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PROPOSE MODIFIED CONTROL CHART FOR MANAGEMENT IN REAL FIELD*

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ABSTRACT

In this paper, we gave 3 suitable modified control chart at the same time shows. First control chart is plot analysis control chart by sampling data, Second control chart is including Upper Spec and Lower Spec in first control chart. Third control chart is including target value and new calculated upper/lower control line by using known average and standard deviation of long term data. If 3 control charts are seen at the same time, there is advantage that can see problem of process at a look. We hope this method proposed in this treatise give many help in spot.

KeyWords: 3 suitable modified control chart, Upper Spec and Lower Spec, target value

Ⅰ. INTRODUCTION

When we visit in real fields of industry, we can find many control chart which is misused. The reason of misusing of Control Chart, it is not enough to understand Control Chart, but data control is poor which is basic problem.

In this paper, we give a few misused control chart in real fields and propose modified suitable control chart. We give example to explain for understanding easily.

Ⅱ. ANALYSIS CONTROL CHART AND MANAGEMENT CONTROL CHART

Control chart used in industry fields is mostly analysis control chart for management. Which is mistake. We use Management Control Chart as Analysis Control Chart. This is fundamental mistake(We think that reason is poor teaching material which explain control chart for management).

By using analysis control chart, it is possible to search whole state of present process. By analysis control chart it is not enough to know information about present circumstance of process, grasp present state, center line and upper/lower control line is calculated using data for short tern sampled. Analysis control chart is satisfied that analyze present state. However, for process administration, then we use Management control chart. Key Point of management control chart use given target value and standard deviation of long term of process. If data do not accumulate long term about process, then control chart is painted using sample data and control chart can use for analysis. Analysis control chart is used for administration early induction and before process was stabilized.

Do not use process management if analysis control chart is used. Field worker is not enough to know control chart correctly, specially means value, standard deviation, short term data, long term data. They have not gather real process data.

Management Control chart manage to keep quality characteristic by fixed value. Management Control chart is essential administration tool of process control that is used to prevent badness by checking stability of process immediately.

Most control chart that use on spot is made by using idea of Shewhart.

$\bar{X}$-R, $\bar{R}$-s, I-MR, I-R/S, Zone, P, NP, U, C

etc which is called Shewhart control chart or 3σ control

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chart. Walter A . Shewhart(1891- 1967) who published control chart in a treatise 「economical quality control of production product」 on May 16, 1924. He studied to find time when must take action to escapes normal activity in Bell laboratories, To use statistics and devises control chart.

Because quality level by his control chart is risen more than before, contribution of Shewhart left in industrial fields is very big. Control chart is quality control technique that is applied in all category business special manufacturing industry and service industry. Shewhart lay stress on normal distribution if accumulated gathering data of process that is managed. Data of normal distribution have 99.73% between mean-3*s standard deviation and mean +3*s standard deviation and outside mean-3*s standard deviation or mean+3 *s standard deviation is 0.27%. He thought that Action must take when data is happened outside of mean±3*standard deviation(Ree, 2005; Ree, 2006; Lim, 2006).

2.1 Management control chart have important 3 statistic

Management control chart is used process manage stability. Using of management control chart depended on post's management control level. Control level of company is different.

2.1.1 Target Value

Target value is given value, Target value should be present state, not future state. Center value is not target value. Center value is mean of gathered data which is calculated value.

Target value is as administration characteristic value should be kept changelessly in spite of lot alteration of material, machine or lot alteration of worker, measurement analysis system. Target value can be changed as following cases.

- When administration target level was changed
- When production condition was revised
- When quality characteristic was changed
- When administration guide was changed

Target value is established based on following cases,

- By authorize laboratory, given value which is measured perfect process
- Mean value that is gotten from other most factory which is same equip productive system.
- Value that wish to manage by most suitable in productive system .
- Value that is satisfied by average value that is gotten by result for last several months of productive system.

If target value is not given based on certain basis, we can't manage process correctly. The Key point of Target value is present state value, not aim value. We hope center line is same target value.

2.1.2 standard deviation

Standard deviation is calculated gathering data from managing process for long term. Standard deviation is value of present capability of process, not aim value.

Standard deviation can be calculated by methods as following.

- Given standard deviation by administration purpose.
- A proposal value of spot engineer who is expert to process
- Standard deviation is calculated by getting through sampling data long term.
- Take standard value which given by machine brand.

Even standard deviation is well managed, can change. If given standard deviation is greater than actuality, defective goods detection is difficult because control line is great. By reverse, if given standard deviation is smaller than actuality, defective goods detection will mistake handle as badness.

2.1.3 Subgroup size

Subgroup is established uniformity production condition as worker, material, utilities and others. sampling data for plot control chart is gathered in same subgroup. Control chart reacts sensitively in subgroup. Control chart is purpose to find while mean value and deviation change. If subgroup is done wrongly, then can't know change in control chart. Change is caused by accidental error in subgroup and abnormal error by changing between subgroup. Error can't search for change because error was mixed if subgroup set is done wrongly. Subgroup standard deviation should choose subgroup. All data should do stratification.

2.2 Analysis of Control chart

In control chart, if data is located above upper or under lower control line, warn that there is not normal of process. Upper control line and lower control line is calculated by gathering data from sampling subgroup.

Purpose of control chart is sensing productive system change. If system was stabilized, data displays normal distribution and sampling data can expect possibility to range in specification.

If there is change in productive system, sampling data may disobey normal distribution more. Control chart rule is sensing and informs that data escapes in normal distribution.

When there is problem with control chart, it is 2 occasion as following.

① Even problem is, but does not inform change. In this case,

Upper control line or lower control line is bigger calculated than actual state of process. In case, damage is big.

② Even practical problem does not exist, then warning message of run rule give sign. Probe problem and repeat analysis though there is no practical problem, fair time and expense are cost for this, Usually, suffer this occasion.

2.2.1 control chart error

There is 2 error of process with control chart. It is accidental error which is changed deviation and abnormal error which is changed means. Total error of process is sum of abnormal error and accidental error.

If process is stable, then average of process is change in near in target value. If Control chart warn process change, then worker should take action to control chart.

2.2.1.1 Abnormal error(Systematic error)

Abnormal error is change of mean value. Mean value change is problem connected with accuracy. That is, it sign mean value is changing. Cause of abnormal error is change of material, lot, worker, gage measure method, measuring instrument, etc.

2.2.1.2 Accidental error(random error)

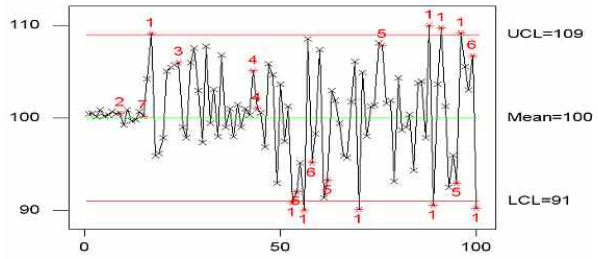
Accidental error displays size of product scattering(standard deviation). If process is administered normally, then suppose that accidental error accomplishes normal distribution. Process can't be fixed all conditions, for example, non-homogeneous of material, worn of machine, outside temperature etc. which cause can't be fixed, some accidental error can't avoid. Accidental error is changed to between upper and lower side of center-line of control chart. Control chart searches for abnormal error and accidental error. Error of such two types is produced by different cause.

<Table 1> run rule of control chart

Rule No	Explain	Error
1	One point from center-line 3*s standard deviation	abnormal accidental
2	9 points is located same upper(or lower) from center-line consecutively occurrence	abnormal
3	6 points increase consecutively or decreases	abnormal
4	14 points are doted contiguously alternately up and down	abnormal
5	2 among 3 pointing escape 2 *s standard deviation from center-line	abnormal
6	4 among 5 pointing escape 1 * standard deviation from center-line	abnormal
7	15 points appear inside 1 * standard deviation from center-line contiguously	abnormal
8	8 serial points are 1 * standard deviation upside or under appeared occasion from administration center-line	abnormal

2.2.2 Run Rule

Use run rule to sense process change in control chart. There is run rule that use 8 kinds on the spot as <Table 1>. If we use Minitab S/W which is popular S/W for control chart, when Data is violated, then run rule no is written in control chart figure.



<Figure 1> Run Rule No 1- 8 is located simultaneous in control chart

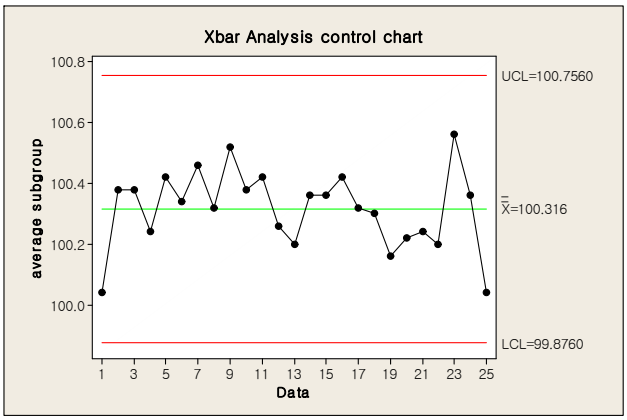
Ⅲ. EXAMPLE MISUSING OF CONTROL CHART

If use analysis control chart for process management, it judge that there is no problem though there is problem. A industry company which product a pipe that use to farm machines. Target diameter of command is 100.0mm and upper spec is 100.5mm, and lower spec is 99.5mm. When get 25 sample data each subgroup sampling 5 data, data is following as <Table 2>.

<Table 2> Sampling Data

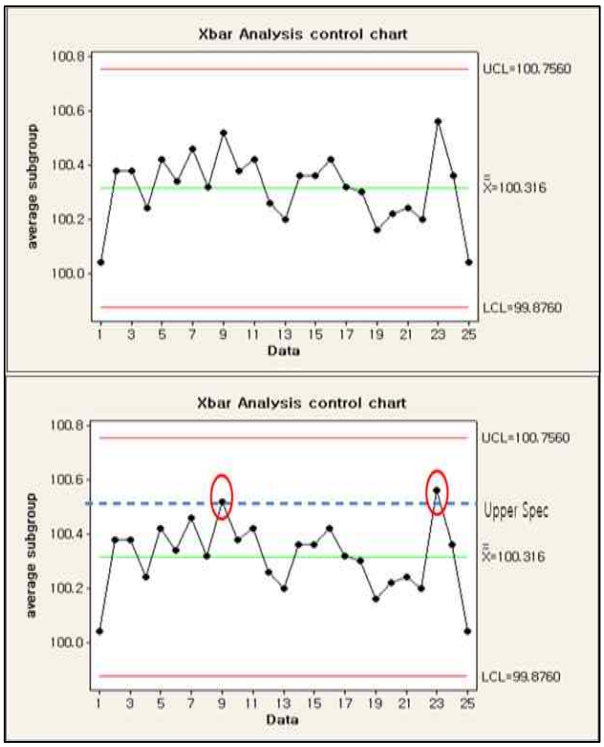
No	x1	x2	x3	x4	x5
1	99.3	100.3	100.3	100.3	100.0
2	100.8	100.5	100.5	99.9	100.2
3	100.8	100.5	100.6	100.2	99.8
4	100.4	100.2	100.4	100.0	100.2
5	100.2	100.4	100.3	100.1	101.1
6	100.0	100.5	100.3	100.6	100.3
7	101.0	100.4	100.4	100.7	99.8
8	100.4	100.3	100.2	100.5	100.2
9	100.3	100.3	100.5	100.8	100.7
10	100.4	100.4	100.4	101.2	99.5
11	100.1	100.5	100.2	100.8	100.5
12	99.9	100.1	100.8	100.0	100.5
13	100.2	100.0	100.4	100.1	100.3
14	99.9	100.4	100.0	100.6	100.9
15	100.2	100.3	100.3	100.4	100.6
16	100.3	100.2	100.8	100.2	100.6
17	100.4	100.3	100.1	100.8	100.0
18	100.6	100.6	99.9	100.3	100.1
19	99.9	100.2	99.9	100.2	100.6
20	100.6	100.1	100.4	99.9	100.1
21	100.2	100.0	100.0	100.4	100.6
22	100.0	100.8	100.3	99.9	100.0
23	100.4	100.4	100.3	101.0	100.7
24	100.7	100.5	100.0	100.3	100.3
25	99.9	100.1	100.6	99.6	100.0

By using minitap 16 versions figure control chart which is analysis control chart. Control chart is exposed that is no problem as like <Figure 2>.



<Figure 2> Control chart of <Table 2>

<Figure 3> is painted upper Spec (100.5) and Target Value (100.0), then 9th and 23th data are badness. If 2 data among 25 data are badness, this process is problem which badness is high



<Figure 3> including Upper Spec and target Value in <Figure 2>

Target value is 100.0, average of <Table 2> is 100.3, central axis of process is above than target value. If <Figure 2> is used real fields, then judge process is no problem, but really have problem, it is mistake.

Ⅳ. PROPOSE SUITABLE CONTROL CHART WHICH INCLUDING SPEC AND TARGET VALUE

As above example, it is possible mistake judge that there is no problem though there is problem. Because process worker can't know average and standard deviation of process because data accumulation does not become(such mistakes are found in spot a lot of places). Zone control chart is suggested to spot for this. Zone control chart is showing score in control chart by dividing $\pm 1\sigma$, $\pm 2\sigma$, $\pm 3\sigma$, but it is not used much on the spot because there is shortcoming that can't see changing situation such as $\bar{X}$ control chart in same time. $\bar{X}$ Control chart that is well used many in spot.

In this treatise, we propose suitable $\bar{X}$ control chart, R control chart is not modified which is no difference in several occasions.

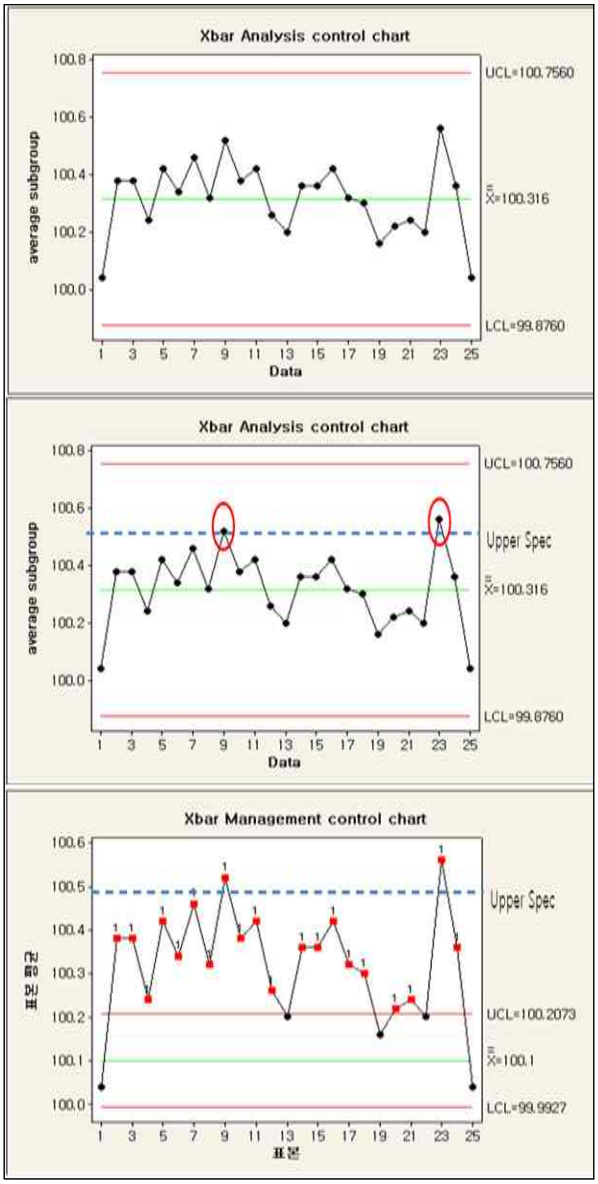
Suggest 3 $\bar{X}$ control charts at the same time as following <Figure 4>. First control chart is plot analysis control chart by using sampling data, Second control chart is including Upper Spec and Lower Spec in first control chart. Third control chart is including target value and new calculated upper/lower limit line by using known average and standard deviation of long term data. If look 3 $\bar{X}$ control charts at the same time, process judgment is easy because can see badness at a look. <Figure 4> is proposed 3 $\bar{X}$ control charts by using <Table 2>.

① By using <Table 2>, we plot analysis control charts.

② In analysis control chart, we paint control chart by including Upper Spec 100.5 Lower Spec 99.5.

③ In above control chart, including Upper/Lower control line, we paint target value 100.0 and new calculated upper/lower control line by using known average 100.1 and standard deviation 0.08.

which is control chart is following as like <Figure 4>.



Top: analysis control chart
Middle : including upper/lower Spec chart
Bottom: including new calculated upper/lower control line and Target value

<Figure 4> 3 $\bar{X}$ Control chart

As <Figure 4> ① Top control chart is no problem by analysis control chart ② Middle control chart including upper Spec 100.5 low Spec 99.5, then 2 places badness happened ③ Bottom control chart, process is serious problem, central axis was risen on the whole, Actuality this process need improvement. As like this example, by using 3 $\bar{X}$ control chart, we can easy find problem which is hidden. It may become help to use on the spot.

Ⅴ. CONCLUSION

There are a lot of bugs in control chart use in industry spot. Although still user don't know enough control chart comprehension, until now, presenting control chart is not conveniently to user.

In this paper, we gave 3 suitable modified $\bar{X}$ control chart at the same time shows. First control chart is plot analysis control chart by using sampling data, Second control chart is including Upper Spec and Lower Spec in first control chart. Third control chart is including target value and new calculated upper/lower control line by using known average and standard deviation by gotten long term data.

If 3 $\bar{X}$ control charts are seen at the same time, there is advantage that can easily see problem of process at a look. We hope, method in this treatise proposed, give many aid in spot.

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현장에서 활용이 가능한 수정 관리도 제안

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국문요약

본 논문에서 우리는 동시에 볼 수 있는 수정된 3개의 관리도를 제안하였다. 첫번째 곤리도는 샘플 데이터로만 그려진 관리도이다. 두번째 관리도는 처음 관리도에 상하한 규격을 포함한 관리도이다. 세번째 관리도는 목표값이 포함되고 오랜 기간 동안의 데이터로 계산된 알려진 평균과 표준편차로 계산된 상·하한 관리선이 포함된 관리도이다. 3개의 관리도를 동시에 보면 즉시 공정의 문제점을 알아낼 수 있는 정점이 있다. 이 논문에서 제안된 방법이 현장에서 활용되어 도움을 주길 희망한다.

핵심주제어: 3가지 수정된 관리도, 상하한 규격, 목표값

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