The Future of **Optimization**

Introduction

While strategic sourcing decision optimization has yet to cross the chasm, still being restricted to innovators and early adopters for the most part, the reality is that it is now a mature technology that turns ten (10) this year. Innovators were already seizing the potential of optimization-based decision support back in 2000 when reverse auctions were just hitting their stride[1]. While they may not have been self-service, deep, or as easy to use as other sourcing applications at first, they were still quite powerful and customers regularly saw significant double-digit percentage returns above and beyond what they'd see just using other e-Negotiation techniques. Sourcing decision optimization was truly a new dawn for strategic sourcing.

Today's optimization algorithms are exponentially more powerful, significantly easier to use, and tightly integrated with full-service e-Negotiation suites. Large real-world scenarios that took impossibly long to process now solve in minutes or seconds. Just a few years ago, algorithms maxed out on a model that tried to optimally allocate a few dozen items to a dozen suppliers, where each supplier had a number of distinct production and warehouse locations, across a few dozen major distribution centers and warehouse locations in the buyer's network which could be served by a few hundred carriers and a few thousand lanes. In comparison, the very best of the modern sourcing optimization platforms can handle thousands of items from hundreds of suppliers with dozens of factories and warehouses and distribute these items optimally across hundreds of buyer distribution centers and warehouse locations and tens of thousands of lanes while simultaneously taking into account thousands of capacity, allocation, mitigation, and qualitative constraints. Some providers can even handle complex global sourcing models that represent a billion dollars in spend.

Strategic Sourcing Decision Optimization has come much further, much faster, than many people thought it would and has been saving an average of 12% above and beyond what can be obtained by reverse auctions and other standard e-Negotiation techniques for years (as first chronicled by Aberdeen back in 2005). However, the reality is that while strategic sourcing decision optimization is being used as a regular course of business it has undeveloped potential and there are still significant opportunities for sourcing leaders to innovate. Furthermore, future developments will likely overshadow today's impressive capabilities.

So, what enhancements are in store for strategic sourcing optimization? It is likely the next decade's innovations will focus on integrating critical business functions and their data into optimization platforms. This combination of process and technology creates a business process "powerhouse" that will model supply chains, support data-driven collaboration with trading partners, sense, respond, learn, and recommend solutions, continuously.

True Supply Chain Modeling

Today, approximately 90% of sourcing models are logistics oriented, even though, in many categories, logistics accounts for a mere 10% of total cost. The same 'network' model that makes the concept readily understood by today's logistics procurement teams lends itself to more strategic categories of spend. Buyers of strategic spend categories struggle modeling or often neglect significant product lifecycle costs such as inventory, network, and associated service costs. At many companies, inventory costs approach 20% to 30% of total product costs, an inappropriately designed network can double (or even triple) inventory and logistics costs, and a poorly designed service chain with a slow response time can result in lost customers, which, in turn, can result in lost sales and large inventory write-offs. These product lifecycle costs and many more decision factors are commonplace in sourcing decision optimization solutions. Future strategic sourcing decision optimization

[1]Going, Going, Gone! The B2B Tool That Really Is Changing The World WEB AUCTIONS ARE REVOLUTIONIZING THE $5 TRILLION MARKET FOR INDUSTRIAL PARTS. IN THE PROCESS THEY'RE WIRING THE RUST BELT FOR GOOD,http://money.cnn.com/magazines/fortune/fortune_archive/2000/03/20/276391/index.htm

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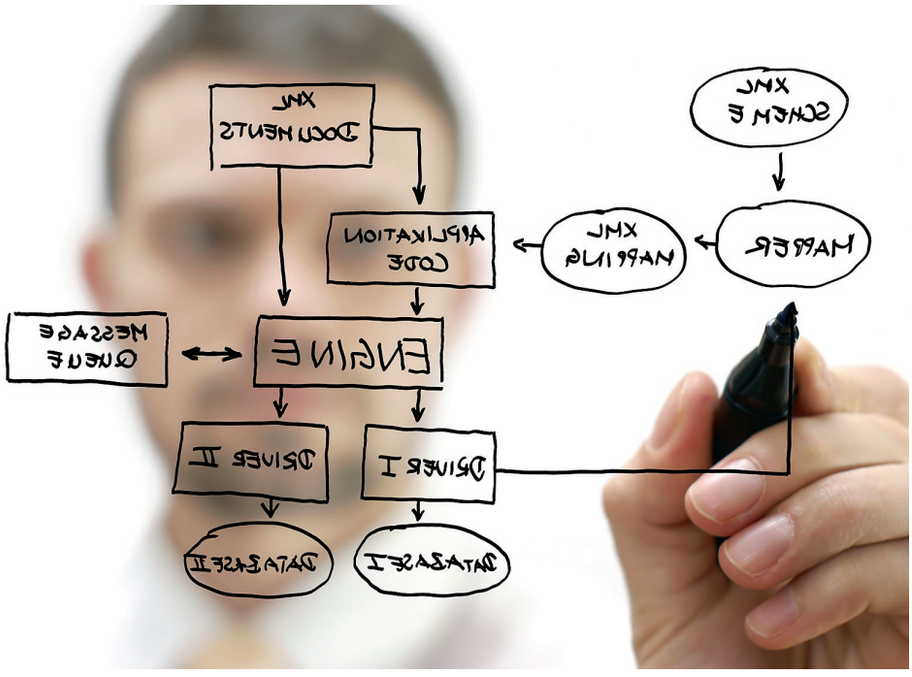
suites will allow a buyer to take the network into account and simultaneously optimize network design and inventory costs with product and logistics costs for entire categories at a time. No longer will an analyst have to run separate models with independent assumptions that can completely wipe out negotiated savings if the underlying assumptions don't mesh. As a result, the future should see more and more sourcing centric models being run until logistics models are an appropriate 10% of models run in the real world.

Flexible Models that Support Supplier-Defined Constraints

Right now, optimization based sourcing allows the supplier's the ability to express their bids more creatively and offer discounts based on volumes, custom-defined lots, and conditional (if/then) buys. In the near future more cost modeling power, currently available to the buyer for what-if scenario construction, will be exposed to the supplier. The current capability is useful, as it lets the software mimic the real-world negotiations that have traditionally taken place at the long table, but future models will provide more powerful cost modeling capabilities to suppliers and allow a richer expression of supplier constraints and preferences.

This upgrade in expressiveness will help markets clear more efficiently. The next step is for these optimization platforms to open up the full constraint-based modeling capability to the supplier who will then be able to offer up sophisticated bid models that capture all of the efficiencies available in the supplier's operation. For example, a supplier might only be able to offer rock bottom prices on a small order if all of the product is produced at a single facility, because each production line has a significant start-up cost. If the supplier is unable to specify this constraint, the supplier will have to bid higher in case it has to absorb the costs of producing the item at two distinct locations. Similarly, the supplier might not be willing to invest in new manufacturing technologies that would speed up, and reduce the costs of, production unless the buyer is willing to commit to buying at least three items (in minimum lot sizes) that would use the technology. If there were 30 items in the buyer's lot, then the supplier would not be able to express this requirement using conventional expressive bidding (as it would require 4,060 custom bid bundles) and the supplier would end up having to bid high as the minimum required award for an investment in new technology might not happen. In addition, the provision of basic constraint modeling and optimization capabilities to the supplier will allow the supplier to model and understand the true costs of its production and distribution network when bidding on the buyer's demand. This enhanced 'demand modeling' will allow the supplier to focus on the provision of bids that are optimal to the buyer, which will make the supplier's offerings that much more attractive. And when the supplier gets more business as a result, both sides will win.



... and Multiple Buyer Defined Options

Right now most strategic sourcing decision optimization platforms are quite powerful as the buyer can take into account both ship from and ship to locations, capacity constraints, allocation-based constraints, if-then constraints, and a myriad of qualitative constraints. However, future optimization platforms will allow the buyer to do embedded substitution analysis, make-vs-buy analysis, and alternate network analysis.

Currently, most strategic sourcing decision optimization platforms assume that one item requirement matches one product from a supplier. A couple of platforms allow multiple products from a supplier to match one item. However, there is not yet a single platform that truly allows embedded substitution, which is necessary when a buyer is sourcing a Bill of Materials for a complex piece of machinery or electronics where engineering can permit substitutions at multiple levels, but not necessarily any substitutions as not all parts will be compatible with all other parts. Right now, to overcome this limitation, a buyer will have to create multiple scenarios and analyze them separately to try and

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get the best deal. This has two limitations. One, in large systems, only a small number of possible configurations can be analyzed. Two, cross-scenario analysis is limited because most of the current reporting engines are designed for comparing "like" scenarios on the same products.

Furthermore, most of today's optimization solutions don't effectively address "make-vs-buy" analysis for custom-made components. For example, if a company is building a car, it can source each major assembly -- the engine, the frame, etc.; or it can source sub-assemblies – the carburetor, the fuel injector, etc; or it can source component parts

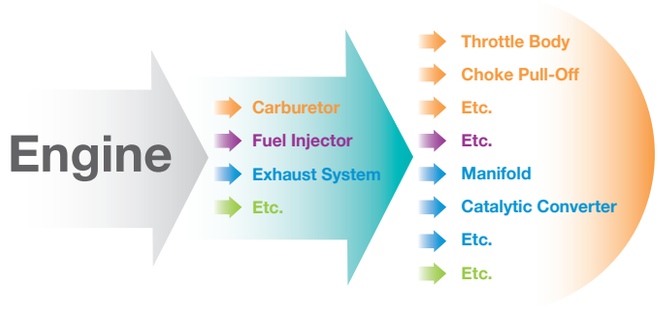


Figure 1: (Major) Components of a Car Engine

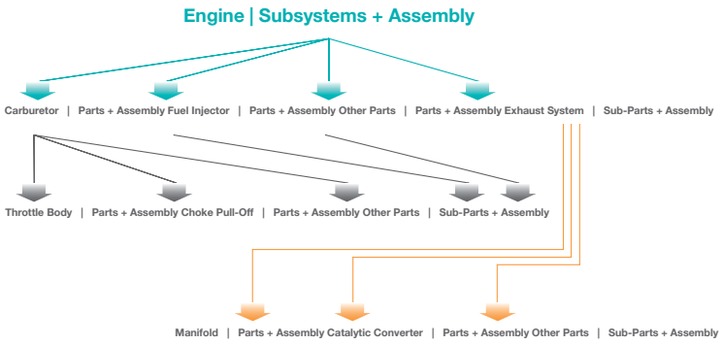


Figure 2: Various Options in the Assembly of a Car Engine

– the throttle body, the choke pull-off, etc.; and so on. It can build the final product in-house from the major assemblies, or have a first tier supplier do it, or have one first tier supplier assemble the major assemblies from the sub-assemblies and send those assemblies to another first tier supplier who will assemble the car, or choose one of a thousand other supply chain models. The figures above hint at the complexity that needs to be considered to truly arrive at a best solution. The best, and most cost-effective, scenario will depend on the particular strengths and cost efficiencies of each supplier in the supply chain. However, it is likely that such a scenario will be realized when the platform supports an integrated make-vs-buy analysis at multiple levels. Currently, no buyer has the time to manually construct the (tens of) thousands of scenarios that would be necessary to capture all of different possibilities that will ultimately be possible with today's modeling capabilities.

Then there's the issue, alluded to in my prediction of the emergence of true supply chain modeling, of the need for alternate network analysis. While certain aspects of a supply chain network will be fixed, such as owned warehouses and supplier factories, certain aspects will be flexible, such as leased distribution centers and leased retail locations. Once the software can also consider alternate locations, and associated costs, a buyer might find that certain, more innovative, suppliers become cheaper in the bigger picture.

Embedded Automated Reasoning and Business Intelligence

Not only will future strategic sourcing platforms be more powerful and permit true supply chain modeling, which will include flexible models on the buyer and supplier side, substitution, make-vs.-buy analysis, and alternate network analysis, but they will also be smarter. After the data collection issue is solved, the next biggest hurdle in the adoption of these systems typically revolves around issues of use. Either buyers don't know where they should start, and will shun adoption of the system, or the early adopters don't know when they should stop an analysis -- stuck in an endless-loop of analysis paralysis. Either way, even if an organization pilots a strategic sourcing decision optimization product, many will delay pushing the system out to the buying organization at large.

Future systems will recommend constraints, and even entire models, based upon past events, similar models, previous buying decisions, time-series network transformations, and market directions. For example, if the category was previously sourced two years ago, the software would recommend starting with (a relaxed version of) the model that the award was ultimately based on the last time (along with an unconstrained model to be used as a baseline). If the category wasn't sourced before, but a similar category was sourced, for example computer components are being sourced and an event was recently held that sourced embedded electronics control systems, the platform would detect the component and supply base similarities and recommend that similar risk mitigation and allocation constraints be considered.

Over time, if the system detects a change in the preferred supply chain topology in

award scenarios, it will start to recommend suppliers and carriers that mesh better with the new network topology as new categories, which traditionally used suppliers and carriers in the old network topology, are analyzed and source. And if the platform is tied into a market data feed and a true spend analysis tool, it will also pick-up on the pricing trends and recommend constraints that steer the organization towards components that use materials that are likely to be lower cost and / or contribute to a lower total cost of ownership.

Not only will future platforms push constraint and model recommendations like Amazon and Netflix push recommendations of "like" books and movies to their users, but the pushed constraint and model recommendations will be highly relevant to the product or service being analyzed. This is because it will be based on company data and market data highly relevant to the company.

Multi-Criteria Multi-Variate Optimization

Right now, just about every strategic sourcing decision optimization solution on the market is cost-centric, but the reality is that it's not total cost of ownership that matters most, but total value management. For example, the lowest cost solution, even after the cost of carbon credits is accounted for, is not necessarily the best solution, especially considering the negative press it could expose the company too if the green activists get wind of the dirty blood red supply chain.

Future platforms will allow for the simultaneous optimization of a number of different objectives and build a Pareto front -- a multidimensional brane or band of possible solutions that simultaneously optimize a number of different requirements, such as cost, carbon footprint, and service level. From this brane (which is a band in three dimensions), the buyer will be able to analyze the cost-carbon-service level tradeoffs inherent in the model and select a solution that optimizes all objectives under consideration in a manner that is most aligned with the values and strategy of the business.

Furthermore, the platform will be able to support any cost-based or qualitative objective that is relevant to the buying organization. Quality, reliability, recyclable content, supply chain length, service level, carbon footprint, and cost will all be supported equally. The buyer will be able to consider the hard and soft costs associated with any product or service being sourced on the same footing, with the true trade-offs made crystal clear.

Embedded Risk Analysis

One of the most significant concerns in today's supply chains, where a major disruption now occurs at least once every year, is that of risk management. How does one identify risk? How does one mitigate risk? How much do the various mitigation options cost? What is the benefit of using them? And how does one manage a disruption when a risk event occurs?

While an optimization-based platform will not be of much help in identifying risk, or much help in identifying non-traditional mitigations, it can be very useful in the analysis of the cost and benefits of various mitigations as well as in the identification of those scenarios that minimize the risk or associated mitigation cost. Future optimization platforms will allow for optimization against one or more risk mitigation objectives as well as expected scenario costs once the probability of a risk, and the cost of an associated mitigation or disruption,is taken into account.

The models will go beyond the simple dual- or tri-source mitigation strategies common in today's platforms and also allow a buyer to define the probability of a disruption and the expected cost of a disruption at the product, supplier, lane, or scenario level. The engine can then return the scenarios with the lowest expected costs or the scenario with the best savings vs. loss ratio. For example, there might be a sole source solution that only costs 100M, but has a probability of disruption of 70% (and an associated cost of disruption that is likely to be 50M) and a dual-source solution that costs 120M, which only has a probability of disruption of 10% (and an associated cost of disruption that is likely to be 10M). In this case, using a simple definition of expected loss as the probability of disruption times the expected disruption cost (using the assumption that if the award period is long enough, the disruption will eventually occur -- which is valid as this is how many insurance models are derived), the first scenario is likely to cost 135 M while the second scenario is likely to cost 121M, and, if the current cost of the category is 150M, the first scenario has a savings vs. loss ratio of 10:7 (or 1.4) and the second scenario has a savings vs. loss ratio of 30:1 (or 30). Either way, it is immediately apparent that the second scenario is a lot less risky.

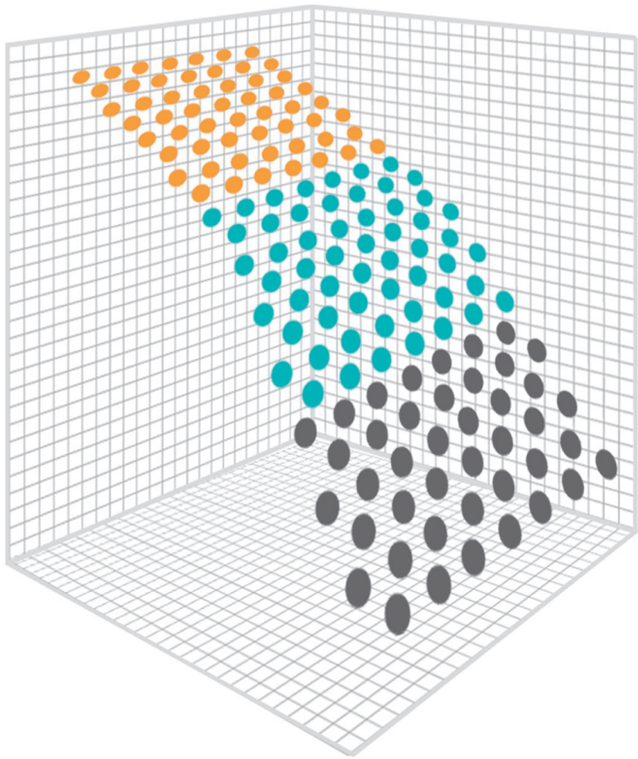
In more advanced scenarios, the buyer will be able to define a cost range and an associated probability function, and this will allow for an even deeper and more realistic risk-based optimization. For example, if the risk is bankruptcy of a key supplier, the cost of the disruption if the risk materializes will be dependent on the amount of time to secure supply from a new source. If it takes thirty days, the cost might only be five million, but if it takes ninety days, the cost could be ten million. However, the probability of ninety days is only one in ten, while the probability of thirty days is one in two. From this, the software will be able to interpolate a probability band and cost range for a more detailed analysis and refined optimization that will produce the scenario with the lowest risk and / or associated cost.

Visualization

Currently, most of the solutions report the optimization results using standard grid based reporting or simple bar charts. Some of the more advanced solutions will even use spider graphs to report the efficacy of the solution against various dimensions. However, these limited two-dimensional displays will not be enough to truly capture the trade-offs inherent in a multi-variate

optimization. Future optimization platforms will use three-dimensional graphics to plot the Pareto-brane of solutions in a multi-variate optimization that balances cost, carbon footprint, and service level and three-dimensional projections to plot the Pareto-brane of solutions in higher dimensional multi-variate optimizations.

With such a solution, where the buyer will be able to rotate the three-dimensional display graph around to get a better understanding of the trade-offs, the buyer will quickly be able to see how the different factors trade off; how lower cost increases



carbon footprint and decreases service levels, how a lower carbon footprint increases costs while lowering some service levels, and how lower service levels decrease costs and increase some carbon footprints.

Furthermore, because such displays will be interactive, the buyer will be able to select a location in the graph which represents a desired trade off, and the platform will automatically generate a model with the appropriate set of constraints to generate the desired solution. As a result, with point-and-click based graphical interfaces, tomorrow's optimization solutions will be even easier to use and control.

Living Models

Not only will tomorrow's optimization solutions be highly visual, but they will also be highly interactive and support "living" models that can be adjusted and guided iteratively in feedback loops. As the models, which will be very large and complex, are solving, the platform will plot interim solutions in real time against the multi-variate objectives. The buyer will not only be able to guide the optimizer towards a desired (range of) solution(s) by selecting the desired area of the interpolated Pareto-brane, in real-time, but will be able to adjust the model -- by altering, adding, or removing constraints, if the optimization does not appear to be headed in the desired direction. The ability to respond to continuous feedback will create better models with better solutions.
Furthermore, since the optimization platforms will be more deeply embeddable into end-to-end sourcing platforms, award models will update over time as orders are made and delivered and these models will be able to be re-run, subject to award conditions, during execution as demands, prices, and turn-rates change. This will allow buyers to re-optimize orders, subject to contract terms, to insure that the best value is always obtained. Instead of being run once and "lifeless", the models will be "living" models that will be run and re-run repeatedly to make sure everything is still going according to plan.

Conclusion

While strategic sourcing decision optimization might be a mature technology now that it has just celebrated its tenth birthday, it's still in its infancy when one considers the significant number of enhancements that can still be made.
It's a powerful technology, but the foundations provided in today's platforms can ultimately support more power than any other e-Negotiation technology on the market today.

The next decade is likely to see the emergence of true supply chain modeling; flexible models that support supplier-defined constraints, embedded substitution, make-vs-buy, and alternate network analysis; automated reasoning and business intelligence; multi-criteria multi-variate optimization; risk analysis; visualization; and living models. And then strategic sourcing decision optimization will truly hit its stride in mainstream sourcing decision making.

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Sourcing Innovation is a resource for sourcing, procurement, and supply chain professionals who are interested in improving themselves and the overall performance of their organizations. Sourcing Innovation is education about, and in-depth analysis of, technologies and approaches that can have a profound impact on the way you do business. The editor believes that the more you know, the better your chances of success.

That's why Sourcing Innovation brings you in-depth technology and vendor analyses, reviews and analysis of some of the more important articles and white-papers that pop-up from time to time, as well as best practices and deep dives into specific solution areas.

Sourcing Innovation also explores key issues that you need to be aware of as a sourcing professional.

Sourcing Innovation, started in June of 2006, is authored and edited by Michael Lamoureux, aka the doctor, a Computer Science PhD who has been heavily involved in the Sourcing and Supply Chain Space since 2000 and the e-Commerce space since 1997. With particular expertise in analytics, modeling, and optimization, the doctor is able to dive much deeper into technology and core issues than the average blogger.

A second primary goal of this blog to raise awareness of innovative best practices and technologies that are relatively unknown but that could be used by a large number of organizations to elevate their performance as a whole. When one combines the impending talent crunch with the rapid rise of developing nations like China and India, innovation takes on a whole new importance, since it might be the only way North America, Western Europe, and other developed nations will be able to compete in the coming decades. Furthermore, the rapid fall of the US dollar in 2007 and the rapid rise in energy and raw material prices globally since 2006 indicate that global business is reaching a fork in the road, and only the organizations that continually innovate will be able to find the path that leads to continued success.

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