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Reduction of Excessive Trimming and Reject Leather by Integration of 7 QC Tools and QC Story Formula: The Case Report of Sheba Leather PLC

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Abstract

At the present time most of Ethiopian leather manufacturing industries are facing tough competition globally due to deteri-orated quality of leather. Clearly known that poor quality results in increasing manufacturing cost. Lastly, the industry becomes unprofitable. In addition, the industries are forced to lose their customers. Sheba leather Industry PLC is one of Ethiopian leather manufacturing industry facing this problem. So, the purpose of the project is to decrease extreme trimmed and rejected leather, to introduce a system that is capable of solving the problem, to expand findings to other sections of the industry. There was a problem of trimmed and rejected skin leather at re-tanning and crust preparation section. 14,879.92 kg of trimmed skin leather and 8,164 pieces of rejected leather. The problem solving methodology approach was used during the project work to reduce both trimmed and rejected leather. Quality control 7 tools were also applied as per the nature of the steps of problem solving. The findings after completion of the implementation period the excessive trimmed leather is reduced to 8,524 kg by 42.71% improvement. The rejected leather of minimized to 5,241 pieces of leather by 35.80% improvement. In addition, systems like standard operation procedure, standardization of four basic autonomous maintenance activities, quality control process chart and operator skill analysis are introduced on potential areas. Besides, the area of the finished leather also improves by 2.2% relative to the input size of the leather. Finally, the department managers took responsibility to sustain the substantial improvements and expand these systems to hide production section of the company.

Keywords: Minimization; Excessive; Leather; Quality

Introduction

The Ethiopia Kaizen Institute in collaboration with Japanese International Cooperation Agency – JICA implementing intermediate level kaizen at companies which have been successfully completing the first level of kaizen implementation in considering their activities on sustaining. Now a days, 12 manufacturing industries are know implementing the intermediate level kaizen at nationwide. From these companies, Sheba Leather Industry is one of these companies currently implementing. The reporter wants to discuss Kick-off was held with Sheba top and middle managements by performing the following activities during the first ICT visit: 'Diagnosis of the current activity of Kaizen office, shoes and tannery section, 'Discussion with HRD 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 ICT with Detail time schedule, Benefits of the project, CSFs 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 for top and middle managements including selected divisions and supervisors was given by performing the following activities. Preparation of training material for top and middle managements. High light training about applicable techniques were given for 20 male management members: TQM, TPS, TPM, A-KPT, PRODUCTION SCHEDULING, MATERIAL REQUIREMENT PLANNING. Company challenges or chronic problems were exploited from the management during discussion. In addition, Extracted challenges from the company convenient three year strategic business plan as seen in the next slide.

Establishing cross functional teams: A-KPT

Six number of cross functional teams are organized from eleven departments which contains 38 members (33 male and 5 female). Two CFT's are given for each EKI trainee. Reduction of excessive trimming and rejection leather CFT is one of those main teams that belong to me. Mr. Haftu Hailu took leading role of the project activities. The team comprise 6 members (5 male and 1 female). Hiluf Birhane and Henock Kassahun from tannery quality; G/meskel G/yohannese, Abrham W/rufael and Alganesh Cherkos from Tannery production; Yordanos abreha from supply.
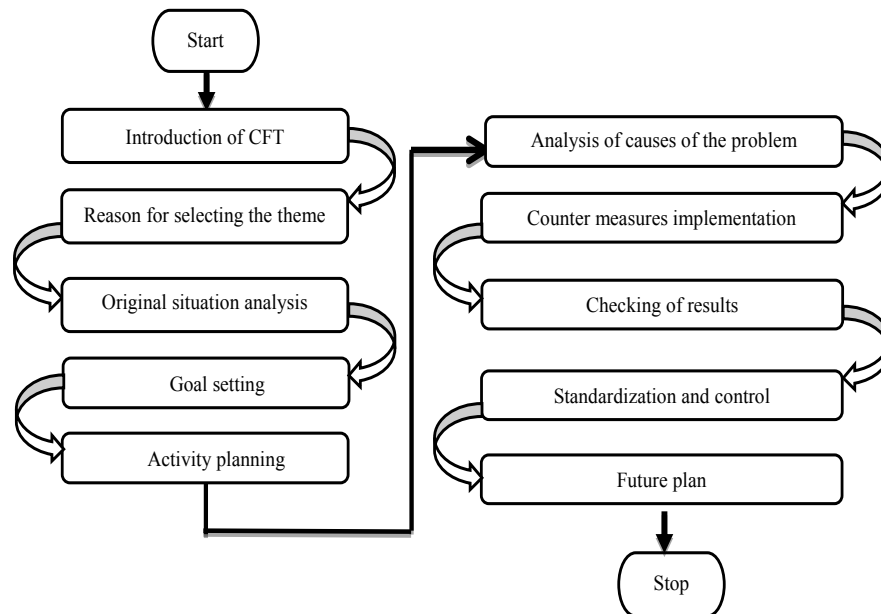
Material and Methods

Different materials like books, journals, and training materials were reviewed to learn more about 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 to the quality control story formula. The problem solving approach methodology is shown in Figure 1 below.

Figure 1: Flowchart of methodology.

Figure 2: The name of the cross functional team is "change."

Discussion and Results

Introduction of cross functional team

The name of the cross functional team is "change." The team comprises 6 members (5 male and 1 female). The name of the members starting from left to right. Edul Gegziabeher from QC Manager, Gebremeskel G/Yohannes Birhanefrom skin production, Hiluf from hide production, Haftu Hailu from EKI, Abreham W/rufael from skin crust preparation, Henock Kassahun from skin QC and Alganesh Cherkos from skin finishing. The minimum age is 28 and the maximum age is 37. The members are from different disciplines of profession (Figure 2).

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

Theme selection

Reasons for theme selection: The reason for selecting the problem, at the time of implementing the project, there was high cost because of excessive trimmed and rejected leather.8164 pieces of leather were rejected due to various types of defects which resulted in poor quality. There was also 14,000 kg of trimmed leather at dry trimming section [1].

Theme selection: In problem selection, the management should focus

Figure 3: Process flow of leather making in Sheba.

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 and international market through maximum utilization of the country hides and skins with continuous generation of wealth to the shareholders thereby contribute its share to the regional and 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 1 below. The management identified 6 main challenges knowledge and skill gap, existing capacity deviation, weak supply process, unequipped product research and development, unable to expand leather goods, weak marketing and sales system. Besides, 21 problems were identified through brainstorming; the critical few are shown in Table 2 below (Table 1).

Prioritizing problems: 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 2).

Theme: Reduction of excessive trimming and rejection leather in skin tannery by following ten steps of Quality Control Story Formula and application of 7 QCQ tools.

Original situation analysis

Trimming leather for suede upper: In current condition analysis, it is recommended to make problems specific by following the Specific, Measurable, Actionable, Reality and Time constrained – SMART principle. Based on this principle, the project work is more focused on the retanning, crust preparation sections of skin production section of suede upper product type (Table 3).

The table particularized that 14,879.92 kg is trimmed out from 266,387 pieces of finished leather. Besides, the category and types of

Strength
- Modern production set-up equipped with modern machine and 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.
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 and 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

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 and other African countries expected to create new markets, Preferential market like AGOA in USA and 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.
Threats
Quality deterioration of raw material leather, Continuous Foreign Direct Investment in the Ethiopian leather sector, High competition from established international brands and 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

Table 1: SWOT analysis.

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 and reject leather	Reduction of trimming and 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**

Table 2: Problem Judgment Criteria for prioritizing problems.

S.No.	Trimming Area	Category of Trimming		Trimmed Weight in kg
1.	Dry Trimming	Abnormal Trim	Trimmer	1,012.26 kg
		Mechanical trim	Machines-Buffing, Dry Shave	3,036.8 kg
2.	Final Dry Trimming	Defect	Knife cut	1367.10 kg.
			Hole	810.99 kg
			Back bone	509.78 kg
			Shape	451.84 kg
			Wound	115.86 kg
			Brand mark	81.10 kg
			Folding	46.34 kg
		Mechanical	Buffing	534 kg
3.	Wet Trimming	Mechanical	Wet shaving	6,913.86 kg
			Grand Total	14,879.92 kg

Table 3: Trimmed leather weight in Kg (from 266,387 pieces of leather).

defects were also recorded. In order to prioritize the defects, pareto diagram tool were used as shown below (Figure 4).

The above pareto diagram shows that the wet and dry trimming mechanical, knife cut and abnormal trim are 20% of vital few but eliminating these causes for trimming contributing high effect on trimming; whereas hole, final dry trim mechanical, backbone, shape, wound, brand mark and folding are 80% of trivial many but contributing less on trimming.

Leather rejection: The skin production section finishing area was the potential area of the cross functional team for identification of types of defects which enables the product to reject. Based on this, 8164 pieces of leather were rejected due to Patchiness - 2558, Wrinkle - 1307, Over thickness - 1006, Hair root - 950, Folding - 765, Flesh - 718, Mechanical - 259, Natural defect - 234, Trim – shapely - 169, Under thickness - 92, Sheep in goat - 43, Looseness - 42, Contamination - 20 and Under buff - 1defects (Figure 5).

From the above pareto diagram patchiness, wrinkle, over thickness, hair root and folding are 20% of vital few defect types which took 80% of the total rejected pieces of leather. This indicates that eliminating these types defects will results on increasing good quality of leather product. Whereas, flesh, mechanical, natural defect, trim shapely,

under thickness, sheep in goat, looseness, contamination and under buff are trivial many defect types that took 20% of the total rejected pieces of leather [2].

Actual input size (area of leather): From the wet blue selection, the input average area of finished goat lining, upper sued and upper military are 3.32, 3.56 and 4.4 square feet respectively. However, the total average is 3.57 square feet; the upper suede raw got skin input area was 5.96 square feet.

Target Setting

For this project work, there are three key performance indicators (trimming skin leather, finished skin reject and size increment. According to Katsuya Hosotani: THE QC PROBLEM SOLVING APPROACH – Solving Workplace Problems the Japanese Way book. There are three standards for setting a goal on page 86: The zero, halving and one-third approach. Among these approaches, the halving approach is selected. Based on this, 14,879 kg of trimmed leather, 5.14% of finished skin rejects and 2.4 (minus) area of leather will be minimized each by 50%. So, the goal of the project will be reduction of excessive trimming and rejection of leather by 50% in skin tannery production until august 2016.
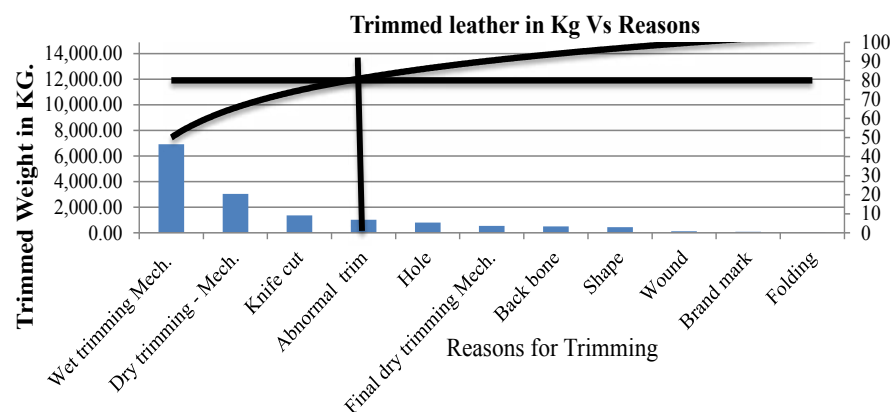

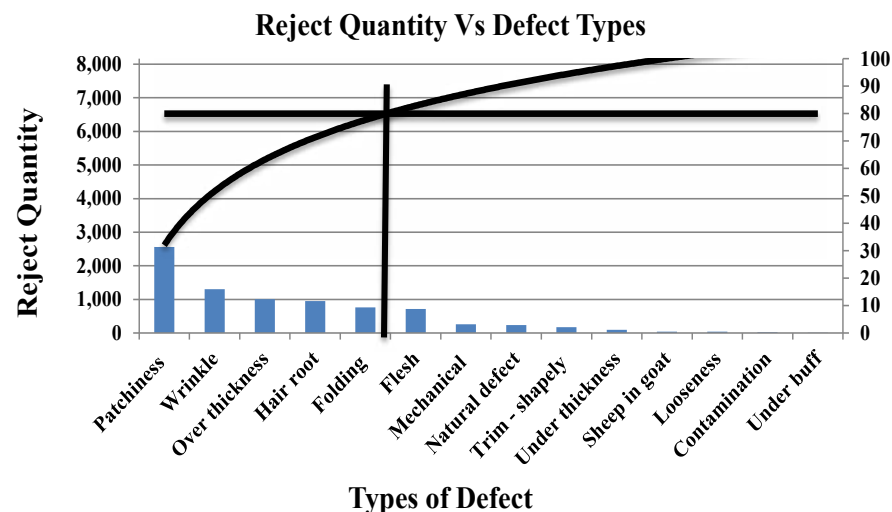**Figure 4:** Pareto diagram for trimmed leather.

Figure 5: Pareto diagram for rejected leather.

Activity planning and actual activities

Activity planning: In this step of problem solving approach, An action plan using the 5W1H soft techniques was prepared as shown in table below. The objective of the project, activities to be implemented, there place where implementation is going on, responsible personnel for every activities, the time frame and techniques that are going to be applicable are listed on the table (Table 4).

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 technical training aimed to reduce operator errors. Unfortunately, this counter measure was not implemented due to unavailability of equipped training centre. Meanwhile, the training center took responsibility to facilitate conducting trainings as per the provided skill matrix shown in implementation of the counter measure section of this report (Table 5).

Cause analysis

In the cause analysis, both fish bone diagram and why – why analysis tools were used. All possible causes for making trimming and rejected leather were listed out using simple brainstorming technique. After listing all possible causes of problem, grouping similar causes have been done in order to identify category of main causes for the problem. After grouping each cause, naming was given for each group. After naming, fish bone diagram was used to show the relationship among all possible grouped causes and main cause. Here, why-why analysis was used to identify possible root causes by discussion. The following two Cause and effect diagrams were prepared for excessive trimming and rejected leather (Figures 6 and 7).

Criteria for selecting critical root causes: The cross functional team members tried to list many root causes using the why – why analysis technique based on data. But, since all root causes are not critical. The team again set selection criteria to identify the true root

causes [3-5]. Effect, frequency and controlling were considered to select the critical root causes. Based, the identified critical root causes have been selected as shown in table below (Table 6).

Note: From the table we can understand that based on the three listed criteria's No QC process charts, No SOP, Not Providing Training and No Autonomous Maintenance Standardization and Defective raw skin have got highest score and these root causes have high contribution on excessive trimming and reject leather. Since they are the critical root causes.

Countermeasure examination and implementation

In determining best solutions it is necessary to consider the following: Feasibility (F): The solutions need to be within the company's resources and schedule; Effectiveness (E): The solutions need to have a reasonable probability of solving the problem; Budget (B): Solution costs must be within the budget of the company and appropriate for the extent of the problem; Employee Involvement (EI): The departments and personnel affected by the problem need to be involved in creating the solution; Focus on Systems (FS): The solutions should be focused on systemic issues; Contingency Planning (CP): All solutions are developed with a certain expectation of success. Based on this, many counter measures have been examined. Herewith below is prepared the table for selected best solutions (Table 7).

Countermeasure implementation action plan 5W1H: After identification of the best counter measures, the cross functional team members were prepared an implementing action plan using 5W1H soft technique (Table 8).

Conducting training for skin tannery by skill assessment analysis: During implementation of counter measures, the first activity done was leveling each employee to four by skill matrix. Because, conducting training as per their level has high impact on successful completion of implementation. The traditional way of company's conducting training is providing technical training to all in one class room. But, there was

PDCA	Why?	What?	Where?	Who?	When?	How?
	Objective	Items to be implemented	Location	Person in charge	Dec 2015-Aug 2016	Method
Plan	Impression, Awareness creation	1st day: Kick-off (1-2 hrs),	Manage. hall	EKI Consultant	December 07	Discussion
		2nd day:Training for management (6 hrs)	Employee hall	EKI Consultant	December 08	CRT
		Confirm company policy	Manage. hall	Top Management	Dec 09-Dec 11	Cross SWOT
	Set up issues	Subject selection	Skin Tannery	Management	Dec 14-Dec 18	Selection matrix
	Capacity building	Training for A-KPT	Skin Tannery	EKI Consultant	Dec 21-Jan 01	CRT and ICT
	Examine	Comprehending the current situation	Skin Tannery	CFT, EKI Consultant	Jan 04-Jan 15	Process map, Pareto Diagram
		Progress sharing meeting	EKI	EKI Consultant	Jan 18-Jan 29	
	Goal setting	Goal setting	Skin Tannery	CFT, EKI Consultant	Feb 01 and Feb 02	The halving approach, line graph
	Collect information	Activity planning	Skin Tannery	CFT, EKI Consultant	Feb 03-Feb 05	5W1H, Gantt Chart
Do	Identify problems	Cause analysis	Skin Tannery	CFT, EKI Consultant	Feb 08-Mar 11	Fishbone Diagram, 5Whys
		Progress sharing meeting	EKI	EKI Consultant	Mar 14-Mar 25	
	Examine and List solutions	Examine counter measures	Skin Tannery	CFT, EKI Consultant	Mar 28 - Apr 06	Judgment criteria, Likert scale
	Implement measures	Implement counter measures	Skin Tannery	CFT, EKI Consultant	Apr 07-July 01	5W1H
		Progress sharing meeting	EKI	EKI Consultant	July 04-July 15	
Check	Confirm	Comprehending result	Skin Tannery	CFT, EKI Consultant	July 18-July 29	Line graph, Pareto Diagram
Act	Follow up progress	Standardization and training	Skin Tannery	CFT, EKI Consultant	Aug 8 and Aug 9	5W1H, Control chart, SOP
		Review of future issue	Skin Tannery	CFT	August 10	Communication Review meeting
		Report to managements of ICT	Manage. hall	EKI Consultant	August 11	
		Final presentation in EKI	EKI	EKI Consultant	Aug 22-Aug 26	

Table 4: Activity planning for the project.

PDCA	What? / Items to be Implemented			Dec.	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.
							When?					
Plan	1st day: Kick-off (1-2hrs),		Plan	→								
			Actual	→								
	2nd day: 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									
		Prep. and Implementation of SOP	Plan					→				
			Actual					→				
		Prep. and Implementation of Four basic AM activities	Plan					→				
			Actual									
		Prep. and Implementation of QC Process Chart	Plan					→				
			Actual					→				
		Performing Skill analysis	Plan					→				
			Actual					→				
		100% Raw skin inspection	Plan					→				
			Actual					→				
Check	Comprehending result		Plan								→	
			Actual								→	
Act	Standardization and training		Plan									→
			Actual									→
	Review of future issue		Plan									→
			Actual									→

Table 5: Actual activities done during in company training.

operator's performance evaluation criteria's. The team discussed on these parameters and agreed to used them for categorizing each operators: Production quantity output per day, Quality of the product – as per the customer requirement, Cost reduction – by eliminating rework, reject, Material handling at workplace, Self – discipline regarding to behavioral changes, Usage of PPE – Personnel Protective Equipment, Implementation of 5S activities, Synergy – interaction with the group, leader, Sense of ownership, Creating new ideas (Table 9 and Figure 8).

The above pie chart elaborates 52.67% of the operators are inexperience, since they are new comers; 42% of operators are dependent and still they need serious follow up from their leaders forman and supervisors. Only 5.33% of operators are independent, they can work alone but could not instruct to others. This analysis also shows that above 50% of operators are inexperience and dependent. They have low skill and knowledge regarding to their working procedures, processes and machines. Obviously, providing on job technical training (since

there is no training center) as per their working areas to fill their skill gaps is unquestionable. Even though, there are no operators who can instruct for others, Quality manager in collaboration with cross functional team members, they conducted technical training regarding to trimming, adjustment, inspection, feeding system, standardized operating procedure for each process and machines, autonomous maintenance, application of QC process chart (Table 10).

Four basic autonomous maintenance activities like inspection, cleaning, oiling and bolt tightening for beam house, retanning and crust preparation section of skin tannery machines is prepared and awareness was created by cross functional team members in collaboration with QC Manager (Table 11 and Figure 9).

Quality control process chart for beam house, retanning and crust preparation section of skin tannery quality in stations is prepared and awareness was created by QC Manager in collaboration with cross functional team members (Table 12).
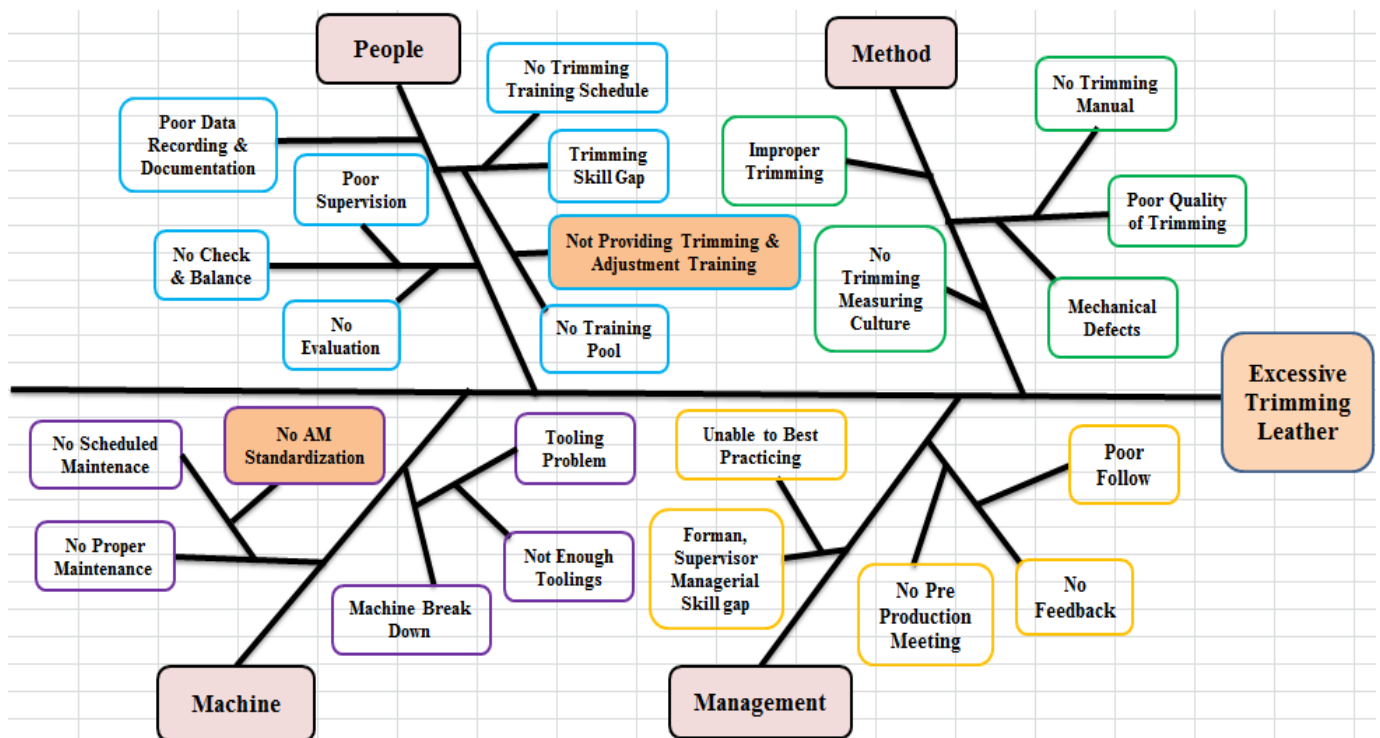
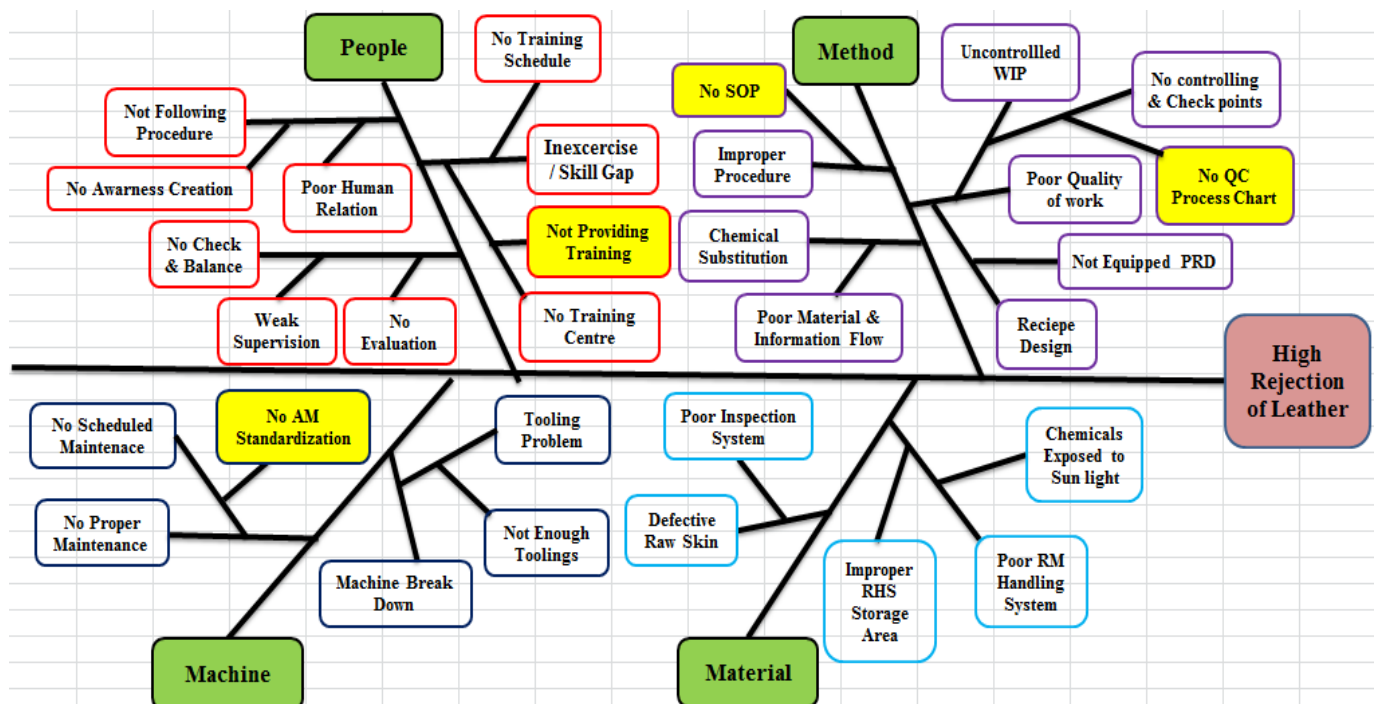**Figure 6:** Fish bone diagram for excessive trimming leather.

Figure 7: Fish bone diagram for high rejection of leather.

Potential Causes	Criteria			Score
	Effect	**Freq.**	**Control**	
Method				
Uncontrolled WIP	9	7	8	504
No controlling and Check points	10	8	6	480
Poor Quality of work	10	6	4	240
No QC Process Chart	10	10	10	1000
Not Equipped PRD	8	8	5	320
Recipe Design	10	8	5	400
Poor Material and Information Flow	10	9	7	630
Chemical Substitution	9	7	6	378
No S.O.Procedure	10	10	10	1000
Improper Procedure	9	8	6	432
People				
No Training Schedule	8	9	8	576
Inexcercise / Skill Gap	10	10	7	700
Not Providing Training	10	10	10	1000
No Training Centre	10	10	6	600
No Performance Evaluation	8	9	6	432
Weak Supervision	9	10	6	540
No Check and Balance	10	8	5	400
No Awareness Creation	8	8	10	640
Poor Human Relation	8	7	8	448
Not Following Procedure	10	6	6	360
Machine				
Machine Break Down	10	6	8	480
Not Enough Tooling's	8	7	9	504
Tooling Problem	8	7	10	560
No Proper Maintenance	9	6	10	540
No AM Standardization	10	10	10	1000
No Scheduled Maintenance	7	6	10	420
Material				
Poor RM Inspection System	10	8	6	480
Defective Raw Skin	10	10	9	900
Improper RHS Storage Area	8	8	6	384
Poor RM Handling System	9	7	6	378
Chemicals Exposed to Sun light	7	8	6	336

Table 6: Critical root causes selection.

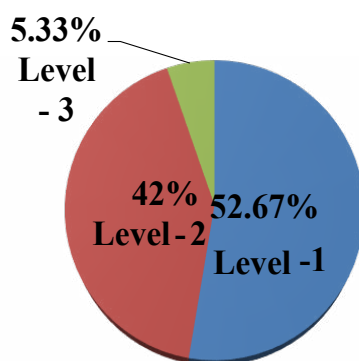| Theme	Problem	Facts	Counter measure	Judgment
Excessive Trimming	Wet trimming Mechanical	Not providing adjustment training	First by established training room with skilled trainer and equipment, then providing technical adjustment training	Excellent
	Dry trimming - Mechanical	Not standardized AM four basic activities	Preparation of standardized four basic AM activities – Inspection, Cleaning, Lubrication (oil), bolt tightening	Excellent
	Knife cut	Selector passes defects like Knife cut	Providing technical training to raw skin selectors	Excellent
	Abnormal trim	Unskilled trimmer	Preparation of trimming manual and providing technical trimming training to trimmers	Excellent
High Rejection	Patchiness	Not standardized recipe and operating procedure	Preparation of standardized recipe design, operating procedure and QC process chart for re tanning drum	Excellent
	Wrinkle	Not standardized recipe and operating procedure	Preparation of standardized recipe design, operating procedure and QC process chart for re tanning drum	Excellent
	Over thickness	No training provided on adjustment	Providing technical training to wet and dry shaving machine operators	Excellent
			Preparation of standardized inspection, cleaning, lubrication (oil), bolt tightening for wet and	Excellent
	Hair root	Chemical painting problem	Preparation of painting manual and providing training	Excellent
	Folding	Poor loading and unloading	Providing technical loading and unloading training to dry shaving, buffing, rotary, vibratory, Sam setting machine operators	Excellent

Table 7: Counter measures Examination.

Reasons for trimming and Rejection	WHAT?	WHERE?	HOW?	WHEN?						WHO?	WHY?
	Problem	Location	Recommended action	Duration April 11-May 27/2016						Person in charge	Objective
				18-22	25-28	02-06	09-13	16-20	23-27		
Wet trimming mechanical	Not providing adjustment training	Wet shaving machine	Adjustment training	→						Retanning supervisor, CFT	To prevent mechanical defect
Dry trim. mechanical	Not standardized four basic AM activities	Dry shaving and buffing	Standardized ICOBT		→					CFT, Skin maintenance	
Knife cut	Selector checking problem	Raw skin store	Training, 100% inspection			→				QC manager, CFT	To prevent passing defect
Abnormal trim	Unskilled trimmer	Wet and dry trimming	technical training (How to trim)			→				CFT	To increase area of leather
Patchiness	Not following the Procedure	Retanning drum	SOP, QC Process chart							supervisor, CFT	To increase leather evenness
Wrinkle	Not following the Procedure	Beam house - Tanning drum	SOP, QC process chart				→			supervisor, CFT	To prevent crease
Over thickness	Adjustment	Buffing, Wet and Dry shaving	Training							supervisor, CFT	To prevent defect
Hair root	Painting - procedure	Beam house – Tanning	SOP, QC process chart					→		supervisor, CFT	To eliminate the hair on grain
Folding	Poor feeding system	Setting out	Training						→	Skin production	To prevent damaged

Table 8: Counter measures implementation action plan.

S.NO.	Section	Level of operators			
		Level-1 (Inexperience)	Level-2 (Dependent)	Level-3 (Independent)	Level-4 (Able to instruct)
	RHS Store	4	2	-	-
	Skin Beam House	7	15	3	-
	Skin Wet Blue Selection	3	11	-	-
	Skin retanning	31	2	-	-
	Crust preparation	27	19	1	-
	Total Quality Control	-	3	2	-
	Finishing	7	11	2	-
	Total	79	63	8	-
	150	52.67%	42%	5.33%	

Table 9: Level of operators.

Figure 8: Pie chart for level of operators.

No.	Major Steps	Time in Second				Process: Wet Shaving			
		Man	M/c	Wait	Walk	Shift: Normal	Talk time	Cycle	Time
1.	Visual checking over all the machine	15				Working sequence	Safety	SWIP	Quality
2.	General switch on	1							
3.	Emergency check	1				Walk ▬▬ Return to Start …			
4.	Button adjustment from stop	1							
5.	Unlock pedal and safety	1							
6.	Adjustment 12 mm and pressure 35-40 bar	25							
7.	Walking for general switch adjustment				20				
8.	Working button on	1							
9.	Unlock pedal and safety	1							
10.	Blade on	1							
11.	Walking to check grinder				7				
12.	Grinder adjustment	13							
13.	Walking back to machine				7				
14.	Grinder on	1							
15.	Grinding process			330					
16.	Testing the grinder using wet blue		45						
17.	Grinder switch off	1							
18.	Blade off	1							
19.	Walking to bring wet blue product				20				
20.	Blade on by pressing pedal	6							
21.	Picking wet blue product	1							
22.	Shaving process		16						
23.	Walking to load and unload wet blue				20	The team was trained for application of the prepared standardized operating procedure. For selected processes and machines of skin section, SOP was developed. An awareness was created for those employees of selected processes and machines.			
24.	Blade off	72							
25.	Work stop button off	1							
26.	Emergency off	1							
27.	Walking to general switch				10				
28.	General switch off	1				Note:- standardized work chart for beam house, retanning and crust preparation section of skin tannery is prepared and awareness was created by QC Manager in collaboration with cross functional team members.			
29.	Cleaning by swipper	120							
30.	Walking to bring air				70				
31.	Cleaning by air	120							
32	Walking to put air tube in its place				70				
	Total	385	61	330	281				

Table 10: Standardized work chart – SOP.

Figure 9: Beam house.

Comprehending the results

The cross functional team members were evaluating the implementation in order to confirming whether the implemented countermeasures have resulted in achieving quantitative and qualitative results for both trimming and rejected leather. Obviously, it is known that when there is less trimming, the size of the leather will remain as it is. There is no opportunity to reduce from one size to another. Based on the evaluation the result is shown below (Table 13).

Discussion on the table: The total trimmed leather weight before implementing the counter measures from 266,387 pcs were 14,879.92 kg. But, after implementation the counter measures the total trimmed leather became 8,524 kg. In sampling, it is possible to use both vary and

Department: Tannery Skin Production			Section: Beam House		Machine: Drum	
Standards for Drum – Cleaning						
S.No.	**Part of M/c – Location**	**Method of cleaning**		**Standard**	**Time**	*Frequency*
1.	Crown	Rag		Shine	10 min	Weekly
2.	Pinon	Rag		Shine	10 min	Weekly
3.	Gear box	Rag		Shine	1o min	Weekly
4.	Bearing house	Rag		Shine	10 min	Weekly
5.	Drum body	Oil		Shine	30 min	Monthly
6.	Gear box motor	Air and Rag		Shine	15 min	Monthly
7.	Electrical board	Rag and emery, paper		Shine	30 min	Monthly
8.	Electrical panel	Rag		Shine	5 min	Monthly
9.	Filter	Water		Shine	6 hr.	6th per month
Standards for Drum – Inspection						
1.	Drum wood	Visual	Rotation	2 min		Daily
2.	Pinion	Sound	Functional	1 min		Daily
3.	Crown	Visual	Functional	2 min		Daily
4.	Gear box	Touching	Vibration	5 min		Daily
5.	Motor	Visual	Functional	2 min		Daily
6.	Banyan	Visual	Functional	1 min		Daily
7.	Darning valve	Visual	No leakage	1 min		Daily
8.	Drum door	Visual	Functional	2 min		Daily
9.	V – belt	Visual	Functional	3 min		Monthly
Standards for Drum - Lubrication						
1.	Crown	Manual by hand	EP3	1.2 kg		6th per month
2.	Pinion	Manual by hand	EP3	1.2 kg		6th per month
3.	Buranz – bushe	Manual pump	EP3	1.2 kg		Weekly
4.	Berak – fliud	Manual by hand	(Oil HBF 4)	0.5 Liter		Once per 2 year
Standards for Drum - Bolt tightening						
1.	Foundation bolt	Wrench	Lock	04		When vibration
2.	Gear box foundation bolt	Wrench	Lock	08		When vibration
3.	Motor support	By hand	Lock	01		When down
4.	Drum door bolt	Wrench	Lock	04		When rearrange water
5.	Drum hop	Wrench	Lock	06		6th per monthly
6.	Electrical board bolt	Screw	Lock	20		Monthly

Table 11: Four basic autonomous maintenance activities.

QC Process Chart			Product name		Plant concerned		Sheba leather	Doc. number	D-01		
					Section		Tannery production				
Department	**RHS Store**		**Product number**		**Line concerned**			**Date**			
Process number	Process name	Facility name or input	Specific Working area	Control Point			Control method				Remarks
				Processing condition	Quality characteristics or checking parameter		Standard	Inspection method	Inspection equipment	Inspection record	
1	Selection	Raw skin	RHS QC section	Grade of raw skin	Hole, knife cut, heat, putrefy, Brand mark, Wound, Shape, crack		RHS inspection standard	Visual	Manual	RHS inspection record chart	
					Size			Measuring	Measuring table		
					Pilling standard WS= 0.60 m and		FIFO	Measuring	Tape measure		
					Air dry = 1.5m						
					Piling date WS < 2 weeks and						
					Air dry < 2 month						
					Trimming: neck part half moon						

**Table 12:** Quality control process chart for RHS.

same sample. But for comparison between the actual situation before and after the implementation I recommend to use same number of pieces (Figure 10).

Discussion on the above figure: The figure shows that the total rejected pieces of leather before implementing the countermeasures like preparing, awareness creation and implementing quality control process chart, quality control check sheet format and standardized operating procedure, were 8164 pcs but after implementing the countermeasures the total rejected pieces of leather becomes 5241 pieces. 2923 pieces of finished skin leather is saved from being rejected. Due to the reduction of excessive trimming from 14,879.92 kg to 8,524

S.No.	Trimming area	Causes for trimming		Trimmed Weight in kg	
				Before	**After**
	Dry trimming – skin leather	Abnormal trim	Trimmer	1,012.26 kg	641.26
		Mechanical trim	Machines (Buffing, Rotary, stacking, Dry shaving and Setting out)	3,036.8 kg	1,873.60
			Total	4049.06	2,514.86
	Final dry trimming – skin leather	Defect	Knife cut	1367.10 kg.	248.60
			Hole	810.99 kg	493.65
			Back bone	509.78 kg	310.30
			Shape	451.84 kg	275.03
			Wound	115.86 kg	70.52
			Brand mark	81.10 kg	49.36
			Folding	46.34 kg	28.21
			Total	3,383 kg	1475.67
		Mechanical	Buffing	534 kg	325
			Total	3,917 kg	1,800.67
	Wet trimming Skin leather	Mechanical	Wet shaving	6,913.86 kg	4,208.46
			Total	6,913.86 kg	4,208.46
			Grand Total	14,879.92 kg	8,524 kg

Table 13: Trimmed weight in kg. (From 266,387 pieces).
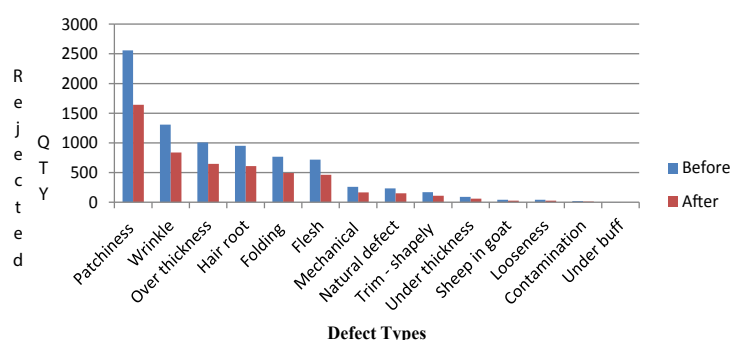
Figure 10: Rejected leather quantity versus defect types (from 158,884 pieces).

Key Performance Indicators	Before, Target, Improvement (%) result		After, Target, Improvement (%) result		Deviation from target
KPI 1: Trimming Leather skin	Before	14,879.92 kg	After	8524 kg	
	Target	7439.96 kg	Target	7439.96 kg	
	Improvement (%)	50%	Improvement (%)	42.71%	-7.29%
KPI 2: Finished Skin Reject	Before	5.14%	Actual	3.3%	
	Target	2.57%	Target	2.57%	
	Improvement (%)	50%	Improvement (%)	35.79%	-14.21%
KPI 3: Size Increment From Input	Before	2.4% (minus)	Actual	2.2%+Ve.	
	Target	1.2% (positive)	Target	1.2% +Ve	
	Improvement (%)	50%	Improvement (%)	191.67%	+141.67%

Table 14: Comparison of target (before) and actual result (after).

kg and reduction of defects on the leather (158,884 pieces) from 5.14% to 3.3%, the output average area of finished is 3.65 square feet [6]. The previous average area of the skin leather before implementation were 3.57. The improvement is (3.65-3.57/3.65) *100 = 2.2%

Confirmation of the trimming leather, finished skin reject and size area increment before, target and improvement% results were compared with after. Based on this, the three key performance indicators are compared as shown below (Table 14).

Discussion on the table: From the table it is shown that for KPI 1 and KPI 2, the target is not achieved. Because, in the counter measure action plan, it is suggested to provide technical or practical training for production, maintenance and quality control staffs. But, since there is no training center, it was difficult to deliver the training. We simply focus on mobilization and awareness creation to all required listed staffs (Figure 11).

Standardization and training - SOP, photo

This step is key for an organization. Improvements must be included in the working procedure. In general, by following the Plan – Do – Check – Act cycle, after achieving results, these results sholud be standardized and must be base line for next activity planning (i.e following Standardize Do Check Act). One thing that must not be forget at this stage of problem solving approach is create an awareness

Figure 11: Discussion on the table.

Figure 12: Improvements must be included in the working procedure.

or conducting training regarding to the results and standards to respected employees is very manadatory. Based on this, the achieved results were presented to company managements by QC Manager. The following table was prepared as a control point for reduction of excessive trimming and rejected leather (Figure 12 and Table 15).

Future plan

In PDCA Cycle, chronic problems are prioritized as per their volume, size or depth. After confirmation of being solved the first ranked problem, the management or team agreed on to solve the second ranked problem or to implement any left countermeasures that did not implement due to various reasons. So, for successful completion of this improvement activity, a detailed action plan should be prepared. Most of the manufacturing companies did not give attention to this activity. Sheba Leather Industry managements, cross functional team members, EKI staff and JICA expert were discuss each other on left counter measures specifically on conducting technical training. After the agreement, the following future action plan was developed and created an awareness to responsible persons (Table 16).

Summary of Technical Report

This is technical report focused on minimization of long delivery time of shoe by integration of 7QC tools and Quality control story formula. At the time of the project, there was customer complaint.

What? Action	When? Duration	Where? Location	Who? Person in charge	How? Method	Why? Objective	Control Point	Monitoring
Implementing Skin Leather Standardized Operating Procedure	Always when Skin Leather Produced	RHS, Beam House, Tanning, Retanning, Crust Preparation	Skin Tannery Production Foreman, Operator	Preparing New SOP for Every Product	Producing Quality Skin Leather Product	Parameters for skin leather	Skin Tannery Production Head
Implementing Four Basic Autonomous Maintenance Activities	Always when Skin Leather Produced	Beam House, Tanning, Retanning, Crust Preparation Machines and drums	Skin Production Maintenance Staffs - Mechanics	Using Inspection, Cleaning, Oiling and Bolt – Tightening Standard Format	Improving the Availability of Machines on The Production	Four Basic AM Activities	Tannery Maintenance Manager
Implementing Quality Control Process Chart	Always when Skin Leather Produced	RHS, Beam House, Tanning, Retanning, Crust Preparation	Skin Quality Inspector	Using Quality Control Process Chart	Preventing Making Reject Products	Defect types as per the section	Quality Control Manager
Consistent Follow Up	Once a Week	Skin Tannery Production	Production, Quality, Maintenance Managers	Establishing Standardized Meeting Schedule	Solving Skin Tannery Problems	Holding once a week meeting	Operation DGM
100% raw skin inspection	Daily	RHS Store	RHS QC Selectors	Using RHS QC check sheet format	Not to pass defected raw skin	RHS defect types	QC Manager

Table 15: Standardization of control points.

Reasons for trimming and Rejection	WHAT? Problem	WHERE? Location	HOW? Recommended action	WHEN? Duration 20016							WHO? Person in charge	WHY? Objective
				Sep.	Oct.	Nov.	Dec.	Jan.	Feb.		
Wet and dry trimming mechanical	Not providing adjustment training	Wet shaving machine	Adjustment training	→						Re-tanning supervisor, CFT	To prevent mechanical defect
Knife cut	Selector checking problem	Raw skin store	Training, 100% inspection		→					QC manager, CFT	To prevent passing defect
Abnormal trim	Unskilled trimmer	Wet and dry trimming	Providing trimming training			→				Skin production, CFT	To increase area of leather
Over thickness	Adjustment	Buffing, Wet and Dry shaving	Training				→			Skin Crust supervisor, CFT	To fulfill the customer requirement
Folding	Poor feeding system	Setting out, Vibratory stacking	Training					→	→	Skin production	To prevent the leather from damaged

Table 16: Future activity plan for solving.

This was originated from not achieving delivery time of Venice model shoe. The management via brainstorming agreed on minimization of long delivery time theme to be tackled by the project. Meanwhile, cross functional team was established from different departments related to theme. The team analyzed original situation of the problem starting from order preparation to final storage time. They confirmed that more than 3 months are taken to produce 240 pairs of shoe. Therefore, the team set a target to reduce by 50 percent. An action plan contained problem solving steps was prepared. Based on studied original situation, cause analysis was done to identify critical root causes. During analysis fish bone diagram, why – why analysis and cause priority number criteria were used. After identifying critical root causes, possible countermeasures were established using criteria's. The possible countermeasures were implemented as per the countermeasure action plan. After the completion of the implementation period, the team evaluated the process and certain achieving tangible result by shortening delivery time to 18,236.55 min. This result is control point of Venice model shoe. The team was trained to standardize, maintain, and improve this control point. At the end, future plan was prepared to implement left best solutions and to solve another new theme.

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