

AN IMPROVEMENT OF THE LEAD TIME IN COLLABORATIVE DEMAND PLANNING BY APPLYING LEAN SIX SIGMA

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ABSTRACT

This study applied the Lean Six Sigma methodology to improve the lead time of Collaborative Demand Planning (CDP) which is done every month to identify the supply and demand, forecasting, and replenishment in HELP International, which is a humanitarian organization. The CDP is crucial in the organization so that the right items with the right quantities are distributed to the beneficiaries on time. Using the Lean Six Sigma by adopting the Define-Measure-Analyze-Improve-Control (DMAIC) concept, the problem was defined, the collected data was analyzed, the factors affecting the longer CDP process lead time were identified, the action plan was recommended for improvement, and the control plan was proposed to be sustainable. The Value Stream Map (VSM) Lean tool was used to have a better understanding of the current process, and the Fishbone analysis was conducted in the measure phase of DMAIC. As a result, the organization found out that the main causes were the steps of CDP, which are reviewing, finalizing the presentation slides, validation process, and reviewing the MRP messages.

To eliminate these factors and improve the lead time, the Failure Mode and Effect Analysis (FMEA) was utilized, and the action plan was recommended for process improvement. Finally, the Lean Six Sigma concept has helped the organization to reduce the CDP lead time from 14 working days to 7 working days, and it enabled to assist the beneficiaries affected by armed conflict and other violence on time.

Keywords: CDP, Lean Six Sigma, VSM, Fishbone analysis, FMEA

บทคัดย่อ

กรณีศึกษาได้นำกระบวนการสินค้าซิกม่ามาใช้ปรับปรุงช่วงเวลาของการวางแผนความร่วมมือของอุปสงค์ (CDP) ซึ่งเป็นกระบวนการรายเดือนในการระบุถึงปริมาณอุปทาน อุปสงค์ การพยากรณ์ และการเติมเต็มเมื่อสิ่งของลดลง ขององค์กร HELP International ซึ่งเป็นองค์กรที่ส่งเสริมมนุษยธรรม กระบวนการ CDP มีความสำคัญในการช่วยกระจายสิ่งของในปริมาณที่เหมาะสมให้กับผู้รับประโยชน์ได้ทันทั่วถึง การใช้สินค้าซิกม่าได้นำกระบวนการ Define-Measure-Analyze-Improve-Control (DMAIC) มาปรับใช้ มีการระบุถึงปัญหา มีการเก็บข้อมูลเพื่อนำมาใช้ในการวิเคราะห์ ปัจจัยที่ส่งผลให้กระบวนการ CDP ใช้ระยะเวลาอันยาวนานถูกแจกแจง แผนการทำงานในการปรับปรุงได้มีการแนะนำ รวมถึงการวางแผนการควบคุมเพื่อให้กระบวนการดำเนินอยู่ การใช้สายธารแห่งคุณค่าซึ่งเป็นเครื่องมือหนึ่งของสินค้าได้นำมาใช้เพื่อให้เข้าใจกระบวนการทำงาน

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ปัจจุบัน การวิเคราะห์ก้างปลาถูกใช้ในขั้นตอน Measure ซึ่งเป็นส่วนหนึ่งของ DMAIC ผลลัพธ์ที่ได้ คือองค์กรสามารถระบุสาเหตุหลักของปัญหา ซึ่งเกิดจากกระบวนการตรวจทาน กระบวนการทำสไลด์เสนองาน การตรวจสอบรับรองกระบวนการ และ การตรวจทานข้อมูลในระบบ MRP

ในการจัดสรรเหตุต่างๆ เพื่อปรับปรุงระยะเวลาการทำงาน การวิเคราะห์ข้อบกพร่องและผลกระทบ (FMEA) ถูกนำมาใช้ การวางแผนการปฏิบัติงานได้มีการแนะนำ เพื่อนำไปใช้ในการปรับปรุงการทำงาน ท้ายสุดแนวคิดลีนซิกซ์ซิกม่าช่วยให้องค์กรสามารถลดกระบวนการ CDP ลงจาก 14 วัน เหลือเพียง 7 วัน ซึ่งสามารถช่วยผู้ได้รับเงินช่วยเหลือ ซึ่งเป็นผู้ได้รับผลกระทบจากการสู้รบด้วยการใช้อาวุธ และความรุนแรงด้านอื่นๆ ในประเทศพม่า

คำสำคัญ: การวางแผนความร่วมมือของอุปสงค์ (CDP) ลีนซิกซ์ซิกม่า สายธารแห่งคุณค่า (VSM) การวิเคราะห์ก้างปลา การวิเคราะห์ข้อบกพร่องและผลกระทบ (FMEA)

INTRODUCTION

HELP International is an impartial, neutral, and independent humanitarian organization whose sole purpose is to protect the lives and dignity of victims of armed conflict and other forms of violence, as well as to provide aid to them. HELP International has been providing humanitarian assistance to the people affected by armed conflict and other violence in Rakhine state, Kachin state, Shan state, Kayin state, and central areas of Myanmar since 2008. HELP International provides food, non-food items, water, sanitation, and hygienic facilities to those people. Moreover, it provides medical assistance to rural health centers and hospitals across the country and performs in the Covid-19 response in collaboration with the authorities and local NGOs. To identify the demand and supply, Collaborative Demand Planning (CDP) is conducted at Yangon head office monthly. The process from reviewing the files by the Customer Service Desk Officers (CSDs) to issuing the purchasing item list by the planner takes a long time that causes a delay in the whole supply chain lead time. Thus, Lean Six Sigma was applied for identifying, analyzing, and improving the CDP's lead time. The objective of this study are as follows:

1. To identify and analyze the root causes of taking 14 working days in the CDP process.
2. To improve the lead time in the CDP process by up to seven working days by implementing the Value Stream Map (VSM) of Lean and the DMAIC methodology of Six Sigma.

The lead time from the CDP process to issuing the purchasing item list to the procurement unit is 14 working days, which is excessively long and has a substantial impact on the whole supply chain lead time. Getting the list late also causes late launching tender, supplier selection, contracting, and ultimately late delivery to the beneficiaries. In fact, receiving the precise items to the exact places at the accurate time is critical. As a result, this study has sought to respond to the research's main question, "How to reduce the lead time of the Collaborative Demand Planning process?"

LITERATURE REVIEW

Collaborative Planning, Forecasting, and Replenishment (CPFR)

Seifert (2003) stated that CPFR is a collaborative effort among all supply chain partners aimed at improving relationships through cooperatively managed planning processes and information sharing. The main goal of CPFR is to improve the precision of demand predictions and replenishment plans in order to reduce inventory across the supply chain and achieve high

service levels of the right products in the right places. Marilyn, Lawrence, and Sharon (2000) explained that the CPFR technique has the advantage of reducing a firm's reliance on previous data. Collaborative forecasting reduces the need to depend on the past. Moreover, Mentzer and Kahn (1997) stated that collaborative forecasting can be a useful tool for improving prominence and teamwork across the supply chain, as well as dropping inventory levels. With the same concept of CPFR, HELP International is doing Collaborative Demand Planning (CDP) on a monthly basis to forecast the supply and demand and replenish the stocks in a timely manner. On the other hand, CDP is done to reduce the inventory level and buffer stocks, and speed up further distribution in the camps. This research was focused on the CDP process in order to minimize its lead time and enhance the whole supply chain service level.

Lean Concepts

According to Bradley (2016), Lean can be regarded as a set of tools for improving a process, with the type of improvement focused on lowering the amount of time it takes to complete the process from start to end, or process lead time. As a result, Lean is an approach to improving processes. To improve the process, Lean focuses on reducing waste and separating value-added and non-value-added workflows. On the other hand, Lean concentrates on maximizing process velocity. The non-value-added activities or seven deadly wastes are identified as Waiting time, Overproduction, Inventory, Defects, Transportation, Over-processing and Wasted motion. According to Mehraei, Thoben, and Scholz-Reiter (2014), Lean thinking is a philosophy that emphasizes getting more done with less. Waste and non-value-added operations inside a system might be discovered in this context. Value-added activities are those activities that consumers (internal or external) are willing to pay for, according to Lean philosophy. Using Value Stream Mapping, all non-value-added activities or those seven deadly wastes should be eliminated, according to Lean principles (VSM), PDCA (plan, do, check, action), 5 S (sort, set in order, shine, standardize, sustain), Using visual systems, Mistake-proofing or the so-called Poka Yoke, Kaizen and Kanban methods. In this study, Value Stream Mapping (VSM) of Lean concepts is applied to improve the Collaborative Demand Planning process.

The Concept of Lean Six Sigma

Lean Six Sigma is a business technique aimed at increasing customer fulfillment and improving the bottom line. It is a data-driven method for examining the fundamental reasons for industrial and business problems/processes and substantially improving the product by reducing faults (pushing toward six standard deviations between the mean and the nearest specification limit) (Taghizadegan, 2006). The Six Sigma method employs a well-defined problem-solving strategy with the application of statistical methods while focusing on reducing variation. Define – Measure – Analyze – Improve – Control are the five phases of the approach (DMAIC). In this research on Collaborative Demand Planning (CDP), the Lean Six Sigma concept was applied systematically. Value Stream Map (VSM), one of the Lean tools, is applied in the Measure point of the DMAIC policy.

DMAIC Model

Shankar (2009) stated that the Define–Measure–Analyze–Improve–Control (DMAIC) method is a Six Sigma practice for process improvement. The DMAIC method takes a problem that has been recognized by the organization and logically applies a set of tools and procedures to arrive at a long-term solution. **Define:** The Define phase begins with the identification of a problem that requires a solution and finishes with a clear understanding of the problem's scope and evidence of management support, allowing the project to move forward by allocating resources. **Measure:** The Measure phase's goal is to gather baseline data on the process that has been recognized as in need of change. To better understand what is happening in the process, customer

expectations, and where the problems are, baseline information about the process is employed. **Analyze:** The Analyze phase's purpose is to better understand the cause-and-effect relationships in our process, or which input parts influence the output, which is the product or service being provided. **Improve:** There is a better grasp of the process that is sought to enhance by the end of the Analyze phase. Then, testing the new enhancement project can begin. **Control:** This is the DMAIC process improvement methodology's last phase. This phase guarantees that the desired modifications and improvements are implemented and sustained.

Cause and Effect Analysis

A huge number of possible sources for an impact or problem are identified in the diagram. It is a method for structuring brainstorming sessions in a variety of settings, including music and the arts in general (Giol, 2019). Because of its structure, it is also known as a Fishbone diagram or Ishikawa diagram named after its inventor Kauru Ishikawa who invented it in the 1960s (Barone & Franco, 2012). The Fishbone diagram shows various influences on the process of exploration for the most likely grounds of a problem. The “effect” of the problem is shown in the box at the head of the “fish.” Principal categories of possible causes branch directly from the spine. Underlying causes branch from each main category of possible causes, and the diagram develops at increasing levels of detail until the causes are identified (Games & Vikhagen, 2011).

Cause and Effect Matrix

Sharma (2017) explained that the Cause and Effect matrix is one of the most commonly used tools to prioritize the causes of an effect. In root cause analysis, the Cause and Effect matrix, often known as an X-Y diagram, establishes the relationship between process input variables and client outcomes. Its goal is to calculate the correlation between key process input variables (X's) and consumer outputs (Y's) quantitatively. It is a terrific tool for prioritizing a huge list of possibilities, and it is especially useful during the DMAIC project's Measure phase. Other activities such as FMEA, multi-variable charts, and correlation analysis can be based on the results of a Cause and Effect matrix (Wang & Lin, 2020).

Failure Mode and Effects Analysis (FMEA)

According to Banduka, Veza, and Bilic (2016), the FMEA analysis connected to the Design phase is a Design Failure Mode and Effect Analysis (DFMEA), and the analysis linked to the process is a Process Failure Mode and Effect Analysis (PFMEA). The traditional risk priority number (RPN) is derived by multiplying Severity (S), Occurrence (O), and Detection (D). RPN goes from 1- 1000 and S, O, and D indexes from 1- 10. Corrective actions should be taken at any time, but especially when RPN exceeds 100 or one of indexes S, O or D exceeds 8. Moreover, Tayntor (2010) stated that the FMEA worksheet is used to identify project risks, estimate the effects on consumers if those risks are materialized, and develop mitigation solutions for high-risk items.

RESEARCH METHODOLOGY

In this research methodology, the DMAIC was used to improve the process. The VSM of Lean tools was utilized in the measure phase.

Define Phase

The researcher gathered data for two years, from January 2020 to December 2021 about HELP International's CDP and then, calculated the lead time. The entire lead time is 14 working days from the time the CDP files are received from the program departments to the time the purchasing item list is issued. The study discovered that the steps of CDP review, presentation

slide finalization by forecaster and Log Co., and CDP validation procedure took the most time. Each of the remaining steps took one working day.

Measure Phase

HELP International's program divisions, also known as internal customers, input forecast data into CDP excel files based on field assessment data. The files are then sent to Customer Service Desk Officers/Supply Chain Officers (CSDs/SCOs) from the Logistics department's Supply Chain unit.

The CSDs review the CDP files and make a clarification with the program if needed. Once the files have been reviewed, the CSDs prepare the presentation slides by summarizing the data from the CDP files and putting the budget data and expenses for overview for the management in the meeting. Once the CDP files and presentation slides are done, they are sent to both forecaster and the logistics coordinator for their further review. Then, Collaborative Demand Planning Meeting involving the program departments, logistics, finance, and management is held on the agreed date. After the meeting, the forecaster writes and finalizes the minutes of the meeting (MoM). Then, the CSDs send the files for validation to the respective program coordinators, finance, and management. When the validation is done, the forecaster uploads the CDP files into the ERP system. Then, the planner receives the MRP (Materials Resource Planning) messages in the system, reviews them by cross-checking with the stock availability, and then issues the purchasing item list to the procurement for further processing. After receiving the list, the Procurement Unit (PU) starts preparing the tender and launches it to the potential suppliers. After selecting the suppliers, and getting an approved PO/ contract, the suppliers and PU sign the respective contracts. On the agreed date, the suppliers deliver the items to the organization's warehouse. The WH team receives the items and makes an entry into the ERP system. For the technical and very specific items, the technician from the program departments inspects the items before receiving them.

This is a visual representation of the CDP process of HELP international, which indicates the people involved and their duties for each step of the process. In addition, the VSM displays each step's lead time as well as its cycle time. Only the process of CSDs assessing the CDP file to issuing the purchase item list to the procurement unit is considered in this study. The further process from tendering to the item's delivery to the warehouse is illustrated in **Figure 1** to have an overview of the supply chain in HELP International; however, this part was not researched.

Cause and effect analysis

As shown in **Figure 2, CDP file**: The CDP file is one of the main root causes of the problem. It is an Excel file with various formulas. During the review process, the CSD discovers incorrect formulae. There is also incorrect data input in the file, such as the wrong choice of item code, wrong choice of forecast type, and unrealistic pricing. In the comment, there are some ambiguous specifications regarding what they required. Since there are only limited item codes available, the item code in the file does not fit the requesters' requirements sometimes. Due to the above-mentioned points, the CSDs have to make a clarification with the requesters back and forth and then make corrections. As a result, the average taken time on this step is four working days which is the main point of taking longer on the process.

- **Many Reviewed Levels on Presentation Slides**: Once the presentation slides have been completed, one of the CSDs consolidates all those and put other slides such as dead stock analysis and expired item list in the file and then finalizes it. Once done, the presentation file has to be sent to the forecaster. The forecaster checks the file against CDP files and then sends

Figure 1: Value Stream Map of Collaborative Demand Planning (CDP) in HELP International

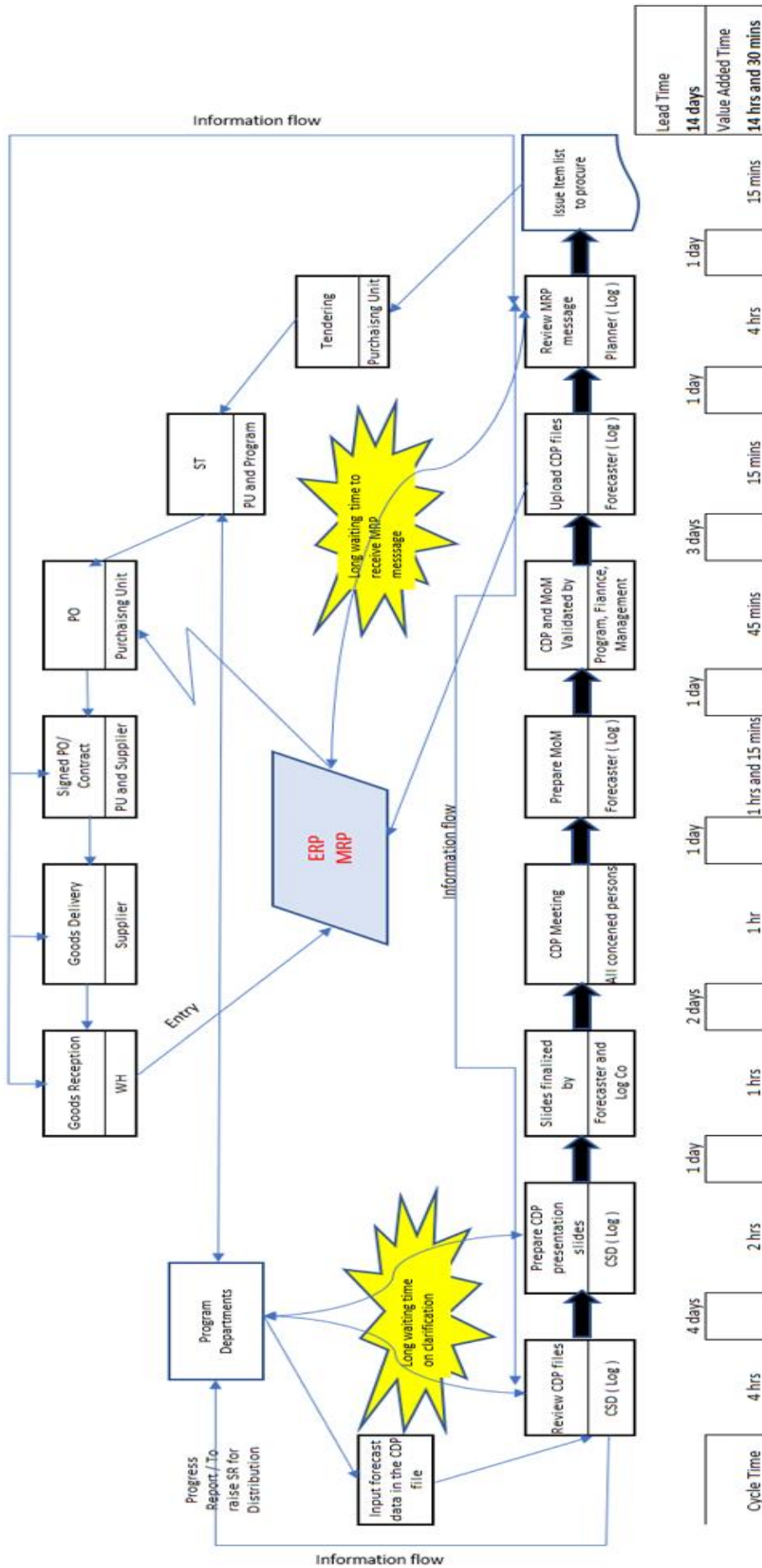
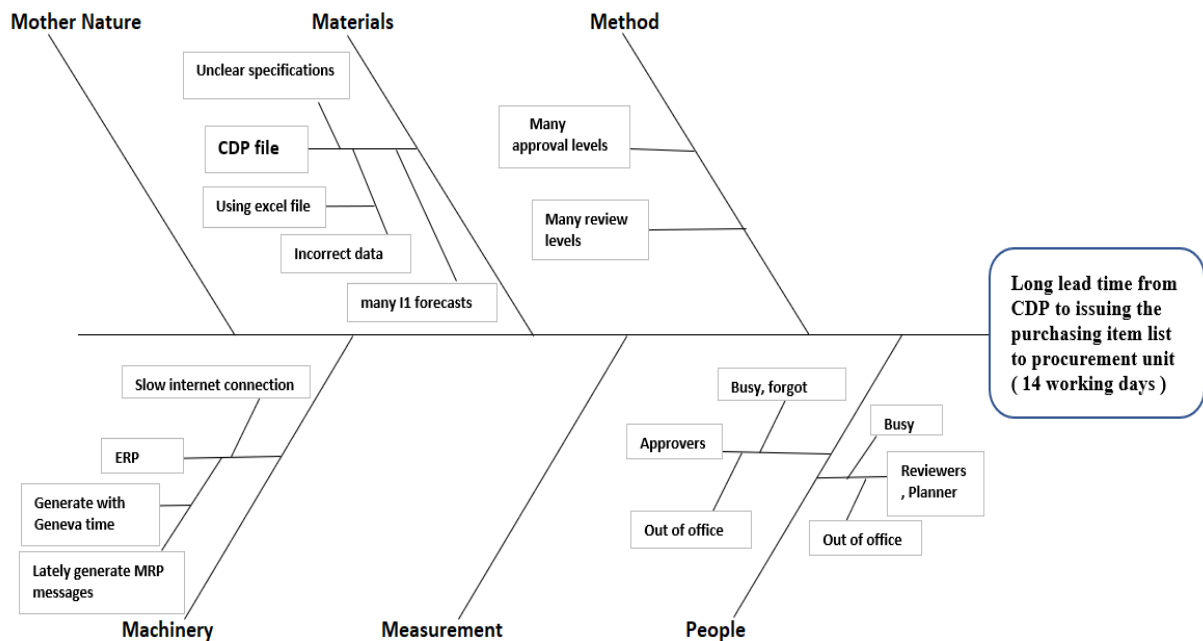


Figure 2: Cause and Effect Diagram



it to the logistics coordinator for further review. From the time of forecaster review to Log Co’s review is two working days.

- **Many Approval Levels:** After the forecaster has completed the MoM, the CDP excel files and MoM have to be sent to the respective program coordinator for approval. Program coordinator sends it to the finance coordinator for further approval and then the finance coordinator sends it to management for final validation. It takes three working days, which is also the main point of taking the process longer.

Analyze Phase

The Cause and Effect matrix is utilized in this phase to investigate the major root causes of the problem and find a suitable solution.

Cause and Effect Matrix

During root cause analysis, a Cause and Effect matrix establishes the relationship between process input variables and consumer outputs. The steps of the CSDs review the CDP excel files, Forecaster and Log Co finalize the presentation file, Validation of the CDP files and MoM, and Planner reviews MRP messages and issue the purchasing item list, are put in the process inputs and then weighted after rating of importance to customer. The Cause and Effect matrix shows the two primary problems with the highest scores, 100 and 123 points respectively. They are the CSDs' examination of CDP Excel files and the CDP file, and MoM validation process, which are two main causes making delay the whole CDP process.

DISCUSSION OF RESULTS

The Improve phase follows, which suggests a new approach for reducing the current CDP lead time. Finally, a Control system is in place to monitor activities on a frequent basis in order to maintain the CDP process's shortened lead time.

Improve Phase

The researcher has a great understanding of the current CDP process after analyzing the root causes of the problems. Thus, based on the DMAIC method, the next step is to improve the process of the Collaborative Demand Planning (CDP) in HELP International. During this phase of improvement, a Failure Mode and Effect Analysis (FMEA) will be carried out, along with recommendations for process improvement, before the new process map is implemented.

Failure Mode and Effect Analysis (FMEA)

The FMEA (**Figure 3**) was structured by outlining potential failure modes, potential failure effects with severity levels, and potential causes with the occurrence, and then calculating the Risk Priority Number (RPN). The causes from cause and effect matrix are put into FMEA form to examine potential failures and prevent their occurrence and then calculated RPN. Then, the action plan is implemented to improve the CDP lead time and the target completion date was in the end of March 2022.

- **Action plan on CDP file:** Because of the use of the Excel file, there are higher chances to put the wrong data and incorrect formulas, and the severity level is very high should the wrong items are given in the list to be procured. Therefore, the recommended action is to deploy the Web page forecasting program, and it can be integrated with JDE, which is being used by HELP International organization. The requester just choose the items they want to make forecasting for further distribution in the Web page program. The benefit is that spending less time on forecasting and reviewing, and there is no way to have wrong formulas, unlike in Excel. The head of logistics in Geneva is in charge of deploying the forecasting Web page program.

- **Action plan for reviewing the presentation slides:** The Customer Service Desk officers (CSD) compile the presentation slides based on the summary data from the CDP files and send them to the forecaster for evaluation, who then sends them to the logistics coordinator for additional review. It takes time for two people to evaluate the slides, which causes the CDP meeting to be delayed. Only one person, preferably the forecaster and deputy logistics coordinator, can handle it alone and present the slides during the meeting. By doing so, the lead time can be reduced in half. This is the responsibility of the logistics coordinator who can delegate with confidence to the deputy logistics coordinator.

- **Action plan on validation of CDP files and MoM:** There are many approver levels for CDP and MoM validation. First, the program coordinator approves and sends it to the finance coordinator, who then forwards it to management for further validation. Due to this fact, it takes much longer and delays the process. Why does the finance coordinator need to approve it? Of course, the program coordinator must do so because he or she is the requester and must confirm the forecast data. Also, the process cannot be moved forward without management's green light. Therefore, both the program coordinator and the management can validate the CDP and MoM instead of doing it by three parties. As a result, the lead time is reduced, and the next step is completed sooner. This is the organization's management responsibility.

- **Action plan on reviewing the MRP messages and issuing the purchasing item list:** The Material Resource Planning (MRP) messages are generated based on Geneva time; therefore, there is a considerable delay for the planner to review them. Myanmar is 5 hours and 30 minutes ahead of Geneva in terms of time. The MRP messages are generated at 9:00 A.M. local time in Geneva, and the planner receives them in the system at 2:30 P.M. local time in Myanmar. As a result, it causes longer time to produce the purchasing item list to the procurement unit for the further tendering process. Thus, the time for MRP production should be set to Myanmar time, which is the responsibility of the Service Desk handling all technical things related to JDE. As a result, the planner could be able to review and provide the purchasing list more quickly.

Figure 3: Failure Mode and Effect Analysis (FMEA)

Project Name: Collaborative Demand Planning Process

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Item/Function	What Could Happen?		Why and How Often?				Action Plan			Action Result				
	Potential Failure Mode	Potential Effects of Failure	Severity	Potential Cause	Occurrence	Current Process Controls (Prevent/Detect)	Detection	Reproduction	Recommended Actions	Responsibility	Target Completion Date	Score	Defect	Prevention
CDP file	Wrong data entry	Wrong items in the purchasing item list and OP	9	Using excel file	8	None	9	648	To implement the Webpage for forecasting and integrate with ERP	Head of Logistics in Geneva Headquarter	31/03/2022	9	3	54
Reviewing the presentation slides	Taking long time on reviewing	Delay the CDP meeting	5	Reviewing by two persons (forecaster and Log Co)	6	None	4	120	Only one person reviews the slides, and presents in the meeting	Logistics Coordinator	31/03/2022	5	4	40
Validation of the CDP files and MoM	Get fully approval lately	Delay the uploading the CDP files into ERP	8	Many approval levels	7	None	8	448	Only the program coordinator and management approve. No need finance.	Management	31/03/2022	8	4	64
Planner reviews the MRP messages and issuing the purchasing item list	Provide the list lately	Delay on tendering	7	MRP messages are generated based on Geneva time	7	None	7	343	The MRP messages has to be generated based on local time	Service Desk	31/03/2022	7	3	42

New Improved CDP Process

After the above recommendations have been implemented, there is a significant improvement in the organization. The new enhanced lead time in Collaborative Demand Planning has dropped to seven working days, which is half of the previous lead time (CDP). The Web page forecasting program has been deployed successfully in HELP International in Myanmar. The internal customers just make their forecast in the program and also the reviewers can do it. Thus, there is no wrong formula problem, not giving the chance to put wrong item codes and unrealistic costs. Moreover, the forecasting program is integrated with the JDE, which is ERP system using in the organization. This is the most significant achievement in the organization.

In **Figure 4**, the yellow highlighted parts, implementing the web page forecasting program, presentation slides finalized by one person, CDP and MoM validated by the program coordinator and management, and MRP messages generated based on Myanmar time are the new improved steps, which make the lead time short. The time from the step of reviewing CDP forecast data by CSD to the time of preparing the presentation slide is two days, and the time it takes for the forecaster to finalize the presentation slides is one day, which is half of the time it took before. It takes one day from the time of the CDP meeting to the time of producing MoM, and two days from the time of CDP and MoM validation to the generation of MRP messages in the system. Ultimately, the planner reviews the MRP messages and sends the purchasing item list to the procurement unit in one day. Therefore, the total improved lead time to complete the whole CDP process is now seven working days. The RPN has dropped to 54 from 648. The RPN that was 120 on the reviewing the presentation slides is now 40, and the RPN that was 448 on the validation of CDP files and MoM becomes 64. After the MRP messages were generated based on local time, the RPN has dropped to 42 from 343. The organization is happy that the RPN in all levels has dropped significantly as mentioned as FMEA table.

Control Phase

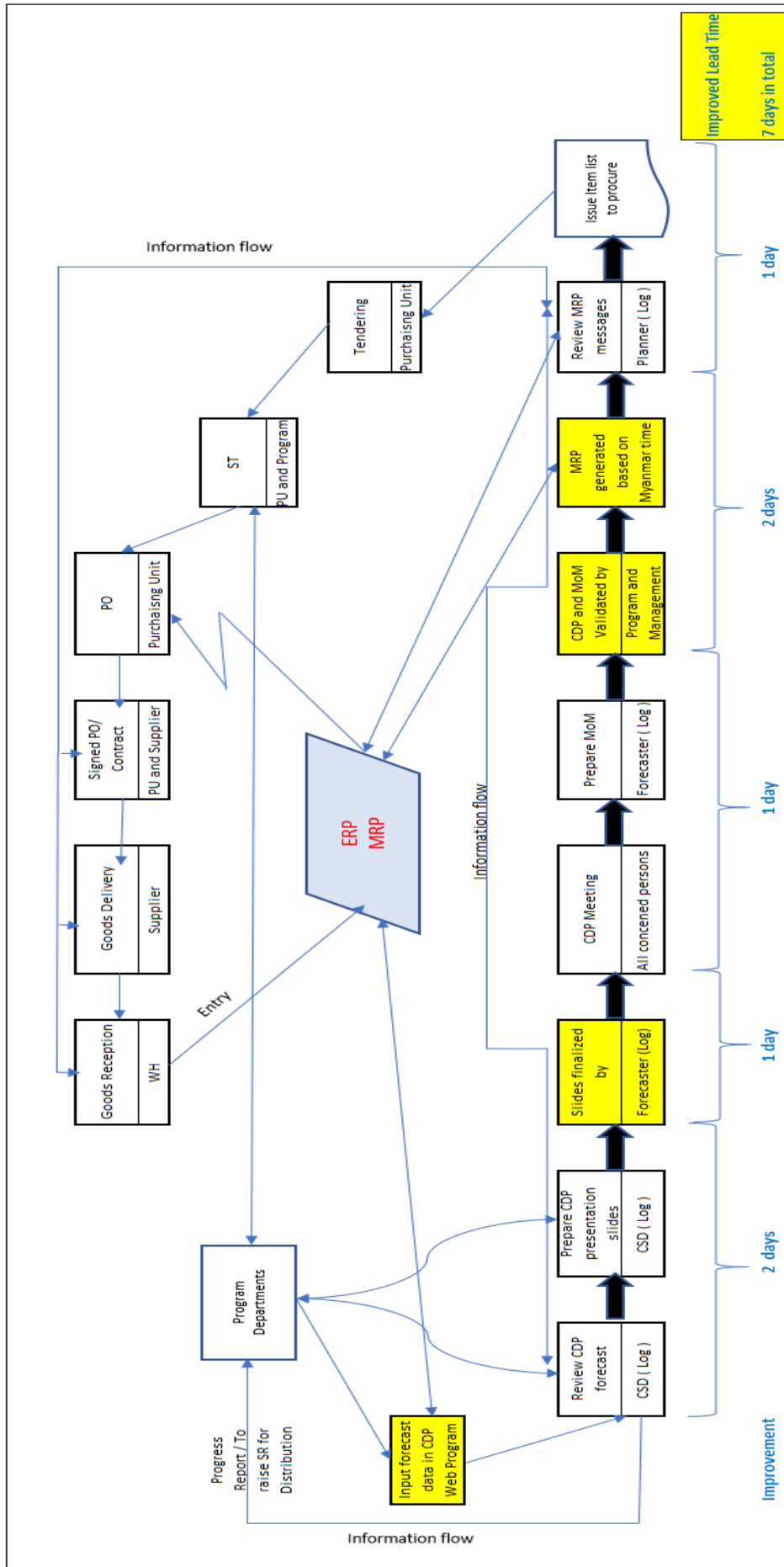
The Control phase of the DMIAC process improvement technique is the final and most essential step. The fundamental goal of this phase is to keep the improved process under control. To put it in another way, the Control phase guarantees that the innovative process is implemented and never returns to previous practices.

By implementing the web forecasting program, the poka-yoke can be included in the system such as not allowing putting the wrong item codes, unrealistic delivery date, forecasted lines duplication, and there is no chance to enter the wrong formula. Thus, this kind of poka-yoke control point has been added to the forecasting program.

Figure 4 is illustrated as a chart describing how to control each step.

- Since there are three CSD officers in the supply chain unit, if someone is absent, another one as a backup person assigned by the forecaster can take care of the tasks for reviewing the CDP forecasts. The reviewing progress is closely followed up by the forecaster.
- The presentation slides' finalization is handled and presented by the forecaster in the meeting. The backup person is the logistics coordinator, and the follow-up person is the CSD officer.
- Regarding the CDP meeting, as an official rule, the meeting date is to be set on the day after three working days from the submission deadline, and the meeting duration must not exceed one hour. The logistics coordinator plays as a timekeeper.

Figure 4: CDP Process with New Improved Lead Time



- Once the meeting has finished, the minutes of the meeting (MoM) is written and completed on the same day. The logistics coordinator is a backup person on this work, and the CSD must follow up closely on the progress and completion for a further validation process.
- Mainly the program coordinators and head of the office approve the CDP and MoM. In their absence, their deputies must validate them, and an internal rule is set to approve completely within two days, one day for the program and one day for management. The CSDs who send for validation must follow up with the approvers on time or if it exceeds the given lead time.
- The planner needs one day in order to issue the purchasing item list to the procurement unit because he or she needs to review the MRP messages and stock availability. The forecaster plays a backup person and follows the person either.

This is the way to control the improved steps to be sustainable. At every step, there is a backup person and a follow-up person in order not to delay the process. **Figure 5**, in detail, describes the steps, process, lead time, person responsible, backup person, follow-up person, and control method.

SUMMARY

HELP International is a humanitarian organization that has been conducting Collaborative Demand Planning (CDP) to identify the supply and demand and make forecasts and stock replenishments on a monthly basis since the JDE migration in 2020. The organization faced a long time in the CDP process, causing delays in the entire supply chain and late deliveries to where the people needed assistance very often. This research has focused on the CDP's lead time improvement. The benefit is that the organization is able to deliver the required goods to the vulnerable people affected by armed conflict and other forms of violence in a timely and efficient manner.

The researcher gathered the data for two years, from 2020 to 2021, and calculated the average CDP process lead time. The two objectives have been set up in order to meet the goal of improving the CDP lead time. The first objective is to identify and analyze the root causes of taking 14 working days in the CDP process and the second one is to improve the lead time in the CDP process by up to 7 working days by implementing the Value Stream Map (VSM) of Lean and DMAIC methodology of Six Sigma. The research question is "How to reduce the lead time of the Collaborative Demand Planning process?"

The literature reviews have been presented, as well as the tools used in the research methodology. After the problem has been defined, the Value Stream Map (VSM) of Lean tools is used to get a clear comprehension of the existing process in the Measure phase of DMAIC and describe the non-value added.

Using the Cause and Effect matrix and FMEA, the primary root causes identified by the Fishbone analysis are analyzed again to determine the risk level of each. After analyzing the problem's root causes, it needs to be improved by utilizing the FMEA with an action plan once more. As a result, the average lead time of the entire CDP process has been reduced from 14 to 7 working days. Moreover, the control plan has been implemented to be sustainable for the improved process and lead time.

Figure 5: Control Plan

Process name	Characteristics				Methods			
	No	Product	Process	Lead time	Person responsible	Back up person	Control method	Follow up
CDP forecast	1	CDP Web program	Reviewing the forecasts	1.5 days	Customer Service Desk Officer (CSD)	There are three CSDs. If someone is absent, another one takes care of his tasks.	Set as a internal rule to complete within the given lead time	Forecaster follows up closely
	2	Presentation slides	Preparing the presentatio slides	0.5 day				
Presentation slides finalization	1	Presentation slides	Finalizing the slides	1 day	Forecaster	Logistics Coordinator	Set as internal rule to finish finalizing the slide within 1 day	CSD follows up closely
CDP meeting	1	Meeting	Holding the CDP meeting	1 hour	All concern persons	-	Set the meeting date on the day after 3 working days from CDP submission deadline officially. As a rule, meeting last no more than 1 hour	Logistics Coordinator plays as a time keeper
Meeting of Minutes (MoM)	2	MoM	Completing MoM	7 hours	Forecaster	Logistics Coordinator	Set as a internal rule	CSD follows up closely
CDP and MoM Validation	1	CDP and MoM	Validation process	2 days	Management	Mainly, program coordinators and head of office approves. In thier absence, thie deputies	Set as interanl rule to approve within 2 days (one day for program coordinator and one day for management)	CSD follows up with the approvers if exceeds the given lead time.
Issuing the list	1	Purchasing item list	Issuing the purchasing item list to the procurement unit	1 day	Planner	Forecaster	Set as a internal rule	Forecaster follows up closely
Total Lead Time _working days				7 days				

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