Incorporation of Control Charts into a Manufacturing Execution System

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Abstract – The wafer fabrication facility at RIT has a primary goal of being a teaching facility. Tracking of the student run wafer lots is accomplished very effectively by MESA, a lot-tracking software package. The system is configured to collect information, but database queries were not set up to display this information. MESA has the option of outputting information from the databases to a statistical software package called Quality Analyst. Quality Analyst displays control charts for the extracted data, providing quick, visual interpretation of the process in question. The adaptation of this software into the RIT Microelectronic Engineering fabrication facility has been achieved. Full realization of the impact on wafer yields has not been extracted so far, but insight into process improvement has already begun.

1. INTRODUCTION

Rochester Institute of Technology is home to the student run Microelectronic Engineering facility. The facility is capable of running both 4" and 6" CMOS processes, consisting of about 70 total process steps each. The information resulting from each of the steps is stored on a centralized computer database. RIT's software of choice is MESA by Camstar Systems Inc. MESA stands for Manufacturing Execution System Application and provides the necessary user interface and database connectivity for tracking the entire student processed lots.

This system has provided the means of collecting and storing the information since it was first installed. However, gathering the information in the form of a query was quite tedious and required certain access privileges. This meant that interpretation of the data was left to a few select users, generally after the runs had long since been completed. A system of control charts was needed to effectively manage the data being collected so improvements to the equipment running the lots could be made. In addition, preventive maintenance schedules could be altered to improve the amount of money RIT would have to spend on key components.

It was decided that Quality Analyst, a statistical software package from Northwest Analytical, would be incorporated into the current system to provide the aforementioned improvements [1]. Because RIT's facility is a teaching one, further instruction beyond just displaying the control chart was deemed necessary for completeness. After investigating MESA's capabilities, the best method to get the interpretation information to the operators was through Microsoft PowerPoint. The combination of all of these elements would provide the means of collecting, displaying, and interpreting the information, real-time.

2. PROCEDURE

RIT's Microelectronic Engineering facility already owned the necessary hardware, software, and licensing to complete the project. Most of the required steps involved the programming and configuration of the software in use.

A. MESA Setup

It was decided that the simplest approach to solving the problem of requiring instructions along with a graphical output of a chart was to let MESA interface directly to Microsoft PowerPoint first. This was accomplished right in the instructions for processing the lot. A user would enter a "1" in the column on the process instruction screen to display the associated document. (See figure 1) This document was previously created in PowerPoint and was a standalone show (*.pps) that would automatically run.

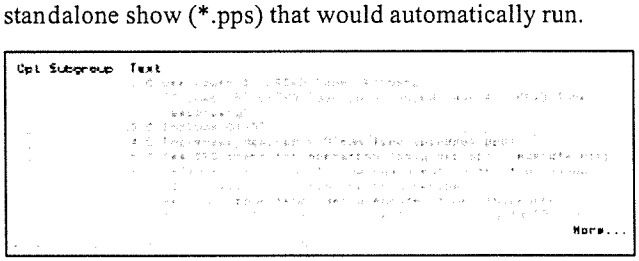

Figure 1 – Command to display SPC chart

The other, more important, setup required for MESA was the actual database queries themselves. A lot of information is stored with the lot data that is collected, such as time of day, operator name, etc. The desired information for displaying on the control charts needed to be sorted out and selected for automatic extraction. In addition, individual names to these queries were needed for later access not only in the MESA screen but also through the open database connectivity (ODBC) driver that Quality Analyst used [2].

B. PowerPoint Setup

The simplest of all to setup were the PowerPoint shows. These were all based on a similar format, allowing the operators to become familiar with the universal layout quickly and easily. The first page gives a basic summary of the information about to be presented. (See figure 2) It displays links for the user to either display the current control charts, both an x-bar and a process capability chart, or an action plan to take when the control chart displayed is out-of-control. The action plan is simply another PowerPoint slide, whereas the link to the control charts is a Quality Analyst run file that causes Quality Analyst to start.

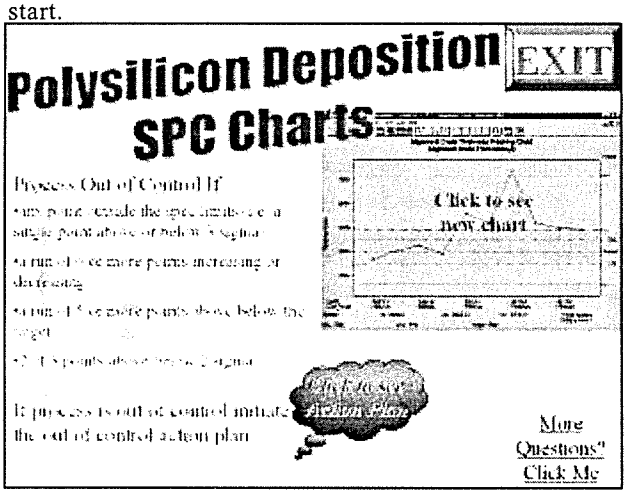

Figure 2 – PowerPoint instructions and chart link

C. Quality Analyst Setup

The most complicated setup was that of Quality Analyst. This is because Quality Analyst creates both a header file (*.hed) and a run file (*.run). The header file defines the variables to display, the data range, control limits, and axes titles from the database query. The run file defines which query to run, where to temporarily store the data, and which charts to display.

Most of the time and effort put into setting up Quality Analyst comes in forming the header file. Thankfully, most of this was easily accomplished through a graphical user interface. The terms chosen for control chart investigation were the lot dates and the mean of the run (film thickness, critical dimension width, etc.). Once the terms were chosen for the charts, the run file needed to be created to read in the data. Using the "connect" command, this causes Quality Analyst to issue a command to MESA, making a brand new chart of the most up to date information. Lastly, the two charts that were initially integrated were the x-bar and process capability charts.

3. RESULTS

Microsoft PowerPoint and NWA Quality Analyst were successfully integrated with the current MESA setup. The CMOS p-well revision 3 process was the only one setup for control charts, but further integration could easily be accomplished. Results for a typical control chart display are shown in figure 3. It was chosen to display both the x-bar and process capability charts at the same time on the user's display, for correlation purposes.

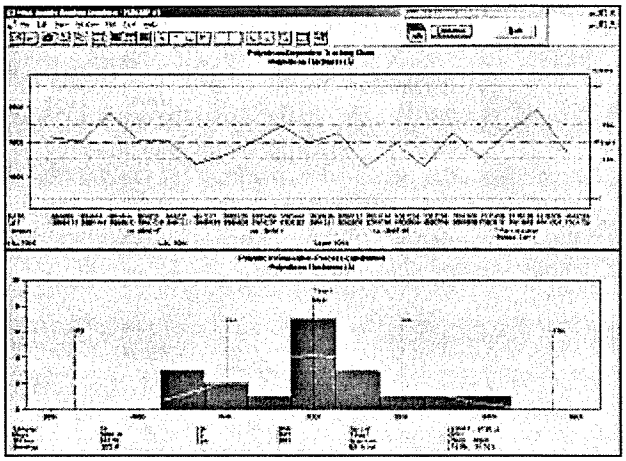

Figure 3 – Quality Analyst SPC charts

Automatic access of the database without an upper level access password is automatically configured when the user logs on to the MESA system. This allows for universal access to the data on the local intranet. In addition, when properly configured, any user could also connect to the system via the Internet.

Equipment results for process capability and preventive maintenance schedules have yet to be determined. The information gathering phase was set to begin upon the completion of this project.

4. CONCLUSION

Integration of the graphical means of analyzing the data collected by MESA was a key improvement to the wafer fabrication facility at RIT. A complete instruction set for creating the required control charts from step one was also created for further statistical integration into RIT's advanced CMOS processes. Further investigation into some of the preliminary process limits will come as the control charts help to improve the equipment in use.

REFERENCES

[1] "NWA Quality Analyst User's Manual," Northwest Analytical Incorporated, 1999.

[2] "Statistical Process Control Reference Manual (Release 2.0), Camstar Systems Incorporated, 1999.

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