Using Statistical Process Control Measures to Minimize Defects in the Plastic Department of Marilao Alerco Industrial Corporation

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Abstract

The study was conducted at a manufacturing company where plastic products are produced. This study aims to find out the possible root cause of rejects in a specific product produce at Plastic Department. In this way, implementing statistical approach on determining the possible cause of rejects and also set standards on how to lessen it that can affect the daily production of the said product. It also gives the idea to the management on how to save cost efficiently by reducing the amount of rejects and determine proper measures to be set according to the result. The charts were very helpful on determining what points are out-of-control and how the process to be changed. This study uses Control Charts for Attributes, to identify the out of control points. The Minitab software application is used as a tool to identify the graph which we can examine the out of control points in the process. This study uses observations and quantitative approach to find what is the root cause of tremendous reject made.

Keywords: Control charts for attributes, Minitab

Background of the Study

A lot of reject were observed produced by the machine in Plastic Department of Marilao Alerco Industrial Corporation. Also, that more rejects were observed that are produced than the good ones. So, it come up with a study to make a quality control on the product and make necessary adjustments by using statistical quality control measurements. The production of utility boxes is chosen because it is one of the greatest number of rejects came from and management said that the ¼ of production of plastic department is coming from utility box.

1. Introduction

Statistical Process Control is used for monitoring a process to identify special causes of variation and idea for the management to take corrective actions appropriate. Statistical process control has seven (7) tools:

- Pareto Diagram
- Cause-Effect Diagram
- Check Sheets
- Process Flow Diagram
- Scatter Diagram
- Histogram
- Control Charts

The problem that needs to be resolved is the adverse effect of numerous reject produced by the machine, so that quality measures or adjustment can be done by the management. The authors of the study want to use control chart for attributes to find out of control points in the process by giving the data of number reject done per hour.

1.1 Literature Review

The control chart is a graph used to study how a process changes over time. Data are plotted in time order. A control chart always has a central line for the average, an upper line for the upper control limit and a lower line for lower control limit. These lines are determined from historical data. By comparing current data to these lines, we can draw conclusions.

Control Charts are an outstanding technique for problem solving and the resulting quality improvement. Quality improvement occurs in two situations. When a control chart is first introduced, the process usually is unstable. As assignable causes for out-of-control conditions are identified and corrective action taken, the process becomes stable, with a resulting quality improvement. The second situation concerns the testing or evaluation of ideas. Control charts are excellent decision makers because the pattern of the plotted points will determine if the idea is a good one, poor one, or has no effect on the process. If the idea is a good one, the pattern of plotted points of the X bar chart will converge on the central line, X_0. In other words, the pattern will get closer perfection, which is the central line. For the R chart and the attribute charts, the pattern will tend to zero, which is perfection. These improvement patterns are illustrated in figure 1. If the idea is a poor one, an opposite pattern will occur. Where the pattern of plotted points does not change, then the idea has no effect on the process. While the control charts are excellent for problem solving by improving the quality, they have limitations when used to monitor or maintain a process. The pre-control technique is much better at monitoring. If the idea is a poor one, an opposite pattern will occur. Where the pattern of plotted points does not change, then the idea has no effect on the process.

2. Methodology

2.1 Research Design

The methodology followed to finish this work was to record the data on rejects per hour, fraction of non-conforming, establish the control charts for attributes. After that, results are analyzed, discussed with the plant's manager, and improvements are suggested then put in experimentation. Finally, all measurements are repeated but for the processes after improvements and effectiveness of solutions are evaluated.

2.2 Sample Size

Data were collected from 8:00 am up to 7:00 pm. The number of rejects were accounted from the hourly production.

` 2.3 Place of application

The company that was selected to be place of our research is at Marilao, Bulacan Philippines. They produced industrial products like plastics, bake lite and aluminum. The study focused on plastic department were most of the rejects are coming. The product is Utility box which households used for electrical purposes

Table 1. Data of per hour reject and production per hour of the machine

Sample Number	Number of production per hour	Number of reject per hour	Fraction of Non-conforming
1 (8am-9am)	74	60	0.81
2 (9am-10am)	79	65	0.82
3 (10am-11am)	68	52	0.76
4 (11am-12pm)	78	56	0.72
5 (12pm-1pm)	67	62	0.93
6 (1pm-2pm)	59	51	0.86
7 (2pm-3pm)	60	49	0.82
8 (3pm-4pm)	55	50	0.91
9 (4pm-5pm)	57	55	0.96
10 (5pm-6pm)	58	52	0.90
11 (6pm-7pm)	50	48	0.96
	Mean: 64.0905 Total production: 700	Mean: 54.5454 Total reject: 600	Mean: 0.8591

In Table 1, samples of data were collected, from 8:00 am to 6:00 pm the hourly reject produced by the machines. As shown above the number of rejects per hour is higher than produced per hour. So much disparity is displayed such that the reason for 85% rejects produced must be investigated.

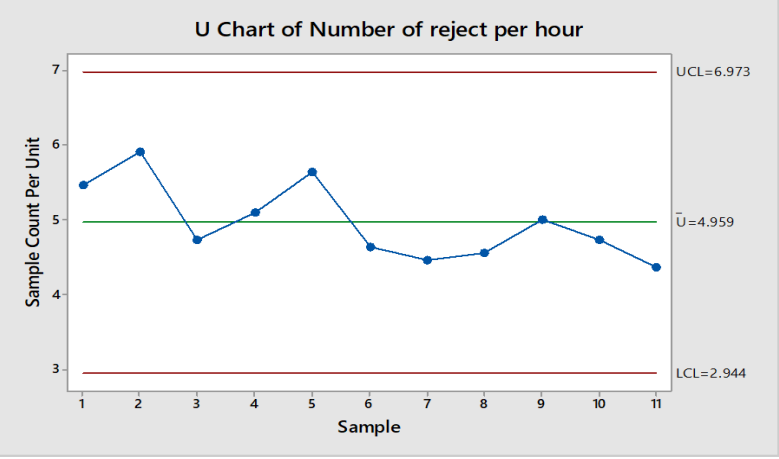

Figure 1: U-chart graph of reject per hour

Figure 1 shows the 3:00 pm-4:00 pm operation hours are on control. More variations are happened on morning because the worker operates the machines said that, it is cause by the start-up of machine.

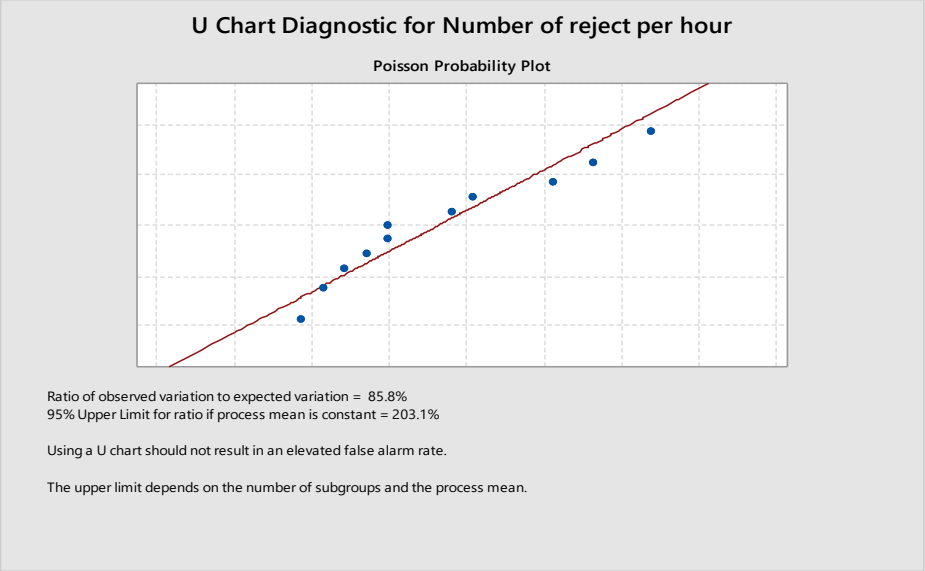

Figure 2: U-chart diagnostic of reject per hour

Figure 2 shows the U-chart diagnostic of reject per hour, many points are not on the center line. Many points were scattered. So, the reject lowered and suggest some adjustment on the process.

3. Corrective Actions

The results above were presented to plant manager, the table and the graph were discussed which the Manager said that the variation is happen because of the start-ups and mold is having two products can produce. The reject has cracks and deformation. The timing of the machine is one of the problems, or maybe the mold because the reject products have deformities. It is advised (1) that the timing of the machine should be adjusted and (2) the mold used for production should be changed.

4. System Development

The corrective actions were suggested to top management and were accepted. The company plans to change the process of mold and adjust the time of making the product. Results below were analyzed and graphs were displayed in Figure 3 and Figure 4.

Table 2: Data of per hour reject after the corrective action imposed

Sample Number	Number of production per hour	Number of reject per hour	Fraction of Non-conforming
1 (8am-9am)	75	32	0.43
2 (9am-10am)	70	33	0.47
3 (10am-11am)	72	30	0.42
4 (11am-12pm)	65	32	0.49
5 (12pm-1pm)	60	36	0.60
6 (1pm-2pm)	67	31	0.46
7 (2pm-3pm)	70	32	0.46
8 (3pm-4pm)	62	31	0.50
9 (4pm-5pm)	50	32	0.64
10 (5pm-6pm)	53	33	0.62
11 (6pm-7pm)	59	36	0.72
	Mean: 63.9091 Total: 703	Mean: 35.5455 Total: 358	Mean: 0.5282

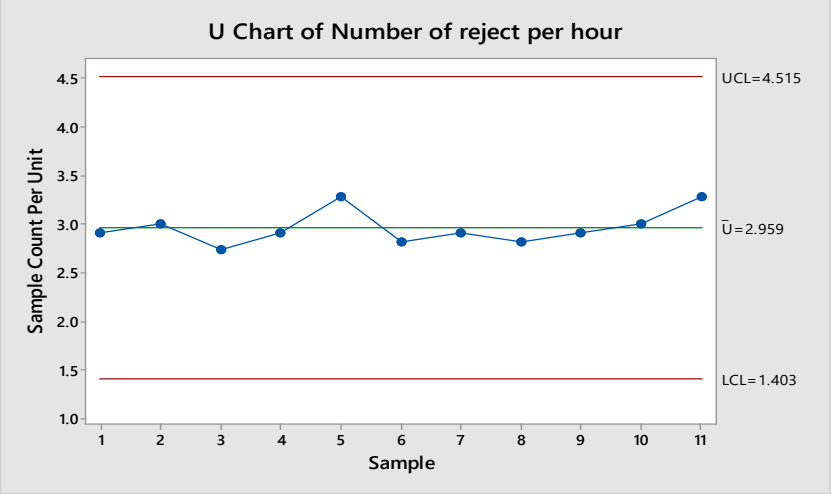

Figure 3: U-Chart of number of rejects per hour after corrective action

Figure 3 shows the less variation occur on control chart after corrective actions were taken. The timing of injection machine was diagnosed and the authors of the study requested to change and adjust the mold. There was less variation encountered as a result of the authors' recommendation. Plant manager said that there would be less rejects if the mold were changed and the time to produce the product is at high possible. The company is delighted and amazed how much reject they produce than the good one. The corrective actions given are good because the control chart shows less variation of low quality happen.

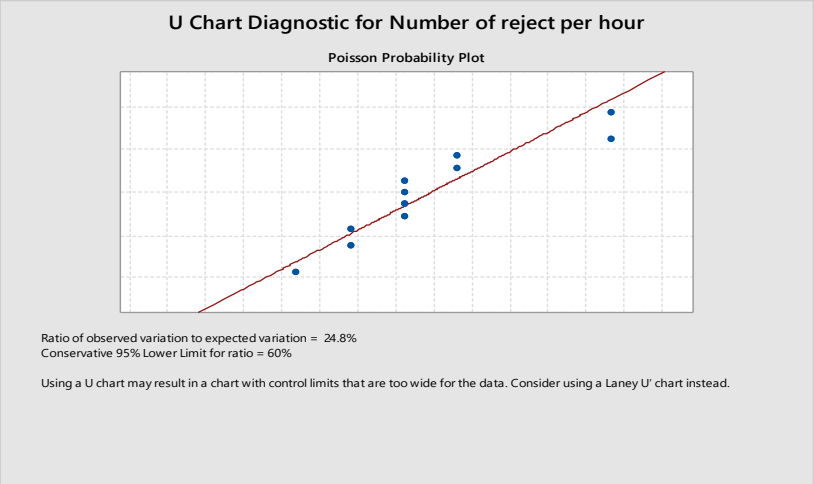

Figure 4: U-Chart diagnostic of rejects after corrective actions taken

Figure 4 shows the less scattered points because corrective actions taken than before applying the corrective actions.

5. Results and Discussion

Table 3 shows the comparison of the limits of the attribute control chart before and after corrective actions were taken.

Table 3: Results before and after corrective actions taken

Parameters	**Before**	**After**
Upper Control Limit	6.973	4.515
Central Limit	4.959	2.959
Lower Control Limit	2.964	1.403

From these tables, the variation happen were observed on the upper and lower control limit also the central limit it is because the reject is become low when the corrective actions taken.

6. Conclusion

In using statistical process control, the massive effect of high rejection rate was observed occurring in the company. It provides so much information on how to addressed the current problem of the company, especially on how to control it. The SPC has proved high effectiveness in centering the processes and producing high quality products. As a result, the authors came up with an action and submitted it to the top management. Rejection rate is lessened as a result of the proposed action. The authors advised to management that, implement quality control on all the machines because it could contribute to low efficiency caused by high rejection rate.

References

Montgomery, Douglas C. Introduction to Statistical Quality Control by Douglas C. Montgomery*, 4th edition*: *John Wiley and Sons.* 2004.

Abdulhadi Altherwi and Hassan Hijry, Implementation of a Statistical Process Control System for a selected industrial plant, *Proceedings of the International Conference on Industrial Engineering and Operations Management*, Detroit, Michigan, September 23 – 25, 2016

Khadem, M., Ali, A., and Seifoddini, H., Efficacy of lean metrics in evaluating the performance of manufacturing system, *International Journal of Industrial Engineering*, vol. 15, no. 2, pp. 176-184, 2008.
International Journal of Quality, Statistics, and Reliability
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