State of the Art

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Criteria for choosing the right decision Support Technology

Choosing the right tool to develop your Supply Chain Model is a critical step toward implementing a solution. There are a variety of software products available in the market, but not all will be a good fit for your needs. The selection process for the right tool will depend on your goals, your familiarity with the principles of modeling and optimization, as well as your comprehension of the business model. In this paper we identify and explain the criteria that will be important as you undertake the selection task.

Introduction

A good number of firms are currently in the process of evaluating tools to implement decision support models or they may soon be undertaking that task. It is cause for caution that other firms that have gone before them have found that, having selected a tool and implemented a solution, it does not deliver the results that they had hoped. Unfortunately, the organizational expenditure and significant cost that such an effort requires, together with the lack of results, leaves a negative impression among those who were involved and a general sense of skepticism about the benefit of decision support models.

In the majority of those cases, the root cause of the problem was lack of knowledge about modeling, optimization and the application of those techniques to solution of actual (as opposed to textbook) problems. In retrospect, it can be seen that the criteria on which the selection of the tool was based were a mismatch with the particular problem to be solved; the purchase decision was made for reasons largely unrelated to the actual need.

To facilitate the selection process and reduce the risk of choosing the wrong software we offer here some guidelines that should prove useful and answer doubts that frequently arise when people evaluate decision support technology for logistics and production:

Functionality of the System Components

1. Integration schema

The first characteristic we need to consider is the capability and facilities for integration with existing applications that form part of the enterprise system and on which the decision support application will depend for necessary information and to which it will export the results obtained.

The diagram in Figure 1 shows one common integration schema. Notice that in the diagram the different Decision Support Models communicate among themselves while at the same time they interact with transactional information system as well as the Analysis and GUI layer. Some decision support tools are self-contained packages and therefore the task of integrating them with other system components becomes even more arduous than building the models that they are designed for.

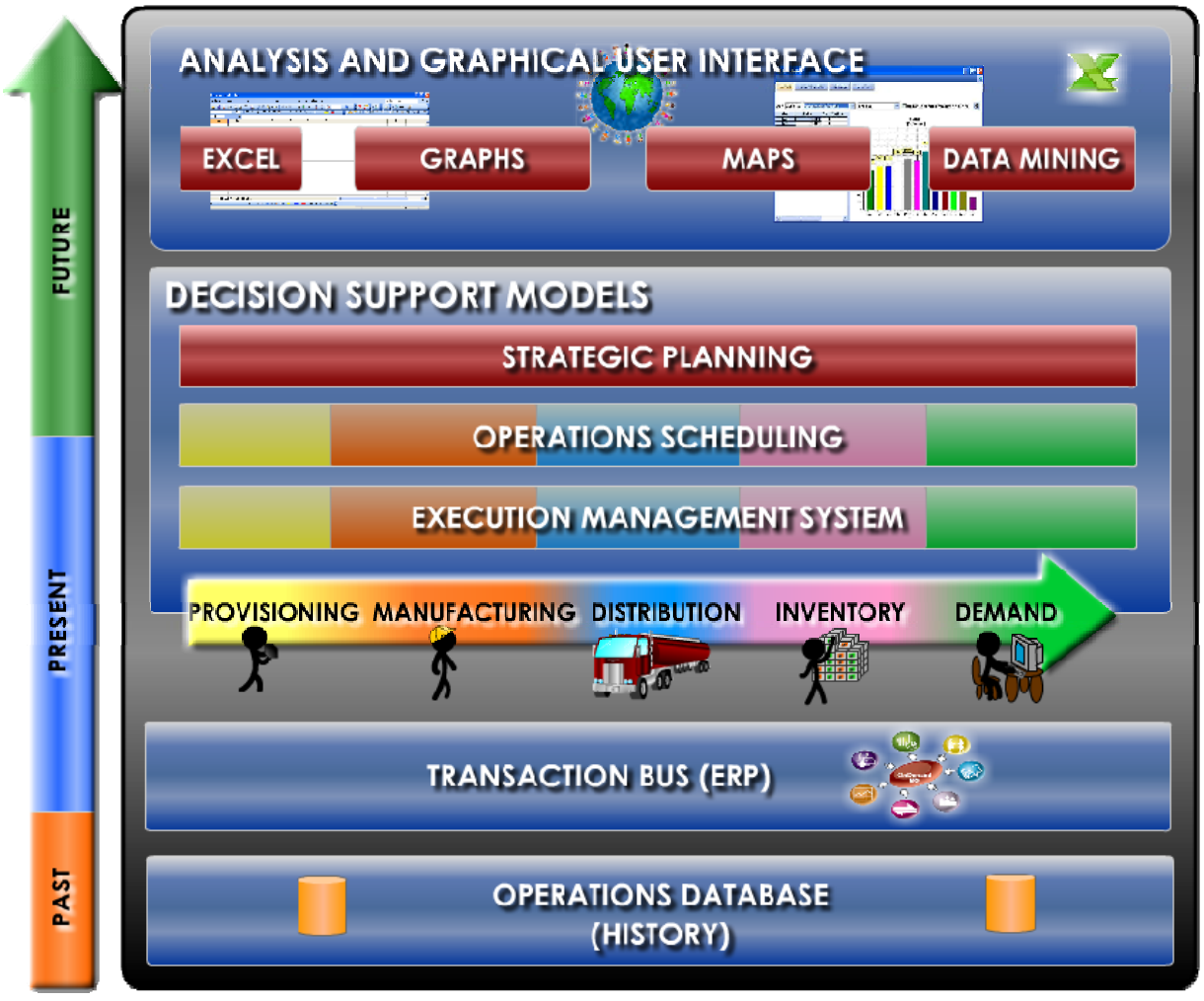

Figure 1: Functional Structure for Decision Making Applications.

2. Levels of Decision Making

From the outset you need to identify clearly the nature of the problem to be solved and recognize that different types of problems require a different focus for their solution along with different models and algorithms.

The different levels of decision making require different paradigms for generating solutions, their nature, scope and robustness.

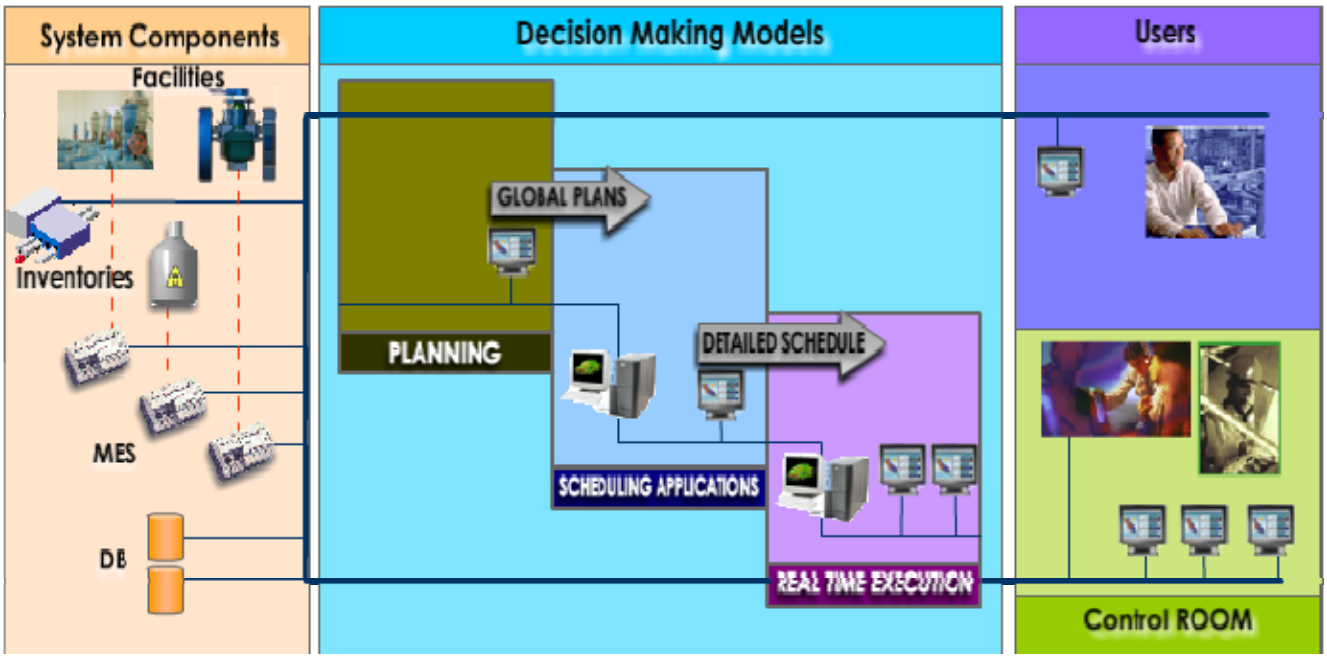

Figure 2: Levels of Decision Making Applications.

1. **Planning** is a long-range, holistic endeavor and needs to take into account multiple, concurrent interactions among the sub-processes in the model.
2. **Scheduling** is a localized, multi-process activity over a medium time horizon and it is constrained by decisions predetermined at the planning level.
3. **Execution** is a real-time, near-term undertaking in which decisions to emend controlled processes do not immediately affect the execution of other processes.

One common mistake that results from the failure to recognize this distinction is trying to resolve a problem at one level by using techniques appropriate to a different level.

It is also important to keep in mind that summing all local solutions will not necessarily lead you to the best overall solution; that is to say, it is not possible to solve the larger business problem by solving and piecing together many specific problems. In fact, just the opposite is true: you need to approach the solution from the top (Planning) down (Execution).

3. Types of products available

There are 3 types of products in the marketplace that offer decision-making support: tools, packages and solutions.

Within each of these 3 types there are different options and technical capacity to generate business value and therefore it is important to consider the type of offer being evaluated to make objective comparisons between different alternatives.

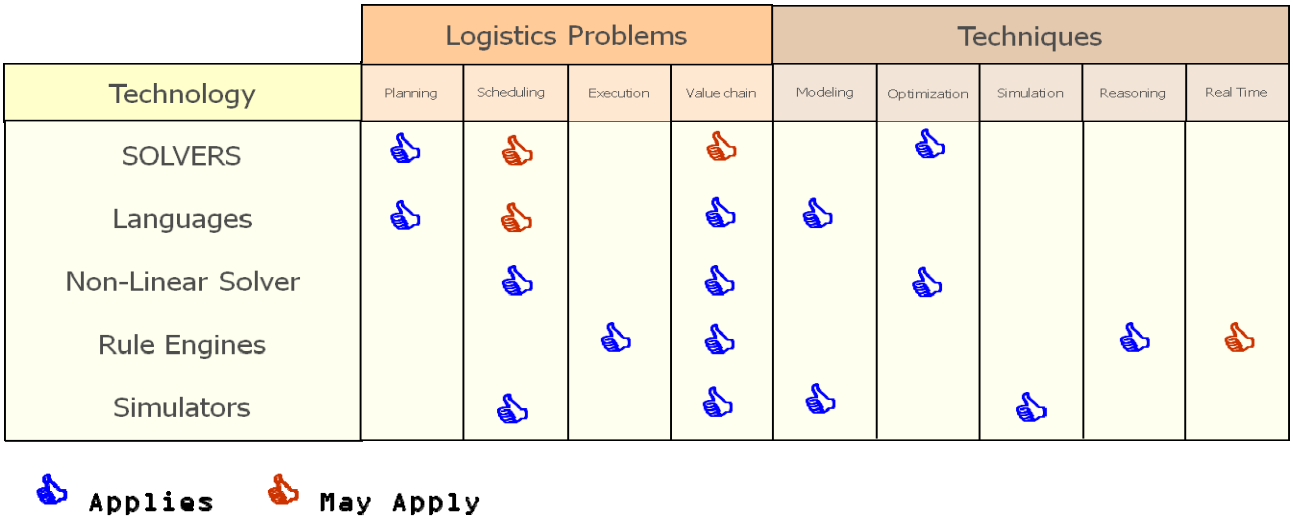

Figure 3: Technologies and their applications.

In Figure 3, the first column on the left shows different product categories according to the technology they employ.

The second set of columns, labeled “Logistical Problems” shows different levels of decision-support problems within the enterprise. You will notice that the different types of problems require different combinations of technology for their solution and that some technologies are not applicable to certain types of problems.

The third set of columns labeled “Techniques” contains the different mathematical and computational approaches employed by different technologies. You will notice, for example, that whereas *Languages* are tools that are used for *Modeling*, they are not used for *Optimization*. You will also notice that *Rules technology* is useful for *Reasoning* but not all rules products in the marketplace are capable of real time reasoning.

Another point of note in Figure 3 is that several types of products offer to solve *Scheduling* problems but there are no guidelines to suggest which product is most suitable in each case.

It is worth noting that Figure 3 reflects the complexity of choosing the appropriate technology and techniques to match the type of problem. In general this is a task that requires (a) an understanding of the technology based on its theoretical fundamentals and (b) familiarity, derived from practical experience, with the actual capabilities of the available products.

1. **Tools.**

   These products are offered at fairly low cost in the form of software libraries that can be combined into a system that provides the required functionality. The eventual efficacy, robustness and cost of the system, however, depends entirely on the ability of the software developer to define the problem, implement the model and configure appropriately to solve the problem.

   Using these tools does not free the user from understanding the theory and technique employed by the tool, although it can reduce the development and maintenance effort. Tools are a good option for research, academic investigation, as well as Solution components (see below).

   To use a tool correctly, you should have a good understanding of the Problem Solving Cycle (*see Figure 4 in "How to Develop Decision-Support Models"*).

2. **Packages**.

   Even though the most attractive quality of commercial packages is "Do It Yourself," it usually turns out to be not as simple as you are led to believe. Without the proper experience, implementing a package can entail significant expense in time and effort.

   One limitation of a package can be its inflexibility for defining the correct model. The majority of these products contain a predefined model that can be configured using predefined parameters that often turn out to be insufficient for representing all the elements of the model corresponding to the desired behavior.

   It is important to distinguish between modification (that is, adding or deleting) the elements of a model as opposed to altering the structure of the model by redefining important behavior. Most packages readily support modification, sometimes in a user-friendly way, but few are open to changing their behavior. That can become a crucial limitation.

   Packages are most suitable for resolving simple, common problems or if the company is willing to trade off some benefits in order to learn about the problem-solving process.

3. **Solutions**.

   The third option encompasses all the qualities required to resolve the problem: focus, development methodology, end-user methodology and functionality tailored to your own business model.

   Solutions comprise services and software. The services include technical consulting and software development, while the software components may be Tools or Packages. As components, Packages can be limiting for the reasons described above, whereas Tools will allow greater flexibility and the likelihood of a more robust solution because, if properly selected, they will proffer all the necessary elements to correctly represent the model's behavior. The quality of the Solution will depend, of course, on the technical understanding and experience of the implementing team.

4. The Implementation Process

After choosing the technology appropriate to the problem and expected use, you need to define the implementation schema. For this, two different methodologies are useful:

1. **Project deployment methodology (***see Figure 4***)**.

   Use a project deployment methodology to achieve 3 things:

- Project focus on target: ensure that the problem is well-defined, that the model is appropriate for the system behavior, and that the solution obtained from the model conforms to the intended criteria and techniques.
- Development and implementation carried out on time and within budget.
- Transfer of the solution to the end-users.

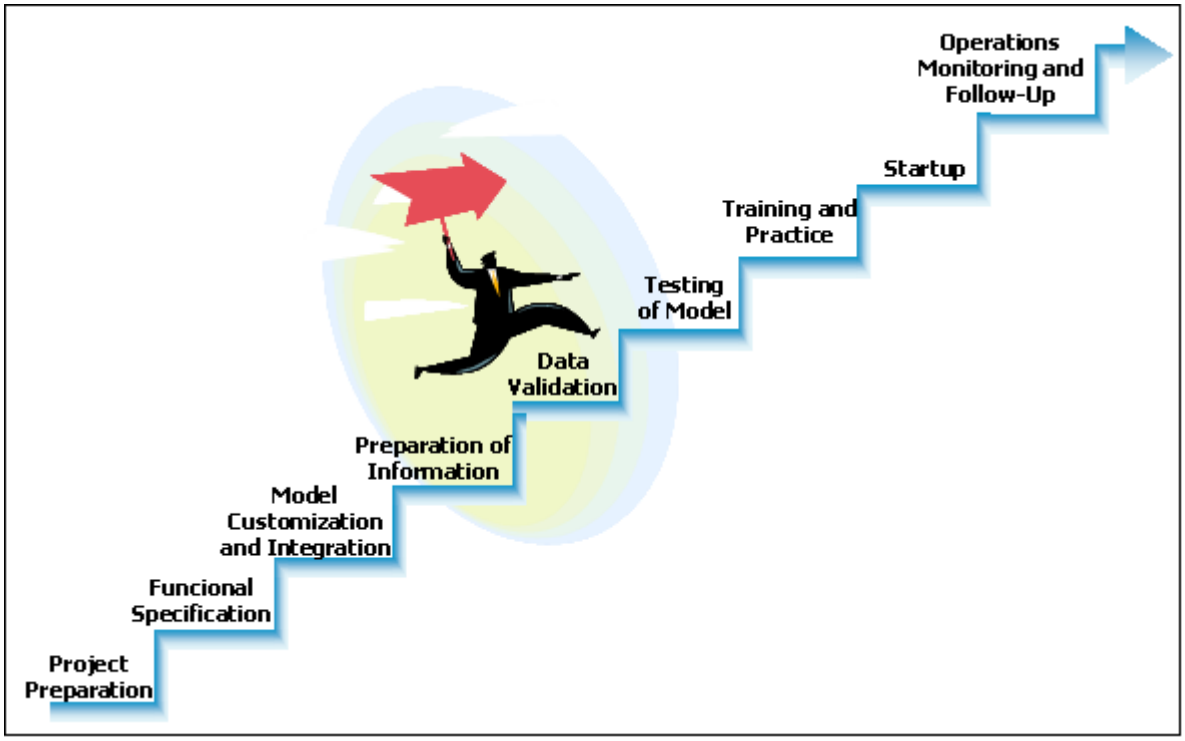

Figure 4: Project deployment methodology.

2. **Model Usage Methodology**.

The methodology that governs use of the model should ensure that the end-user employs the model effectively to generate value for the company. This methodology should explain with sufficient detail a sampling of examples across the spectrum of situations that can occur and how to apply the technology to create useful solutions.

The Usage Methodology should include detailed descriptions that encompass the planning cycle including the following:

- Clearly explain how the planning cycle will be carried out with reference to the company's business model.
- Figure 5 depicts a detailed planning process and shows users and activities.
- A clear explanation of this process will enable the user to understand the benefits that can be obtained from the methodology by enabling the comparison alternative solutions and by allowing concurrent planning of all the business processes.
- The methodology should also describe the different planning cycles – short-term, mid-term, and long-term – and their interaction with other operations in the organization.

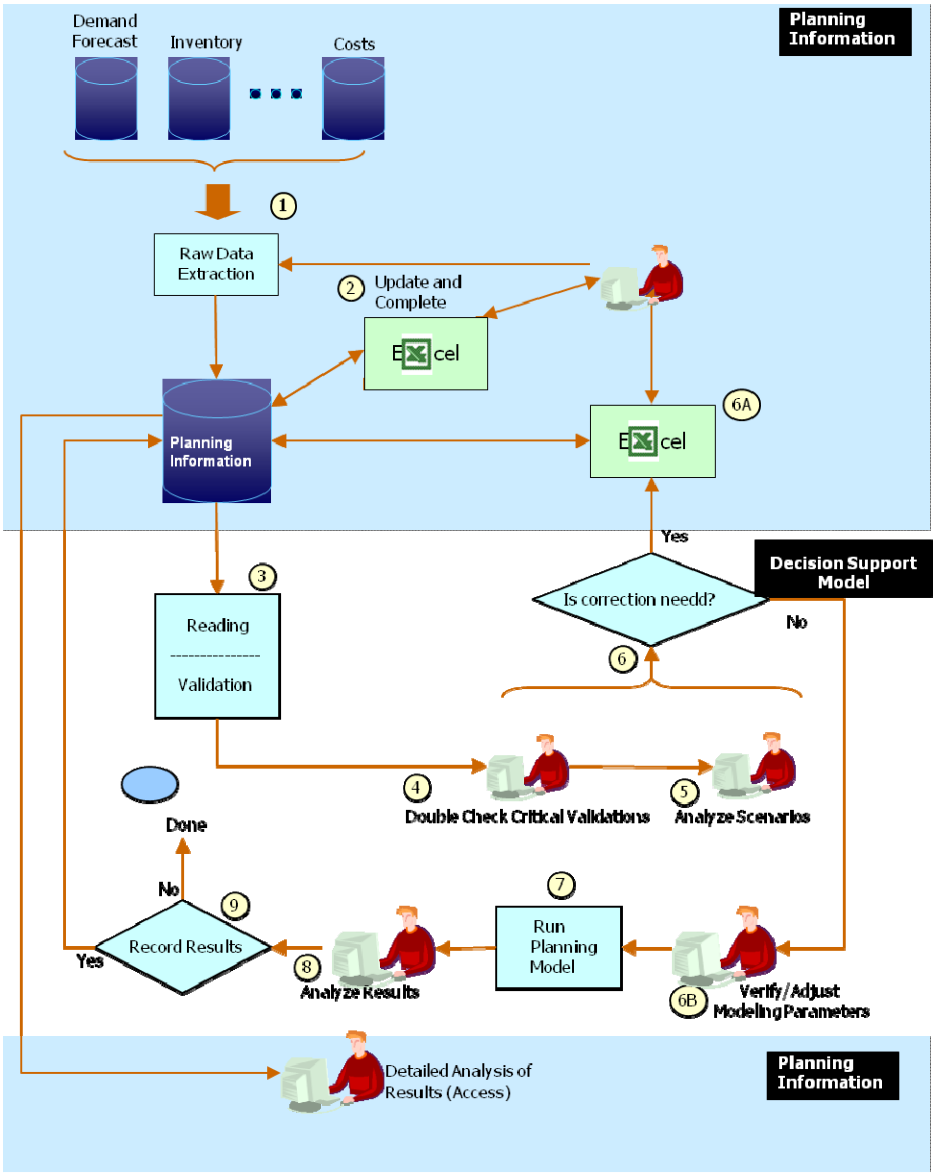

Figure 5: Step by step planning process.

(1) Recompilation of Information	*(6A) Corrections to Scenario*
(2) Update and fill in Information	*(6B) Verify/Adjust Modeling Parameters*
(3) Review and validation of Scenario	*(7) Run Model*
(4) Verification of Critical Validations	*(8) Analyze Planning Results*
(5) Analysis of Scenario information	*(9) Log Planning Results to Database*
(6) Does Scenario need correction?	

5. Capabilities of the technology

Having reached a clear picture of your particular needs in light of the issues described above, you are well-positioned to choose between alternative technologies in terms of their qualities to enable you to effectively model the problem in question.

i.	Easy of use	Easy to learn	Easy to maintain	Easy to analyze
ii.	Powerful	Huge models	Multiple objectives	Robust
iii.	Fast	Solutions in minutes	Compare alternate solutions	

The evaluation criteria are grouped below in 2 tables. In the first table are those criteria that are most important to ensure that the model solves the problems for which it is intended; in the second table are criteria that are less critical in terms of quality of results but useful to facilitate ease of use and operation.

1. **Technical selection criteria for modeling and optimization**:

	Criteria	Why it is important
✓	*Robustness of the model.*	It is important to realize that a model that is nearly complete may be of very little practical use (that is to say, if I have 90% of what I need for the model's attributes, I may only be able to generate a solution that encompasses 10% of its potential).
✓	*Breadth of coverage.*	It refers to the ability to model different kinds of elements – commercial values, priorities, service criteria, corporate policies and practices, exceptions, etc. This is not to be confused with the capability to add elements to the model such as another plant, product, market sector, etc.
✓	*Manage simultaneous focus on business and operational objectives.*	A technology that jointly handles both focuses will enable you to solve problems that achieve greater benefits.
✓	*Balance multiple objectives.*	Every decision problem involves two or more decision criteria. An acceptable model should be able to find the optimal balance of mutually conflicting objectives.
✓	*Ability of the model to generate at least one feasible solution.*	This is a criterion that users seldom consider unless they have had experience in modeling. Most optimization technologies allow the user to constrain the problem so rigidly that no solution can be found. When that happens, the system notifies the user that "no solution can be found for this model." That's a puzzling and frustrating message for the user, leaving him or

		her with no guidance about how to revise the model. Friendlier technologies anticipate or minimize the possibility of constructing an infeasible model and they may provide guidance for correcting the source of the problem.
✓	*Flexibility to simulate several versions of the model under different conditions*	A flexible technology will provide "what-if" scenarios that facilitate decisions at the strategic, tactical o operational level.
✓	*Decision tree.*	A comprehensive decision-making methodology, rather than generating a single optimal solution, should include the comparison of multiple, feasible solutions with consideration of several objectives to be optimized. A technology that enables you to compare alternatives will better accommodate teamwork in the planning process.
✓	*Visibility into the model.*	For the modeler as well as end-users, it is important to understand the structure of the model to be solved because the model reveals the consequences of the optimized solution. Ability to view and understand the behavior of the model is critically important especially for complex problems such as optimal supply chain alignment. If the implications and causes of decisions within the model are hidden, then the end-user cannot feel comfortable with recommendations. This is a step beyond – and shouldn't be confused with – a graphical layout of the structure of the supply chain network. Here we are talking about the dynamic implications of the optimized solution for the flow of goods over time in the supply chain.
✓	*Rapid response time in generating a solution.*	The time it takes to generate a solution generally depends on the size and complexity of the model as well as the solution technology being employed. Although there is no exact time limit for solving a model, you need to take into account the practical implications of deriving a solution. If you need to make a decision within an hour or two, then overnight will not suffice.
✓	*Analysis capabilities.*	A model's solution may contain thousands of variables and so the solution can be viewed from many different angles. With so much information, the end-user can quickly become overwhelmed when trying to understand the solution. It is important that the technology provide tools to summarize and compare alternative solutions while at the same time drill down to understand the details of different solutions if need

		be.
✓	*The same platform to address different problems.*	Since different problems may require different approaches and different optimization techniques, a useful feature of some technologies is that they encompass a variety of approaches and techniques. Otherwise modelers and end-users find themselves using different software, with different interfaces and data organization, to resolve different kinds of problems. This is not a prohibitive encumbrance but certainly an annoyance.

2. **Technical criteria for selecting platforms and support**:

As already noted the following criteria are important but are contingent on those above because the choice of platform and support will be of little consequence if the problem cannot be solved correctly.

✓	*Usability of the software.*	It includes capabilities for integration, development environment, language and interface.
✓	*Ability to add elements to the problem definition.*	This refers to how easily the end-user can adjust the scenario to produce different solutions as opposed to the modeler making changes in the model itself.
✓	*Technical support.*	It includes training, questions and answers by phone, Internet and, when necessary, on site.
✓	*Documentation.*	
✓	*Analysis.*	Solution results available in tables, graphs, reports and other formats that are configurable by the end-user.

Conclusion

Choosing the right technology depends on the type of problem to be resolved and the preferred approach.

Every decision support product in the marketplace has its pros and cons so each should be evaluated in terms of how it addresses your particular needs.

There are a dozen or so criteria for comparing and evaluating decision support products; some are "need to have" while others are "nice to have."

Choosing the wrong technology for your particular problem will result not only in lost time and money but also sow doubt in users' minds about the practicality of this technology. Trying again for a second time will meet more skepticism.

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