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Quality Control of Product: Statistical Process Control

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***Abstract*— the problems faced by PT. Wahana Java Semesta Intermedia are still the emergence of defect products in every production and it escaped from quality control checked thus it reaches the consumer. This study aimed to analyze the application of products quality control system applied in PT. Wahana Java Semesta Intermedia, Radar Banten Newspaper products whether it is well within the control or not and looking for the factors that causing to the defect products. Data collection and information obtained from interviews and documentation for the number of products and production defects for three months in PT. Wahana Java Semesta Intermedia. The methods used to analyze products quality control by using statistical process control and fishbone diagram to determine the cause of defects products. Results showed that products quality control in PT. Wahana Java Semesta Intermedia is still controlled by the largest type of defects that is blurred ink with defects percentage 59.79% and with 1.26% percentage of defects from amount of checked production. Factors causing defects products are human, machine, work methods, environment and materials, in this case human is the primary cause of defects products.**

Keywords—Quality Control, SPC, Fishbone Diagram

I. INTRODUCTION

A good business event if in manufacturing or service cannot be separated from the consumer and the product. Along the advances information and technology today, the company is required to face consumers who are increasingly sensitive to the quality of goods or services that they wish to consume. To face this condition the company must pay attention to the quality of its products and intensified to produce quality of goods or services, so that the product can be accepted by consumers and competence in the market with the other products.

The company's quality control is necessary needed, by producing the customer's needs the company will attract consumers to buy the company's products in fulfilling their needs. So that from the consumer buying company can increase profits.

Many methods can be used to control the quality with each characteristic. Using Statistical Process Control (SPC) in quality control means quality is controlled from the beginning of production process, during the production process until the finished products. Before products will sell, the products have been examined then the good products will be separated with the defect products so that total product will decrease.

One of SPC tools is control chart and depend on one research say that it is not easy to successfully implement effective and sustainable control methods. The control chart is one commonly used tool in the measure and control phase. Control charts can also act as a means of organizational learning [1]. In other hand, the review about paradigm shift in types of SPC control chart does show clearly that the application boundaries extend considerably beyond manufacturing and that the range of problems to which SPC control chart techniques can be applied are much wider than commonly assumed. The paper has highlighted the critical fundamental and technical issues which need to be addressed with non-standard SPC chart applications [2].

Statistical quality control can detect errors or irregularities statistically [3]. SPC has the potential to improve the quality of maintenance, delivery process and ultimately the safety of patients or customers [4]. The application of statistical tools such as control charts, histogram, caused and effect diagram along with process capability analysis is presented in the study to eliminate quality problems arising out of various assignable causes during machining of crankcase. It is observed from the study that when the special or assignable causes of variation are present in manufacturing, the process is deemed to be out-of-control then use of SPC [5]. Depend on this view in this research SPC will use for knowing the condition of quality control.

Large and small companies realized the importance of quality, but each company has a different view on the implementation of quality control. PT. Wahana Java Semesta Intermedia is one company of newspaper printing in Serang Banten, where market covering the area of Banten Province and with one of product named Radar Banten. As one of big company in Banten and has large market coverage in Banten Province, they need a system of quality control for increase consumer loyalty to the Radar Banten newspaper. The quality of the newspaper is not only on paper forms (that are not defects such as blurred, cropped and so on), but also the quality of advertising services corresponding to customer orders and the quality of the news on Radar Banten newspaper. PT. Wahana Java Semesta Intermedia (Radar Banten) has understood well for the importance of quality.

In the fact for Radar Banten, there are still defect newspapers product that escaped from quality control checked thus it reaches the consumer. As noted by some consumers Radar Banten based on interviews in March 2013. Some consumers of Radar Banten newspaper still often found defect product of Radar Banten newspaper, there is some unclear writing caused blurred ink on the paper. In addition, there are several mistyping errors and patches of ink around the printed Radar Banten newspapers. In other cases, the newspaper layout found in wrong accurate position and some of the pictures were cropped. Based on interviews with department of production, type of defect newspaper most often found are paper cut not on its part, blurred ink on the text and dirty patches when printing process. If the consumers reach defects products, it will impact to decreasing consumer trust to Radar Banten newspaper.

The problems that will be discussed in this research are:

- Does the implementation of quality control in PT. Wahana Java Semesta Intermedia (Radar Banten) are under control limits.

- What factors are causing in the implementation of quality control in PT. Wahana Java Semesta Intermedia (Radar Banten).

The purposes of this study are:

- To analyze the implementation of quality control in PT. Wahana Java Semesta Intermedia (Radar Banten) in an attempt to determine if the defects products are under control or outside the control limit.
- To identify any factors that cause in the implementation of quality control on products manufactured by PT. Wahana Java Semesta Intermedia (Radar Banten).

II. THEORETICAL BASIS

Quality control is technique and planned activities or actions undertaken to achieve, maintain and improve the quality of products and services to comply with predetermined standard and could meet customer satisfaction. The main objective the implementation of quality control is to get a guarantee that the quality of the products or services produced in accordance with the quality standards have been established and in accordance with the desire consumers by the most optimal cost [6].

Accurate and valid data will we got as well for the analysis by using seven tools. The main statistical tools can be used as tools for quality control, which is; check Sheet, histogram, control chart, Pareto diagram, causal diagram, scatter diagram, and process diagram. Before that we must know that Statistical Process Control is a statistical technique used to determine the condition of quality product, SPC widely used to ensure that the process match with standards so that the products also have a good quality [7]. In other words, Statistical Process Control is a process used to monitor the standards, create a measuring and take corrective action while a product or service being produced.

The framework used in this study illustrates how quality control using statistic can analyze the degree of defects product which produced by PT. Wahana Java Semesta Intermedia (Radar Banten) that over the tolerance limit, after that identify the cause of such problems and the last make suggestions or recommendations for improvement of quality in the future. Based on the theoretical basis and previous research, we can make frameworks in this study.

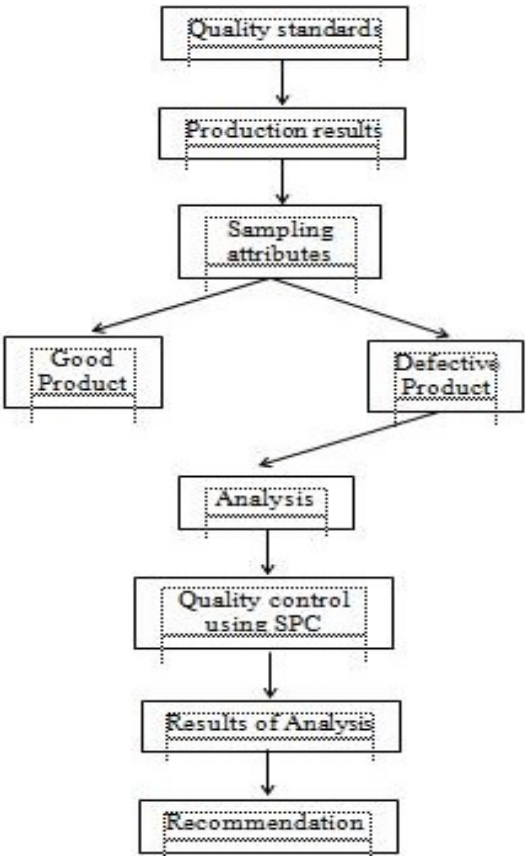


Fig. 1. Research Framework

III. RESEARCH METHODS

The variable of this research is quality control, in which the quality control problem is a problem that can't be measured directly and need detailed indicators to be measure clearly. Thus the problem of quality control is a latent variable. Latent variable is a formation variable or hidden variables that must be declared by using an indicator. Another name for the latent variable is a factor, construct, or unobserved variable [8]. The indicators regarding quality control in this study is the number of defective products, the number of samples.

The population and the sample in this study is the number of Radar Banten newspaper produced by PT. Wahana Java Semesta Intermedia during the three months from January to March 2013. Data used in this study consisted of secondary data about the number of production, product defect and the number of samples. There are also primary

data based on interviews to employees and customers of PT. Wahana Java Semesta Intermedia. Data obtained is quantitative and most of the data obtained from the company that became a place of research. Quantitative data in few articles mentioned such as numerical data in spreadsheets, databases or log files, and only a handful discuss quantitative data above and beyond aggregate usage statistics [9]. Quantitative data in this research obtained from the interviews and the document / records of the production and the quality control department.

IV. RESULTS AND DISCUSSIONS

Quality control of finished product is done through the inspection. In general, the characteristics of good quality standard for newspapers are clean, flat ink absorption (the prints are not blurred), the edges of the paper cut according to the machine settings.

The first step taken to analyze statistical quality control is to create a table (check sheet) production quantities and product defect / incompatible with quality standards.

TABLE I. RADAR BANTEN NEWSPAPER TOTAL PRODUCTION JANUARY 2013

Date	Print Circulation (Copy)	Type of Defects (Copy)			Total Defects (Copy)
		Dirty Patches	*Blurred*	*Cropped*	
1	0	0	0	0	0
2	20516	52	119	30	201
3	20500	62	150	38	250
4	20330	51	119	32	202
5	29430	41	90	26	157
6	15090	31	75	19	125
7	20645	52	121	30	203
8	20824	63	149	38	250
9	20910	56	119	33	208
10	20855	88	210	53	351
11	20885	50	120	30	200
12	20359	67	149	39	255
13	15100	62	151	38	251
14	31440	55	132	33	220
15	31170	60	144	36	240
16	31145	52	122	30	204
17	20859	65	156	39	260
18	31163	50	120	30	200
19	20250	70	168	42	280
20	15080	62	150	38	250
21	31013	78	189	47	314
22	31320	53	121	30	204
23	20916	82	198	50	330
24	0	0	0	0	0
25	20830	68	162	41	271
26	20240	48	114	29	191
27	15571	66	158	39	263
28	20923	75	180	45	300
29	31030	88	210	53	351
30	20790	50	118	30	198
31	20750	113	270	67	450
Total	659934	1810	4284	1085	7179
Average	22756	63	148	37	248

[a] Source: PT. Wahana Java Semesta Intermedia, 2013

TABLE II. RADAR BANTEN NEWSPAPER TOTAL PRODUCTION FEBRUARY 2013

Date	Print Circulation (Copy)	Type of Defects (Copy)			Total Defects (Copy)
		Dirty Patches	*Blurred*	*Cropped*	
1	20760	63	150	38	251
2	29923	78	186	47	311
3	15070	6	15	4	25
4	20948	18	42	11	71
5	31094	88	209	53	350
6	20722	113	270	68	451
7	20690	83	197	50	330
8	22915	55	132	33	220
9	19860	70	168	42	280
10	0	0	0	0	0
11	31340	54	130	33	217
12	20540	56	138	35	229
13	31193	78	186	47	311
14	20995	98	234	59	391
15	20776	80	192	48	320
16	29890	108	257	65	430
17	14926	81	195	49	325
18	20943	73	174	44	291
19	20789	93	221	56	370
20	20888	95	228	57	380
21	31067	105	252	63	420
22	31036	112	266	68	446
23	19869	138	329	83	550
24	15107	87	210	53	350
25	25798	75	179	45	299
26	14745	62	149	38	249
27	21905	90	216	54	360
28	31186	73	175	44	292
Total	624975	2132	5100	1287	8519
Average	23147	79	189	48	316

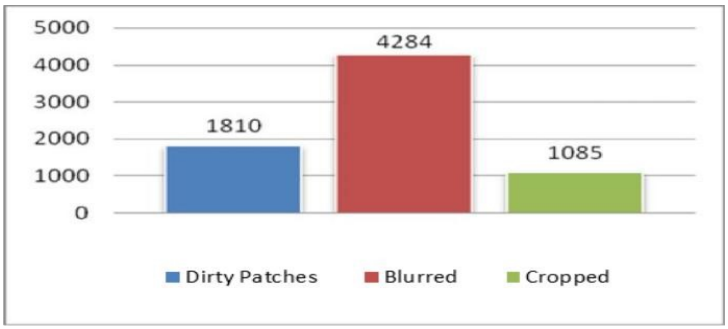
[b] Source: PT. Wahana Java Semesta Intermedia, 2013

TABLE III. RADAR BANTEN NEWSPAPER TOTAL PRODUCTION MARCH 2013

Date	Print Circulation (Copy)	Type of Defecrs(Copy)			Total Defects (Copy)
		Dirty Patches	*Blurred*	*Cropped*	
1	34400	74	169	43	286
2	29544	65	156	39	260
3	15060	81	195	49	325
4	30630	83	198	50	331
5	30805	75	180	45	300
6	30946	95	228	57	380
7	20740	90	216	54	360
8	30835	98	239	60	397
9	29865	143	342	86	571
10	14857	88	210	53	351
11	25830	70	168	42	280
12	0	0	0	0	0
13	31082	68	162	41	271
14	31010	95	228	57	380
15	31035	130	312	78	520
16	30200	83	198	50	331
17	14860	72	173	43	288
18	31179	77	179	49	305
19	31264	113	269	68	450
20	31090	98	234	59	391
21	31228	78	191	49	318
22	32970	97	229	56	382
23	30028	93	221	58	372
24	14940	125	299	75	499
25	31141	83	197	53	333
26	31187	103	246	62	411
27	32345	98	240	61	399
28	31305	83	195	55	333
29	0	0	0	0	0
30	30170	95	228	57	380
31	14924	135	323	81	539
Total	805470	2688	6425	1630	10743
Average	27775	93	222	53	370

[c] Source: PT. Wahana Java Semesta Intermedia, 2013

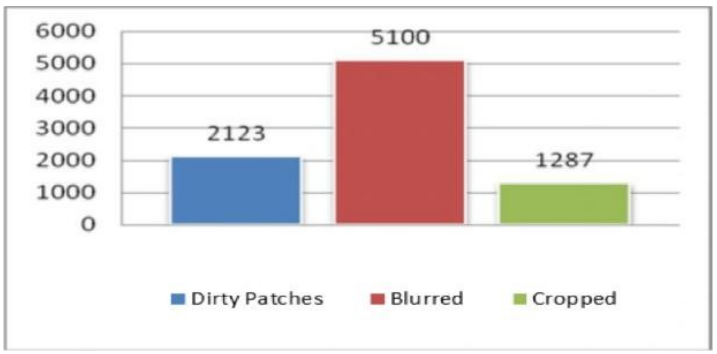
After check sheet is done, next step is to create a histogram. The histogram is useful fatherly see what kind of the most common defects.



[d] Source: Secondary data were processed, 2013

Fig. 2. Histogram of Radar Banten Newspaper Defects Product January 2013

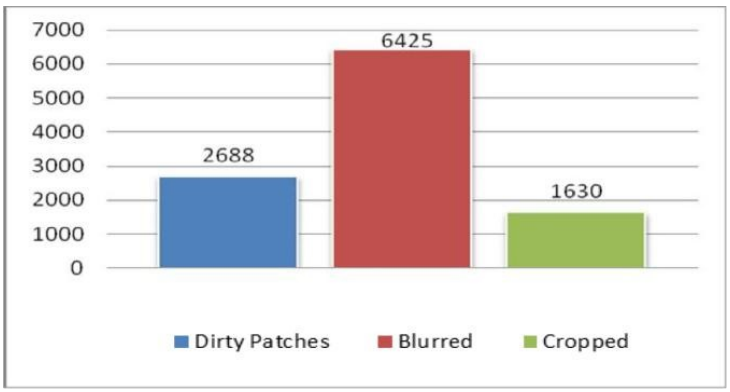
In January, the most dominant types of defects caused blurred ink. The average defect caused blurred ink was 148 copies or 59.7% from total newspaper defects. The average for the dirty paper and cropped are 63 copies or 25.2% and 37 copies or 15.1%, less than the average number and percentage of newspaper caused by blurred ink. In addition the percentage of defects in January is 1.09% from total production or products are checked for the month.



[e] Source: Secondary data were processed, 2013

Fig. 3. Histogram of Radar Banten Newspaper Defects Product February 2013

In February, the most dominant type of defect is still caused by ink blur. The average defect caused blurred ink in February was 189 copies or 59.9%, increasing 41 copies of the average defects in January. While the average for the dirty paper and cropped are 79 copies or 25% and 48 copies or 15.1%, which also increased from January. But in the average and the percentage of defects is still lower than average and the percentage for blurred ink newspaper. Percentage of defects in February is 1.36% from total production for the month and increase 0.27% from January.



[f] Source: Secondary data were processed, 2013

Fig. 4. Histogram of Radar Banten Newspaper Defects Product March 2013

Similarly with the conditions in January and February, the type of most dominant defect newspaper in March was caused by ink blur. Even in March the number is decreasing, with the average of newspapers defects caused blurred ink is 214 copies or 59.81%. The type of dirty paper and cropped also increased by an average of defects and defect percentage around 90 and 54 copies or 25.02% and 15.17%. The percentage of defects in March is 1.34% from total production in that month, decrease 0.02% from the month of February.

Based on histogram from January to March 2013 above, the type of most defect products is caused by blurred ink. The number of newspaper blurred was increase in every month likewise with dirty newspapers and cropped paper, but the number with blurred ink is the most dominant defect. Total defect of newspaper in January is 7.179 copies from 659.934, 8.519 from 624.975 copies in February and 10.743 from 805.470 copies. In addition the percentage of defects has increased every month, with the percentage of defect products in January is 1.09% 0.27% increase in February became only 1.36% and decreases of 0.02% in March became 1.34%.

After creating a histogram, next step is to create a p-chart or control chart, which the function to see the company quality control position. The steps in create a map of the control is as follows.

A. Calculating percentage of defects

TABLE IV. TOTAL PRODUCTION, PRODUCT DEFECTS AND DEFECTS PRODUCT PERCENTAGE RADAR BANTEN NEWSPAPERS JANUARY - MARCH 2013

Date	January 2013			February 2013			March 2013		
	Total (Copy)	*Total Defects (Copy)*	*Defect (%)*	*Total (Copy)*	*Total Defects (Copy)*	*Defect (%)*	*Total (Copy)*	*Total Defects (Copy)*	*Defect (%)*
1	0	0	0	20760	251	1.21	34400	286	0.83
2	20516	201	0.98	29923	311	1.04	29544	260	0.88
3	20500	250	1.22	15070	25	0.17	15060	325	2.16
4	20330	202	0.99	20948	71	0.34	30630	331	1.08
5	29430	157	0.53	31094	350	1.13	30805	300	0.97
6	15090	125	0.83	20722	451	2.18	30946	380	1.23
7	20645	203	0.98	20690	330	1.59	20740	360	1.74
8	20824	250	1.2	22915	220	0.96	30835	397	1.29
9	20910	208	0.99	19860	280	1.41	29865	571	1.91
10	20855	351	1.68	0	0	0	14857	351	2.36
11	20885	200	0.96	31340	217	0.69	25830	280	1.08
12	20359	255	1.25	20540	229	1.11	0	0	0
13	15100	251	1.66	31193	311	1	31082	271	0.87
14	31440	220	0.7	20995	391	1.86	31010	380	1.23
15	31170	240	0.77	20776	320	1.54	31035	520	1.68
16	31145	204	0.66	29890	430	1.44	30200	331	1.1
17	20859	260	1.25	14926	325	2.18	14860	288	1.94
18	31163	200	0.64	20943	291	1.39	31179	305	0.98
19	20250	280	1.38	20789	370	1.78	31264	450	1.44
20	15080	250	1.66	20888	380	1.82	31090	391	1.26
21	31013	314	1.01	31067	420	1.35	31228	318	1.02
22	31320	204	0.65	31036	446	1.44	32970	382	1.16
23	20916	330	1.58	19869	550	2.77	30028	372	1.24
24	0	0	0	15107	350	2.32	14940	499	3.34
25	20830	271	1.3	25798	299	1.16	31141	333	1.07
26	20240	191	0.94	14745	249	1.69	31187	411	1.32
27	15571	263	1.69	21905	360	1.64	32345	399	1.23
28	20923	300	1.43	31186	292	0.94	31305	333	1.06
29	31030	351	1.13				0	0	0
30	20790	198	0.95				30170	380	1.26
31	20750	450	2.17				14924	539	3.61
Jumlah	659934	7179		624975	8519		805470	10743	

[g] Source: Secondary data were processed, 2013.

B. Calculating Central Line (CL)

Central Line is the middle line between the upper control limit (UCL) and lower control limit (LCL). The center line is a line that represents the average defect rate in a production process. To calculate the center lines use the formula:

$$CL = \bar{p} = \frac{\sum np}{\sum n} \quad (1)$$

Annotation:

$\sum np =$ Total Defects

$\sum n =$ Total Information Obtained

[h] Source: Heizer and Render, 2005.

TABLE V. TOTAL NUMBER OF DEFECTS, TOTAL NUMBER INSPECTED, *CENTRAL LINE* (CL) RADAR BANTEN JANUARY - MARCH 2013

Month	$\sum np$	$\sum n$	Central Line
January 2013	7179	659934	0.011
February 2013	8519	624975	0.014
March 2014	10743	805470	0.013

[i] Source: Secondary data were processed, 2013.

C. Calculating Upper Control Limit (UCL)

To calculate upper control limit performed by the formula:

$$UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) \quad (2)$$

Annotation:

$\bar{p}$ = product defects average / central line

n = size of each sample

[j] Source: Heizer and Render, 2005.

1) January 2013

Subgroup 1: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20516}\right) = 0.013$

Subgroup 2: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20500}\right) = 0.013$

Subgroup 3: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20330}\right) = 0.013$

And so on

2) February 2013

Subgroup 1: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20760}\right) = 0.016$

Subgroup 2: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{29923}\right) = 0.016$

Subgroup 3: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{15070}\right) = 0.016$

And so on

3) March 2013

Subgroup 1: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{34400}\right) = 0.015$

Subgroup 2: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{29544}\right) = 0.015$

Subgroup 3: $UCL = \bar{p} + 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{15060}\right) = 0.015$

And so on

D. Calculating Lower Control Limit (LCL)

To calculate the lower control limit or LCL performed by the formula:

$$LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) \quad (3)$$

Annotation:

$\bar{p}$ = product defects average / central line

n = size of each sample

[k] Source: Heizer and Render, 2005.

1) January 2013

Subgroup 1: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20516}\right) = 0.09$

Subgroup 2: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20500}\right) = 0.09$

Subgroup 3: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20330}\right) = 0.09$

And so on

2) February 2013

Subgroup 1: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{20760}\right) = 0.011$

Subgroup 2: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{19922}\right) = 0.011$

Subgroup 3: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{15070}\right) = 0.011$

And so on

3) March 2013

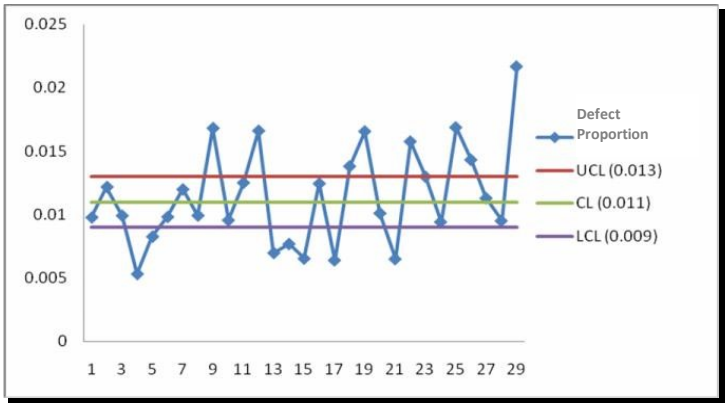
Subgroup 1: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{24400}\right) = 0.011$

Subgroup 2: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{29544}\right) = 0.011$

Subgroup 3: $LCL = \bar{p} - 3\left(\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right) = 0.11 + 3\left(\frac{0.11(1-0.11)}{15080}\right) = 0.011$

And so on

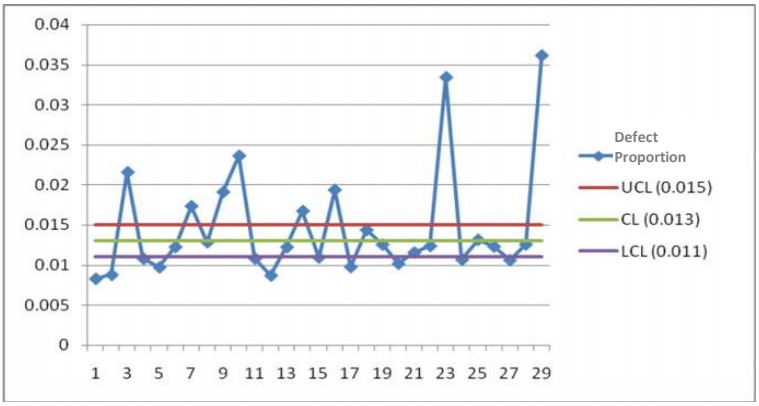
From the calculation above, we can make a p-chart using Microsoft excel 2007 which can be seen in figure below:



[l] Source: Secondary data were processed, 2013.

Fig. 5. P-Chart of Radar Banten Newspaper Proportion Defects January 2013

In January there are 8 points above the line of upper control limit (UCL) and 7 points under the line of lower control limit (LCL). From 29 points, there are 8 points above the line of upper control limit (UCL), its means 27.6% defect products is over from tolerable limits. The 24.1% defect under LCL line indicates the proportion of small defect. While 14 points or 48.3% still in line between LCL and UCL, indicating defect is still in tolerance.

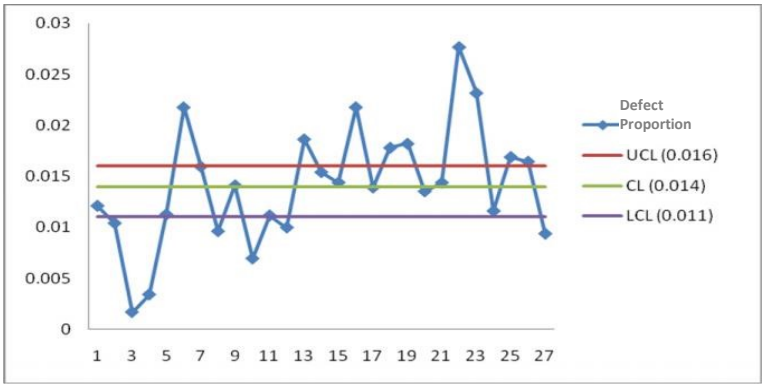


[m] Source: Secondary data were processed, 2013

Fig. 6. P-Chart of Radar Banten Newspaper Proportion Defects February 2013

Above is P-Chart in February, there are 9 from 27 points are above the line of upper control limit (UCL). Its means 33.3% defect is over from tolerable limits. Meanwhile, 26% defect under LCL line indicates the proportion of small defect. 40.7% defect is still inline between UCL and LCL control

limits or 11 point is indicates the number of defects that over the control limit are increase from January. The percentage of defect that over the control limit is increased 5.7% from January. This indicates the control or supervision of the quality declined from the previous month.



[n] Source: Secondary data were processed, 2013

Fig. 7. P-Chart of Radar Banten Newspaper Proportion Defects March 2013

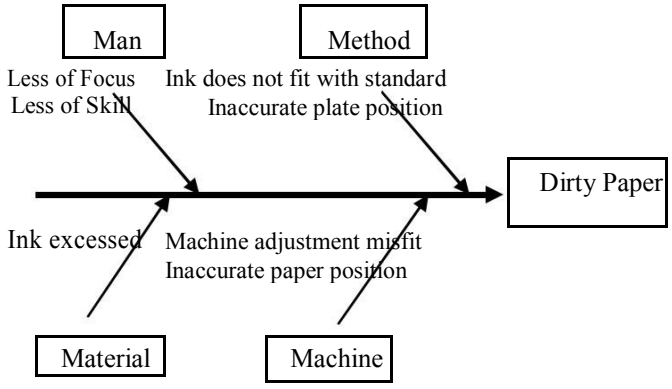
In March, the point that over the control limit is 8 points from 29 points. Its mean 27.6% defect over the control limit. 34.5% or 10 points under the line LCL and 37.9% or 11 points defect still in control of the boundary area or still between UCL and LCL line. This condition shows declining condition from January until March. In January defect are still in line of UCL and LCL is 48.3% that decrease in February become 40.7% and more decrease become 37.9% in March.

From three control maps above, we can see that the defect newspapers over the control limit still fluctuate each month. The fluctuating number of defect product above UCL shows inconsistency quality control of product in PT. Wahana Java Semesta Intermedia. Because of that PT. Wahana Java Semesta Intermedia need a better quality control system. In January 27.6% defect is over the control limit and then increased to 33.3% in February. However, for the month of March, the defect is above UCL line decrease to 27.6% but still biggest than the percentage of decline in January. In addition, in January there is one point outlier then increased in February and March become 2 points outlier. Outlier point is higher point then the other is because of the defect number and the percentage of defect is high on that day. This p- chart result was seen the number of points that are above the upper limit is still fluctuating, rising in February and declined in March. Moreover, with increasing outlier points that are outside the UCL line indicates declining activities in quality control and this condition need more attention.

Causal diagram or Fishbone diagram was made after the p-chart to analyze the factors that become the cause of product defects. The factors that influence and cause defect products can generally be classified as:

- *Man*, i.e. workers in the production process.
- *Material*, i.e. the components in producing products into finished goods.
- *Machine*, i.e. equipment used during the production process.
- *Method*, i.e. instructions or work orders to be followed in the production process.
- *Environment*, i.e. the circumstances around the production site, which directly or indirectly affect the production process.

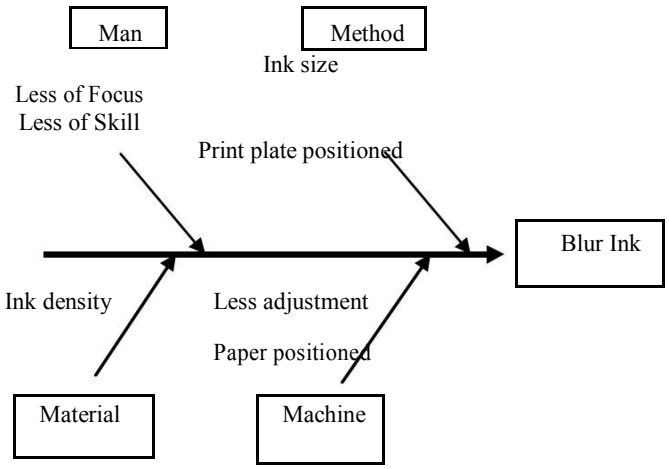
We can see from histogram in figure 2 until figure 4 that there are three types of defect product in the production process are dirty paper, ink blur, and cropped paper. As a tool to find the cause of the defect, fishbone diagram is used to explore each type of defects. Here is a causal diagram use for dirty paper, ink blur, and cropped paper.



[o] Source: Secondary data were processed, 2013

Fig. 8. Fishbone diagram of Dirty Newspapers

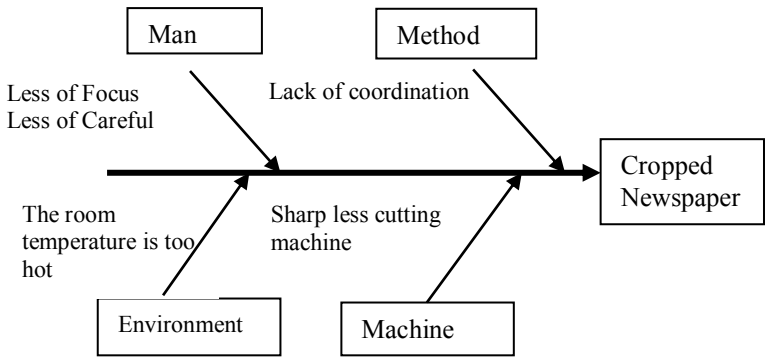
Newspapers were dirty it caused by poor ink absorption, ink too fluid and the ink too much which caused the product is not worthy to published. This usually because of the ink on the printing is too much and liquid, causing some printouts are inkblots. In addition, other factors that caused the paper become dirty is the position of the paper and printing plates does not fit caused by workers who are less focused. Setting machines that do not fit well also caused the prints are ink blots and dirty.



[p] Source: Secondary data were processed, 2013

Fig. 9. Fishbone diagram of Blurred Ink Diagram

Printing results with blurred ink caused by the absorption of the ink are not doing well, because of that blurred ink product is considered not worthy to publish. This usually occurs at the start of printing, because at the beginning of printing ink on the printing machine is still concentrated (not too liquid) that caused some printouts look blurry. In addition, other factors that caused this problem that ink is not fit caused by workers who are less focused. Machines adjustment that not fit also caused blurred prints.



[q] Source: Secondary data were processed, 2013

Fig. 10. Fishbone diagram of Blurred Ink Diagram

Cropped newspapers which does not fit with the layout during the cutting process by the machine then there are inaccurately text or picture, caused by less careful operator while checking machine adjustment or checking the sharpness of the cutting blade. Employee's less of careful also caused by hot room temperatures from the machine. Moreover lack of coordination between operators also cause the disrupted of machine adjustment.

V. CONCLUSIONS

Conclusion

- Quality Control
  Based on the histogram, the highest defect for 3 months is caused blurred ink with 59.79% and defect caused by dirty paper with a percentage of 25.07%. Defect caused as newspapers cropped is not on part with 15.14% percentage of defects. The percentage of defects inspected by total production is 1.26%. Based on the results of the control map (p-chart) can be seen that the quality control is over the control limit. This can be seen in the control chart that shows there are many points that are over the control limit, the point is fluctuating. In January, 27.6% defect is over the control limit and increased to 33.3% in February decreased to 27.6% in March.
- Based on the fishbone diagram we can see the factors that cause in the quality control are man, machine, work methods, materials and work environment. Where is the

biggest cause factor caused by man or workers who are less focused or less skilled.

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