Reduction of Long Delivery Time by Implementing Advanced Kaizen (Problem Solving Approach)

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Abstract

The purpose of the project is to minimize existing long delivery time of shoe Venice model by integration of 7QC tools and Quality control story formula. At this time most of Ethiopian manufacturing industries are facing big challenges to exceed their customers' expectations. For the reason that these industries could not achieve the delivery time that fixed by the customer. Sheba leather Industry PLC is one of Ethiopian leather and shoe manufacturing industry facing this problem. As well, generating skilled manpower capable of continuously solve problems analytically. At the time of the project, there was customer complaint. This was originated from not achieving delivery time of Venice model shoe. It takes more than three months to dispatch 240 pairs of Venice model shoe. In addition, there was concentration of wastes like transportation, waiting, defect and inventory. The methodology followed for this project is problem solving approach. Ten steps of quality control story formula integrated with quality control seven tools were used. The findings of the project after the completion of nine month implementation period, the team confirmed the result with set target by holding again process analysis. 38 activities were non-value adding that are wastes. Due to this reason, the delivery time is shortening by 18,236.55 min with 51.08 % improvement. In addition, process analysis and application of quality control process chart were familiarized. Any manufacturing industries can similarly use and follow the problem solving approach and 7 QC tools to eliminate wastes. Due to time constraint, the project is only focused on Venice model shoe, however there were more than 30 model shoe types. At the end, the cross functional team members should solve another chronic problem by practicing problem solving approach. The top management should monitor and evaluate the activities in order to sustain intermediate level kaizen implementation.

Key words: Delivery time, 7 QC Tools, QC story, Intermediate level kaizen, Cross-functional team, Sheba

1. Introduction

Delivery time is one of the three key elements of QCD satisfying customer requirements. On-time product delivery to the customer or adhering to the due date is critical to achieve customer satisfaction together with quality and cost in a competitive market environment (Ethiopian Kaizen Institute, 2011). Now a days , Ethiopian manufacturing industries are facing big challenge on time delivery due to various internal and external factors like: knowledge & skill gap in technical and management areas; wasteful resource use; entangled with challenges, problems and state of hopeless; stagnant and stressful working culture ; ineffective use of change tools. Due to this scenario Japanese International Cooperation Agency-JICA in collaboration with Ethiopia Kaizen Institute agreed on disseminates kaizen throughout the country step by step. Currently, more than 400 organizations are implementing kaizen. Among these 110 are manufacturing industries. 12 of them are under implementing intermediate level kaizen. Sheba leather PLC is one of the leather and shoe manufacturing industry implementing intermediate level kaizen. The company is a subsidiary of the EFFORT group. It was established in 1993 at Wukro Wereda of Eastern Tigrai zone with the primary objective of mobilizing regional and national resources to contribute in the economic development of the country in general and Tigray in Particular. The company is engaged in production, distribution and sale of finished leather; leather Shoes, Canvas Shoes, Leather articles and glove within the local market and export market. The company has two main sections. The tannery and shoe section. Above 800 employees are working on the company.

Kick-off was held with top and middle managements to start the intermediate level kaizen. In the first In company training visit the following activities were performed 'Diagnosis of the current activity of Kaizen

office, shoes and tannery section, 'Discussion with human resource development manager on how to continue ICT activity and their necessary requirement, 'Conduct Kick off meeting for 13 management members with JICA expert, including: Objective of the project, Managements expectation from the advanced kaizen, Applicable technics by factory type, Schedule of in company training with detail time schedule, Benefits of the project, critical success factors for the successful completion of the project associated with top, middle mgmt. and employees, Wet blanket lists for the project, Discussion whether we exceed their expectation or not, 'Discussion with JICA expert on how to proceed the project activity.

Highlight training on TQM, TPS, TPM, Advanced Kaizen Promotion Team, Production Scheduling, and Material Requirement Planning for 20 male top and middle managements including selected divisions and supervisors was given. Trainees were exploited company core challenges for successful completion of 5 year strategic plan. The core challenges are existing the skill and knowledge gap that do exist in the whole structure of the company; existing capacity deviations among sections like tannery-tanning, retaining, crust preparation and shoes-cutting, stitching, lasting due to bottlenecks of the production process; existing poor supply process to receive input supply, logistics and weak responsive environment strategically partnering with shoe component and accessory supplier, chemical supplier, RHS Suppliers & Spare part supplier; un structured Product Research and Development facilities to respond to the ever fast-paced changes in demands and fashion trends; not capable of investing for expansion of leather goods such as gloves, belts, wallets and leather bags and unable to create more jobs around their company; Weak marketing system and poor sales distribution channel;

The general objective of implementing intermediate level kaizen on the company is to solve these vital few problems. However, there are specific objectives like improving productivity, quality, delivery time etc. Six themes were selected by following policy deployment as shown at results and discussion part. The management discussed and selected departments directly related to themes. Based on this, 11 departments were selected. 38 members (33 male & 5 female) were grouped in to 6 cross functional teams. This project work focused on one of the cross functional team which was in charge of minimization of long delivery time of Venice model shoe. An integrated 7 quality control tools and quality control story formula approach was used to solve the problem.

2. Literature Review

2.1. Delivery Time

It is difficult to find literature review specifically on delivery time. The researcher used meaning of delivery time synonymously the lead time. Manufacturers that can't deliver on time won't keep their customers happy or keep them at all. This reality is all the more reason why small and mid-sized manufacturers need to get their products into customers' hands as quickly as possible. Often, however, bottlenecks in the production process make this impossible. (Fred & John, 2003). Let us see different researchers thought regarding to delivery time of either service or product delivery. Lead time can be defined as total time required to manufacture an item, including order preparation time, queue time, setup time, run time, move time, inspection time, and put away time (Muhammad et al., 2013). It is the time interval between the initiation and the completion of a production process. For make-to-order products, it is the time taken from release of an order to production and shipment. For make-to-stock products, it is the time taken from the release of an order to production and receipt into finished goods inventory.

On time delivery is a measure of process and supply chain efficiency which measures the amount of finish goods or services delivered to customers on time and in full. It helps determine how efficiently we are meeting our customer's or agreed deadlines. If the figure is too low or below the benchmark it could be used as a signal that somewhere along the supply chain there are bottlenecks, inefficient or time consuming processes which are not adding value and warrant further investigation or a slower delivery method is being employed. Lead time can be defined as total time required to manufacture an item, including order preparation time, queue time, setup time, run time, move time, inspection time, and put away time. It is the time interval between the initiation and the completion of a production process (Ranjan et al., 2014).

According to (Deepak, 2013) On-time delivery means measures the percent of time an order is delivered to the customer within the promised time. (Note: The promised date is expected to be strictly the total cycle time plus total shipping time. No buffers are expected to be included.) the calculation is Orders delivered on time / Total number of orders shipped.

According to (Vikas et al., 2011) delivery time directly affects customer satisfaction. Previous researchers that operations performance of service delivery can positively affect customer satisfaction (Stank et al. 1999). Many researchers have studied the influence of waiting time over customer satisfaction/loyalty

(Taylor, 1994; Pryun & Smidts,1998; Antonides et al. , 2002; Bielen & Demoulin, 2007). Their studies concluded that although waiting time does not affect loyalty directly, it influences service satisfaction which has direct effect on customer loyalty. According to (Bielen & Demoulin, 2007), waiting time issues arise due to imbalance between demand and capacity.

The researcher argues on the above definitions. The researcher defines delivery time as the total time taken from order delivery time (for example, marketing department of Sheba Leather Industry is 800 km far from company), order preparation time, queue time, setup time, run time, move time, inspection time, put away time and shipping time (the products delivered to customer), to produce a single or batch size product. One key point that should be remind is that the integration of supply, Production, Maintenance, Quality control and Marketing departments is very mandatory for successfully achieving the delivery time. Before starting implementation of this intermediate level kaizen project, we focused on formation of the cross functional team members from the above mentioned departments.

Deemak's philosophy of nonflow environment in discrete world regarding to customer delivery is fit to the case company customer delivery system. Even though the production type of Sheba Manufacturing Industry is make to order, the production flow is with high concentration of waiting and queue time.

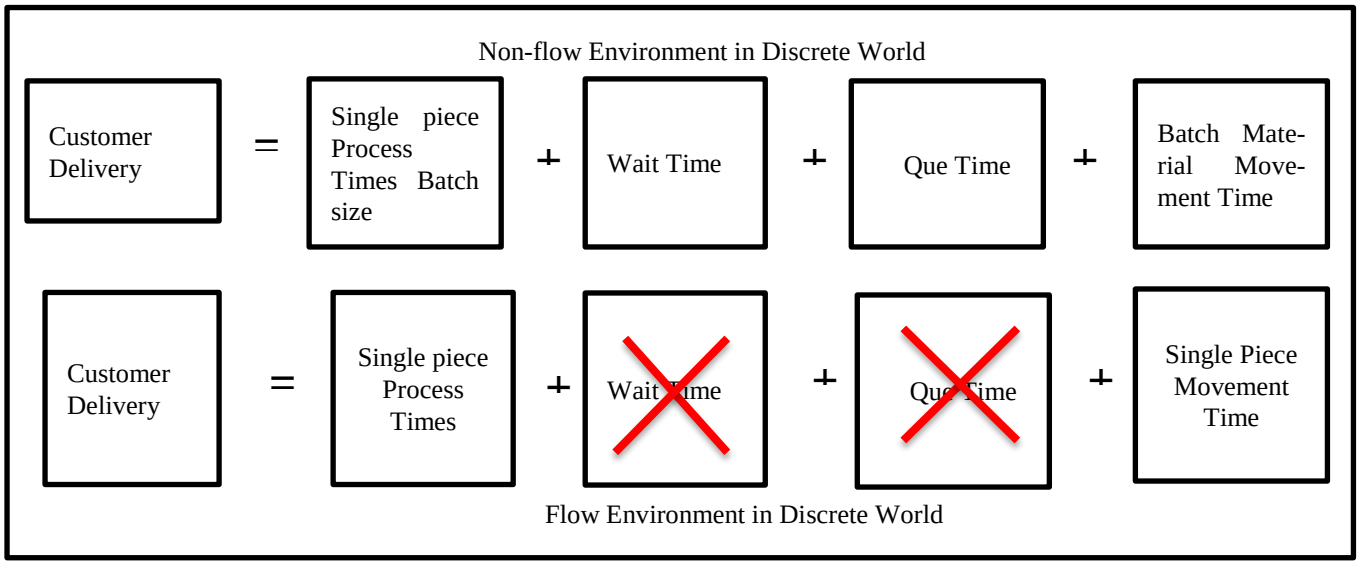


Fig. 1 Flow impact on customer order completion response (Deemak, 2013)

2.2. Quality Control 7 Tools and Quality Control Story

Currently there is a significant number of quality management tools available, so the selection of the most appropriate is not always an easy task. Tools are essential ingredients of a process and basic instruments for the success of a quality program. Many companies have used tools without giving sufficient thought to their selection and have then experienced barriers to progress. Quality Tools cannot remedy every quality problem but they certainly are a means for solving problems. Consequently, it needs to be emphasized that while tools can be very effective in the right hands, they can be very dangerous in the wrong hands. It is, therefore, important to know how, when and which tools should be used in problem solving or improvement processes. Today there are more than a hundred different tools available. Many scientists have tried to define them and differentiate among them on various bases (Basu, R, 2004). Tools are generally a means of accomplishing change and in this paper we will focus on the most fundamental quality tools called the seven basic quality tools - 7QC tools. They are easy to learn and handle and are used to analyze solutions to existing problems. These seven quality tools are basic for all other tools. According to (kehone & Dennis, 1990) there are many ways to implement process control statistically. Key monitoring and investigating tools include histograms, check sheets, pareto charts, cause and effect diagram, scatter diagram, control chart and graphs. The seven quality tools were first emphasized by Ishikawa (in the 1960s), who is one of the quality management gurus. His original seven tools include stratification, which some authors later called a flow chart or a run chart. They are also called the seven "basic" or "old" tools. After that other new tools have been developed for various purposes but the basis for every work is related to the 7QC tools (Tague, N.R, 2005). These tools are also fundamental to Kaizen and Juan's approach to quality improvement (Osanna, P.H., et al. , 2004).

According to (Daniel, 2009) Histogram is defined as a bar chart showing a distribution of variables and this tool helps to identify the cause of problems in a process by shape of the distribution as well as the width of

the distribution. Check sheet is a paper form on which items to be checked have been printed already so that data can be collected easily and concisely. It's main purposes are to make data gathering easy and to arrange data automatically so that they can be used easily later on. Pareto Diagram is a bar graph used to arrange information in such a way that priorities for process improvement can be established. It is used to display the relative importance of data and to direct efforts to the biggest improvement opportunity by highlighting the vital few in contrasts to the use full many. Cause and effect diagram is a tool that helps identify, sort, and display possible causes of a specific problem or quality characteristics. It graphically illustrates the relationship between a given outcome and all the factors that influence the outcome. It is used when we need to identify the possible root causes, the basic reasons, for a specific effect, problem, or condition; sort out & relate some of the interactions among the factors affecting a particular process or effect and analyze existing problems so that corrective action can be taken. Scatter diagram in practice it is often essential to study the relation to study the relation of two corresponding variables. The two variables are a quality characteristics & a factor affecting it, two related quality characteristics and two factors relating to a single quality characteristics. Control chart is the fundamental tool of statistical process control, as it indicates the range of variability that is built in to a system (known as common cause variation). It helps to determine whether or not a process is operating consistently or if a special cause has occurred to change the process mean or variance. Graphs are used in a variety of ways to make observation of events, outputs and other occurrences of a process or in a workplace. Its uses include: change/trend identification; analysis; control; planning; and explanation (JICA - EKI, 2011).

Quality control story refers to a procedure to present problem solving activity results in Plan-Do-Check-Act cycle (Toyota-global, 2015). It closely relates to the procedure of the quality control circle activity. Quality control story is a rule-of-thumb procedure, should be flexibly applied to individual situations. Following is a ten step procedure for a problem-solving type activity: (i) introduction of the cross functional team; (ii) reason for selecting the theme; (iii) current (original) situation analysis; (iv) goal setting; (v) activity plan; (vi) analysis of causes of the problem; (vii) measures examined and implemented; (viii) checking of results; (ix) standardization and control; (x) future plan to solve another problem according to (JICA - EKI, 2011).

It is impossible following problems solving approach without application of quality control 7 tools. Different authors also tried to show the relationship between quality control tools and problem solving steps.

Table 1 Seven QC Tools and Steps of PDCA – Cycle relationship (Mirko et al., 2009)

Seven basic quality tools (7QC tools)	Steps of PDCA-cycle				
	Plan	Do	Plan, Check	Plan, Act	Check
	Problem identification	Implement Solutions	Process analysis	Solutions development	Result evaluation
Flow chart	✓			✓	
Cause-and effect diagram	✓		✓		
Check sheet	✓		✓		✓
Pareto diagram	✓		✓		✓
Histogram	✓				✓
Scatter plot			✓	✓	✓
Control charts	✓		✓		✓

The researcher argues with the above table 1. When we see it, the table only focused on to show the relationship of PDCA Cycle and QC 7 tools. It does not show the relationship with problem solving 10 steps. So that, the researcher shows on table below that the integration of 7 quality control tools & soft techniques and quality control story as per the steps of the plan – do – check – act. This integration was also applied during the intermediate level kaizen project implementation at the Sheba Leather Industry.

Table 2 QC 7 tools and QC story in relation with PDCA cycle (Source: Researcher)

PDCA Cycle	QC Story Formula	QC 7 Tools & soft techniques
Plan	(i) Introduction of the cross functional team	Process Mapping
	(ii) Reason for selecting the theme	Bar graph, Radar chart
	(iii) Current (original) situation analysis	Pareto diagram, Histogram
	(iv) Goal setting	Line graph
	(v) Activity plan	Gant chart
	(vi) Analysis of causes of the problem	Fish bone diagram , scatter diagram
Do	(vii) Measures examined and implemented	5W2H, Judgment criteria's
Check	(viii) Checking of results	Check sheet, Histogram, Scatter plot, Control charts
Act	(ix) Standardization and control	Control chart, check sheet
	(x) Future plan to solve another problem	5W2H

3. Material and Methods

Different materials like books, journals, and training materials were reviewed to learn more for the integration of 7 quality control tools and problem solving approach. Check sheet, pareto diagram, cause and effect analysis, control chart and process flow chart were applied correspondingly to the quality control story formula. The problem solving approach methodology is shown in figure 2 below.

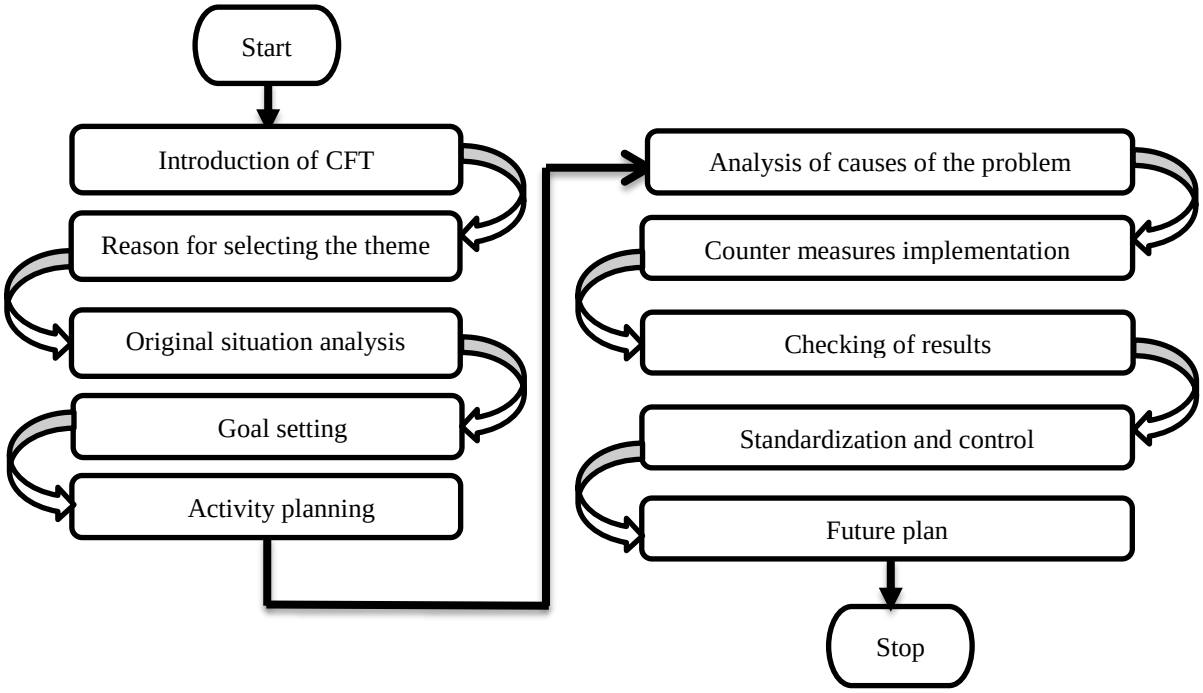


Fig. 2 Flowchart of methodology

4. Discussion and Results

4.1. Introduction of Cross Functional Team

The name of the cross functional team is **"yemayebeger."** The team comprises 8 members (7 male & 1 female). The name of the members starting from left to right Kibrom Haile from lasting , Tewodros shoe production manager , Tewelde from cutting quality control, Mikael Desta from cutting ,Kinfe Asmelash from kaizen office, Semen from stitching production, Tsigabu Hailu from stitching & lasting quality con-

trol, Tuemay from finishing production and Kidan from supply. The minimum age is 28 and the maximum age is 37. The members are from different disciplines of profession.

The overall flow diagram of shoe production is sketched in figure 3 below using process mapping technique. The elliptical, arrow, parabola, rectangle and triangle shapes are demonstrating starting & ending, transportation, operation, inspection and storage respectively.

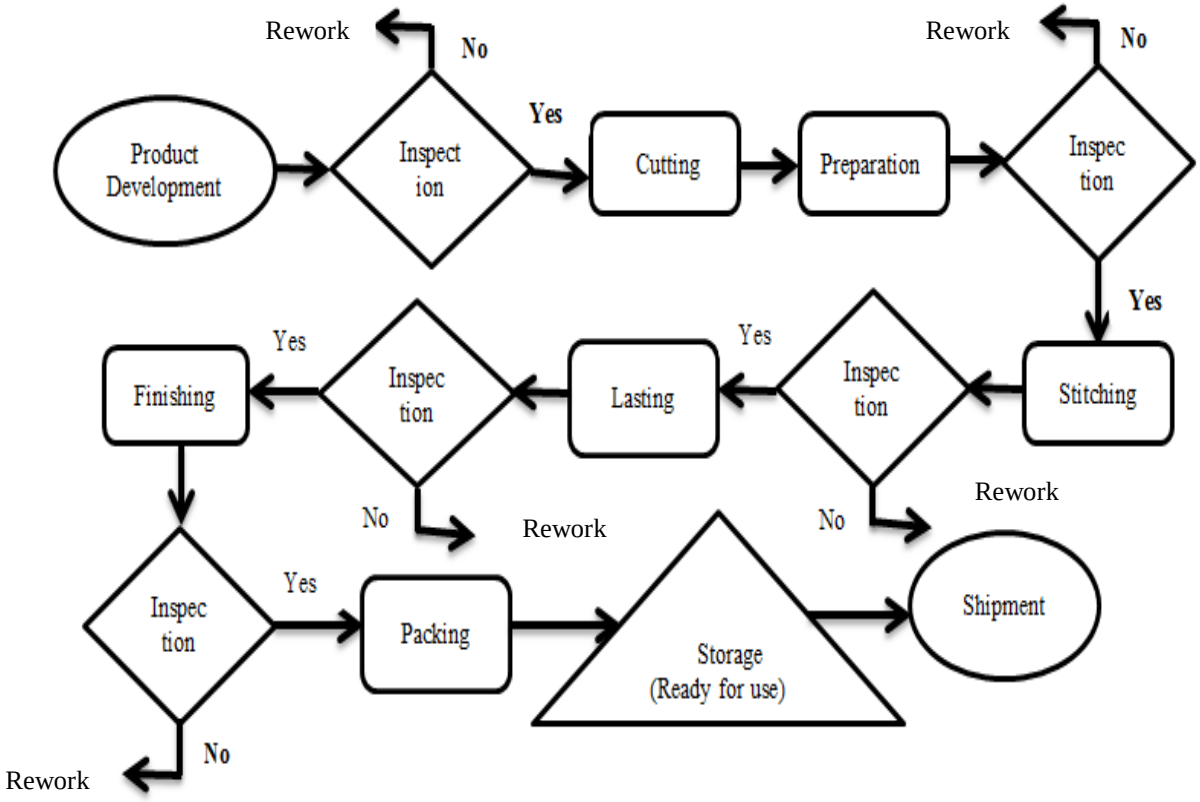


Fig. 3 Process flow of shoe making in Sheba

4.2. Theme Selection

4.2.1. Reasons for Theme Selection

The reason for selecting the problem, at the time of implementing the project, there was customer complaint because of unable to achieve delivery time specified by Venice model shoe customer. It takes more than 3 months to produce 240 pairs of shoe (in average 3 shoes per day). But, the global bench marking is 6 pairs of shoe per day which is 50 % more than the case company. In addition to this, there is high setup time, transportation time, waiting, rework, inspection time, delay, bottle neck operations on the production

few due mention. This theme is also having directly high impact on successful completion of the strategic plans basically profitability. Besides to these, all the managements are agreed on this theme to be number one for solving.

4.2.2. Theme Selection

In problem selection, the management should focus on those problems that are interruptions for successful completion of company strategic plan. Based on this, the team evaluated vision, mission, SWOT analysis, challenges. Based on this, Mission of the company is to provide best leather and leather products to the local & international market through maximum utilization of the country hides & skins with continuous generation of wealth to the shareholders thereby contribute its share to the regional & national economy. Vision of the company is "Be branded footwear supplier to the local and international market by 2020". The company SWOT is shown as table 3 below. The management identified 6 main challenges knowledge & skill gap, existing capacity deviation, weak supply process, unequipped product research & development, unable to expand leather goods, weak marketing & sales system. Besides, 21 problems were identified through brainstorming, the critical few are shown in table 4 below.

Table 3 SWOT Analysis (Sheba, 2015)

Strength - Modern production set-up equipped with modern machine & equipment which enables us to produce variety of foot wear styles including mass injection shoes, Having good image and dependability in our customers, Young and easily trainable labor, Integrated Production set up with flexible machines and equipment to produce variety of products, Being a member of EFFORT group.	**Opportunities** -Incentives and support given to the leather sector by the government of Ethiopia, Support -LIDI and EKI, Tax discount for shoe accessories, Proposed free zone for sale of imported shoe components in Ethiopia, The chance to create synergy with sister companies, Economic growth Ethiopia & other African countries expected to create new markets, Preferential market like AGOA in USA & EEA in EU, Increased locally available shoe inputs via increasing FDI, Abundance of cheap labor opp.to international competition, Shifting of the world economy from unipolar to multi-polar expected to create new markets, Growing fashion consciousness globally.
Weakness : High cost operator: -Unable to build reliable supplier and components supply, Un able to build cheapest Component and raw material source, Low productivity, Underutilization of capacity, Unable to produce value adding products, Lack of technical skill and knowledge in both production, Limited skill in design and product development, Low Industrial discipline and working culture, Unable to capture existing market - domestically & internationally. **Long Through put time:** -Inefficient process, mismatch of production capacities, Weak Supervision of man power and process, Delayed Delivery **Quality of products is not satisfactory:** -Not Standardized bill of material, Problem in inspection in input, process and output, Limited capacity in product development, Poor customer complaint handling	**Threats** Quality deterioration of raw material leather, Continuous Foreign Direct Investment in the Ethiopian leather sector, High competition from established international brands & domination of big Chinese companies operating in US and EU markets, World economic slowdown may affect expected demand, Isolated from capital city, similar industries and suppliers, Substitution of leather Product with cheap synthetic shoes

The following judgement criteria's were set to identify theme. These criteria's are management policy-A, urgency-B, effects level-C, Activity period-D, Cross functional-E, Cause for generated other evils-F, Solved by advance kaizen tools - G and Opportunity for capacity development - H. Simple check sheet containing list of problems and judgement criteria was used to prioritize problems.

Table 4 Prioritizing Problems

Problem	Theme	Judgment criteria								Score	Rank
		A	B	C	D	E	F	G	H		
High cost of product of shoes	Reduction of cost of product	17	20	22	14	20	17	17	16	143	**4**
High inventory stock	Reduction of inventory stock	14	17	21	19	14	17	20	17	139	**5**

Long delivery time in shoes	Minimizing long delivery time	19	23	21	22	22	22	21	18	168	**1**
Low product diversification	Increasing product diversification	18	15	19	13	17	16	19	19	136	**6**
Excessive trimming & reject leather	Reduction of trimming & reject leather	23	21	20	18	16	17	19	17	151	**2**
Low OEE	Decreasing OEE	15	19	19	15	20	16	20	21	145	**3**

Theme: - Minimization of long delivery time of Venice model shoe in shoe production section by following ten steps of Quality Control Story Formula and application of 7 QCQ tools.

4.3. Original Situation Analysis

It is obviously known that delivery time contains 5 elements of operation time, inspection time, storage time, transportation time and Delay. The time taken to complete 240 pairs of shoe was measured and identified as per the 5 elements of delivery time using process flow chart. Starting from order preparation time to shipment contains 187 activities. The total time takin to complete the products is 37,281.55min. as shown in table 3 below. Besides to this analysis, the cross functional team also observed the layout of the production shop floor, existing rework, skill assessment.

Table 5 Process flow chart for processes before implementation in second

S.No.	Process	Time in Second	Operation	Inspection	Storage	Transportation	Delay
1.	Sending customer order via fax or mail – Mkt Dept.	1020	X				
2.	Customer order preparation in – Supply Dept.	7218	X				
3.	Customer order dissemination to PRD Dept.	4110	X				
4.	PRD checks the feature of the model on the catalog	2120	X				
5.	Bola preparation in Planning department	6106	X				
6.	Bola dissemination to Production & supply department	3128	X				
7.	Checking the availability of RM at store & Withdrawing	5100	X				
8.	Queuing in cutting section	14400					X
9.	Transportation to outside store	140				X	
10.	Finished leather store keeper size sorting	15	X				
11.	Transportation back to cutting for size approval	1060				X	
12.	Searching for department heads for size approval	500					X
13.	Transportation to outside store for loading leather	161				X	
14.	Transportation back to cutting raw leather inspection	120				X	
15.	Temporary raw leather storage - queuing	20			X		
16.	Performing raw leather inspection	3840		X			
17.	Transportation to consumption area	15				X	
18.	Temporary storage - queuing	108000			X		
19.	Matching production order and leather consumption	209	X				
20.	Transportation to cutting machine	75				X	
21.	Transportation back to cutting dies area	45				X	
22.	Searching cutting dies	10	X				
23.	Transportation to cutting machine	45				X	
24.	Cutting operation - machine	150	X				
25.	Cutting operation - manual	300	X				
26.	Cutting upper lining	5964	X				
27.	Transportation to cutting inspection	40				X	
28.	Performing cut components inspection	17040		X			

Based on the above process flow chart, the total time taken for each category in minutes and frequency of its activities for operation, inspection, storage, transportation and delay are 29,094.82 min (117) , 828.88 min (10) , 4702.77 min (6) , 44.38 min (36) , 2610.70 (18) respectively. So, the total time taken to finish 240 pairs of Venice model shoe is 37,281.55 min and 187 numbers of value adding, non-value adding activities that must be removed.

4.3.1. Inconvenient layout

The existing shoe production lay out contained visible wastes like high operator & material transportation and waiting as shown in figure 4 below. Therefore, modification on the existing layout definitely brings improvement. Because, these two wastes maximizes the delivery time of shoe that results on customer complaint. The production shop floor existing layout is drawn as shown in figure 4 below.

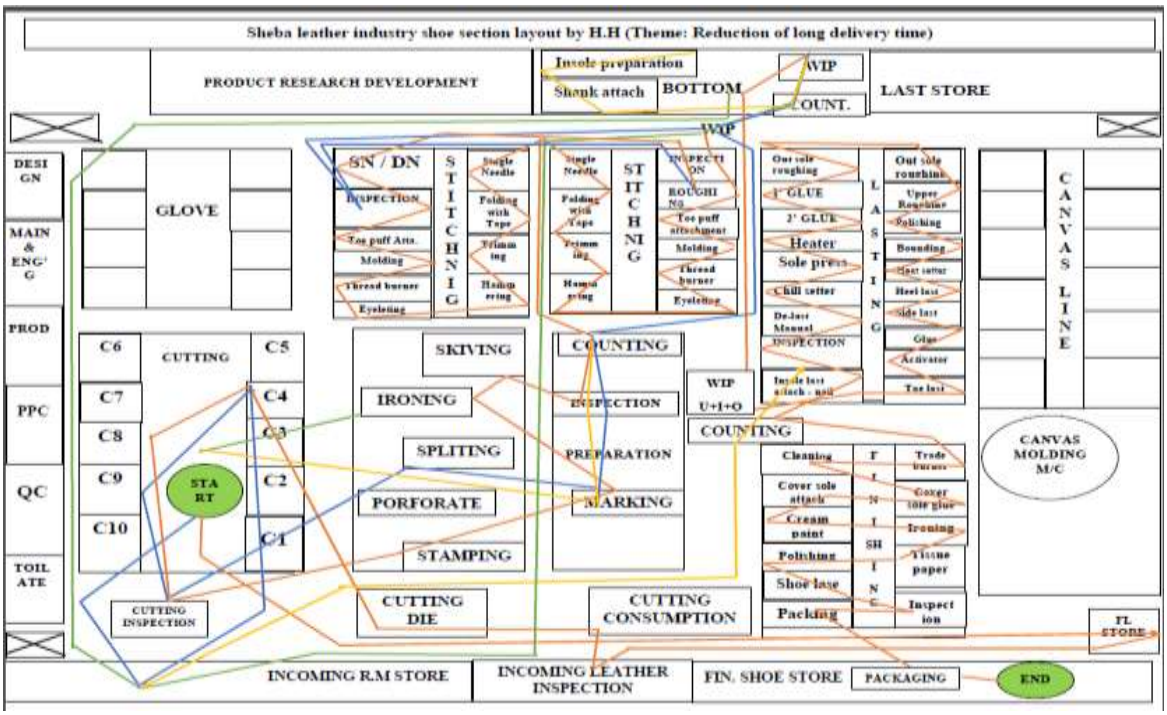


Figure 4 Inconvenient shoe production layout

4.3.2. Actual Situation on Rework

During the current situation analysis, we have seen high rate of rework on the production especially on lasting and a little bit in stitching sections. Rework by itself has high negative power on achieving delivery time. It maximizes the operation running time. So, minimizing rework, definitely improves the running time which results in reducing long delivery time of Venice model shoe. For example, the existing rework on lasting section at toe last machine is recorded and presented as shown in figure 5 and 6 below.

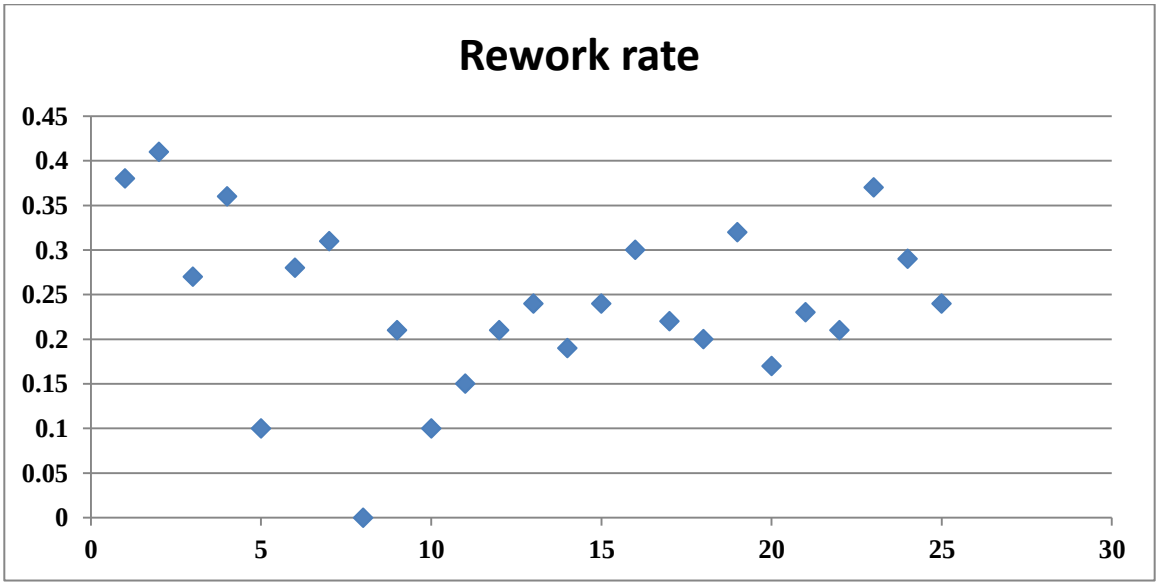


Fig. 5 Scatter diagram for lasting rework

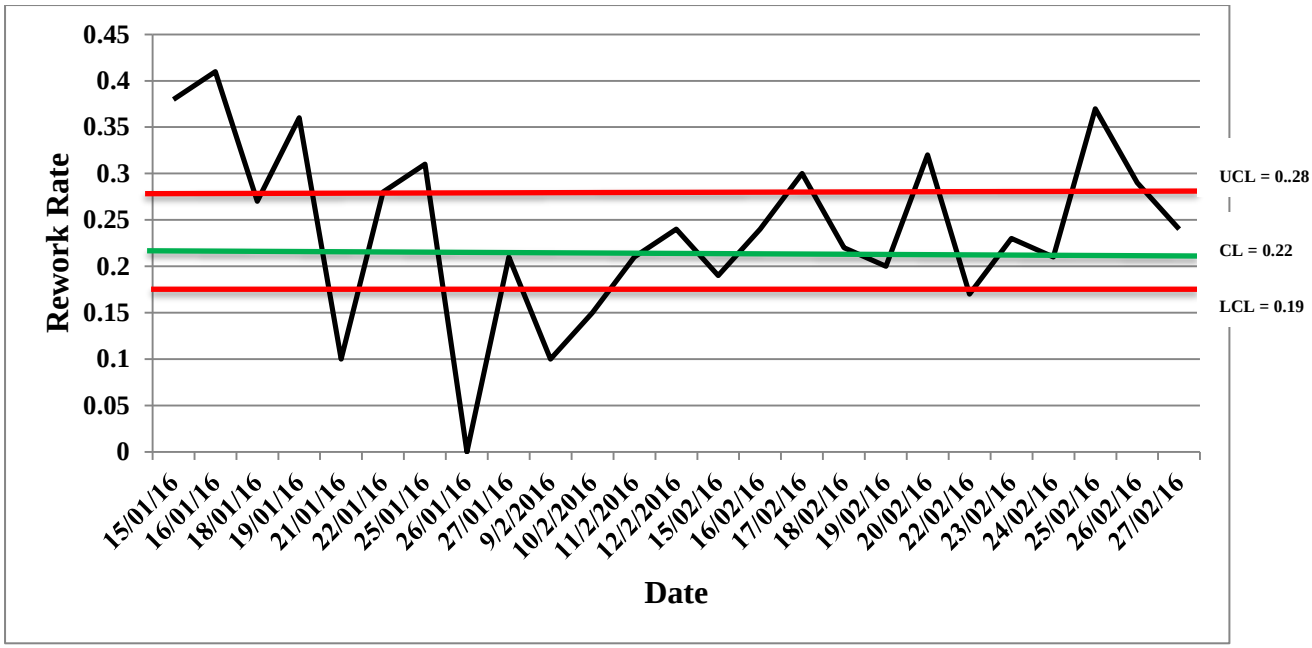


Fig. 6 Control chart for lasting rework (toe last machine)

Note:- Firstly, when we see the scatter diagram figure 5, there is weak or low correlation among each points. There is small relation between the reasons or causes of the problem and existing rework. Secondly, when we see the control chart figure 6, ten points are out of the upper and lower control limits. This shows that, the shoe making process in the lasting section is unstable or uncontrolled. There should be improvement by tackling the reasons that made rework.

4.4. Target Setting

According to Katsuya Hosotani: THE QC PROBLEM SOLVING APPROACH – Solving Workplace Problems the Japanese Way book, there are three approaches for target setting.From these approaches, halving approach is selected. The Key Performance Indicator of the problem is delivery time of Venice Model shoe. The current situation showed already that 37,281.67 min took to complete 240 pairs of shoe. Based on the selected halving approach, the original situation is expected to reduce to 18,640.5 min by 50 % improvement which is called target of the theme. In general, the goal of the project is reduction of long delivery time of Venice model shoe by 50 % until august 2016.

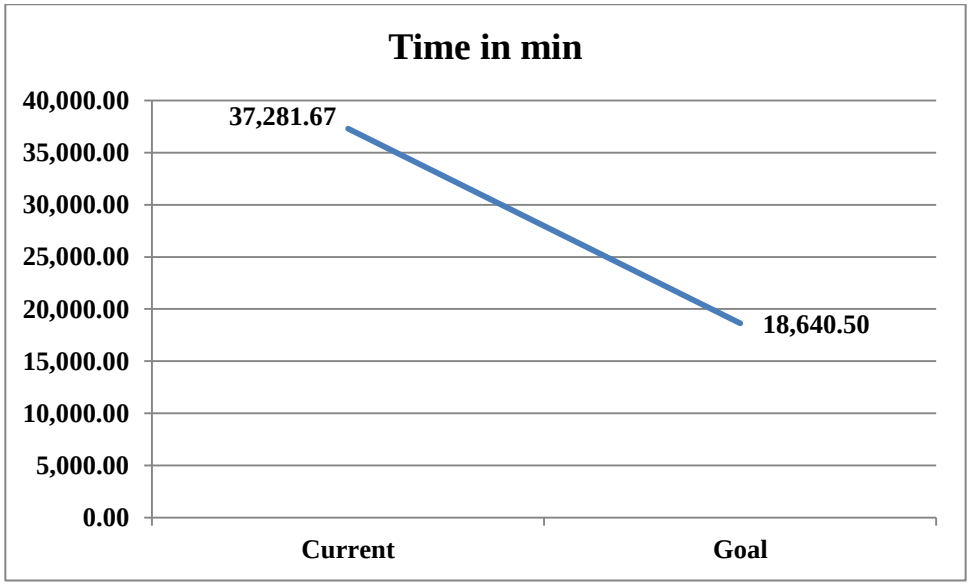


Fig. 7 Line graph for setting goal

4.5.Activity planning and Actual Activities

3.5.1. Activity Planning

Before proceeding to cause analysis, the cross functional team has established an action plan that contains major problem solving steps using the 5 W 1H (When, Where, What, Who, Why, and How). Besides to this after completion of the project the team also evaluates whether the major activities are done or not. Based on this, the activity planning before implementation and actual activity after implementation are prepared as shown below. The general approach of in company training was 1 month & 2 weeks stayed at company for implementation and 2 weeks at Ethiopian kaizen institute for compiling results and progress sharing meeting.

Table 6 Action plan using 5W1H

Item What?	Duration:- December 2015 to August 2016 When?									Place Where?	Responsibility Who?
	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	August		
Kick-off, training for management										Shoe Section	EKI Consultant
Subject selection	→									Shoe Section	Company Management
Training for A-KPT										Shoe Section	Consultant
Comprehending the current situation		→								Shoe Section	CFT, EKI Consultant
Progress sharing meeting										EKI	Consultant
Activity planning			→	→						Shoe Section	CFT, EKI Consultant
Cause analysis										Shoe Section	CFT, EKI Consultant
Progress sharing meeting										EKI	EKI Consultant
Counter measure					→	→	→			Shoe Section	CFT, EKI Consultant
Progress sharing meeting										EKI	EKI Consultant
Comprehending result								→		Shoe Section	CFT, EKI Consultant
Standardization & training									→	Shoe	CFT
Report to management										Shoe	Consultant
Final presentation										EKI	Consultant

3.5.2. Actual activities

When we compare the activity planning with the actual activities done, the identified counter measures were implemented as per the schedule. The team later agreed on conducting continuously at least once a month technical training aimed to reduce operator errors. However, this counter measure was not implemented at per the schedule. After tough discussion with top management, the training center took responsibility to facilitate then, they conduct the training as per skill matrix. See the pictures at result checking stage of the project.

Table 7 Actual action plan using 5W1H

PDCA	What? Items to be Implemented		When? Dec.	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.
Plan	Kick-off (1-2hrs),	Plan	----->								
		Actual	→								
	Training for management (6hrs)	Plan	----->								
		Actual	→								
	Confirm company policy	Plan	----->								
		Actual	→								
	Subject selection	Plan	----->								
		Actual	→								
	Training for A-KPT	Plan		------>							
		Actual		→							
	Comprehending the current situation	Plan		------>							
		Actual		→							
	Goal setting	Plan			---->						
		Actual			→						
	Activity planning	Plan			---->						
		Actual			→						
Do	Cause analysis	Plan			---->						
		Actual			→						
	Examine counter measures	Plan				---->					
		Actual				→					
	Implement counter measures: Providing Technical Training	Plan					---------->				
		Actual					→				
	Performing operation analysis	Plan					---------->				
		Actual					→				
	Modification of existing layout	Plan					---------->				
		Actual					→				
	Prep.& Implementation of QC Process Chart	Plan					---------->				
		Actual					→				
	Counting semi-finished products	Plan					---------->				
		Actual					→				
	Make safety stock	Plan					---------->				
		Actual					→				
Check	Comprehending result	Plan								---->	
		Actual								→	
Act	Standardization and training	Plan									---->
		Actual									→
	Review of future issue	Plan									---->
		Actual									→

3.6. Cause Analysis

In cause analysis, CFT members listing all possible causes by using simple brain storming technique. These possible causes were categorized in group under main causes. Cause and effect diagram was used to show the relationship among possible causes and main causes. In addition to this, why – why analysis soft tool, observation and documents were reviewed and used to identify root causes. Since more root causes were identified, in order to select the critical root causes the cross functional team members were set three parameters effect, frequency and detection by ranging each parameter from 1 to 10 for selection of critical root causes.

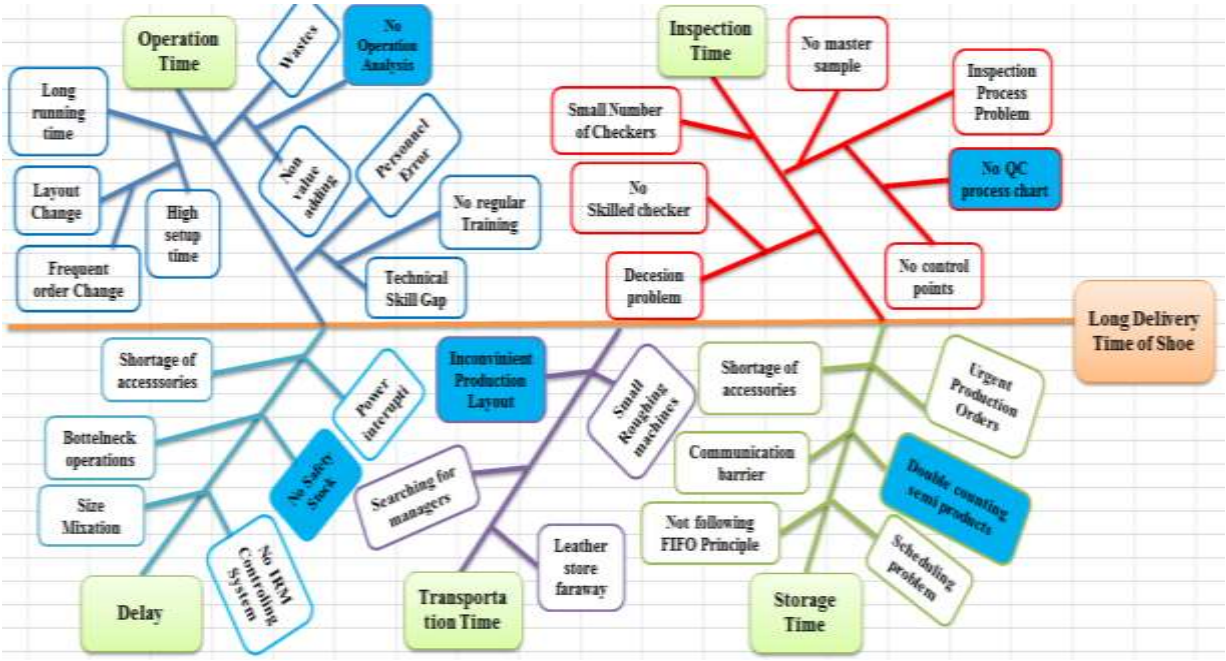
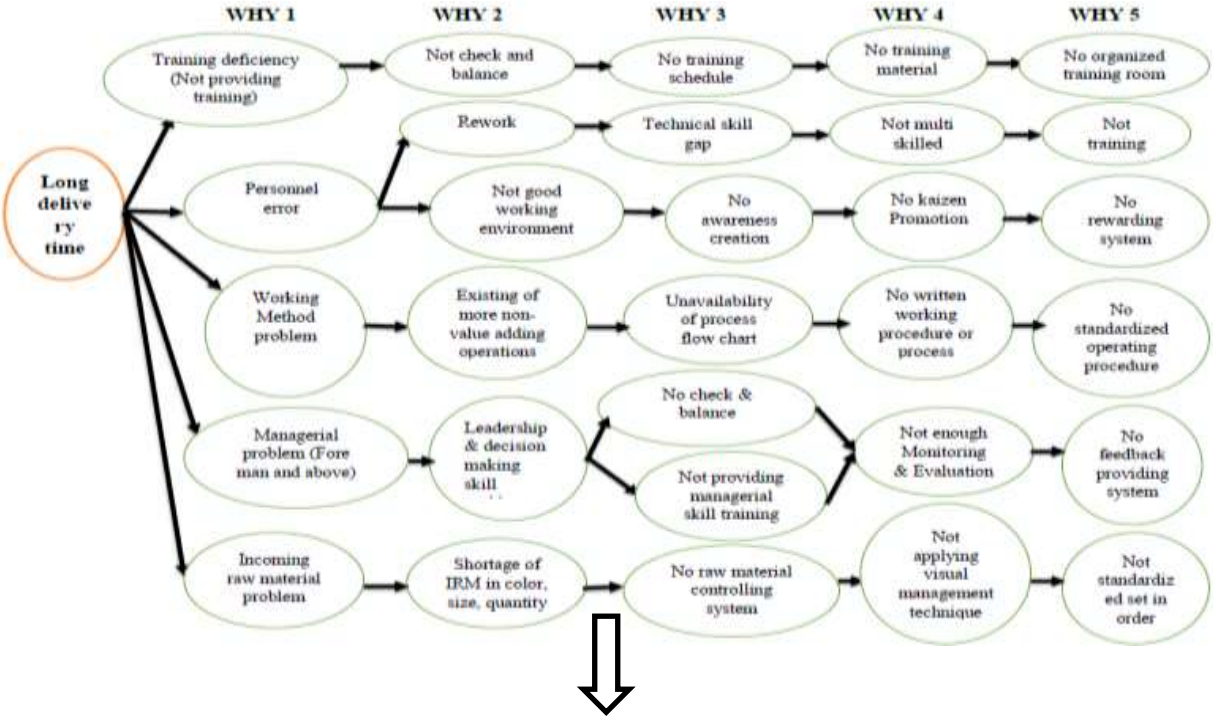


Fig. 8 Fish Bone Diagram



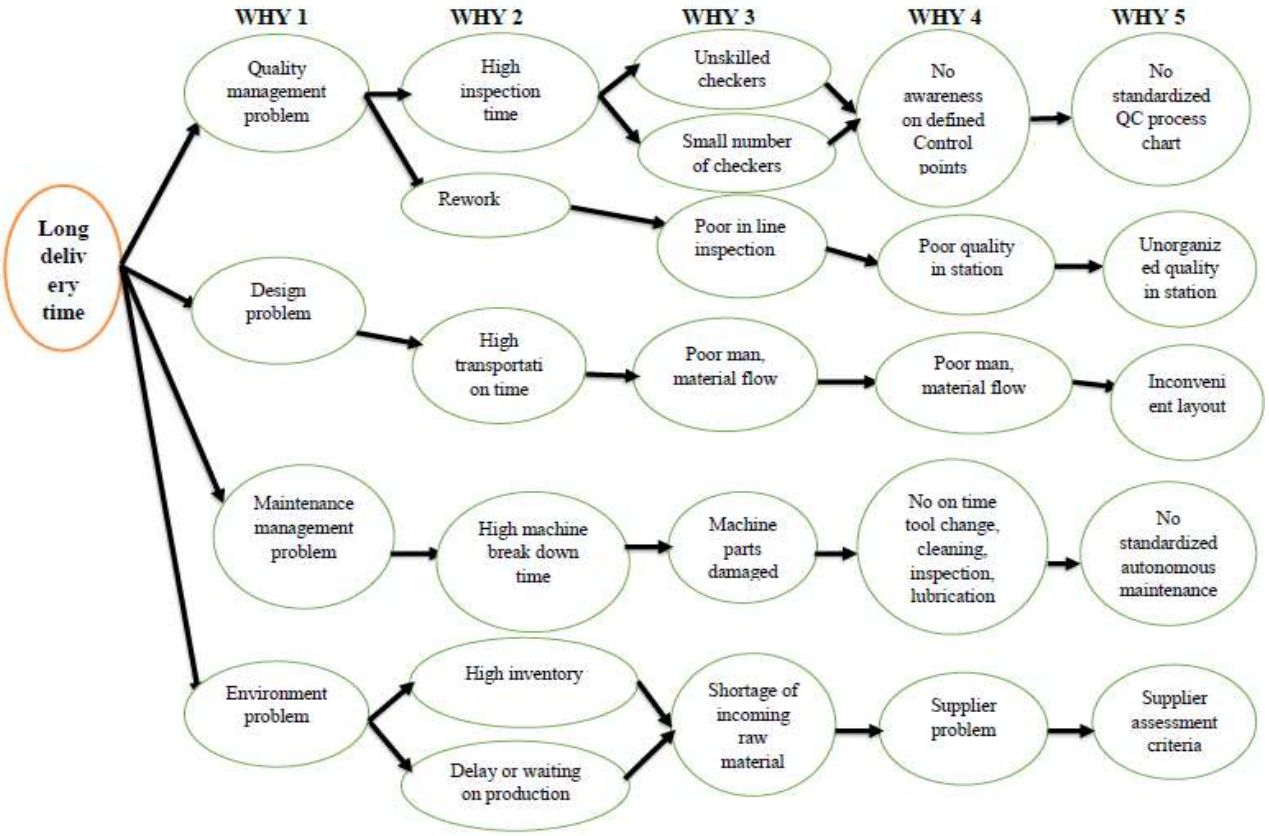


Fig. 9 Why – why analysis

The cross functional team members through discussion, they tried to ask five times why to get the true root cause. But, due to unavailability of data for those causes, they agreed to use the above mentioned parameters for selection of critical root causes based on the fish bone diagram. Based on it, Critical ones are well identified as shown in table 8 below. These are QC process chart, no operation analysis, in convenient layout, Double counting, no Safety Stock have got highest score of multiplication of the three parameters..

Table 8 Critical root causes identification

Root causes	Criteria			Rate	Score	Remark
	Effect	Frequency	Detect			
Operation time						
Frequent order change	10	6	4	240	3.26 %	
No operation analysis	10	10	10	1000	13.58 %	CRC
No regular training	8	8	5	320	4.34 %	
Technical skill gap	10	9	10	900	12.22 %	
Inspection time						
No skilled checker	10	10	6	600	9.53 %	
Small # of checkers	8	9	6	432	6.86 %	
No QC Process chart	10	10	10	1000	15.88 %	CRC
Delay						
Power interruption	8	7	9	504	13.39 %	
Size mixation	8	7	10	560	14.87 %	
No safety stock	10	10	10	1000	26.56 %	CRC
Transportation time						
In convenient layout	10	10	10	1000	23.09 %	CRC
Small roughing m/cs.	7	8	6	336	7.76 %	
Searching for managers	10	9	7	630	14.55 %	
Storage time						
Shortage of accessories	10	10	9	900	20.78 %	
Double counting	10	10	10	1000	23.09 %	CRC
Not following FIFO	8	8	6	384	8.86 %	

3.7. Countermeasure Examination and Implementation

3.7.1. Counter Measure Examination

After identifying the critical root causes, the cross functional team members were discussed on counter measures. They listed many possible solutions to tackle the critical root causes. Meanwhile, they were also discussed on listing criteria's to select best solutions. Based on this, members agreed on three fundamental criteria's like feasibility, effectiveness and employees involvement. Members were rated factors 1 up to 5. Excellent - 5, very good - 4, good - 3, fair - 2 and poor – 1. The counter measures were examined and the result is shown as in table 9 below.

Table 9 Counter measures examination - rating

Problems	Facts	Counter measures	Criteria			Judgement
			Feasibility	Effectiveness	Involvolvement	
No operation analysis	Value adding , nonvalue adding and waste activities are not identified on the production	Using process flow chart, identifying all three operation types	5	5	5	Excellent
No QC Process chart	There is no control and check points on the shop floor checkers table.	Application of QC process charts on quality in station to identify problems	5	5	5	Excellent
No safety stock	The supply section did not have safety stock for Venice model accessories	Supply department should have enough number of Venice model accessories	5	5	4	Very good
In convenient layout	There is high transportation due to unorganized shop floor layout	Modification on existing layout	5	5	5	Excellent
Double counting	There is redundancy of counting semi – finished products by checkers and material controllers	Both material and quality controllers should count together once	5	4	5	Very good

3.7.2. Counter Measure Action Plan

The counter measure action plan is developed using 5W 1H simple technique. This action plan is the heart of the problem solving. Because, in order to achieve set objective right counter measures should implement at the right time, right place, with right person in charge to solve the identified problems. So, managements should give high attention and follow up. The developed action plan is shown as table 10 below.

Table 10 counter measure action plan

WHAT? Problems	Where? Location	HOW? Counter measures	WHEN? Duration: April 11-Aug 27/2016					WHO? Person in charge	WHY? Objective
			April	May	June	July	August		
No operation analysis	Shoe production section	Using process flow chart, identifying all three operation types	→					Cross functional team	To eliminate Muda
No QC Process chart	Quality in station	Application of QC process charts on quality in station to identify problems	→	→	→	→	→	Cross functional team	To minimize inspection time
No safety stock	Incoming raw material store	Supply dept.should have enough number of Venice model accessories	→	→	→			IRM store keeper , CFT	To eliminate unlike inventory
In convenient layout	Shoe production area	Modification on existing layout	→	→	→	→		Cross functional team	To eliminate Muda of transport
Double counting	stitching, lasting, mini store	Material &quality controllers should count once	→	→	→	→	→	Material controller	To shorten time

3.8. Comprehending Results

In realizing improvements, the cross functional team members were evaluated first the counter measure action plan where best solutions were implemented as per the developed action plan or not. Unfortunately, the selected five counter measures were implemented successfully. However, conducting technical training to improve human errors like rework was not implemented. The management on discussion agreed on conducting training by company training Centre. Second, members again identified all activities and measured the time taken to complete each item using stopwatch time study. Based on the evaluation, after merging and eliminating non value adding activities the total number of items were reduced from 187 to 149 that resulted in minimization of the total time taken to produce 240 pairs of Venice model shoe from 37,281.67 mints to 18,236 mints which is 51.08 % improvement as shown in table 11 below.

Before implementing the recommended best solutions, the total time taken to deliver 240 pairs of Venice model shoe were 37,281.67 minutes. After process analysis using process flow chart by identifying value adding and non-value adding activities by eliminating wastes & combining some non-value adding activities, adding one checker for each section, modifying existing layout resulted in total time taken to deliver 240 pairs of shoe took 18,236.55 minutes which is 1 month and a week. Still, there is a room for improvement. In addition, when operators and checkers took technical training regarding to their processes obviously the rework will also got reduced. There is still high room for improvement.

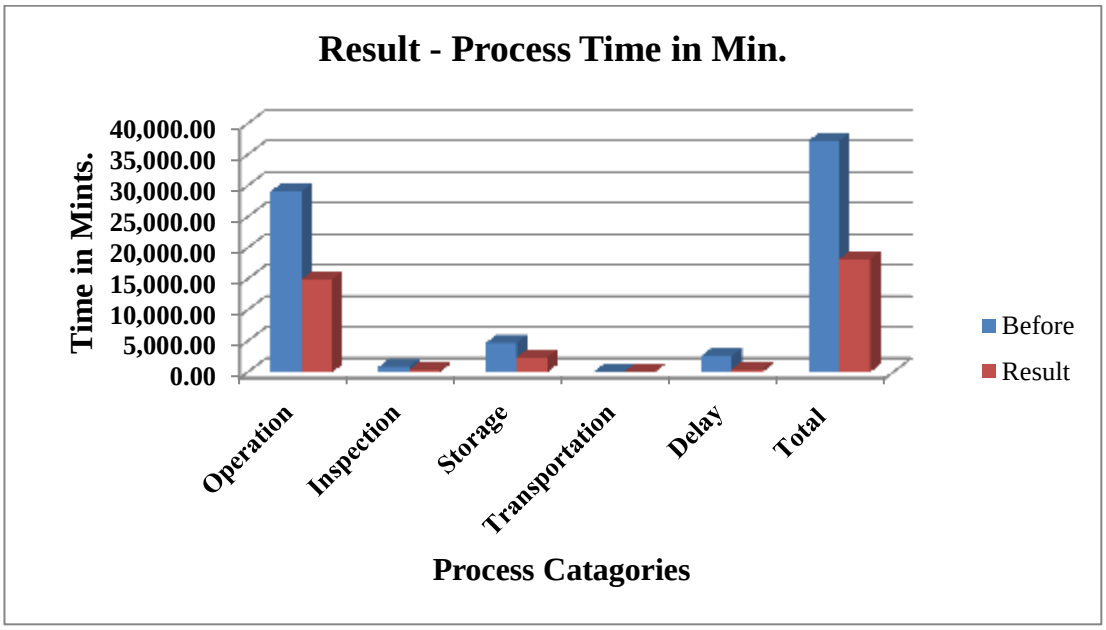


Fig. 10 Summary of result

The cross functional team members also evaluated the r**atio of time** for value adding and waste of time - the value adding activities are taken 18,236.55 minutes (48.91 %) and unimportant non-value adding activietes that are wastes took 19,045.12 minutes (51.08 %).

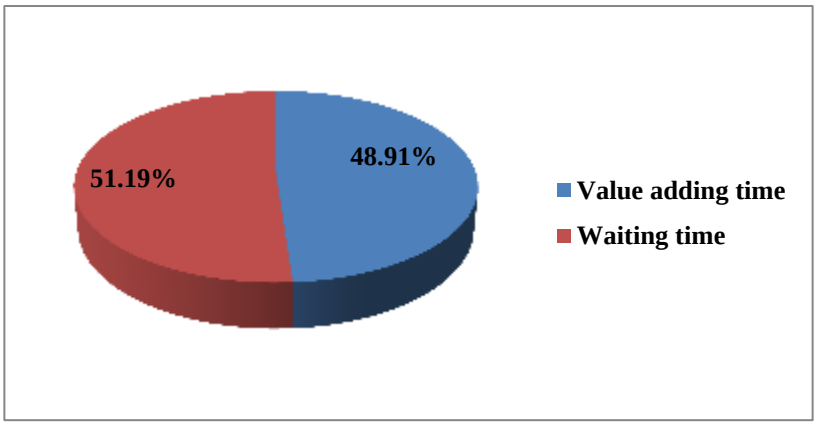


Fig. 11 Ratio of time for value adding and waste of time

Table 11 Process flow chart for each process after implementation in second

S.No.	Process	Time in Second	Operation	Inspection	Storage	Transport	Delay	NVA
1.	Sending customer order via fax or mail – Mkt Dept.	1020	X					
2.	Customer order preparation in – Supply Dept.	7218	X					
3.	Customer order dissemination to PRD Dept.	4110	X					
4.	PRD checks the feature of the model on the catalog	2120	X					
5.	Bola preparation in Planning department	6106	X					
6.	Bola dissemination to Production & supply department	3128	X					
7.	Checking the availability of RM at store & Withdrawing	5100	X					
8.	Queuing in cutting section	14400					X	NVA
9.	Transportation to outside store	140				X		NVA
10.	Finished leather store keeper size sorting	15	X					
11.	Transportation back to cutting for size approval	1060				X		NVA
12.	Searching for department heads for size approval	500					X	NVA
13.	Transportation to outside store for loading leather	161				X		NVA
14.	Transportation back to cutting raw leather inspection	120				X		NVA
15.	Temporary raw leather storage - queuing	20			X			NVA
16.	Performing raw leather inspection	2840		X				
17.	Transportation to consumption area	15				X		
18.	Temporary storage - queuing	108000			X			NVA
19.	Matching production order and leather consumption	209	X					
20.	Transportation to cutting machine	75				X		
21.	Transportation back to cutting dies area	45				X		
22.	Searching cutting dies	10	X					NVA
23.	Transportation to cutting machine	45				X		
24.	Cutting operation - machine	150	X					
25.	Cutting operation - manual	300	X					
26.	Cutting upper lining	5964	X					
27.	Transportation to cutting inspection	40				X		
28.	Performing cut components inspection	6360		X				

The following ideas were created for eliminating and combining activities. For eliminating waiting time due to counting, both material controller & respective checker together counting once. For the availability of small number of checkers on the cutting, stitching, lasting and finishing quality in stations, we recommend allocating additional checkers from operators since they know where the defect is existing. In addition to this, checkers better recording defect types on the developed quality control check sheet format as per the sections. In sole press machine due to the speed of the conveyer and existing long distance between sole press and the upstream process manual upper and out sole attaching, It is better assigning **one helper to feed the required amount of upper sole attached to the sole press** machine by applying **pairing number as per the size**. In final inspection in lasting due to the existing of many assembled products and only one counter , It is better assigning **one helper to feed the required amount of assembled Venice model to downstream process** of thread burner rather than **counting in finishing section**.

For eliminating unlike transportation - to finished leather store, putting finished leather inside shoe incoming raw material store. To preparation edge for glue making, changing glue making station near to splitting machine. To preparation inspection, changing final inspection station near to skiving machine. To lasting edge, putting chamfering or skiving machine in bottom section.For eliminating unlike transportation to lasting edge for roughing in sole, better using insole without sponge in bottom for making trimming operation. To mini last store which is found far from lasting section, better forming shelf in the lasting section near to lasting final inspection or the starting and ending of the lasting conveyer.

For eliminating unlike storage – inventory of cut components of Venice model, recommended balancing size of cutting components based on **bola recorded information** for issuing cut components to the next downstream stitching process.

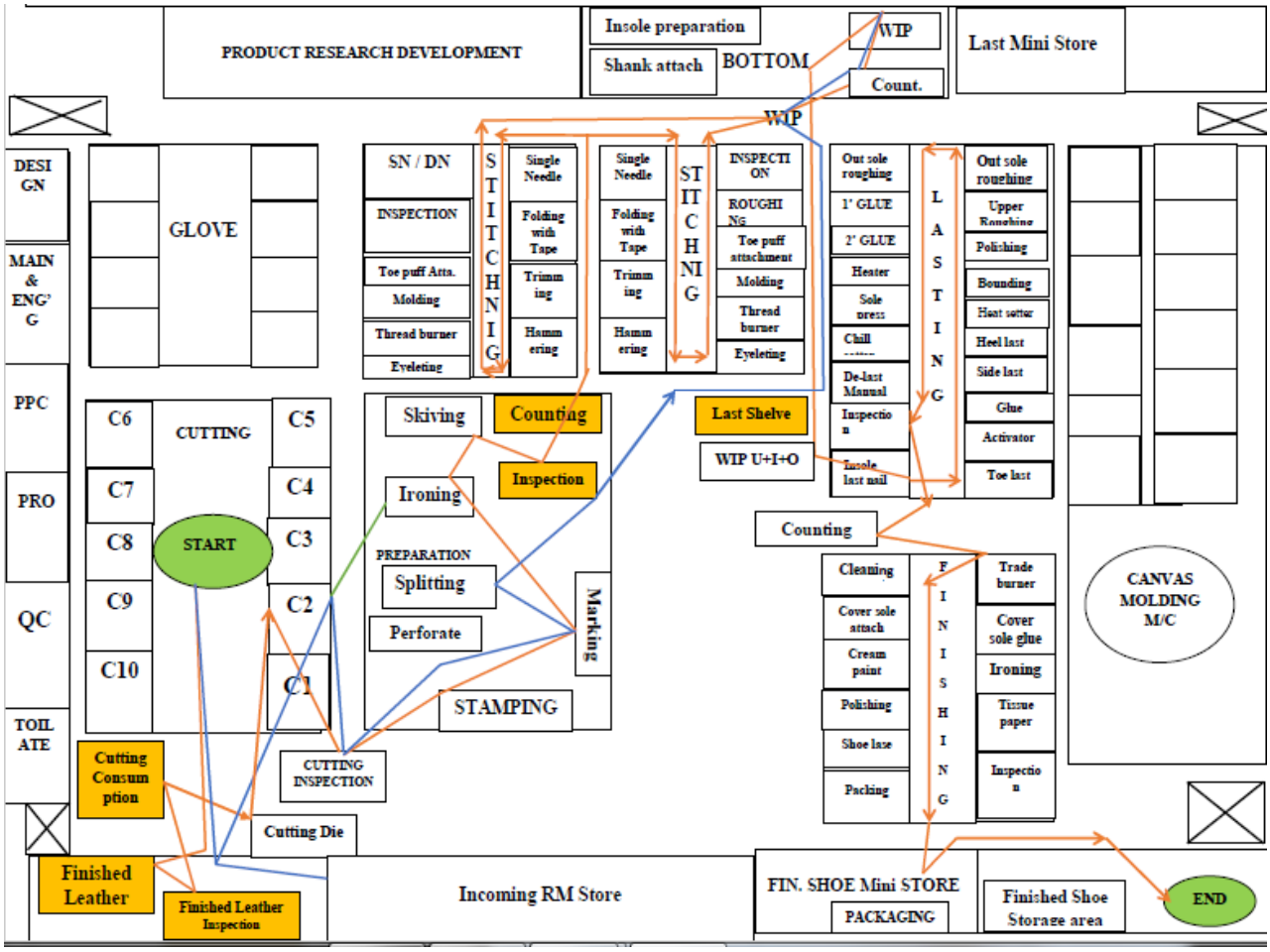


Fig. 12 Improved Shoe Production layout

Results were confirmed by comparing with set target. In the original situation analysis, the total time taken to deliver 240 pairs of Venice model shoe was 37,281.67 minutes. After counter measures implementation, the actual time taken was reduced to 18,236.55 minutes. When compared to the set target, the target was minimizing to 18,640.5 minutes by 50 %. The actual result is 403.95 minutes more than the set target. This is 1.08 % higher than the target. In general, the project was successful.

Table 12 Comparing result with the set target

KPI	Current	Target	Result	Comparing with the target
Delivery time of 240 pairs of Venice Model shoe	**37,281.67 min**	**18, 640. 5 min**	**18,236.55 min**	**+ 403.95 min**
		50 %	**51.08 %**	**+ 1.08 %**

Even though we have got an improvement by reducing total time from 37,281.67 minutes to **18,236.55 min**, still there was a room for improvement. But, there was no enough Venice model production order to exercise repeatedly. Some urgent production shoe orders were there.

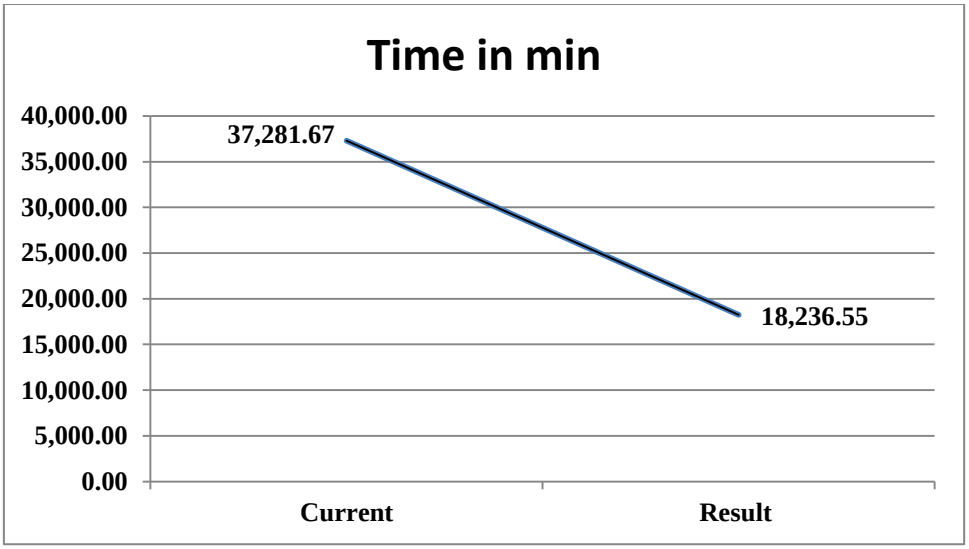


Fig. 13 Comparison of target and result

3.9. Standardization and Training

In quality control story formula, any new invented systems and achieved results are control points of the identified process. These control points should be standardize, improve and maintain during the production of Venice model shoe. Another, important activity that has been done at this stage was conducting training regarding to the new invented systems and control points to the respective employees in shoe production of cutting, stitching, lasting, finishing and mini stores. In addition to this, the top management should always monitor whether control points are standardize, improve and maintain using structured checklist. 18,640.5 minutes is the control point for producing 240 pairs of Venice model shoe. Operation analysis, application of quality control process chart, counting once, maintaining modifying layout & safety stock should always standardize, improve and maintain. The cross functional team members established an action plan that must be continuously done to sustain results. The action plan is presented as shown in table 13 below.

Table 13 Standardize activities

What? Action	When? Duration	Where? Location	Who? Person in charge	How? Method	Why? Objective	Control Point	Monitoring
Operation analysis	Always when Venice Model Produced	Shoe section	Shoe Production Foreman	Process flow chart	Eliminating Muda	Defect types	Shoe Production Head
Counting once	Always when Venice Model Produced	Shoe section	Material controller and checkers	Recording on logbook or checklist	To eliminate waiting	Counting time	Supervisor
Modification of lay out	Always when production order changes	Shoe section	Shoe Production Foreman	As per layout principle	Eliminate Muda of transport	Transportation time	Shoe Production Head
Implementing QC Control Process Chart	Always when Venice Model Produced	Quality in station	All Quality In station Inspectors	Using Quality Control Process Chart	Preventing Making **Defect &** Reject Products	Defect types	Quality Control Manager
Holding safety stock	Once a year	Shoe Production	Supplying department	Holding allowable incoming raw materials	Prevention of production delay	Checking accessories	Operation DGM

3.10. Future Plan

Most of the time, globally published quality control story related books did not contain future plan. As we have seen from the beginning, managements have prioritized critical problems. These critical problems should solve one by one. Inappropriately, the first ranked theme is solved, then next the second ranked theme will be solved either by cross functional team members or by new trained cross functional teams.

4. Conclusion and Recommendation

The following specific conclusions have been compiled from the project administered during the implementation. Awareness creation to top management and conducting training on TQM, TPS and TPM for department managers, supervisors and cross functional team members facilitating the project implementation. Taking the leading role of intermediate level kaizen project implementation by department managers have high effect on successful completion of the project. Formation of cross function team members from different departments related to selected theme is key for successful completion of the intermediate level Kaizen. By integration of quality control seven tools and quality control story formula, long delivery time of leather shoe can be minimized. Even though there is big room for improvement, the total time taken to produce 240 pairs of Venice model shoe is 18,236.55 min. absolutely eliminating wastes and unimportant non value adding activities resulted on increasing the value adding time. Both department managers and existing cross functional team members or new organized team members of the company should follow the problem solving approach - PDCA cycle extensively for process control and improvement. Any manufacturing industries can use and follow the integration of 7 QC Tools and QC story formula as per the step of PDCA cycle as shown in table 2 in order to satisfied customers by achieving the delivery time.

Table 2 QC 7 tools and QC story in relation with PDCA cycle (Source: Researcher)

PDCA Cycle	QC Story Formula	QC 7 Tools & soft techniques
Plan	(i) Introduction of the cross functional team	Process Mapping
	(ii) Reason for selecting the theme	Bar graph, Radar chart
	(iii) Current (original) situation analysis	Pareto diagram, Histogram
	(iv) Goal setting	Line graph
	(v) Activity plan	Gant chart
	(vi) Analysis of causes of the problem	Fish bone diagram , scatter diagram
Do	(vii) Measures examined and implemented	5W2H, Judgment criteria's
Check	(viii) Checking of results	Check sheet, Histogram, Scatter plot, Control charts
Act	(ix) Standardization and control	Control chart, check sheet
	(x) Future plan to solve another problem	5W2H

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