

BUILD AS YOU GO: THE FLEXIBLE APPROACH TO CREATING A MANUFACTURING INFORMATION SYSTEM

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Abstract

Growing worldwide competition has led manufacturing managers to focus on quality and productivity improvements as key factors in reducing costs and increasing product quality. The Kohler Company's Cast Iron Division is utilizing several SAS* software products to build an integrated manufacturing information system to support these improvement efforts. The Cast Iron Division has maintained control and end-user focus during construction of the system by adopting an incremental implementation strategy using engineering staff to write most of the code.

This strategy along with the flexibility and integration of the various SAS products have afforded this build-as-you-go approach. This approach has contributed to acceptance of the new system and increased use of statistical process control techniques in managing the operation. Substantial cost reductions have resulted from the quality and productivity improvement efforts during the past two years.

Introduction

The Kohler Co., headquartered in Kohler, Wisconsin, is the country's leading manufacturer of plumbing and specialty products and a major producer of engine-driven generators and cast iron, four-cycle engines. Founded in 1873, the company was originally an iron and steel foundry involved in the manufacture of agricultural implements. The product line switched to plumbing products when, in 1883, a hog scalding was modified by adding four legs, giving birth to the company's first cast iron bathtub. The Cast Iron Division continues to build on its legacy of innovation through implementation of technology and increasing use of statistical analysis for process control and improvement.

The production of enameled cast iron plumbing fixtures (bathroom lavatories, kitchen sinks and bathtubs) involves several manufacturing processes (see Figure 1). System development efforts started in December 1986 in the Enamel Shop where the final stage of production occurs. Management in this area outlined the need to modernize the local computer system and improve data collection and analysis capabilities.

Local management had attempted to automate the operation's production and inspection data using personal computers but quickly ran into capacity problems. The mainframe system offered plenty of capacity, and SAS software would facilitate local control through data entry, storage and reporting. The company runs the SAS System in batch under MVS/XA and interactively under TSO on an IBM 3081 machine.

ENAMELED CAST IRON PRODUCTS
PROCESS FLOW CHART

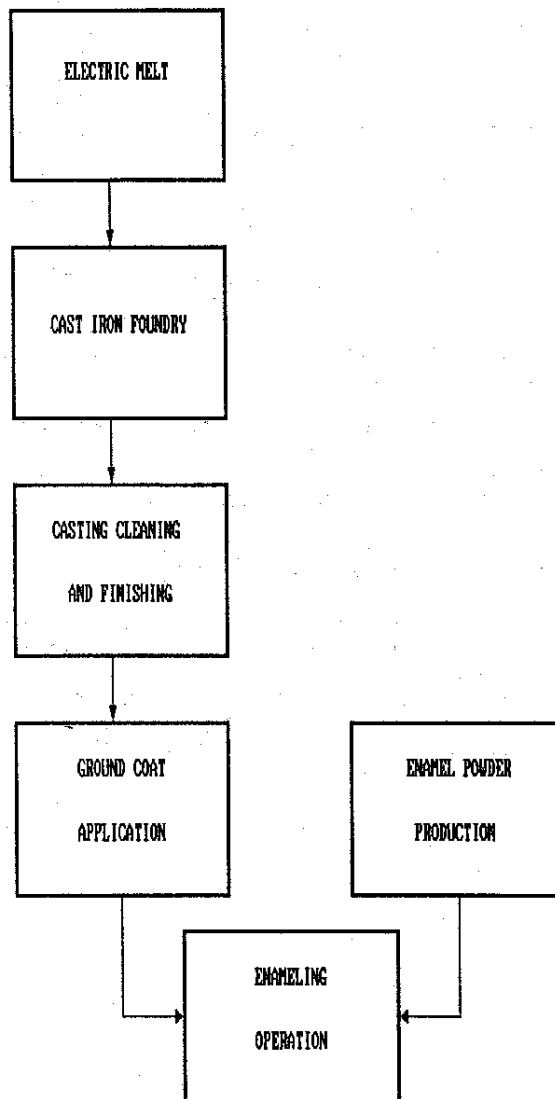


Figure 1

Getting Started - Phase I

The decision to proceed with developing the system using SAS software and the mainframe computer was quickly followed with the first deadline of January 12, 1987. This was the date set for the first weekly report produced by the new system. The deadline precipitated the build-as-you-go strategy.

Working with the central data processing department, space was allocated and construction of the database structure commenced. Several meetings between Enamel Shop personnel and the engineering staff resulted in agreement on specifics for the database design (number, type and names of variables), the data entry screens, the data entry resources and a prioritized list of reports to be developed.

Hardware considerations quickly surfaced. The Enamel Shop had obtained access to the mainframe computer earlier in the year. A spare CRT was requisitioned to provide local input capability. Output capability did not exist and approvals were sought for purchasing a printer. Approval was obtained, the purchase order released and the printer installed in June 1987.

The SAS software products fulfilled primary user requirements. The list includes:

- Data editing through SAS/FSP* and base SAS software via a check program.
- Report writing utilizing base SAS software.
- Rudimentary statistical analysis performed with base SAS software.
- Quality control statistics calculated with SAS/QC* acquired in September 1987.
- Database management duties carried out through the Display Manager System (DMS) and PROC CONTENTS and PROC DATASETS.

Fast response and flexibility were other factors affecting acceptance of the SAS system. Quickly responding to requests for changes to existing reports or development of new reports was a way for the culture to test the capability of the system. Passing this test was important in removing a potential reason for rejection of the system. Due to the limited resources, a sequential develop-test-implement scheme for the entire system was not feasible. Features of the SAS software products afforded the flexibility to create individual reports and make changes to the database structure when required. Reliance on the flexibility features enabled the adoption of the build-as-you-go approach appropriate to the resource level and implementation plan for this application.

SAS software provided benefits outside of the Enamel Shop for future considerations. These benefits include:

- Compatible database structures.
- Access by company personnel outside of the Enamel Shop through the mainframe system.
- Flexibility to expand, change and/or link as future needs evolved.

Several constraints emerged during the development of the system which proved to be challenging but not insurmountable. These constraints included:

- End-user expectations of short lead times for report creation.
- Minimal budgetary support.
- Resistance to changing formats of existing reports. (This resulted in developing customized reports versus using PROC FREQ or PROC TABULATE).
- End-users with little or no SAS experience.
- Limited support from the central data processing department.

Tailoring the new system to generate existing reports was a key element in providing an image of continuity. This image was important in gaining the acceptance by members of the Enamel Shop culture and opening the door for expanded use in the future. Members of the team were especially sensitive to this issue because of past efforts which had met with limited success. Phase I proceeded with development of the data entry screens and routine reports (see Figure 2).

SYSTEM DESIGN - PHASE I



- data entry screens
- daily reports
- weekly reports
- monthly reports
- quarterly reports
- special requests

Figure 2

Using SAS/AF* - Phase II

As more people learned of the system's capabilities, more requests were made for specific reports and information. Creating a menu driven application for non-SAS users to access the system would provide a mechanism to satisfy the rising number of requests. A menu driven system would also provide the supervisors and operators with a way to obtain performance feedback on a regular basis. SAS/AF was the logical choice to facilitate construction of the menu driven application.

Two summer interns were assigned the task of building the SAS/AF application. The structure of the system was changed to facilitate increased use of the system and simultaneous data entry. A separate smaller SAS data set was created strictly for data entry, and a menu driven system was created for the main SAS data set. Every night the contents in the data entry SAS data set are appended onto the main SAS data set (see Figure 3).

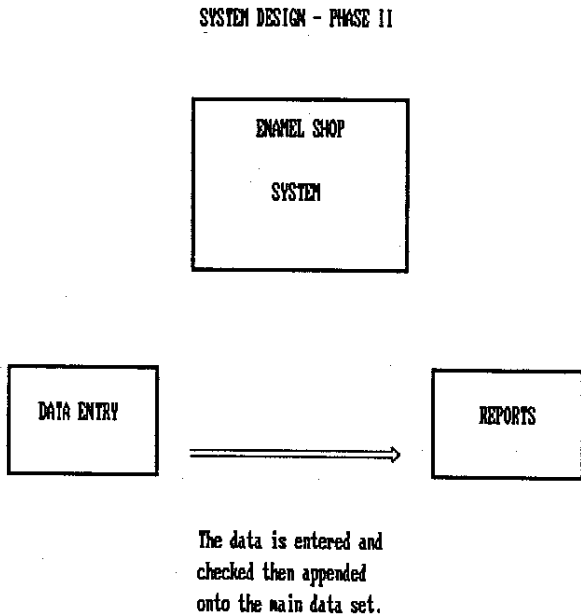


Figure 3

Several problems were encountered during development of the menu driven application. One problem pertained to region size. This application required a larger region size, and TSO would not allow users to specify a larger SIZE. The solution consisted of a computer analyst expanding the maximum allowable region size in the user attribute data set (UADS) for each user.

Another problem surfaced with the seemingly trivial decision about terminal screen size. A great deal of reprogramming was required to change menu screen widths when a personal computer user was unable to access the system through terminal emulation because the menu screens were 132 columns wide versus 80 columns wide for the personal computers.

Printing reports was also a challenge. The solution consisted of submitting the program as a batch job with the MVS JCL statements necessary to send the print to the desired printer. The JCL and the SAS/AF program were written to a temporary external file and submitted to run as a batch job via the TSO SUBMIT command.

System documentation proved to be cumbersome and time consuming until a SAS/AF list program was discovered in the SUGI 12 Proceedings.¹

Access to the system is obtained by logging on to TSO with a valid TSO user identification and choosing an option on one of the ISPF option menus. This brings the users directly to the main menu of the SAS/AF application. (When the ISPF option is selected, a command procedure is invoked that allocates the required files, creates an AUTOEXEC file containing the PROC DISPLAY command, and invokes the SAS command procedure. The SAS Display Manager is entered and the AUTOEXEC file is executed.) When exiting the system, users are returned to the ISPF option menu. Users who are not allowed to access the data sets as controlled by RACF security receive a security violation error message.

The design for the menu driven system of the data entry SAS data set included accessing the data entry screens and running the check program to find input errors. The menu driven system for the main SAS data set first consisted of accessing and running routine reports. The main system was expanded to include the capability for users to create their own reports (see Figure 4). This capability has enabled employees to access data specific to the situation, in various formats, and with short response time thus improving the amount and quality of information used in the decision making process.

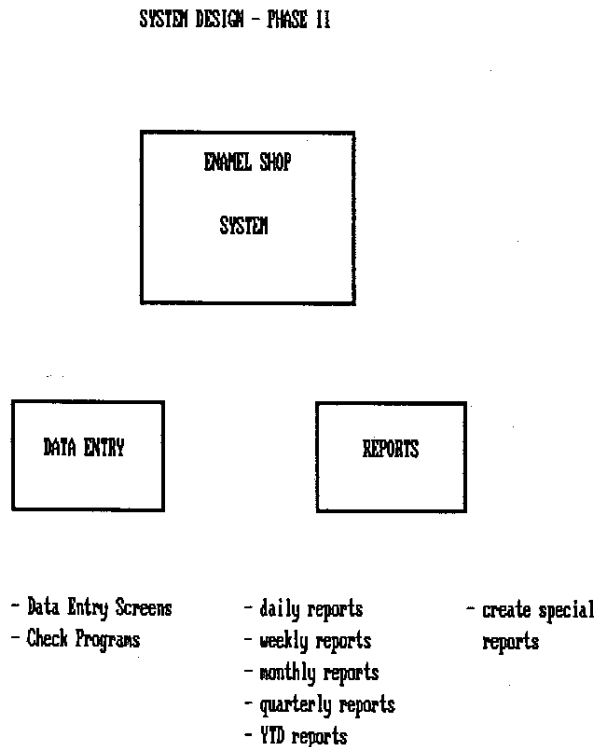


Figure 4

Future Plans - Phase III

Refinement and expansion of the system is planned for the future. Improvements in the quality of data created and gathered are underway with a pilot bar code project. Direct linking of analog and digital instruments is being investigated to include process variable data to be input directly into the system. The objective is to eliminate data collection, transcribing and data entry errors through electronic links. Integration of the system with the accounting, payroll, inventory and engineering information systems will be possible once the quality of the data reaches a higher level of accuracy and reliability.

Several other manufacturing operations in the company have initiated efforts to utilize SAS software in similar applications. The experience gained from the first application will enable smoother, quicker development of subsequent systems.

Results

The build-as-you-go approach has provided the flexibility necessary to maintain continuity in the manufacturing operations. The various features of base SAS software and SAS/QC have allowed increased application of statistical methods on the shop floor. SAS/AF has enabled increased access to important operating data to most levels of the organization. Improved quality and productivity have enhanced the company's competitive position in the marketplace. Contributions to the Cast Iron Division's bottom line have been quantified by a 30% reduction in the cost of quality over the past two years.

REFERENCES

1. Sisemore, R. David, "%AFLIST - A MACRO TO DOCUMENT SAS/AF SOFTWARE LIBRARIES," in SUGI '87, Proceedings of the Twelfth Annual SAS Users Group International Conference, Dallas, Texas, February 8-11, 1987, p. 1220.

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