TKI DINALOG
Dutch Institute for Advanced Logistics

OPTIMIZATION OF THE CONTROL OF QUALITY

OPTIMIZING THE CONTROL OF QUALITY OF OCÉ'S PRINTERS

This research project is conducted at Océ Technologies, which develops, manufactures and sells printing and copying hardware and software. More specifically, within Océ, this research is held within the Black & White group. The Black & White groups includes a series of high speed black and white cutsheet printers. Instead of having a lot of inventory, buyers of these printers can for example print a whole book within two minutes. This research focuses on identifying quality issues in an early stage. The Black & White group encountered multiple problems regarding the quality of their machines. Instead of figuring this out when the quality has already detoriated drastically, the Black & White group wants to be able to know about possible issues as soon as possible. This is done by analyzing individual machine data, which are then used to discover general problems on various population levels.

SHEWHART CONTROL CHART

At first, a literature study is conducted in order to define which method, according to the literature, is best suited to detect and control quality issues. An adapted version of the so-called Shewhart control chart is used as method to identify the quality issues of Océ's printers; an example is shown as Figure 1. The Shewhart control chart uses statistical data of a population to identify deviations. Normally, the Shewhart control chart only identifies significant deviations, points that are below the lower control limit (LCL). Therefore, rules are added to make the Shewhart control chart more sensitive to trends. Since we are interested in identifying quality issues, the control chart only identifies negative trends and deviations.

The horizontal axis of the control chart displays the week numbers plus the year. It is preferred to analyze the key performance indicators (KPI's) per week in order to detect quality issues as soon as possible. The vertical axis displays the KPI Mean Clicks Between Error (MCBE) for Machine Recoverable Errors (MRE). This KPI represents how many cutsheet prints there are between consecutive errors. This KPI is found to be best

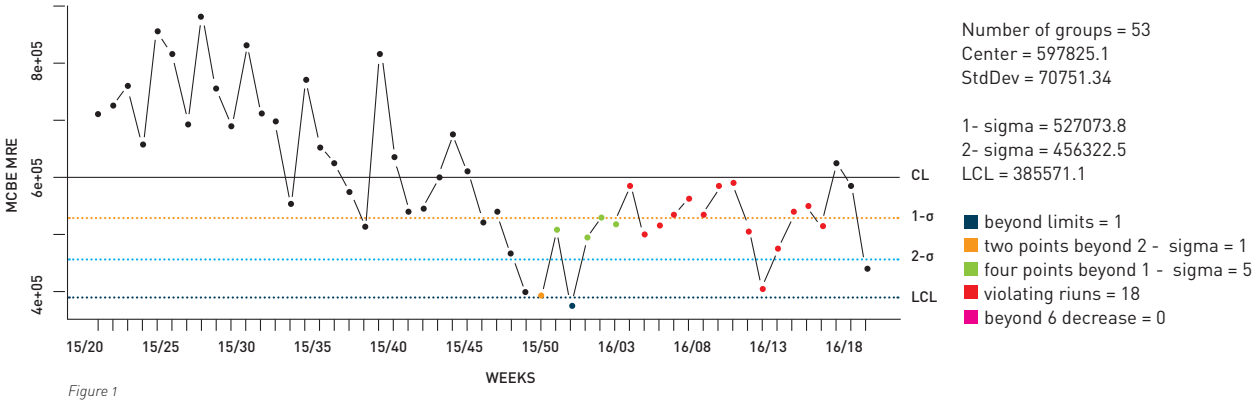


Figure 1

suited for identifying quality issues. If a point in the control chart is displayed in a certain color, one of the rules is violated. The rules are ordered based on the severity of the violation. A week with an MCBE MRE below the LCL is marked red. If the second consecutive week has an MCBE MRE below the 2-σ line, the week is marked orange, and so on. A week can violate multiple rules, but will get the color of the most severe violation. In this particular control chart a clear negative trend is shown, which is detected by the control chart after approximately 5 weeks.

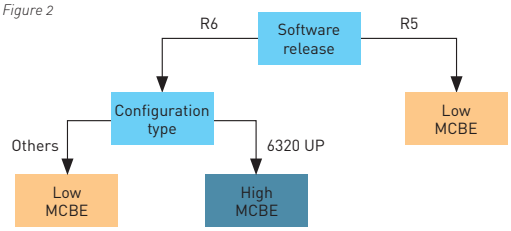
FINDINGS

After implementation of the Shewhart control charts and additional charts, the obtained models were tested using real data of Océ's printers. It is advised to have a one year dataset in order to use the Shewhart control chart. Since the average time of a service visit by a technician is two weeks and most of the data is retrieved by these technicians, the data of the last two weeks mostly consists of data from badly performing machines. Therefore, the last two weeks should not be included as they give invalid negative results. This, however, could be used to promote Océ Remote Service as that will enable data retrieval at any given time. We found that the Shewhart control chart is indeed able to detect and trigger data instances that are out of control. It was found, among others, that in one of the software releases mistakes were made that were not recognized by Océ. After detection, action regarding this problem was immediately taken by the service department of the Black and White group.

CONCLUSION

With the Shewhart control charts and additional Pareto charts, we are able to identify where and when something went wrong in a population of machines. We believe that future research in the `what went wrong' is required. Looking at Figure 1, we can with relative ease detect there is problem in a certain time period. Unsupervised classification methods can help to find the cause of a potential quality issue. Figure 2 displays an example of a decision tree. If we make a decision tree that is grouped on the problematic time periods found by the control charts, we could find which attributes of the data caused the bad performance. Looking at Figure 2, configuration type 6320 with software release 6 has a high MCBE. This might indicate that there is a problem with the software of the new configuration type (6320).

Figure 2



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