

Supplier Management with SAS® Supply Chain Solutions

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ABSTRACT

This paper presents an overview of the SAS® approach to supplier management, focusing on the use of SAS' well-established optimization expertise to aid in selecting and evaluating suppliers. The supplier management solutions are explored individually and are shown in the context of a complete spectrum of SAS supply chain solutions.

INTRODUCTION

The purpose of this paper is to introduce and describe the SAS approach to supplier management, part of an integrated set of knowledge-based supply chain solutions being developed by the SAS Supply Chain Center. The paper touches briefly on the overall SAS approach to supply chain optimization, and then moves on to describe the business problems solved and the techniques employed by the SAS supplier management solutions.

Briefly stated, managing a diverse group of suppliers involves much more than simply accounting for the goods that they contribute to the supply chain. Equally important are the relative strengths and weaknesses of the suppliers in delivering those goods, along with their contribution toward satisfying business rules controlling the makeup of your supplier portfolio. SAS supplier management solutions add structure, order, and direction to the process of managing and evaluating suppliers, and form an integral part of the SAS solution for Supplier Relationship Management (SRM).

The two supplier management solutions discussed here, Supplier Performance Rating (SPR) and Supplier Portfolio Optimizer (SPO), employ mathematical optimization to aid in evaluating suppliers and restructuring supplier portfolios. Each uses a Web interface that eliminates the need for any in-depth knowledge of optimization but enables users to take full advantage of the insights that it can provide.

SUPPLY CHAIN ISSUES AND SOLUTIONS

The supply chain symbolizes the web of facilities, activities, processes, and relationships that enable the flow of goods from raw materials and essential components to finished products. Suppliers provide goods used in manufacturing or assembly of products, which are in turn shipped to distribution centers, local warehouses, or retail locations. The goal of any supply chain is to provide finished goods to consumers.

At each stage of the supply chain issues arise that in turn raise questions critical to the success of the supply chain. Transportation questions—modes of transport, fleet sizing, and more—apply throughout the supply chain. At the consumer end of the supply chain customer service requirements must be set and decisions on customer sourcing and customer relationship management (CRM) must be made. At the central manufacturing and distribution stages questions about optimal inventory replenishment and production planning and scheduling are uppermost. Finally, at the initial supplier stage buyers must decide what to buy, in what quantities, where, and from whom. Figure 1 shows the structure of a typical supply chain and the issues that arise at various stages.

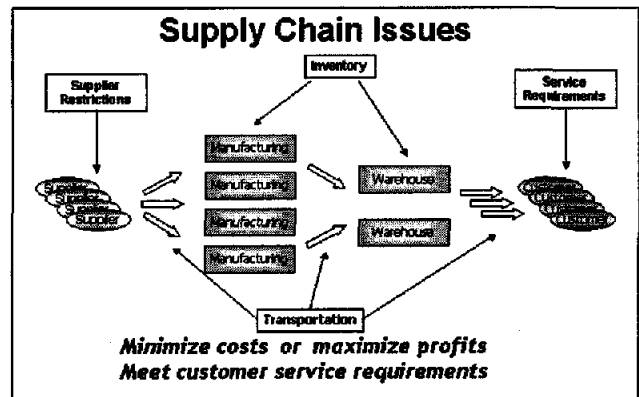


Figure 1. A typical supply chain and related issues.

"PUSH" OR PRODUCTION-FOCUSED PLANNING

Traditional planning techniques took too little notice of the linkage between the stages of the supply chain. At the consumer stage, a sales forecast predicted what goods could be sold and in what quantities. Back at the manufacturing stage planners looked at goods on hand, plant capacities, and work in progress—but not at the sales forecasts—and planned to manufacture the mix and quantities of products that they believed their operations could produce. These goods were then "pushed" through the remainder of the supply chain to be purchased (hopefully) by consumers. Too often, demand for sought-after items went unmet due to insufficient production while inventories of low-demand, over-produced items piled up.

"PULL" OR CUSTOMER-FOCUSED PLANNING

A more modern approach emphasizes that all supply chain activities are interrelated and links all planning to the sales forecast. Forecast sales combine with on-hand stock information to drive inventory and warehousing needs, which in turn feeds requirements to the manufacturing stage. Combined with work in progress and components/materials on hand, the manufacturing needs drive procurement requirements. Thus, all activity in the supply chain is pulled forward by the demand at the consumer level, in a "pull" or customer-focused model. This is the approach that SAS adopts in its supply chain optimization solutions.

SAS SUPPLY CHAIN SOLUTIONS

In addition to adopting the customer-centric "pull" model for supply chain planning, SAS supply chain solutions carry a number of other distinct advantages. SAS' data access and data warehousing skill enables SAS supply chain solutions can draw relevant information from ERP (Enterprise Resource Planning) systems, corporate legacy systems, or any source of interest. In generating the sales forecast, SAS solutions leverage the outstanding forecasting capabilities of the SAS System. Modeling and optimization utilizes the established SAS expertise in operations research and management science.

Overall, SAS supply chain solutions are being designed to be easily customizable to meet specific supply chain needs and to add value whether they are used individually or in an integrated supply chain optimization solution. Web interfaces for these solutions are being designed to provide a consistent, familiar

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appearance that gives business users an intuitive grasp of the issues and options without requiring an in-depth knowledge of the underlying methods used in supply chain planning.

SAS supply chain solutions fall into four major categories. Supplier Management is the focus of this paper, and includes both Supplier Performance Rating (SPR) and the Supplier Portfolio Optimizer (SPO). Production Planning leverages SAS' established and field-tested project and resource management capabilities, and includes such solutions as Advanced Planning and Scheduling (APS) and Cycle Time Reduction (CTR). For more information on Cycle Time Reduction, see Jennings and Kulkarni [2001].

Further along the supply chain, Demand and Inventory Planning includes both the SAS Demand Planning Solution and the Inventory Replenishment Planner (IRP) for identifying, testing, and maintaining replenishment policies that meet customer service goals at lowest cost. Enterprise Supply Chain Planning takes a broad view of the supply chain, using a network approach to plan for production, packaging and distribution. Finally, a specialized data model, the Supply Chain Data Warehouse, is being developed to serve as a foundation for these solutions.

SUPPLIER MANAGEMENT SOLUTIONS

As noted earlier, SAS supplier management solutions consist of Supplier Performance Rating (SPR) and Supplier Portfolio Optimization (SPO). SPR and SPO are also key components of SAS' Supplier Relationship Management (SRM) solution, complementing the Procurement Vision product and adding analytical planning power to the visibility into current purchasing practices that Procurement Vision affords.

SUPPLIER PERFORMANCE RATING (SPR)

Supplier Performance Rating (SPR) is designed to rate and rank suppliers when considering multiple performance criteria simultaneously. It provides an automatic method for scoring and comparing suppliers, eliminates the need to determine weights for calculating the scores, and can account for business rules in the process.

SUPPLIER PERFORMANCE RATING: BUSINESS PROBLEM

In many businesses, data on supplier performance is collected and used for evaluating suppliers. Unfortunately, grading and comparing suppliers based on this data often is not straightforward, due to the presence of numerous and possibly conflicting evaluation criteria. For example, if one supplier outperforms all others according to one performance criterion but fails to achieve satisfactory levels on other criteria, it becomes unclear how to proceed with the comparison.

The traditional solution is to assign a fixed weight to each criterion to form an aggregated, weighted score for each supplier. Usually, weights are chosen to support specific business rules (such as weighting quality measures more heavily than financial measures to reflect their greater importance). Several problems can arise from this approach, including the following:

- Weights are subjective, difficult to agree on, and have a tremendous effect on the final scoring.
- It is difficult to balance relatively strong and relatively weak performances for different criteria.
- Differences in units of measurement for the criteria can

distort the influence of the weights used in the scoring.

The business problem can be stated most simply as how to best rate suppliers on the basis of multiple, possibly conflicting, performance measures and account for business rules.

SUPPLIER PERFORMANCE RATING: SOLUTION

Supplier Performance Rating (SPR) implements an innovative solution to this business problem. SPR solves the problem of differing measurement units among criteria by normalizing the performance data. This eliminates units from the measures, removes distortions associated with differences in units, and provides for more balanced comparisons.

SPR solves the difficult problem of determining weights by evaluating each supplier in isolation and optimizing the supplier's performance relative to all other suppliers (based on Data Envelopment Analysis). Automatically calculating optimal weights for each supplier's performance criteria avoids the problems resulting from assigning fixed weights to all suppliers.

SPR uses the optimally calculated weights to compile the relative scores used to compare and rank the suppliers. SPR captures business rules by enabling you to place limits and other restrictions on the weights used for the various performance criteria. This establishes rules on the relative importance of the criteria, and can also be used to account for imprecise performance information.

The SPR methodology is driven by the performance data. After normalizing each performance criterion, SPR uses linear programming to calculate weights on each supplier's performance criteria that optimize the supplier's overall performance rating. This rating is the weighted sum of the supplier's individual performance scores, with the weights being determined individually (and optimally) for each supplier. When this process is complete a ranking of all suppliers is possible.

SUPPLIER PERFORMANCE RATING: REPORTING

SPR produces supplier rating reports in two formats: ranked listings of suppliers and ranked bar charts of suppliers, each annotated with ranking, tier, and relative score (scaled from 0-100). For each type of report, the tier classification can be done on the basis of either the relative supplier score or the percentiles on the relative supplier score. Figure 2 shows one such report, with the tiered optimal supplier scores displayed in chart form.

Optimal ranking using SPR				
Tier (by optimal scores)	CSL Rank/Tier	Unit	Name	Relative score
	1	614733525	VICROY ELECTRONICS	100.00%
	2	106323595	DELTA ELECTRONICS CO	94.64%
	3	026424556	MORRIS INC	66.83%
	4	117395095	LABELSTAR	63.09%
	5	007322423	SIGNCO COMPANY	61.57%
	6	053122107	MARKETING SALES CO	60.47%
	7	002895175	MILTON EQUIPMENT	57.64%
	8	189839390	GHZ ENTERPRISES	57.14%
	11	672995345	JERSEY ELECTRONICS	56.17%
	10	038804662	MMA INC.	56.17%
	9	043565324	ESS WEAVER INC	56.17%
	12	043908105	COMPUTER IMAGE SYSTE	47.98%
	13	054968774	MARKMATE	45.96%
	14	075101345	MEDCO SALES CO	45.88%
	15	043817774	QUESTCO COMPANY	39.55%
	16	035453638	DCL INC	35.55%

Figure 2. A Supplier Performance Rating Report.

Upcoming releases of SPR will add the ability to determine supplier tiers by more advanced methods, including the use of statistical clustering techniques.

SUPPLIER PERFORMANCE RATING: POSSIBLE USES

SPR has a broad range of possible uses, and the underlying techniques used by SPR have almost unlimited applicability. Within the confines of supplier management, the most immediate use of SPR is in the periodic review of supplier performance. In this role, SPR can easily provide its ratings, rankings, and tier assignments as input to the Supplier Portfolio Optimizer, discussed in the following sections of this paper. Another opportunity to use SPR occurs in the Request For Proposal (RFP) or Request For Information (RFI) process, during which the purchasing company may need to shorten the list of bidding suppliers based on their past performance. In this scenario SPR's performance ratings could easily drive the reduction in the pool of bidding suppliers.

SUPPLIER PORTFOLIO OPTIMIZER (SPO)

The Supplier Portfolio Optimizer (SPO) assists in structuring and restructuring portfolios of suppliers, with a goal of maximizing the buyer's benefit while meeting specific requirements on portfolio makeup. SPO relies on rationalized supplier data describing suppliers and the goods that they provide, available from a number of sources such as Dun & Bradstreet. SPO provides guidance for answering strategic questions such as:

- Who should we buy from?
- Should we spend more or less with a supplier?
- What should our expected risk be?
- What should we buy from a given supplier?
- How should we alter our buying practices?

SUPPLIER PORTFOLIO OPTIMIZER: BUSINESS PROBLEM

Often, businesses don't have enough information on their suppliers of parts, raw materials, and other critical items. They cannot readily and easily determine how much they are spending, what they are purchasing, who their top suppliers are, or the answers to many other important questions. Surfacing such information effectively is one key to improving the buyer's position and to negotiating better relationships with suppliers. Another key to managing supplier relationships is an organized approach to moving from your current supplier portfolio to your desired supplier portfolio. In improving a supplier portfolio, one of the most often-mentioned goals is better negotiating leverage. Typically, though, buyers face restrictions as they pursue this goal. These restrictions or requirements may originate from internal business rules on supplier selection, from regulations specific to the business's industry, or from other sources. Some examples of these restrictions include:

- "At least 5% of our purchases should be made with small businesses."
- "We should have 5 to 10 suppliers of paper goods."
- "To ensure quality, buy at least 25% of all supplies from ISO compliant businesses."
- "The average financial stress score (FSS) of our supplier portfolio should not exceed 1.7 and the average supplier evaluation risk (SER) should not go beyond 2."

What's needed is a method for reshaping the supplier portfolio, focusing on the goal of maximizing negotiating power while adhering to whatever restrictions may apply.

SUPPLIER PORTFOLIO OPTIMIZER: SOLUTION

SPO's solution technique is based on mathematical optimization (specifically, mixed-integer programming) and is aimed at making procurement choices that maximize negotiating leverage within the restrictions created by the business rules governing the makeup of the supplier portfolio. As is true with SPR, the user interface provided by SPO does not require users to understand the fine points of mathematical optimization, but only to grasp the concepts motivating the demographic, budgetary, geographic, and other business rules on the supplier portfolio.

The SPO user selects from a menu of possible business rules to apply, and customizes each rule used by specifying parameter values such as minimum percentages, budgetary upper and lower bounds, and regional distribution targets. SPO then finds the combination of purchases and vendors that meets or exceeds the specified requirements and maximizes purchasing leverage. SPO achieves this by consolidating purchases to buy mainly from suppliers for whom the company is a major client, while simultaneously maintaining a balanced and diversified portfolio as required by the business rules.

SUPPLIER PORTFOLIO OPTIMIZER: REPORTING

SPO can produce a wide variety of reports describing the optimized supplier portfolio and the accompanying purchasing recommendations. Examples include reports on detailed and aggregated purchases from suppliers, recommended suppliers for specific commodities, and geographical purchasing summaries. Additionally, a summary executive report offers multiple views of the current and optimized supplier portfolios, highlighting the advantages that optimization offers.

Detailed Purchases Scenario: Reduction_DB_NewData						
Commodity	Supplier	Current Purchases (\$)	Optimized Purchases (\$)	Change (\$)	Change (%)	
1. ELECTRONIC COMPONENTS	059651240 TTR METALS	416	389	(27)	(6.00%)	
2. ELECTRONIC COMPONENTS	056778700 UPTON PRODUCTS	92	85	(7)	(8.00%)	
3. ELECTRONIC OTHER ANTI-STATIC DEVICES	113317523 SCI-KON CORP	23	21	(2)	(8.00%)	
4. ELECTRONIC WIRE-BONDING AGENTS OR CEMENTS	181549912 THUNDER FABRICATION	5	5	0	(0.00%)	
5. ELECTRONIC INDUSTRIAL CHEMICALS AND ADHESIVES	085327463 ANKATOL	7	1,179	1,172	17700.00%	
6. ELECTRONIC INDUSTRIAL CHEMICALS AND ADHESIVES	038044002 NMA INC.	29				
7. ELECTRONIC DATA STORAGE CORP	051499222 DATA STORAGE CORP	71				
8. ELECTRONIC BANDWIDTH SYSTEMS	109150006 BANDWIDTH SYSTEMS	45				
9. ELECTRONIC SCI-KON CORP	113317523 SCI-KON CORP	1,124				
10. ELECTRONIC INDUSTRIAL CHEMICALS AND ADHESIVES		1,079	1,079	0	(0.00%)	
11. ELECTRONIC INDUSTRIAL CHEMICALS AND ADHESIVES		1,079	1,079	0	(0.00%)	
12. ELECTRONIC INDUSTRIAL CHEMICALS AND ADHESIVES	034829900 CAPICOM SUPPLIES	58	54	(4)	(8.00%)	

Figure 3. A Supplier Portfolio Optimizer report.

SUPPLIER PORTFOLIO OPTIMIZER: POSSIBLE USES

The usage possibilities for SPO are quite similar to those for SPR. First, SPO is well suited for use in the periodic review of a supplier portfolio. This may be especially important if, for example, the purchasing firm completes a merger or acquisition and must deal with an augmented supplier portfolio. Additionally, SPO can (like SPR) assist in the Request For Proposal (RFP) or Request For Information (RFI) process. In this role, SPO can be refocused to minimize overall spend while satisfying the requirements outlined in the RFP or RFI, identifying a lowest-cost set of bidders.

SUPPLY CHAIN SOLUTIONS: COMPONENT INTEGRATION

The integration of the SAS supply chain solutions mirrors the causal relationships highlighted in the "pull" model of the supply

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chain. Demand Planning at the customer end of the supply chain feeds critical information to Inventory Replenishment Planning at the warehousing and distribution level, which in turn supplies requirements for Advanced Planning and Scheduling at the manufacturing stage. Other influences on manufacturing scheduling include Cycle Time Reduction and Equipment Maintenance Scheduling. The manufacturing schedule generates requirements for supplies, which are assigned to current and potential suppliers via Supplier Management. The result is an end-to-end plan for the improvement of overall supply chain performance.

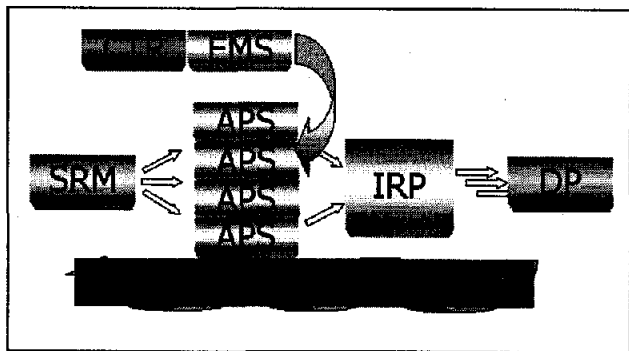


Figure 4. Component Integration

For any particular situation, any or all of these solutions can be implemented, and can add value to the supply chain either individually or by working together.

SUPPLY CHAIN SOLUTIONS: SUPPORTING DATA ARCHITECTURE

Underlying and supporting this planning work is the Supply Chain Data Warehouse, the repository of all relevant data on the past and current performance and future direction of the supply chain. Owing to the ease with which SAS can access data from virtually any source and in any format, the Supply Chain Data Warehouse can draw needed information from ERP systems, business legacy systems, or wherever the data resides.

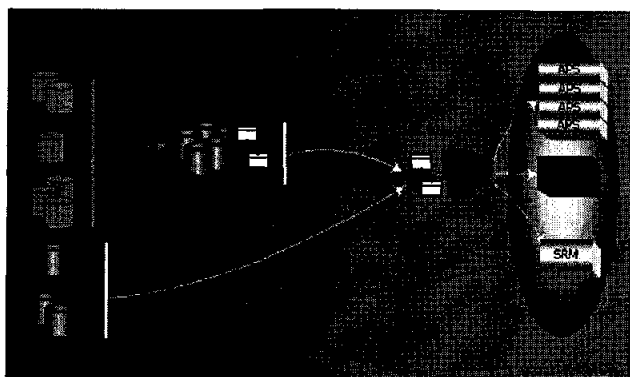


Figure 5. Supporting Data Architecture

The supply chain solutions draw data from the Supply Chain Data Warehouse and produce tactical and strategic plans for the supply chain. The information describing these plans is stored in the data warehouse and can also be fed back to ERP systems and legacy systems in order to put the plans into motion.

SUPPLY CHAIN SOLUTIONS: SERVER ARCHITECTURE

All SAS supply chain solution are designed with Web interfaces and can run in a distributed processing environment with a thin client. Only a Web browser and the necessary authorization are needed to access the solutions and their reports, while an application server can support each solution and another server can perform the needed optimization. By enabling such a thin client interface, SAS supply chain solutions make it easy to distribute both the planning power and the strategic and tactical supply chain plans that they provide.

CONCLUSION

SAS is developing a set of solutions targeted at assisting with the assembly, structuring, restructuring, and management of a large supplier portfolio. With Supplier Performance Rating and Supplier Portfolio Optimization, SAS applies its established optimization expertise and power to the problems of rating supplier performance in a balanced and comprehensive manner and configuring supplier selection and purchasing to maximize leverage. Each solution is designed to be customized to meet Individual client needs, and can participate not only in a complete Supplier Relationship Management solution but also in larger Supply Chain Optimization solutions.

REFERENCES

Jennings, D., and Kulkarni, R. (2001), "Cycle Down To Launch: Streamlining Production at Lockheed Martin," paper presented at SUGI 26 (SAS Users' Group International), Long Beach, CA.

SAS Institute Inc. (2000), "Supplier Management: Optimally Managing the Supplier-Buyer Relationship," Internal Document, Cary, NC: SAS Institute Inc.

WEB RESOURCES

For more information on SAS Supply Chain Optimization, see <http://www.sas.com/supplychain>. This site includes information on the various solutions being developed by the SAS Supply Chain Center as well as demonstration versions of many of the solutions.

For information on the SAS Solution for Supplier Relationship Management, see <http://www.sas.com/solutions/srm>.

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