Using the SAS® System to Improve Software Quality Reporting

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Introduction

SAS® programs are used to collect data about software quality which is transferred from external sources. SAS programs are also used to create graphical reports for management reporting. In addition, SAS programs were written to allow graphical programs to produce analysis lines for predicting future trends and for detailed analysis.

The use of SAS programs drastically reduces the time necessary to produce quality reports and helps to standardize trend programs.

Mission of the IBM Boulder Programming Center

The IBM Boulder Programming Center provides system architecture and develops software to enable printing across the IBM system and printer product line.

The primary focus is:

- Operating environments for Systems Application Architecture (SAA™)
- Advanced Function Printing (AFP) printers.

Quality Improvement Objective

Each release of a software product has an obligation to improve quality. To track this improvement in quality, a number of monthly reports are published, in addition to online corporate computer systems which are available to look at various quality parameters.

In general, programmers look for the absence of "problems" to achieve quality. A bug/problem is "an error in a program". For our mutual benefit, and to speak clearly on the subject, quality is defined here as an absence of problems.

Discoverers of problems

The "customer" doesn't always discover that a computer program is not producing the expected results. A VALID problem can be discovered by any of these three groups:

- FIELD (a customer)
- DEVELOPER (the development group that wrote the program)
- INTERNAL (the group that supports the program).

Regardless of who discovers the problem, the computer program and its documentation are corrected. As these problems are discovered, monthly quality reports are generated which eventually work their way back to the responsible location.
Quality Reporting Before SAS

Collection of Quality Data

Before SAS programs became part of the quality reporting scheme, quality reporting was limited to the following sequence:

- Collection of software quality data at corporate level
- Divisional summary
- Tabular detail (monthly totals prepared manually)
- Subsequent distribution of reports.

Quality Reports

Tabular reports were prepared in Boulder around the 15th of the month to show the year-to-date quality of Boulder products. These tabular reports showed total closed problems classified by:

- Valid
- Invalid.

Preparation of these reports was time consuming and, because the collection of data involved manual entry, was subject to errors.

Figure 1 shows an example of the tabular reporting before SAS programs were used.

<table>
<thead>
<tr>
<th>J</th>
<th>F</th>
<th>M</th>
<th>A</th>
<th>M</th>
<th>YTD</th>
<th>PROJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSED</td>
<td>11</td>
<td>12</td>
<td>23</td>
<td>14</td>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>VALID</td>
<td>9</td>
<td>8</td>
<td>18</td>
<td>9</td>
<td>1</td>
<td>45</td>
</tr>
<tr>
<td>INVALID</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>19</td>
</tr>
</tbody>
</table>

Figure 1. Previous Quality Report: This shows the number of problems per month

Misinterpretation of Quality Reports

Misinterpretation of quality reports results when someone tries to analyze a problem mathematically when it can more easily be accomplished visually. To deal with this problem, I needed to provide a fresh analysis and re-interpretation of data by turning to a visual approach.

To present this important data, SAS programs were written to connect other quality reporting systems and to create graphic reports.
SAS Programs Written to Improve Quality Reporting

SAS programs were written to accomplish the following:

- Collect quality data
- Differentiate types of problems
- Produce graphical output
- Create SAS data sets for:
  1. Trend Projections
  2. Analysis by Release

Collection of data

Using a corporate tool, software quality data for the IBM Boulder Programming Center products is accumulated at IBM Headquarters and sent to Boulder. SAS programs read the "flat file" and create SAS data sets by year.

Differentiation of Problems

Each VALID problem is divided into one of three categories:

- FIELD
- DEVELOPER
- INTERNAL

Produce Graphical output

Each month, we construct temporary files by software product type.

A **PROC SUMMARY** is then used to total the problems by month. Next, a **DATA step** takes the monthly figures and totals the problems by type. Following this, a six-month rolling average is calculated.

A **DATA step** is then invoked to place commands into an **ANNOTATE = data set** to position text labels to enhance the graphical output.

To customize the graphics output from **PROC GCHART**, the **ANNOTATE** option is specified. This allows the frequency of each problem type to be positioned next to the space indicated by the vertical bar for that problem type.

As a final enhancement, the line style and color are changed to indicate whether the product met or exceeded its quality objectives.

A **PROC GCHART** is run to create vertical bar charts representing the six-month average and the most recent six months data. Within this procedure, **PATTERN** statements are used to define color and patterns of the different problem types.

See [Discoverers of problems](#) for a discussion on different problem types.
New Quality Report

Nowhere is the principle that "a picture is worth a thousand words" better illustrated than with the well-designed SAS graphics that we now have. The meaning of an otherwise confusing and uninteresting (see Figure 1 for the previous tabular report) set of figures can be driven home clearly, quickly, and forcefully. This figure shows the new Quality Report.

Figure 2. Quality Report using SAS: See "Discoverers of problems" for a discussion on different types of problems (problems). "DEVELOPER" problems are plotted on this chart as "LAB" and "INVALID" problems plot as "INVALID".
Trend Projections

A flat file is built which contains the monthly totals for a specific problem type. By electronically linking this flat file with a TREND PROJECTION program, we are able to produce trend-analysis charts for an individual problem type. This is illustrated in this figure.

Figure 3. Trend Projections: After building flat file with SAS programs

Analysis by Release

Additional SAS programs have been written to utilize the SAS data sets. This allows an analysis of quality for each software release. This figure shows a PROC G3D plot of APARs by release.

Figure 4. PROC G3D Analysis of APARs by Release
**Significance of using SAS**

Connecting quality reporting systems with SAS results in these benefits:
- Standardized reporting
- Increased productivity
- Reduced turnaround
- Material cost savings
- Higher quality.

**Standardized reporting**

When trend analysis charts are prepared, you can construct graphical charts for specific types of software problems. Before these SAS programs, the charts showed only a projection of total problems.

**Increased productivity**

The greatest productivity improvement has resulted from the overall systems approach that has been taken. By making the distinction between types of problems, all facets of software development can now be considered by exercising effective trade-off decisions.

One excellent, relatively easy and direct approach to productivity improvement is to deal constructively with counterproductivity (that is, to identify and remedy counterproductive factors that are present before using SAS programs to coordinate our quality reporting).

**Reduced Turnaround**

The quality reports can be updated in a matter of hours, whereas before, several days were necessary to manually enter the latest data.

**Material Cost Savings**

A great deal of the effectiveness of a cost-control effort hangs on the ability to focus the attention of 1) Software Development and 2) Test Managers to those areas in which it is required. Quality reporting graphics therefore have earned consideration in the cost-to-benefit analysis of quality.

**Higher Quality**

Using SAS programs to create graphic quality reports has helped to increase Boulder Programming Center quality awareness. Whereas IBM has many excellent quality programs and publications, I believe the most effective quality awareness program has been to use existing systems inside the Boulder Programming Center. Quality awareness is not just making publications and quality promotions, and so forth; it is spreading information. This is what has been done with these new SAS graphical reports.

**Acknowledgments**

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1. SAS is a registered trademark of SAS Institute, Cary, North Carolina, USA
2. Systems Application Architecture (SAA) is a trademark of the IBM Corporation, Armonk, New York
4. A "flat file" contains data values in virtually any form from cards, disk, or tape