Quality Improvement of Black Spot Defects in the Plastic Injection Molding Process at Company ABC

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Abstract

Company ABC is a manufacturing company and committed to providing high-quality metal stamping and plastic injection molding products. The main objective of the study is to reduce the black spot defects in Case Lower (68 MB62) that occurred in the plastic injection molding process. The researcher used Lean Six Sigma Methodology as a technique to reduce quality problems. Applied research was used as the research design in the study. Based on the findings of the study, the problem occurred in the filtering process and as a result, black spot defects had the highest defect percentage equivalent to 7.85%. The overall current process performance or Process Z was 1.42 lower than the standard value of 2.00. Further validation was made using Why-why analysis and found out that filter mesh design was the identified root cause of the problem. To reduce the percentage of defects, improvement of filter mesh design was completed and after implementation, the data was collected and based on the results the defect percentage was reduced to 2.16%, overall process performance or Process Z increased to 2.02 higher than the minimum limit of 2.00. For the improvement to be sustained, a work instruction and control plan was developed.

Keywords
Blackspot, Six Sigma, Injection molding, Process capability, Filter mesh

1. Introduction
Company ABC is a manufacturing company and committed to provide high quality Metal Stamping and Plastic Injection Molding products. The company manufacturers various parts for different items such as computers, printers, cameras, appliances, automotive and other related plastic moldings, and metal stamping products. The company adheres to the highest quality standard to delightfully satisfying their customers with regards to quality, service, and delivery. The researcher observed the operations particularly the quality issues encountered in the production, and it was found out the top defects were present in the plastic injection molding process specifically in the Case Lower (68-MB62) product which accounted to overall rejection rate of 17.46%.

Furthermore, in producing the Case Lower (68-MB62) product, the recycled raw materials were placed into the grinding machine to cut it into small pieces. It was observed that cutting blades are not properly cleaned before the next use and as a result the residue of raw materials left from the blades mixed in the new sets of raw materials to be processed. After which, the finished products from the grinding machine with contaminated materials will be placed in the filter machine to remove the very small pieces and portions with an incorrect cut and transferred into the mixer machine to combine the foreign and contaminated materials. The researcher found out during the observation that the portions with an incorrect cut do not pass through the filters and are mixed up with the materials in the mixer machine. The residue materials in the filter will then be placed in a storage box and to be delivered into the plastic injection molding machine. Then the vacuum tube will be used in absorbing the combined materials directed into the pellet with residue materials. The researcher found out that the residue materials get sipped first in the vacuum tube, turning it into black while being melted and burned. After molding, the final product is produced in which the black spot defects were observed.

Black spot defect is now clearly defined as small dark particles or spots on the surface of an opaque part or within the transparent part and which has highest percentage of defects and affects the overall production performance. To further analyze the root cause and recommend improvement the researcher focused on the plastic injection molding process of Case Lower (68-MB62) product which contributes the highest percentage of defects. Consequently, the researcher used the Lean Six Sigma methodology to solve the quality problem. And this quality tool is widely used by many organizations in reducing quality issues and sustaining quality through continuous improvement.

1.1 Objectives
The main objective of the study was to improve the quality by reducing the black spot defects in the plastic injection molding process. Specifically, it aimed to answer the following objectives.
1. To define the current defect condition of case lower (68-MB62).
2. To measure the percentage of defects of case lower (68-MB62) and evaluate the process capability.
3. To analyze the root cause of black spot defects, present in case lower (68- MB62).
4. To improve the black spot defects by improving the filter mesh design.
5. To develop control plans to sustain the improvement.

2. Literature Review
Nowadays, continuous improvement has become the main goal of any organization desiring to achieve quality and operational excellence to enhance performance (Antony et al. 2012). Hence, Six Sigma has become one of the popular business strategies for enabling continuous improvement in diversified industries. Snee (2010) emphasized that Six Sigma is quality management tools and an advanced business strategy and methodology that increases process performance, improves bottom-line results, enhances customer satisfaction, and develops leadership skills by using DMAIC, a disciplined systematic improvement approach. Garza-Reyes (2015) stated that Six Sigma focuses on the product's or process' critical quality characteristics which are relevant to customers. Erdogan and Canatan (2015), mentioned that Six Sigma is a strategy which uses statistical methods to provide, measure, analyze, renovate, and control optimal efficiency in a business process and further stated that Six Sigma is a method that is adapted by various companies all over the world because of its consumer-oriented approach and its aim for the continuation of the company.

Furthermore, Desai (2012) stated that Six Sigma is a technique that can bring breakthrough improvements almost in every sector through overall operational excellence. In addition, Six Sigma can be described as a technique or set of quality management tools that are aimed at process improvement and reducing variability to reach near perfection in terms of quality (Tari et al.,2010). According to Grudowski (2015), combining two complementary approaches—Lean Management and Six Sigma—better interacts with the numerous variables that determine the company's effects: productivity delivery speed, and quality, while ensuring external and internal customer satisfaction. Albliwi et al. (2015) mentioned that Lean and Six Sigma have become the most popular business strategies for deploying continuous improvement. Mutia and Nyambegera (2014) pointed out Six Sigma methodology to be a powerful business strategy that has been well renowned as an imperative for achieving and sustaining operational and service excellence.

In the study conducted by Yousefi and Hadi-Vencheh (2016), Six Sigma is defined as an innovative method, which improves the business strategically. They further stated that Six Sigma is an orderly, advantageous, customer-centered, and systematically optimizing method which covers the entire organization. In addition, the study of Teli, Majali, Bhushi, & Patil (2012) claimed that making use of the Six Sigma concept helps keep the quality of the product controlled in a pleasing way to avoid unnecessary downsizing of one's overall profits. In cases where business quality costs start to limit incoming profits, the best way to save everything is by employing the Six Sigma methodology to the entire operation. Chaurasia et al. (2016) pointed out in their study, to reduce variation, the Six Sigma approach uses strategic process selection. It is further confirmed by Antony (2015), that "Six Sigma can be extremely useful if variation within the process causes defects or errors or even failures which lead to customer dissatisfaction. In the study carried out by Laureani et al. (2013), it is pointed out that Lean Six Sigma (LSS) is one of the proven applications in healthcare to augment productivity and performance system. They further stressed out the fact that, by improving productivity and performance, a considerable number of organizational benefits can be achieved, even implemented by relatively apprentice users. In the research carried out by Krishnan (2016), it is mentioned that the organizations have deliberately taken an interest in the implementation of quality initiatives. This is for improving their products and service to survive volatile market conditions. In the study carried out by Mishra

et al. (2016), various factors affecting manufacturing flexibility are identified. Hence, "Operational improvement practices" is highlighted by them as one of the factors influencing manufacturing flexibility.

3. Methods

This research utilized the applied research as research design to determine the current condition of the production operations which intended to find out the quality problems and recommend corrective actions. Applied research is inquiry using the application of the scientific methodology to generate empirical observations to solve critical problems in the company operations. The participants of the study were from the cooperative team of the company composed of Quality/Engineering/Training and Production and the researcher. The data gathered was analyzed by using Lean Six sigma tools such as Pareto Chart, Process mapping, Project Charter, Time Series, Laney P-chart, Why-why analysis, Binomial capability, Hypothesis testing and Control Plan.

4. Data Collection

The researcher handed a letter of request to conduct a study to Company ABC. After the approval of the HR Manager, the Head Manager of Engineering oriented the researcher about the overall production and different products they are producing. The data gathering started from January to March 2021. The researcher used Minitab software version 18 to help in analyzing the data.

In the define phase, the researcher conducted an interview with the operator, staff, and production managers about the current process and product quality control specifically, the number of defects produced in every process of the operation. The data given presented the different kinds of defects that occurred in plastic injection molding operation in the case lower (68-MB62) products. Pareto Chart was used to determine the defects to be prioritized. A Project Charter was also developed to summarize the objectives, scope, and deliverables of the study.

The measure phase was conducted last May 2021 since all data from the plastic injection molding process were given to the researcher by QA Supervisor. A Time Series Analysis was performed to determine the trend and gap from the target. The researcher used binomial capability analysis to evaluate whether a process can produce output that meets customer requirement.

The analyze phase was conducted last May 2021, and the researcher mapped the process to further analyze the operation of the Plastic Injection Molding. The Why-why analysis was used to determine the root cause of the problem. The implementation of the improvement was organized by the team for the whole month of June 2021. The researcher proposed the improvement of filter mesh design in Case Lower (68-MB62) product to reduce the black spot defects in the Plastic Injection Molding process and performed the hypothesis test to compare the significance of the improvement. Lastly, in the control phase, the work instruction was developed to sustain the improvement.

5. Results and Discussion

5.1 Define Phase

The study started by determining the problem which will be the focus of the study. The researcher was provided by the company with a copy of the data on defects from January to March 2021. From the data, the researcher developed a Pareto Chart to determine which defect had the highest percentage. The data was limited only to year 2021.
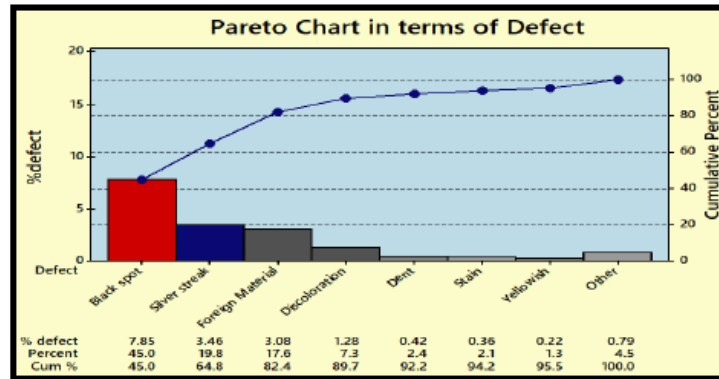

Figure 1. Pareto Chart

The figure 1 shows that the vital few, or 80 % of the problem was emanated from the defect known as Black Spot and Silver Streak. On the other hand, the defect is known as Foreign Material, Discoloration, Dent, Stain, Yellowish and others belong to 20% or the useful many. The researcher determined the top three main problems of the company. Based on the Pareto diagram, the Black Spot had the highest percentage of defects equivalent to 7.85%. The researcher decided to choose the black spot defects found in the plastic injection molding process as the focus of the study.

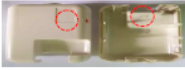Figure 2. Project Charter

The figure 2 shows the project charter to summarize the project. Based on the project charter. The main goal was to reduce the defect percentage from 7.85% to 4.50%, the project committee members included were the quality

engineer, quality control supervisor, production maintenance, and project adviser. The project timeline was set from April - July 2021 and the project scope was focused on the plastic injection molding process.
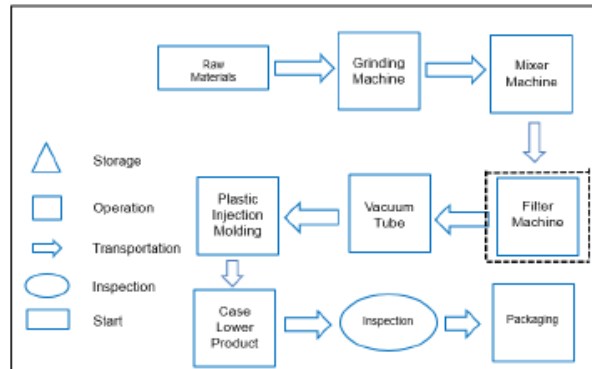

Figure 3. Process Mapping

The figure 3 shows the process mapping of the project which clearly showed the sequence of the processes from the grinding process to the packaging process. The researcher focused on the plastic injection molding process which was identified as the main source of the problem.

5.2 Measure Phase

The measure phase was the second phase of the DMAIC methodology The researcher collected the data needed based on the identified problem. The data collected by the researcher was based provided by the company based on their actual daily inspection records from January to March 2021.

Table 1. Black spot Defects

| DATE	Output	REJECT	%	Target	DATE	Output	REJECT	%	Target
03-Jan-21	8673	455	5.25	4.50	19-Feb-21	6270	603	9.62	4.50
04-Jan-21	15362	677	4.33	4.50	20-Feb-21	5219	1012	12.39	4.50
05-Jan-21	10697	614	5.74	4.50	23-Feb-21	1306	175	8.41	4.50
06-Jan-21	14047	458	3.26	4.50	24-Feb-21	8527	2526	27.62	4.50
07-Jan-21	14067	948	6.74	4.50	25-Feb-21	9364	2040	18.79	4.50
08-Jan-21	15315	528	3.45	4.50	26-Feb-21	6999	1641	20.44	4.50
09-Jan-21	9110	662	6.27	4.50	27-Feb-21	9529	1375	7.43	4.50
10-Jan-21	3024	232	7.67	4.50	28-Feb-21	9326	938	10.06	4.50
11-Jan-21	11956	1422	6.89	4.50	01-Mar-21	10284	978	7.51	4.50
12-Jan-21	11757	527	4.48	4.50	02-Mar-21	3000	32	1.07	4.50
13-Jan-21	11923	256	2.15	4.50	03-Mar-21	6297	355	5.64	4.50
14-Jan-21	11150	292	2.62	4.50	04-Mar-21	11158	755	4.77	4.50
15-Jan-21	11596	116	1.00	4.50	05-Mar-21	9571	304	3.18	4.50
16-Jan-21	11986	215	1.79	4.50	06-Mar-21	10788	610	5.65	4.50
17-Jan-21	11074	276	2.49	4.50	07-Mar-21	1032	42	4.07	4.50
18-Jan-21	10774	231	2.14	4.50	08-Mar-21	9118	173	1.90	4.50
19-Jan-21	11379	337	2.96	4.50	09-Mar-21	10286	397	3.86	4.50
20-Jan-21	4614	1023	20.17	4.50	10-Mar-21	6488	332	5.12	4.50
21-Jan-21	12549	400	3.19	4.50	11-Mar-21	5505	221	4.01	4.50
22-Jan-21	7070	221	3.13	4.50	12-Mar-21	10552	272	2.58	4.50
23-Jan-21	1900	123	6.47	4.50	13-Mar-21	10032	327	3.26	4.50
28-Jan-21	1068	379	35.49	4.50	14-Mar-21	10808	261	2.41	4.50
30-Jan-21	6656	698	8.49	4.50	15-Mar-21	7801	181	3.15	4.50
06-Feb-21	3913	1504	38.44	4.50	16-Mar-21	10517	513	2.88	4.50
07-Feb-21	4170	1516	23.35	4.50	17-Mar-21	10746	763	6.35	4.50
08-Feb-21	7072	1275	12.03	4.50	18-Mar-21	10988	643	5.85	4.50
09-Feb-21	10852	2965	23.32	4.50	19-Mar-21	8466	268	3.17	4.50
10-Feb-21	3064	300	7.79	4.50	20-Mar-21	3348	167	4.29	4.50
11-Feb-21	10579	1597	13.01	4.50	21-Mar-21	11134	361	3.24	4.50
12-Feb-21	3814	747	16.59	4.50	22-Mar-21	11168	300	2.69	4.50
13-Feb-21	10130	2865	25.28	4.50	23-Mar-21	11142	167	1.54	4.50
14-Feb-21	10185	1470	8.43	4.50	24-Mar-21	8888	204	2.30	4.50
15-Feb-21	19745	1639	8.30	4.50	25-Mar-21	9685	427	4.41	4.50
16-Feb-21	11960	1657	8.85	4.50	26-Mar-21	10704	392	3.66	4.50
17-Feb-21	15394	1405	9.13	4.50	27-Mar-21	10948	118	1.08	4.50
18-Feb-21	19214	1927	6.03	4.50	28-Mar-21	11076	452	4.08	4.50
					AVERAGE			7.85%	4.50
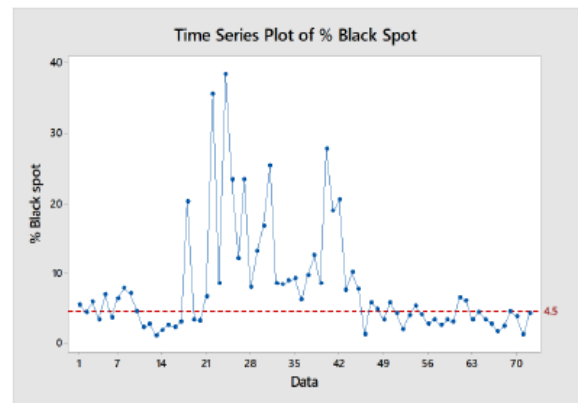
Figure 4. Time Series for Black spot in Inspection Line

Table 1 shows the data of black spot defects in Case Lower (68-MB62). Based on the data gathered, there was an average of 7.85% black spot percentage. The target standard set by the improvement team and researcher was to reduce the percentage of black spot defects to 4.50%.

The figure 4 shows that the graphical presentation of data in form of time series. The figure showed that the percentage of black spot defects was beyond the target percentage of 4.50% which indicates a need for process improvement.
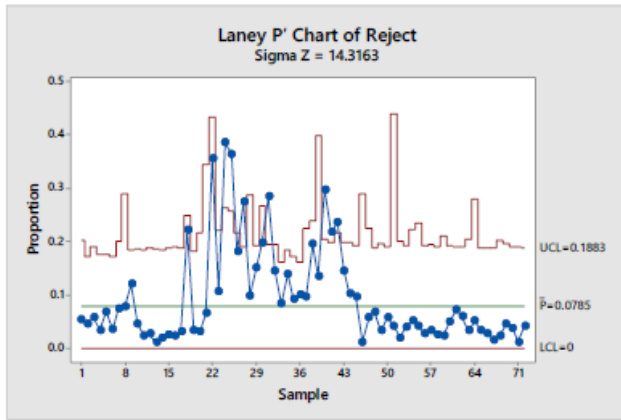

Figure 5. Laney P-chart for Case Lower (68-MB62)

Table 2. Binomial Process Capability Analysis

SUMMARY RESULTS	
%Defective	7.85
Lower CL	7.79
Upper CL	7.92
Target	4.5
PPM DEF	78,512
Lower CL	77,867
Upper CL	79,161
Process Z	1.42
Lower CL	1.41
Upper CL	1.42

The figure 5 shows the Laney P Chart of the black spot defects of Case Lower (68-MB62) in the plastic injection molding process. The upper control limit was 0.1883, with a proportion mean of 0.0785 and the lower control limit of 0. And because the sample sizes are unequal, the control limits vary. The sigma Z value (approximately 14.3163) is greater than 1, which indicates that the control limits on the Laney P' chart are wider than those on a traditional P chart to adjust for overdispersion.

While the table 2 shows the binomial process capability analysis for Case Lower (68-MB62). To further assess the capability of the process, the researcher used the binomial capability to monitor the process if it is capable or not. Process Z was used as the parameter to test process capability. The higher the process Z, the better the process performance. The ideal value of process Z is equivalent to 2 or higher. Based on the summary results, the process Z value is equivalent to 1.42 which is lower than the standard value of process Z equals 2.0 or higher, Therefore, the process is not capable to meet the specification requirements of the process.

5.3 Analyze Phase

In this phase, the objective is to find out the root causes of the problem that occurred in the filter machine process which contributes a high percentage of black spot defects in the plastic injection molding process. To determine the exact and most likely causes of major defects, the researcher analyzed the problem using why-why analysis to clearly understand and found out the main problem.

Table 3. Why-why Analysis

PROBLEM	1st WHY?	2nd WHY?	3rd WHY?	CONTROL	ACTION
Black Spot Defect	Change material requirements	The old filter machine does not capable to filter the raw materials	The filter mesh design is larger than the raw materials	In Control	Improve the filter mesh design

Table 4 shows the why-why analysis of the black spot defects. Based on the analysis it was found out that the main root cause of the problem was the mesh design of the filter not capable of the new raw material requirements. The researcher recommended a corrective action to improve the filter mesh design.

5.4 Improve Phase

In this phase, the researcher consults with the improvement committee members and develops an improvement action to fix the problem in the operation of the Plastic Injection Molding process. After the improvement action, observing and monitoring the result is needed to identify if there is an improvement after taking necessary action.
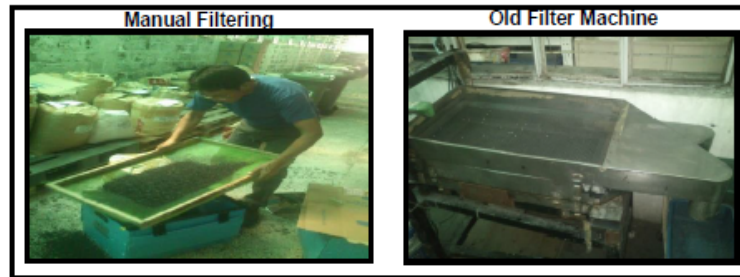
Figure 6. Old Filter Machine

Figure 6 shows the picture of the old filter machine. This machine was used to remove the very small pieces and portions with an erroneous cut which are mixed up with the materials in the grinding machine. The size of the hole does not fit the materials that fell in the designated filter which causes black spots, and it was observed that the old filter machine does not work properly. Thus, the operator needs to manually operate to ensure that the materials are filtered accurately.
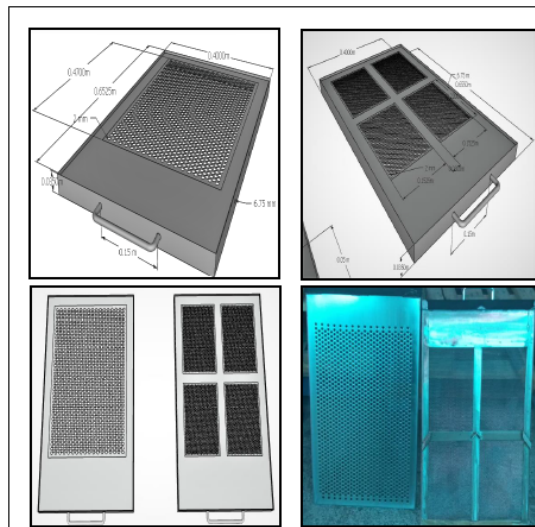
Figure 7. New Design of the Filter

Figure 7 shows the new design of the filter. The size of the hole is designed to filter the very small pieces of particles to reduce black spots. The design considered the measures of the material needed to produce the Case Lower (68-MB62) product. Both filter design has the same length measures 0.6525 meters (m), width measures 0.4000 meters (m), thickness measures 0.0350 meters (m), from upper to lower margin measures 0.05 meters (m) and the screws measures 6.75 mm. The size of the hole's top filter design measures 8mm while the size of the bottom of the hole filter design measures 2mm. The bottom filter design is divided into four (4) the length measures 0.2200 meters (m) and the width measures 0.1525 meters (m) and the margins measure 0.0300 meters (m). The new work instruction procedure was made to ensure the proper maintenance of the filter machine.

Table 4. Defects Data After Improvement

| No.	Output	Reject	%	No.	Output	Reject	%
1	8,788	171	1.95%	37	5,231	178	3.40%
2	12,009	150	1.25%	38	8,875	199	2.24%
3	13,693	189	1.38%	39	5,412	239	4.42%
4	8,736	73	0.84%	40	8,824	236	2.67%
5	13,719	125	0.91%	41	9,270	289	3.12%
6	12,524	175	1.40%	42	3,424	85	2.48%
7	11,429	157	1.37%	43	8,921	202	2.26%
8	11,607	158	1.36%	44	5,456	156	2.86%
9	10,978	214	1.95%	45	5,957	92	1.54%
10	13,772	203	1.47%	46	5,181	108	2.08%
11	13,941	224	1.61%	47	5,680	285	5.02%
12	11,625	228	1.96%	48	8,319	168	2.02%
13	5,967	141	2.36%	49	8,197	215	2.62%
14	9,752	172	1.76%	50	8,535	265	3.10%
15	11,626	247	2.12%	51	8,052	222	2.76%
16	11,000	187	1.70%	52	9,447	231	2.45%
17	10,648	119	1.12%	53	6,823	225	3.30%
18	2,689	20	0.74%	54	13,270	281	2.12%
19	7,593	225	2.96%	55	11,436	289	2.53%
20	13,884	122	0.88%	56	13,292	242	1.82%
21	12,366	205	1.66%	57	13,300	188	1.41%
22	13,871	285	2.05%	58	10,206	193	1.89%
23	4,154	158	3.80%	59	12,011	223	1.86%
24	9,710	230	2.37%	60	14,816	246	1.66%
25	5,970	125	2.09%	61	10,662	208	1.95%
26	6,904	256	3.71%	62	6,700	150	2.24%
27	12,117	259	2.14%	63	11,492	298	2.59%
28	13,755	201	1.46%	64	11,000	211	1.92%
29	7,655	290	3.79%	65	7,032	212	3.01%
30	14,388	290	2.02%	66	11,952	210	1.76%
31	5,938	125	2.11%	67	3,000	112	3.73%
32	9,419	290	3.08%	68	4,148	82	1.98%
33	7,576	251	3.31%	69	10,990	265	2.41%
34	3,490	81	2.32%	70	9,035	236	2.61%
35	6,418	292	4.55%	71	5,585	200	3.58%
36	7,951	236	2.97%	72	6,716	289	4.30%
				Average	665,909	14,404	2.16%
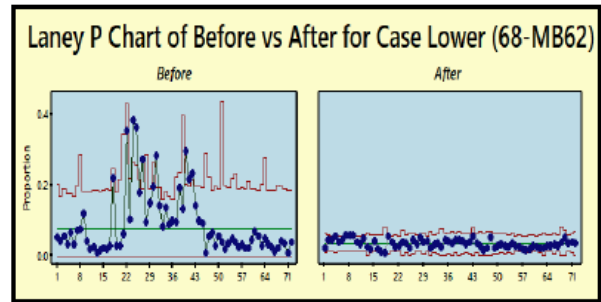
Figure 8. Laney P-chart Before and After Improvement

Table 4 shows the overall defect percentage of 2.16% after using the filter machine and figure 8 shows the comparison of the Laney P Chart of the actual compared with the improvement. This was illustrated to visually determine the gap of the improvement. Based on the figure 8, it showed that seven points are out of control. While after the improvement, it was concluded that the process was stable and in control.

Table 5. Before and After Improvement Binomial Capability Analysis Comparison

		BEFORE	AFTER	CHANGE
PROCESS CHARACTERIZATION	Number of Subgroups	72	72	-same-
	Average Subgroup Size	9248	9248	-same-
	Total Items Tested	665,909	665,909	-same
	Number of Defectives	52,282	14,404	37,878 (72%)
PROCESS CAPABILITY (OVERALL)	%Defective	7.85	2.16	-5.69
	95% Confidence Level	(7.79, 7.92)	(2.13,2.20)	
	PMM (DPMO)	78,512	21,631	-56,881
	Process Z	1.42	2.02	0.61

Table 5 shows the summary report for the binomial capability of Case Lower (68-MB62) before and after improvement. Based on the comparative results in terms of process characterization, the number of subgroups before and after improvement was seventy-two (72) subgroups, 9,248 for average subgroup size, 665,909 for the total items tested, and 52,282 for the number of defectives while after the improvement using the same parameters the results showed that the number of defective units decreased from 52, 282 to 14, 404 or with the overall improvement of 72%.

In terms of process capability, the results revealed that the percentage of defectives before was 7.85% and it went down to 2.16%, defect per million opportunities (DPMO) before was 78, 512 and it went down to 21, 631 and process Z before was 1.42 and after improvement, it went down to 2.02. Based on the requirements, the higher the process Z, the better the process performance. The ideal value of process Z is equivalent to 2 or higher. Therefore, the process is capable to fulfill the requirements of the customer.

After the comparison of binomial capability analysis, the researcher conducted the hypothesis test using Paired t-test to validate the improvement significance. The hypothesis test used for this study were as follows.

Ho: There is no significant difference between before and after improvement.
Ha: There is a significant difference between before and after improvement.
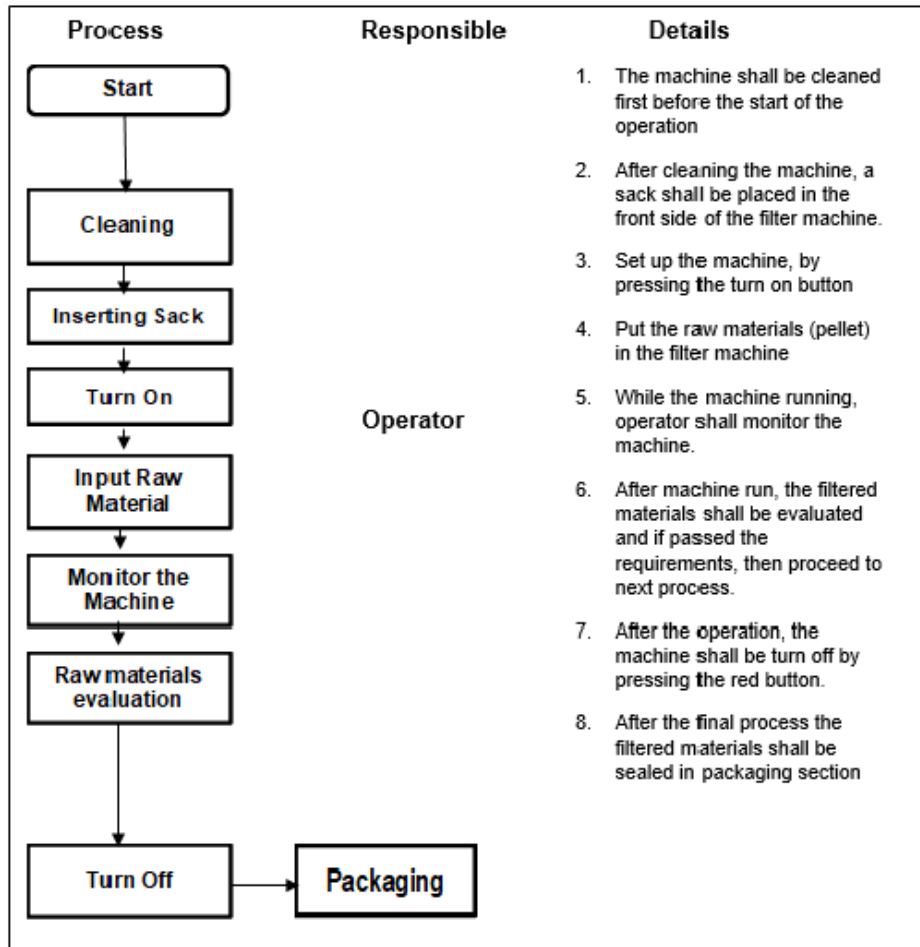
Table 6. Test of Improvement Significance

Paired T-Test	Defect Percentage	T-Value	P-Value	Interpretation
Before	7.85	6.09	0.000	Significant
After	2.16			

Legend: If the P-Value > 0.05, not significant. If the P-Value < 0.05, significant

Table 6 shows the hypothesis test for the actual compared to them before. Since the P-value is equivalent to 0.00 which is less than the predetermined level of significance of 0.05, thus the alternative hypothesis was accepted. This means that the improvement done was effective.

5.4 Control Phase

In the control phase, it was referred in maintaining the implemented improvement done in the process. The goal of the control phase ensured changes implemented are being maintained and can be used for continuous monitoring of the process.

Process	Responsible	Details
Start		1. The machine shall be cleaned first before the start of the operation
Cleaning		2. After cleaning the machine, a sack shall be placed in the front side of the filter machine.
Inserting Sack		3. Set up the machine, by pressing the turn on button
Turn On	Operator	4. Put the raw materials (pellet) in the filter machine
Input Raw Material		5. While the machine running, operator shall monitor the machine.
Monitor the Machine		6. After machine run, the filtered materials shall be evaluated and if passed the requirements, then proceed to next process.
Raw materials evaluation		7. After the operation, the machine shall be turn off by pressing the red button.
Turn Off → **Packaging**		8. After the final process the filtered materials shall be sealed in packaging section

6. Conclusion

Based on the findings gathered and concerning the objective of the study, the following conclusions were made. In the Define phase, the researcher was able to identify the top problem of the company using Pareto Analysis. Based on the Pareto chart the black spot defects were identified as the main source of the problem which was equivalent to 7.85%. The process mapping was applied to locate the main source of the problem and was noticed in the filtering process. The project charter was used to present the overall target improvement of 4.50%, project timeline from April – July 2021, and scope of the project in the Plastic injection molding process. In the Measure phase, the researcher presented the breakdown of 7.85% from the month of January-March 2021. A time series was utilized to illustrate the details of the defect percentage versus the overall target. Using Laney p-chart, it was found out that the proportion of variation in control limit based on the results was out of control while process performance was not stable to meet the customer requirements.

To further validate the overall process performance, the binomial capability results showed the results below the target of 2.00 which indicates that the process is not performing well. In Analyze phase, the researcher utilized the Why-why analysis to further investigate the root cause of the problem. It was revealed that the root cause of the problem is the filter mesh design. In Improve phase, the researcher together with a team from the company came up with an improvement plan to reduce the problem. The team came up with an improved design of the filter mesh. After the implementation of using the newly improved filter mesh, the researcher gathers data, and it was found out that there was significant improvement after comparing the control limit variation, process performance, and overall defect percentage which indicates the effectiveness of the improvement action. In the Control phase, the researcher developed a control plan for the filtering process to sustain the improvement and prevent the recurrence of the problem.

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Biography

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