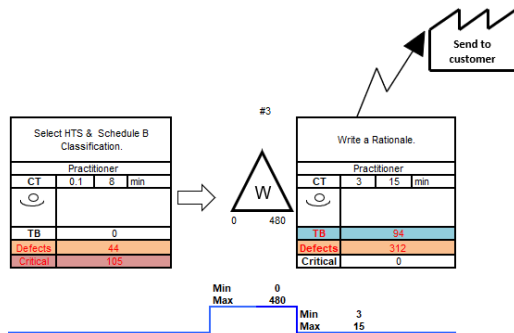


Figure 14
Future Value Stream Map section 6

The future VSM Figures 12 to 14 represented the desired results once the corrective actions are implemented.

Table 7
Results from Current and Future Value Stream Mapping

VSM	Current State	Future State	Difference (min)
	Max (min)	Max (min)	
Waiting Time (WT)	15360	1440	13920
Process Time (PT)	150	150	0
Lead Time (LT)	15510	1590	13920
Lead Time Standard deviation (SD)	2962	208	2754
Lead Time Average	3308	1612	1696
	Current State	Future State	Expected reduction
Total Turnbacks	266	134	132
Total Defects	1047	491	556

After considering the implementation of the improvements, the lead time was reduced from 15510 minutes to 1590 minutes, and the waiting time was reduced from 15360 to 1440 minutes. Although the processing time remains the same, a reduction of 13920 minutes was reached for waiting and lead times. The expected reduction in turnbacks is 132 and the expected reduction in defects is 556.

Standard deviation and average calculated from 25 current process data and 25 future process data.

Table 8
Root Causes and Corrective actions summary

Root Causes	Corrective Actions
Requestor does not include the minimum necessary information to complete the request.	Create email template requesting additional information.
	Notify the requestor that the classification will be completed with a tentative HTS using available information and classifier criteria.
The Product Definition form is not easy to understand for non-classifiers or requestors	Modify the Product Definition form to make it easier to understand to non-classifiers or requestors
There is no time limit for request to be on hold due to lack of information.	Create email template for request cancellation and follow up messages.
Global Trade company has limited access to required databases, or due to the type of access level granted.	Actualization of the Induction Program to the Global Trade company Team to provide or ensure all new members have access to all HTS research required tools - Databases
Third Parties contracts protect technical data of the items being assessed. Therefore, information provided and available about the item is limited.	Revise actual Product Definition templates available to align with HTS requirements.
The proficiency level of practitioners working on items of complexity Levels 1, 2 & 3.	Create schedule for the HTS Doubts Discussion meetings to include additional technical training of functionality, end uses and how to identify/differentiate similar devices of same part family of the most frequently received items.
	Assigned an official mentor and create the escalation process for doubts or concerns regarding HTS classifications.
Company not having access to Customs Info tools.	Request access to Fleetcare with justification necessary to get the correct access.
	Complete the transaction of the purchase of Customs Info tool for the Team.
Update the "Rationale Grammar & Syntax" document and make official part of the instructions.	Edit document: Rationale Grammar & Syntax to provide a full structure of what is needed in the HTS Rationale including examples and submit it to the DMS system to make it an official document.
The proficiency of practitioners working on items Level 2 and Level 3 is in development.	Add to the training material, additional guidance on level 2 and level 3 items.

Lead Time Standard deviation (SD) from the current process was 2962 and the SD from the future process is 208. The significant decrease in the standard deviation value tells us that the future process is much more robust and has less variability; this indicates that implementing the improvements positively contributed to the classification process. Performed a mean hypothesis test for two populations to validate the improvement results in the process. Sample A was for the current process and sample B was for the future process. $H_0: \mu_a = \mu_b$ and $H_1: \mu_a > \mu_b$. Since the p-value was smaller than the significance level (alpha), H_0 can be rejected, the smaller the p-value, the more it supports $H_1: \mu_a > \mu_b$

The mean hypothesis support that the lead time mean of the current process is greater than the lead time mean of the future process, which indicates that there was a significant reduction in lead time.

Table 9
Mean Hypothesis Test Results

Hypothesis Test Results Test with Unknown Variance (Student T Distribution)		
Sample	A	B
Std. Dev.	2962	208
X Bar	3308	1612
N	25	25
T exp	2.86	
V	24.0	
Pvalue	0.0044	
Alpha	0.05	

Performed a variance hypothesis test for two populations to validate the improvement results in the process. $H_0: \sigma_a = \sigma_b$ and $H_1: \sigma_a > \sigma_b$. Since the p-value was smaller than the significance level (alpha), H_0 can be rejected, the smaller the p-value, the more it supports $H_1: \sigma_a > \sigma_b$. The variance hypothesis support that the variance of the current process is greater than the variance of the future process, which indicates that the process is now more consistent.

Table 10
Variance Hypothesis Test Results

Hypothesis Test Results Test Variance of two Populations (F Distribution)		
	A	B
Sigma	2962	208
V	24	24
F exp	202.79	
Pvalue	0.000	
Alpha	0.05	

CONCLUSION

During this design project, the HTS and Schedule B classification process was studied for improvement. This classification process has a turnaround time required by the customer of two days. Although this process is sometimes part of an approval process with a different turnaround time, this difference and some inefficiency in the classification process have resulted in late deliveries. For example, from January 2021 to December 2021, 108 of the 326 requests approvals requiring HTS and Schedule B classification took longer than three (3) days, affecting the delivery date of the approval requests.

Lean-Kaizen principles were applied to propose valuable improvements to the process to comply with the customer turnaround time and make the necessary changes to reduce the turnaround time in the classification process by 50%. DMAIC methodology was used as a quality strategy to go through the process. In the different phases of the DMAIC methodology, several lean tools, like the SIPOC diagram, project charter, time study, current, and future Value Stream Mappings, and root cause analysis, were developed to study and analyze the classification process for improvement implementation purposes. As a result, one delay action, three waiting times situations, and seven kaizen bursts were identified, and twelve corrective actions were proposed for improvement following lean-kaizen principles. The corrective actions are currently being worked on for improvement implementation in the classification process. The Current and Future value stream mapping results can be emphasized that the maximum lead and waiting times are reduced from almost eleven days to one day. Since the processing time remains the same, these time reductions will help with the 50% goal of time reduction proposed by the classification process and the 33% reduction goal for the total turnaround time in the request approval process. The hypothesis tests shows that the proposed and implemented improvements are effective. The mean hypothesis support that the lead time mean of the current

process is greater than the lead time mean of the future process, which indicates that there was a significant reduction in lead time. The variance hypothesis support that the variance of the current process is greater than the variance of the future process, which indicates that the process is now more consistent. The standard deviation and variance values shows us that the future process is much more robust and has less variability; this indicates that implementing the improvements positively contributed to the classification process

The defects are expected to be reduced but not eliminated. The defects from new and complex parts sometimes have limited or no information. The HTS and Schedule B classification procedure involves the interpretation that it is affected by technical background experience and the stage of the learning curve of the classifier. New parts defects will be reclassified as major defects. An information-sharing procedure will be implemented for all the team to gain it. Overall, turnbacks reduction will be 50% or more, and it is expected to reduce critical defects on inspections that will be reflected in the next 3 to 6 months of data.

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