

The Value of SAS in Manufacturing

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ABSTRACT

SAS® offers several extremely powerful and useful products, tools, and solutions for the manufacturing sector. Although many other vendors offer niche products that target that market, SAS fills a definite void. As consultants or as project managers within a manufacturing company, you may find it challenging to decide when and where the power of SAS is justified or even essential in the short-term and in the long-term. This paper will clarify

- The offerings from SAS
- Where and when SAS is appropriate to use
- The value SAS brings to the bottom line
- The knowledge required to build SAS applications in manufacturing.

To support the discussion, I will present several sample Web-based applications that have been utilized with great success in manufacturing to capitalize on SAS's analytical depth and data management flexibility.

INTRODUCTION

SAS software provides so much breadth and depth of capability that everyone has difficulty describing what it does without just saying "everything". Unfortunately, no product can be the best at everything and no one would believe that one product could do everything anyway. More believably, SAS has many "sweet spots", some that are well advertised and some that are under marketed or insufficiently documented.

To compound the confusion, software capability is often viewed from either of two dimensions: the technical dimension or business dimension. Unfortunately, not everyone is trained to recognize both dimensions simultaneously. For example, from the technical perspective, most people agree that SAS is the most powerful statistical package in the world. From the business perspective, most people agree that SAS is the most powerful statistical package in the world. They sound the same, but are not interpreted the same. Most business or industry specialists are not statisticians and therefore do not see how the statistical capability relates to their needs.

In recent years, SAS has recognized this incongruence and attempted to package their "sweet spots" of technology in "business solutions". Unfortunately, the number of possible business solutions is almost infinite and each package takes time to design and develop. So, most business problems that are solved successfully with SAS software result from businesses relying on knowledgeable individuals who can visualize both dimensions and happen to be in the right place at the right time.

In this presentation, I am focusing on one industry specialty: manufacturing. I hope to expand on SAS technical capabilities that range from highly utilized in practice to untried possibilities that can be used to bring competitive advantage to a the manufacturing-related business. As you will see, even the specialty of manufacturing is not narrow enough in scope to be covered in detail within this paper. The many facets of manufacturing harbor a multitude of niches and specialists. So, my examples will focus primarily on statistical quality control, leaving the elaboration of other techniques for another time.

LINKS IN THE MANUFACTURING CHAIN

Before describing the technical services that SAS may provide to the manufacturing process, I want to identify the components in the manufacturing chain of events and itemize some of the major concerns or issues that manufacturers encounter.

Obviously, manufacturers manufacture. In other words, they build things. In some cases, manufacturers create products using raw materials, such as the pharmaceutical company that combines chemicals to produce a drug. In other cases, a manufacturer is building a product by assembling parts that were made by other manufacturers, as in the case of automobile or washing machine makers.

A manufacturer's success is ostensibly dependent upon their manufacturing ability as well as the quality of the parts or raw materials. But, even if you make the best product in the world, success and profitability will be elusive unless you also ensure that distribution, sales, and product advertising are effective.

Figure 1, "Links in the Manufacturing Chain", shows the relationship of these components to each other and introduces some questions that should be addressed at each link. Later I will show how these issues can be handled with sets of SAS tools. For this presentation, I am focusing on the analytical services from SAS, although I could also identify another distinct set of capabilities within SAS within the realms of technical services or data management.

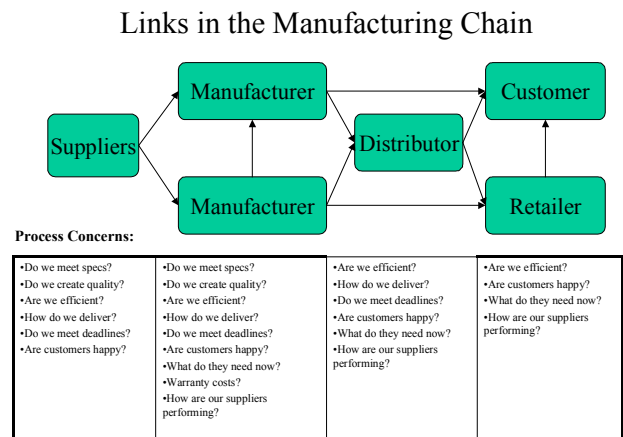


Figure 1

For this discussion, I do not address business processes that are common to all business, such as accounting, human resources management, or basic sales. I have tried to narrow the scope to those areas that are unique to manufacturing, although I may cross the line in several places.

I have organized the questions listed in Figure 1 in the following basic groupings:

- Planning
- Quality
- Relationships
- Distribution

Note that in this presentation, I am concentrating on larger, more complex manufacturing endeavors, even though quality is important to any size organization. Admittedly, deciding how big you have to be to justify spending funds on advanced software systems is definitely one of the biggest challenges. Hopefully, my discussion will help you evaluate when the return justifies the investment.

GENERAL TOOLS

Before I delve into each category, I should point out that I will not be discussing the delivery mechanisms for these solutions. In other words, SAS provides several types of "wrappers" and "delivery vehicles" for customizing how the analytical solutions below are implemented.

For example, each of the tools and solutions below could be accessed via a Web application, using tools such as SAS/IntrNet, Integration Technologies, and AppDev Studio. In addition, data may be stored in SAS data sets, SAS MDDBs, Oracle tables, MS SQL Server tables, or some other database structure. Data warehousing will most likely play a critical role in addressing many of these questions, so SAS Warehouse Administrator should also be considered. Although my demonstrations will present specific solutions, complete with delivery mechanisms, I will not expand on those in each category description.

You should also note, that with the introduction of SAS Integration Technologies combined with the flexibility of SAS/Access, SAS has opened their architecture making it easier for you to blend SAS into your existing environment, so you can easily utilize the power of SAS where and when you want to.

POSSIBLE SAS TOOLS APPLIED:

Base SAS, SAS/FSP, SAS/IntrNet, SAS Integration Technologies, AppDev Studio, SAS/Access to your specific database, SAS Warehouse Administrator, Enterprise Guide

MANAGING THE PLAN

By "managing the plan" I am referring to the tasks of determining:

- What products to build?
- How much to build?
- When to build?
- How to build?

Assuming the available products have been designed and tested, I am referring to demand management and optimized product mix. SAS statistical tools are indeed utilized heavily in the research and development phase, such as during the clinical trials of new drugs. In this paper, I am focusing on the movement of products from raw materials to the consumer.

DEMAND MANAGEMENT AND FORECASTING

Whether your process adheres to "just-in-time" (JIT) manufacturing or not, forecasting future demand throughout the process chain becomes essential if you want to satisfy customers and stay competitive. Using the data management and integration tools of SAS to feed sophisticated forecasting models; you can prepare yourself for the inevitable fluctuations in sales. Demand management encompasses other techniques, such as optimized shipping, but they will be covered below.

Demand management and forecasting can and should be applied at all nodes: suppliers, manufacturers, distributors, and retailers.

POSSIBLE SAS ANALYTICAL TOOLS APPLIED:

SAS/STAT, SAS/ETS, SAS Risk Management, SAS/GRAPH

OPTIMAL PRODUCT MIX

Any time you have to combine raw materials to create a product, you are faced with managing the raw materials and optimizing the pricing, inventory costs, manufacturing cost, and by-products. For example, if you run a large brewery operation, but you have only one processing line, you need to balance what mix of beer styles will maximize profits and meet consumer demand, while minimizing production cost, waste of by-products, and utilization of expensive ingredients.

In small cases, these types of problems can be solved easily in your head or on paper, but these problems quickly grow beyond our comprehension without help from analytical methods that fall under operations research and optimization.

SAS provides an extremely powerful, but under-utilized tool called

SAS/OR, which solves these types of problems along with many others. Other companies provide similar tools, but SAS/OR is extremely robust and handles large problems better than most. SAS/OR users must, however, have knowledge of SAS programming and must understand how to formulate a linear or non-linear optimization problem. By hiring qualified employees or consultants to set up the problem, you can increase your profits quickly by saving money that you did not know you were throwing away.

POSSIBLE SAS ANALYTICAL TOOLS APPLIED:

SAS/SSTAT, SAS/OR, SAS/GRAPH

DEMO OF MANAGING THE PLAN

During the presentation, I will demonstrate a simple example of using forecasting and optimal product mix in manufacturing.

MANAGING QUALITY

Everyone wants to create quality products, but quality depends on quality ingredients and quality processes. The only way to ensure both is through good design -- following engineering specifications -- and constant measurement. Assuming that your design is fine, you should measure your product's quality at multiple levels:

- In real-time during construction
- Over time after construction
- At accounting time after construction
- In the consumer's possession after distribution

REAL-TIME QUALITY MONITORS

Adhering to engineering specifications is often easier said than done. If quality is affected by temperature, you have to live by the thermometer. You cannot bake a cake at 500 degrees Fahrenheit and expect anyone to like it. So in real-time, you need to monitor all of the critical conditions to insure that your process and environmental factors are in control and on target (capable). With real-time monitors, you can react quickly to bring your processes back under control and within specifications.

HISTORICAL ANALYSIS

In addition, you may want to examine historical trends to see if other factors may have influences (degrading or improving quality) during manufacturing. For example, you may find that quality declined whenever you used the raw ingredients from a specific supplier. With this valuable information, you can improve quality in the future, but also may be able to receive compensation from the inferior supplier.

By combining the quality measures with the environmental data, you can apply data mining techniques using SAS Enterprise Miner to reveal patterns or relationships that may explain changes in quality. Generally, this approach can be expensive, but if your yield does not meet your expectations or customers are not happy, the return on investment could be well worth the cost.

YIELD ANALYSIS

All successful manufacturers strive to maximize quality, but as businesses, they must also work to maximize profits. One component of profit is yield. Maximizing the yield out of your raw materials can be achieved by optimization (as discussed above) and by reducing rejects. So, monitoring yield from your process not only measures potential consumer satisfaction, but also profitability.

SAS reporting and analytical tools can illuminate yield figures and reveal excess waste, which lead to reduced profits. By linking your quality management data to your financial data, you can measure the pulse of your operation from your desk.

TRACKING PRODUCTS AT THE CUSTOMER LOCATION

Finally, even though you have tested your product extensively during R&D and just before it went out the door, you may find that consumers are experiencing problems in the field and are therefore disillusioned with your company. You may find that consumers are using the product in ways that you did not

anticipate or in untested (by you) environments. Two ways you can monitor this situation is through warranty analysis and customer relationship management (CRM), which include survey methods and other techniques.

By studying warranty claims and registrations, you can, not only examine your warranty expenses, but you can evaluate failure rates and their causes. In addition, your situation may justify the utilization of data mining techniques to discover customer fraud or service provider fraud.

POSSIBLE SAS ANALYTICAL TOOLS APPLIED:

SAS/QC, SAS/STAT, SAS/GRAPH, JMP, Enterprise Guide, Enterprise Miner

SAS provides several tools that easily perform these quality related tasks. Although SAS has the capability to collect real-time data from the manufacturing process, other tools may be better suited for the actual data capture process. SAS/QC, however, offers tremendous power and flexibility for monitoring and analyzing quality data in both real-time and historical. If you want to build a robust, data-driven quality application, SAS with SAS/QC is hard to beat. The SAS tools will scale with your growing needs and permit you to automate many processes that would otherwise require redundant manual operation.

SAS/QC offers all of the basic statistical quality control tools, such as control charts, comparative histograms, capability analysis, Pareto charts, experimental design, and more. In addition, SAS/QC offers tools to analyze the reliability of a product, which can be used to study warranty data. With each tool (procedure), SAS/QC offers an extensive set of options that makes it easy to customize what you analyze and how the results appear. SAS/QC can be seamlessly embedded in Web applications.

I listed JMP, which is a stand-alone product from SAS Institute. JMP has grown very popular for ad hoc quality analysis. The software is easy to use and reasonably priced. Using JMP in your research labs or ad hoc sampling labs provides a perfect compliment to a larger production quality system using SAS/QC.

DEMO OF MANAGING QUALITY

In the presentation, I will provide an extensive demo of a real quality management system based on SAS/IntrNet, SAS/Access, SAS/GRAPH, and SAS/QC. If time permits, I will show some warranty analysis graphs.

MANAGING RELATIONSHIPS

Managing relationships should take place at all levels and in both directions. In other words, sellers should always know what their buyers want and think, while buyers should always evaluate the performance and success of their suppliers. In other words, manufacturers, for example, should actively research how their customers respond to their products and should analyze the performance of their suppliers.

SAS offers specific solutions for analytical customer relationship management (CRM) and analytical supplier relationship management (SRM). You can, however, augment these offerings by customizing your own solutions using all of the available tools within SAS.

This topic deserves another paper of its own.

POSSIBLE SAS ANALYTICAL TOOLS APPLIED:

SAS/STAT, SAS/OR, SAS/QC, Enterprise Miner, Enterprise Guide, Webhound, SAS/GRAPH, SAS SRM Solution, SAS CRM Solution

MANAGING DISTRIBUTION

Managing distribution can be applied to all levels in our process and refers to the optimal movement of goods (raw materials, parts, and products) from supplier to buyer. This topic falls under the larger buzzword of supply chain management. Many other

vendors have specialized in supply chain management and may or may not attempt to optimize movement of goods using analytical methods.

Although SAS does not offer a dedicated package for supply chain management, SAS does offer the optimization tools that augment or "sit on top" of other tools. SAS/OR provides powerful capabilities to solve transshipment problems.

POSSIBLE SAS ANALYTICAL TOOLS APPLIED:

SAS/STAT, SAS/OR, SAS/GRAPH

DEMO OF MANAGING DISTRIBUTION

In the presentation, I will show a sample transshipment problem that demonstrates this application.

SUMMARY

I have skimmed the surface of how well SAS integrates into the manufacturing infrastructure. Hopefully, I have revealed the primary "sweet spots" for SAS to manufacturing. In order to be competitive, manufacturing related organizations need to analyze at every level. The bigger your operation grows, the more opportunities arise for the evolution of inferior (or wasteful) processes.

In Figure 2, I have modified the original diagram to summarize and illustrate where the analytical services can be applied in the chain.

SAS provides many tools that can be applied to reveal and help remove these problem areas. Currently, most of the tools require either knowledge of statistical applications (such as statistical quality control, linear or non-linear optimization, or predictive modeling) or technical knowledge (such as SAS programming, Web programming, or database programming), but solutions are being packaged and experienced experts are available to help you apply these tools.

With the new open architecture of SAS, you now have the option to mix and match technologies, but more importantly, the varying skills of your employees and consultants. The SAS application does not have to be implemented by a team that is 100% SAS programmers. Even when SAS is the critical component of the application, SAS expertise could only make up a small percentage of the skills required to complete the project.

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SAS in the Manufacturing Chain

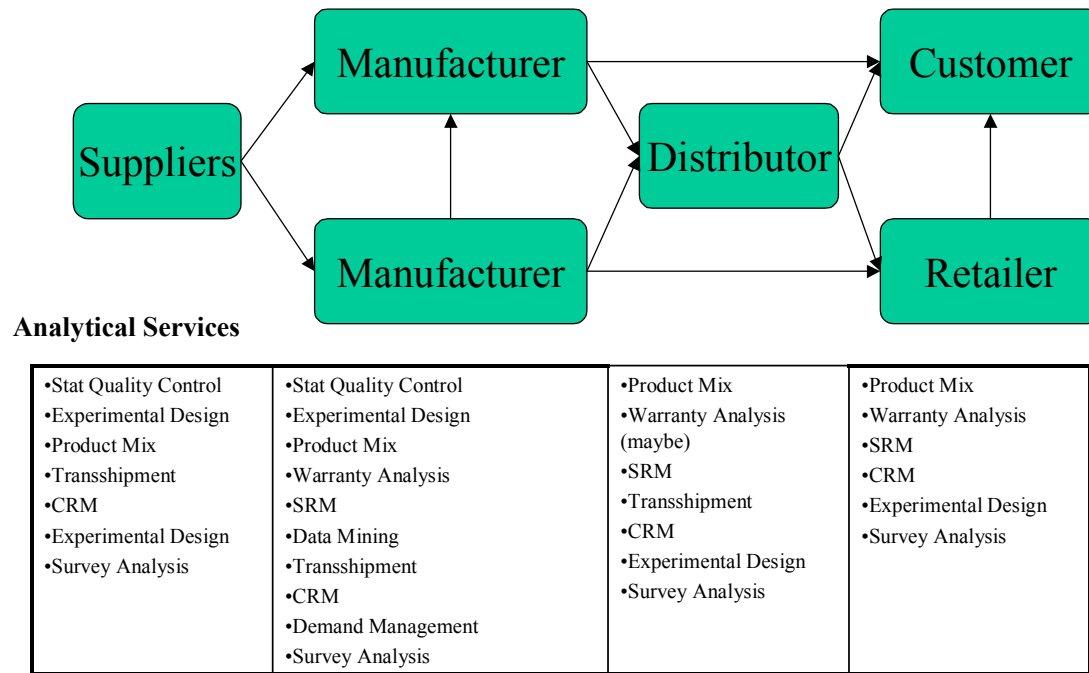


Figure 2