1999/2000 Quality Management Student Project Competition

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Project Title: Quality Management of Multi-layer Printed Circuit Board Manufacturing Industry in Hong Kong and Shenzhen

Abstract

The objective of this project is to analyze and improve the quality control in the printed circuit boards (PCBs) manufacturing industry. This project had been carried out in two different PCBs manufacturing companies, which are Company A in Shenzhen and Company B in Hong Kong. In this project, two manufacturing processes have been chosen to study. They were screening process in Company A and lamination process in Company B. Apart from quality analysis of these two manufacturing processes, I also compared and contrasted the process management of these two PCBs manufacturing companies. The fact is that the process management and quality control are quite different in the two companies.

In the aspect of process management, the QA engineers in Company A are task-oriented. The QA engineer may be the specialist of some operations / tasks in one process. In Company B, the QA engineers are process-oriented. Each QA engineer is assigned to deal with the quality issue of one or two manufacturing processes. Moreover, in Company A, the quality data is stored in the computer, while in Company B, the data is stored in paper document. Furthermore, there is a SPC team in Company A to do all the quality control issue in the production line. However, in company B, each department is deal with the quality control issue for its manufacturing process.

In the aspect of quality control, the SPC tools used in company A are Xbar-R chart, X-MR chart and U chart. While the SPC tools used in company B are Xbar-R chart, X-MR chart, U chart, Pareto chart, Cause & Effect Diagram and FMEA chart. In company A, the production data is updated every four hours. However, in company B, the production data is updated once a week.

In Company A, the objective was to improve the process capability of screening process. In order to improve the process capability, I have to find out the standard setting for the

screening process, which can reduce the variability of screening process. This can be achieved by conducting the Design Of Experiment (DOE). To achieve this objective, firstly the SPC analysis was carried out to evaluate the present printing performance. From the analysis result, the printing performance of machine no.12 was not very satisfactory. Therefore, machine no.12 was chosen to carry out the designed experiment.

In the first designed experiment, I tried to find out some new factors, which may have significant influence on the printing performance. I can then include these new significant factors into our second designed experiment for further analysis. . The factors included in the first designed experiment were age of the stencil, paste volume, blade type and side of the stencil. From the result of first DOE, only blade type and stencil side could be included in the second designed experiment for further analysis.

Generally, from the result of second DOE, low viscosity, low speed, front blade, right side can provides low variation of the solder paste height. Nevertheless, these factors should be interpreted individually. The suggested levels of the factors are not the standard setting for the screening process. The recommended level is only the one-to-one correlation of each factor to the variation of the solder paste height. Besides, it is important to note that these results are only valid on machine no.12 and stencil no.25. After reducing the variation of the solder paste height, the process capability can be increase normally.

In Company B, I focused on the quality analysis of lamination process. This study was started from the research and the data analysis stage to the recommendation and suggestion stage. Many statistical quality tools such as Residual plot, ANOVA Regression analysis and Process Capability analysis were applied in the analysis.

According to Quality Assurance engineers and the past data analysis, lamination process is regarded as the critical manufacturing process that contributes to the problem of stretching and shrinkage in the multi-layer printed circuit boards. Therefore, this process was focused and the statistical quality analysis was conducted. Lamination analysis was then carried out during my research study. From the result of lamination analysis, the pressing locations inside the oven have significant effects on the degree of stretching and shrinkage. The optimal location settings inside the oven are panel no.4, sheet no.4 and book no.4. However, it should be remarked that the effect of pressing locations on the degree of stretching and shrinkage should be treated independently.

Company B is recommended to conduct the Design of Experiment (DOE) in this process. In this way, more factors, which can exert significant effect on the degree of stretching and shrinkage, can be found in the lamination process. By using the optimal setting of these factors from the designed experiment, the performance of lamination process can be improved.