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Minimization of Rework in Food Industry byApplying Pareto Chart and Cause Effect Diagram

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Abstract- As food manufacturing sector is an emerging sector in Bangladesh, quality improvement can play an indispensable role in improving productivity and economic development for our country as well. The fast changing economic conditions such as global competition, declining profit margin, customer for high quality product and reduced lead-time etc. The demand for higher quality product is increasing and to survive in the competitive market food manufacturers need to improve their operations through producing the product right first time. This paper illustrates a very detailed investigation on rework reduction as well as quality improvement of a food factory by applying Pareto Analysis and Cause-Effect Diagram. The aim of this study is to minimize rework generation that will improve productivity and profitability. One month data has been collected from the management, then Pareto Analysis and Cause-Effect Diagram are performed on them. The application of this paper improves the process performance of the critical operational process, leading to better utilization of resources, decreases variations and maintains consistent quality of the process output. The outcome of this observation demonstrates that a manufacturing industry can gain higher productivity and profitability. It also minimizes cost and reduces the production time.

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Strictly as per the compliance and regulations of :

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I. Introduction

The food industry has played an immense role in the development of industrial sector of Bangladesh. Although it started lately, it soon established its reputation in the competitive Bangladeshi market. In many food manufacturing processes, some of the products can be defective due to an unstable production environment, non-perfect technology or human mistakes. Instead of being disposed of, defective items are more and more put into recovery processes in order to reassemble material and value added. These reuse activities are also supported by a growing environmental consciousness. Recovery actions belong to the broad field of Reverse Logistics which deals with all kinds of reuse processes in supply chains. As a major activity in this context we face rework which aims at recovering defective products in such a way that they definitely meet the quality level of a good item. Integrating rework and manufacturing processes successfully leads to challenging planning and control problems, especially if both processes are using the quite same equipment. Rework is the unnecessary effort of re-doing a process or an activity that was incorrectly implemented or produced at the first time. It is an endemic feature of food manufacturing and is a fundamental factor that contributes to time, effort and cost overruns in manufacturing processes.

Rework occurrences adversely impact the performance aspects of food manufacturing process e.g. with respect to costs, time, quality as well. The impacts of rework on food manufacturing management control include (a) additional time to rework, (b) additional costs for covering rework occurrences, (c) additional materials for rework an subsequent wastage handling, (d) additional labor for rework and related extensions of supervision manpower.

Although changes may be considered as inseparable in some perspectives, uncontrolled occurrences of rework and wastages should be effectively controlled to improve various targeted objectives of food manufacturing process e.g. with respect to timeliness, costs targets and product quality as well. The study has been conducted in food industry that chiefly aims at (a) identifying significant rework items and their root causes in the manufacturing process and (b) developing structured frameworks for effective rework control and management.

Minimization of reworks is a must in quality and productivity improvement. Reworks are the nonproductive activities focusing on any activity that customer are not willing for. Nonproductive activities describe that the customer does not consider as adding value to his product. By reacting quicker in minimization of reworks to make a product as per customer demand with expected quality, the company can invest less money and more costs savings. Therefore, the study has been carried out in food manufacturing industry named Nestle Bangladesh Limited. In the organization, we worked in a particular section (i.e. manufacturing section) for a particular product (i.e. noodles) to identify reworks so as to eliminate them for saving time, cost and improved product quality. A general overview over the development is given in this paper that suggests

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how to handle these issues and bring down the rework to minimum conclusively.

II. Methodology

In this study, we have maintain some basic steps. We apply some fundamental Quality Control (QC) tool for our analysis purpose. The method we followed is described by some steps in below:

a) Industry & Factory Selection

Industry and Factory selection is most important with respect to our study. As we planned to minimize the rework generation in a Food industry, we have gather information and communicate with some of the declining industry in the market for helping them to develop its production.

b) Conducting Case study

In this step, we have studied the whole process of production and review of the existing quality system. We also go through some research work related with our field.

c) Accumulation of Information

Collecting the relevant information we used the Check sheet for everyday rework generating at different place. This data collection process lasts for 12days.

d) Problem Identification

We analysis the raw data and we interpret this data in the Pareto Chart and identify the vital few and most critical zone of rework generation.

e) Analysis & Calculation

After processing the Pareto chart we have analysis the most critical Zone with Cause-effect diagram and find the actual problem that lies behind the loss of productivity. A cost calculation of the total rework is also calculated for getting the total monitory loss in every month.

III. Rework

Broken cakes, chips generated from cakes are usually called Rework. Certainly, the dry rework is a safe product and can be consumed, but the QA release is required for it. But the concern is, it is not at the desired shape. So, it needs further processing with new batch. Chips are generated at different transformation zone, from one conveyor to another conveyor at wrapping section. If any problem occurs at wrapping machine, cakes are temporarily stored at different buffering boxes from slat conveyor. While buffering, cakes may get broken and chips are also generated as well. Thus rework generates. But, generation of rework is undesired and the general practice is to minimize the rework generation as less as possible.

a) Types of Rework

Steam Rework: Rework collected from Roller section to Pre-Dryer section is called steamed Rework. Shelf life of this Rework is 2:30 hours. It must be mixed with dough mixture within that time after having prescribed treatment.

Dry Rework: Rework collected at wrapping section is called Dry Rework. Expired time of this Rework is 90 days. It needs Soaking operation for oil removal and then gets mixed with dough mixture.

IV. Process Flow in Noodle Line

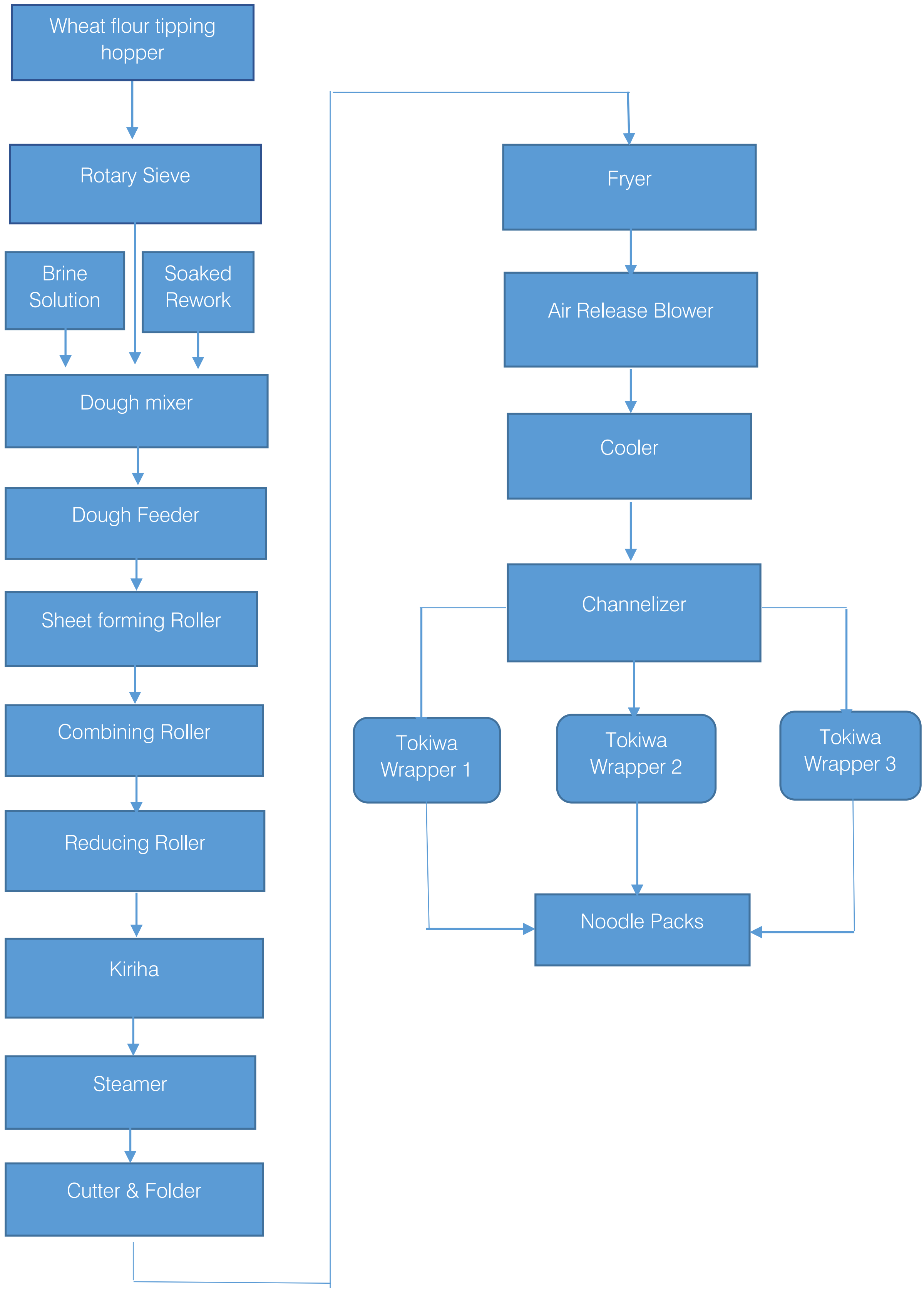

Fig.1 : Process flow Diagram of Noodle Line

V. Experimental Data

Week	Day	Buffering Box	Channelizer	Feed Conveyor	Sachet Dispenser	Metal Detector	Auto Feeder	Pull Conveyor	Slat Conveyor	Overhead Conveyor	Total
1	1	270	8	4	3.5	2.5	9	1.5	.5	.5	299.5
	2	265	6	5	2	2	8	2	.5	1	291.5
	3	280	5	3	4	1.5	7.5	2	1	.5	304.5
	4	285.5	10	4.5	5.5	1	9.5	2	.5	.5	319
	5	265.5	6.5	3	4.5	2	7.5	1.5	.5	1	292
	6	277	7	2.5	3	2.5	7	2	.5	.5	302
2	1	265	6	3	2	2	5	1.5	.5	.5	285.5
	2	285	5.5	2	2.5	1	4.5	1.5	.5	1	303.5
	3	277	4	5	3.5	2	6	2	1	1	301.5
	4	282	3.5	4.5	3	2.5	4.5	1.5	1	1	303.5
	5	284	3	4	2.5	3	7	1.5	.5	.5	306
	6	268	3	5	4.5	2.5	4	2.5	.5	.5	290
Total		3304	67.5	45.5	40.5	24.5	79.5	21.5	7.5	8.5	3678.5
3	1	52	3.5	4	2	3	3	2	.5	.5	29.5
	2	61	5	3	1.5	1.5	2.5	1	.5	1	38
	3	53	4	3	2	2	3.5	1.5	1	1	29
	4	50	5	6	2	1.5	2	.5	.5	.5	38
	5	46	5.5	4	3	2.5	3	1	2	1	45.5
	6	49	6	5	4	2	2	1.5	1	1	42.2
4	1	54	3	6	2.5	1.5	2.5	2.5	1	1	39.5
	2	51	3.5	4	3.5	2	1.5	1	1	1	40
	3	60	3.5	3	4.5	1.5	2.5	2	.5	.5	40
	4	65	3.5	2.5	3.5	1	2	1.5	1	.5	35.5
	5	46	4	2.5	3	2.5	3	1	2	.5	39.5
	6	54	4	3	3.5	2	2	2	.5	.5	41
Total		641	50.5	46	35	23	29.5	17.5	11.5	9	417

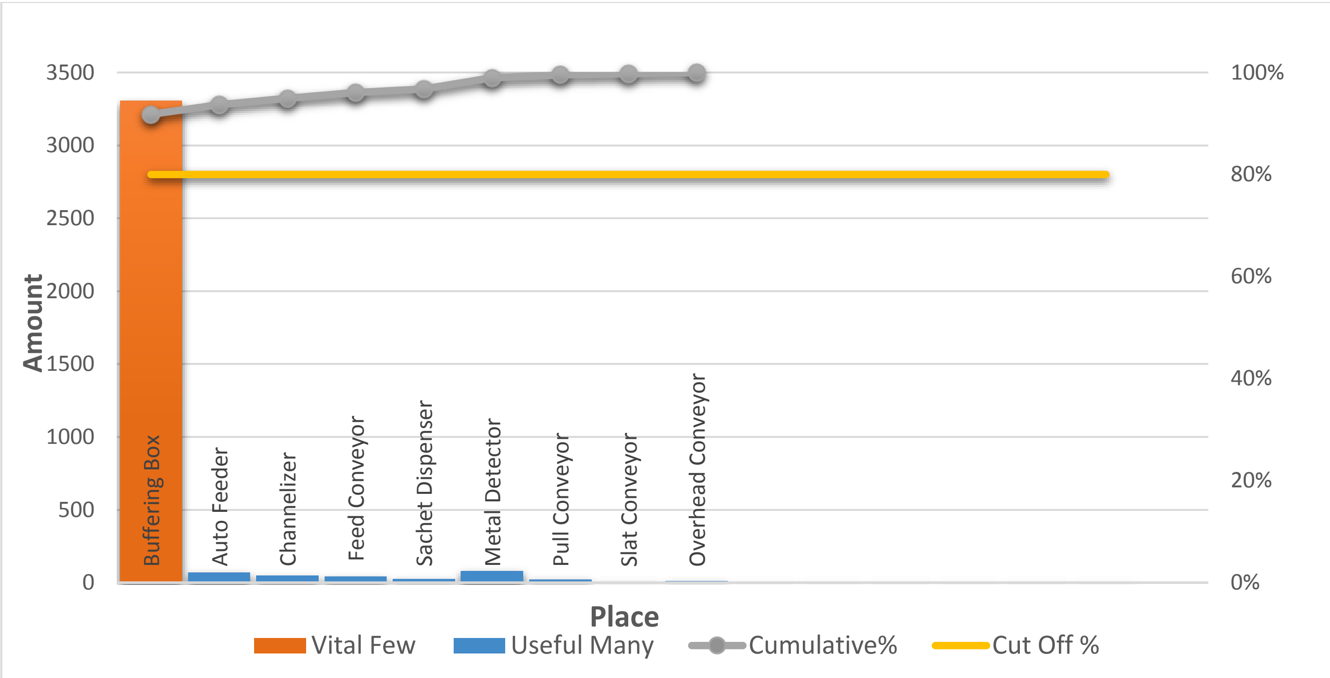

Chart 1: Pareto chart of Rework generation before implementation

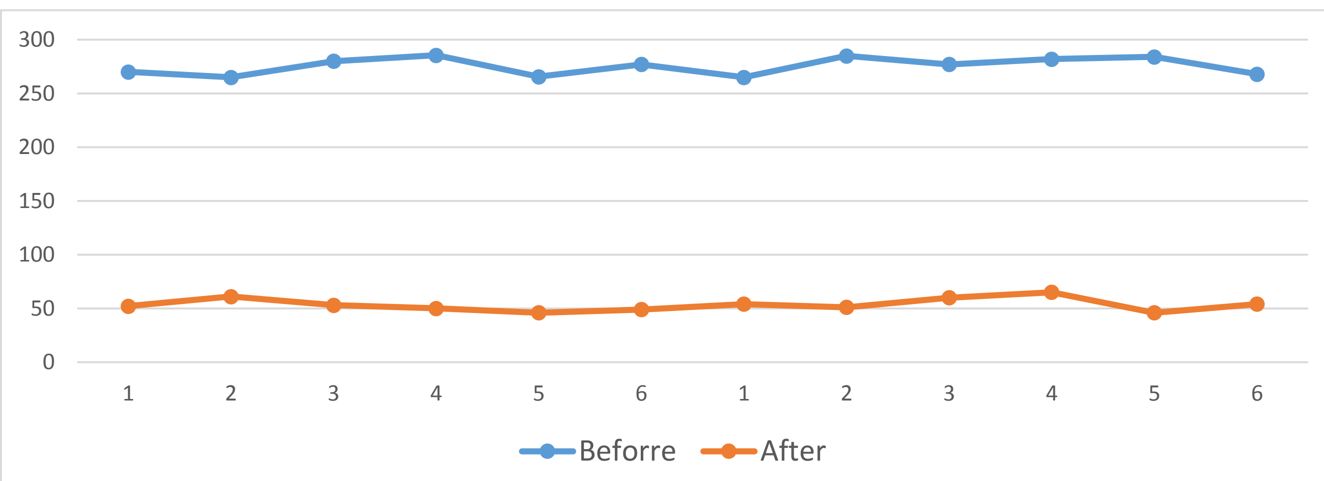

Chart 2 : Daily rework generation at Buffering Box

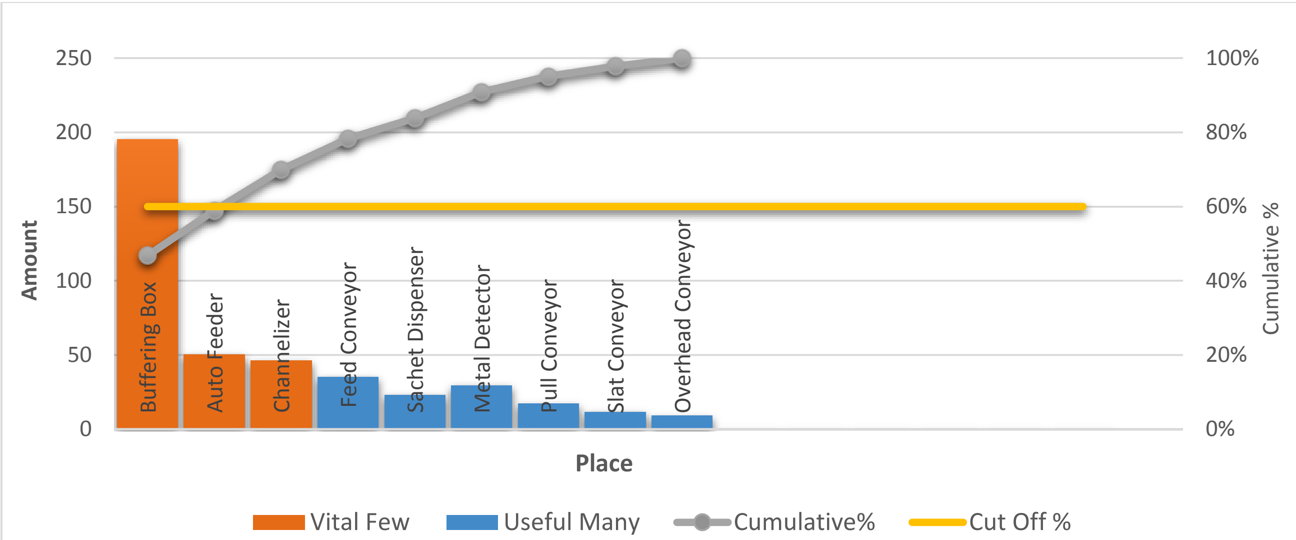

Chart 3 : Pareto chart of Rework generation after implementation

VI. Cause-effect Diagram

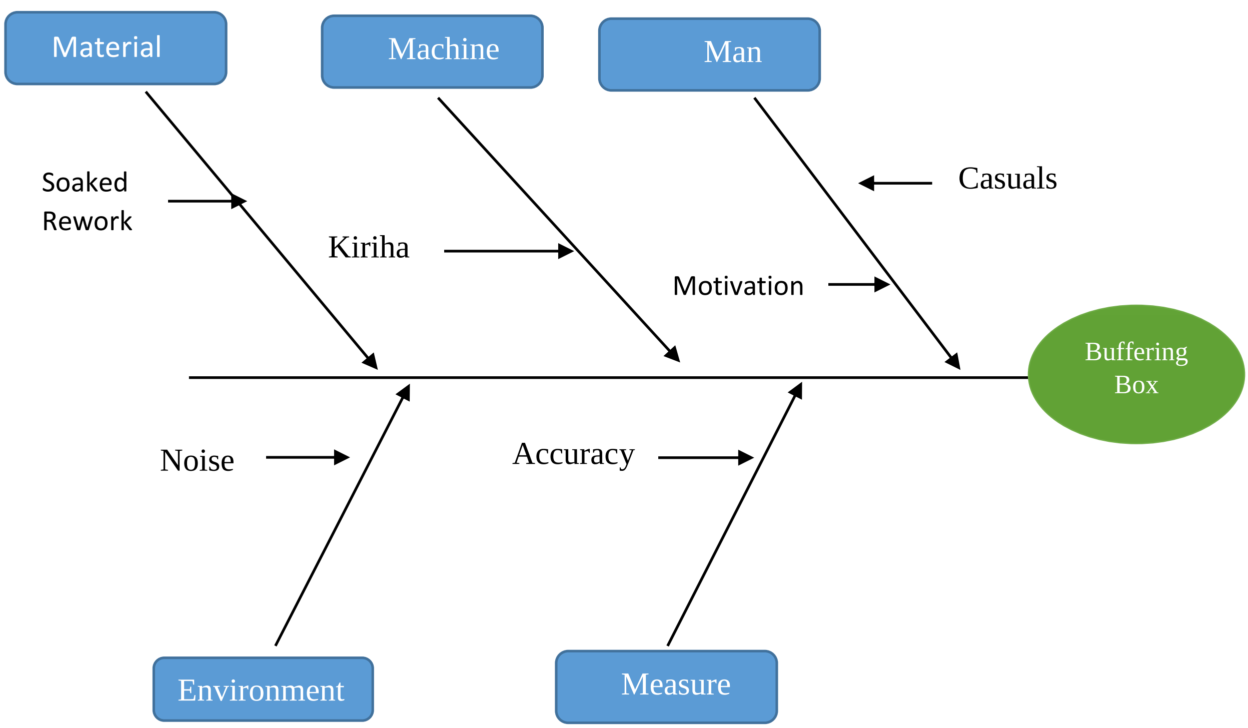

Diagram 1 : Cause effect diagram for Buffering Box

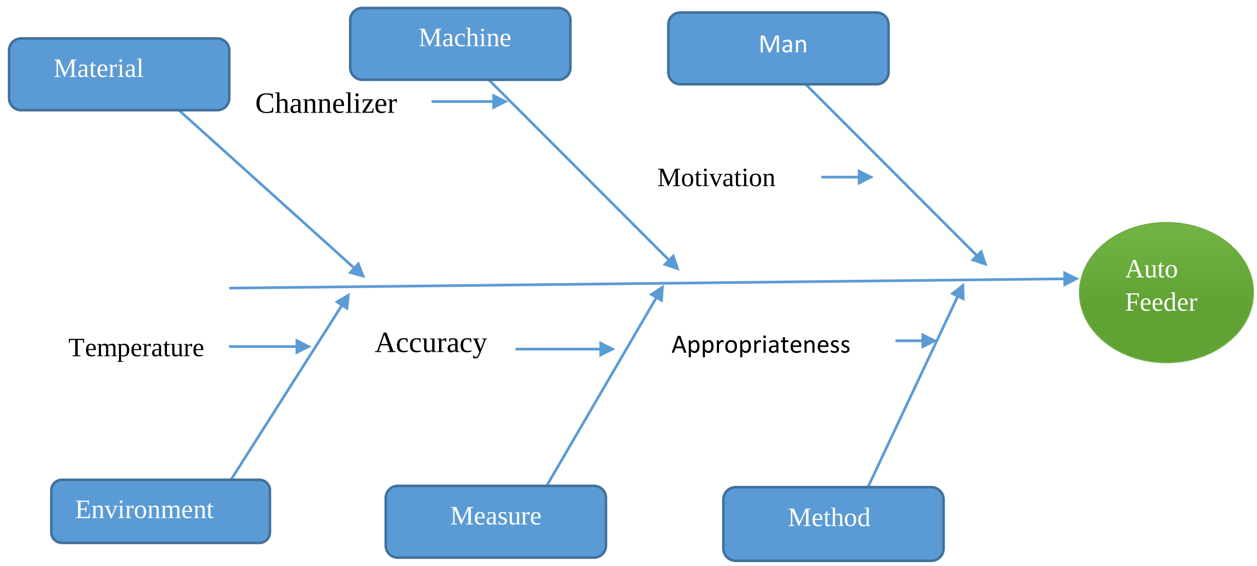

Diagram 2 : Cause effect diagram for Auto Feeder

VII. Cost Analysis

Table 1 : Cake Falling on Side Wall

Sample No	Weight of Cake		Rework generation	Average quantity of Rework generation (gm)
	Before (gm)	After (gm)		
1	65	63	2	2.33
2	62	61	1	
3	64	61	3	
4	65	62	3	
5	63	60	3	
6	61	59	2	

Table 2 : Cake Falling on Bottom Portion Buffering Box

Sample No	Weight of Cake		Rework generation	Average quantity of Rework generation (gm)
	Before (gm)	After (gm)		
1	62	58	4	3.16
2	64	61	3	
3	65	62	3	
4	63	59	4	
5	64	62	2	
6	66	63	3	

Storage capacity of one Buffering box = 1120 pcs of cakes

General cut speed = 55 pcs/min

Total no. of cakes cut per minute = Cut Speed $\times$No. of lanes $=55\times9=$ 495 pcs/min

No. of cakes passes through every Slat Conveyor per

minute$=\dfrac{No.of\ cakes}{No.of\ slat\ Conveyor}$

Rework contribution from one buffering box = 6 Kg (measured manually)

$$=\frac{495}{3}=165\text{pcs}$$

Time needed to fill the buffering with cakes

$$=\frac{Storage\ capacity\ of\ one\ buffering\ box\ (pcs)}{No.of\ cakes\ at\ slat\ conveyor}$$

$$=\frac{1120}{165}=\cong 6.8\text{ min}$$

Per minute Rework generation from one Slat

Conveyor $=\dfrac{6.8}{6}=.88$Kg/min

In case of 100 Kg Rework generation from one buffering box,

Idle time of wrapping machine =

$$\frac{Total\ rework\ geneartion\ at\ buffering\ box}{Per\ minute\ rework\ generation\ at\ three\ slat\ convetor}$$

$$=\frac{100}{0.88}=113\text{ min}$$

Cost before applying our proposed process

Material	Amount	No. of line	Total Amount	*Loss	Loss in BDT
	3304 kg	3	9912Kg	0.3×9912=2973.6Kg(estimate direct loss 30% of total rework)	654192
Labor	113 min	3	339 min	339min (100% loss of labor) 339×33.04=11200.56min	19444
				Total Daily loss	673636

Material	Amount	No. of line	Total Amount	*Loss	Loss in BDT
	641kg	3	1923kg	576Kg	126720
Labor	113min	3	339min	339*6.41=2173 min	3772
				Total Daily loss	130492

VIII. Discussion

We found 3304kg rework generated in every month by buffering box. That`s why we add some features in it to control and minimize the huge loss of raw material. Our proposed buffering box minimize about 80% of its local rework produced in the buffering box. After applying our proposed recommendation almost BDT 543144 saved per month.

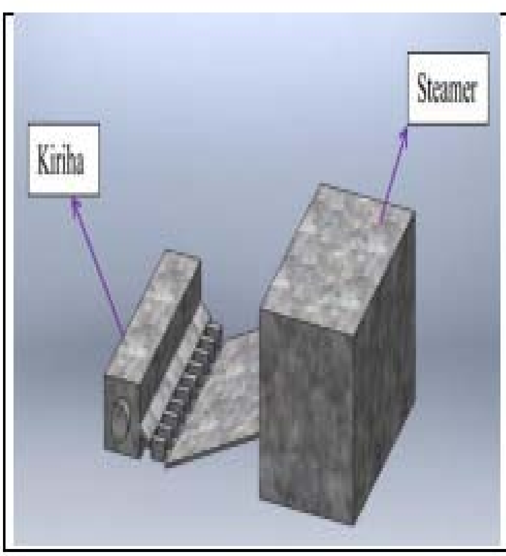

Figure 1 : Existing

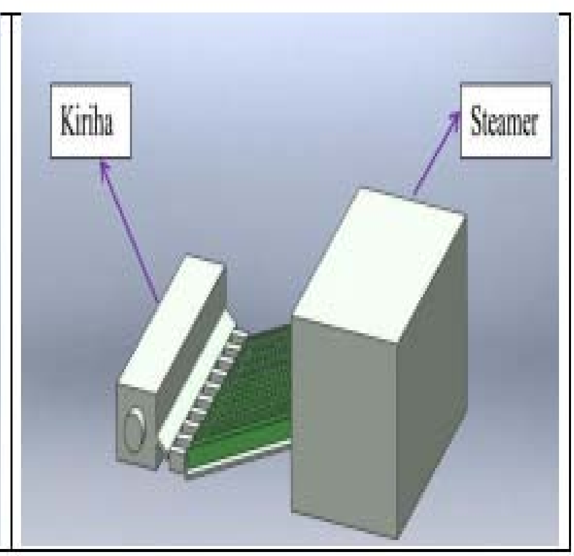

Figure 2 : Proposed

IX. Conclusion

Bangladesh, an emerging food manufacturing country faces a huge trouble with its conventional food processing method. The country now experienced a lack of quality control hence most of the factory are semi- automated or partially automated, that's why a huge portion of rework is generating every day. Rework minimization is very necessary for increasing productivity. Our primary objective was to find out the main rework generating area and then find out its solution. We have performed Pareto-chart analysis to measure the higher concentration area. After all, we conducted a complete cause-effect analysis to find out the principal cause of the problem. About 89% rework generated in Buffering Box area and the second most in Auto feeder. We finally gave some suggestions and a little bit change of design in the buffing box. After implementing this steps we further took the data and found about 80% of rework can be minimized in the buffering box area.

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