ENTERPRISE SIMULATION – A PRACTICAL APPLICATION IN BUSINESS PLANNING

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ABSTRACT

The Vanguard System^{TM} is a Web-based collaborative modeling software for enterprise simulation and business planning. It supports proactive decision-making, resource optimization, and strategic planning using a number of novel capabilities including: enterprise simulation, collaborative modeling, a Wiki-style knowledge portal, and grid computing. Perhaps the most distinctive characteristic of the Vanguard System is its ability to capture and process Knowledge the way traditional Business Intelligence (BI) systems process Data.

1 INTRODUCTION

Modeling and simulation (which we will refer to as simply "modeling" in this paper) is an essential process in modern business management. Models allow managers to test ideas in a virtual world where mistakes are inexpensive; they provide a framework for comparing competing alternatives; and, they help managers to clarify the potential risks and rewards of pursuing actions.

What's more, modeling is pervasive. For example, every time someone in an organization builds a spreadsheet to "run the numbers", they are actually building a model. While this is a subtle realization for many companies, it is an important one. Companies invest significantly in modeling, and they invest even more by shaping company strategy around the results that are generated. Yet in many companies, modeling is disorganized, myopic, and inefficient. Because of its importance, there are advantages in treating modeling and simulation as an enterprise-wide, strategic initiative.

The Vanguard System has done for modeling and simulation what Business Intelligence (BI) systems have done for data analysis – it has provided a standardized foundation for treating modeling as an enterprise-wide, strategic initiative.

Such an initiative requires the ability to scale the modeling and simulation activity to the enterprise level, the ability for individuals throughout the organization to simultaneously work together on complex models, the ability for individuals throughout the organization to contribute and manage knowledge about their areas of expertise, and the ability to run very large simulations in seconds and minutes instead of hours and days. The Vanguard System satisfies these needs with core capabilities that include among others enterprise simulation, collaborative modeling, a Wiki-style knowledge portal, and grid computing.

2 ENTERPRISE SIMULATION

Applying modeling techniques on an enterprise scale is frequently called Enterprise Simulation (ES). It has two distinct objectives:

1. Provide a top-down view of a business enterprise to support strategic decision-making.
2. Enable a wide spectrum of individuals in an enterprise to apply modeling techniques to routine decisions.

Until now, no tools have existed that could adequately satisfy these objectives. Business Intelligence and similar historical reporting systems help monitor business operations, but they cannot help companies evaluate new ideas for which there is no history. Spreadsheets, the default modeling tool when there is no coordinated modeling effort, are flexible but lack scalability, version control, a collaborative nature, and a means of publishing for widespread use.

The Vanguard System is unique in its ability to satisfy ES objectives. It supports a complete toolbox of analytic techniques including Monte Carlo simulation, forecasting, optimization, decision tree analysis, and others (see Figure 1). It can cut the cost of building business models by simplifying model structures and encouraging reuse of prior work. It can improve the accuracy of models by allowing users to divide the modeling task between individuals with specific domain knowledge. It has an open, transparent, and graphical modeling interface that displays models as hierarchical trees in order to improve the communication

and understanding of model functionality (see Figure 2). And, the Vanguard System can encourage the use of modeling for routine decisions by making models as easy to use as a Web site.
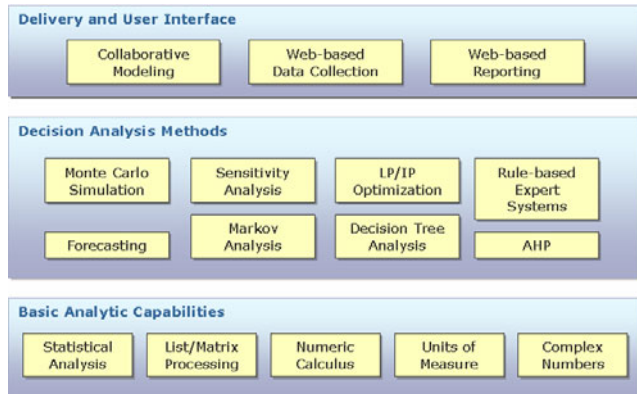

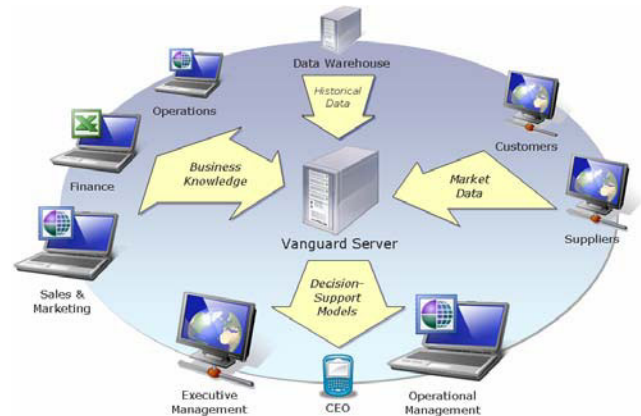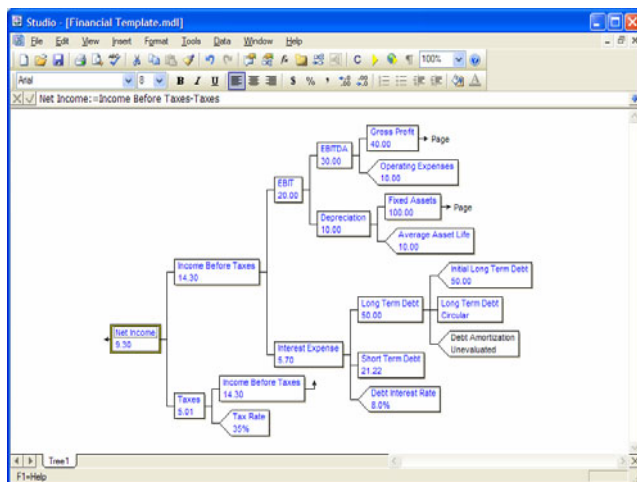Figure 1: Layered capabilities architecture

Figure 2: Graphical modeling interface

3 COLLABORATIVE MODELING

Collaborative modeling allows many individuals in a company to contribute to a joint modeling effort in a way that risks and opportunities throughout the organization are captured and rolled up in real-time without any loss of detail.

Vanguard's component-based modeling technology allows companies to build large-scale, distributed models by linking together smaller, component models that are built independently. Users can model facets of a business in a way that is most useful to them and the system ensures that these models will work as components in a collaborative model.

The intricate complexities of getting all of the component models to work together when they are built by people in different countries using different currencies, different time scales, different update schedules, etc., are all handled completely automatically by the Vanguard System.

Figure 3: Collaborative network architecture

4 WIKI-STYLE KNOWLEDGE PORTAL

Models can be shared with others and applied at all levels of an organization by publishing them to the Vanguard System's Wiki-style Knowledge Portal. Here, models take on two new characteristics: they are simultaneously Web applications that any individual with a Web browser can use (See Figure 4); and, they are components that anyone can link to in their models (see Figure 5). Users don't need to know anything about modeling, and modelers don't need to know anything about how to build web applications.

For Web-based users, the Knowledge Portal becomes a resource where they can find pre-built models to use in their work. Since the models are completely open and transparent, users can see all underlying assumptions and suggest improvements. Plus, users who have some modeling skills can even update the models themselves without fear that they will break something. This open update architecture is based on the Wiki style of Knowledge Management.

The real benefit the Knowledge Portal provides goes beyond making specialized decision-support models available to all employees; the real benefit is that these models are automatically converted into components that people can use as the basis for other, higher-level models. This means that users don't have to start from scratch when they build new models.

For example, users in Operations will not have to forecast sales as part of their production-planning model because they can link to a sales forecast model maintained by Marketing. Similarly, an inventory-planning model can

get its basic input by linking to the newly created production model.

This sort of collaborative modeling is less structured than a top-down company simulation in that these models grow from the bottom-up in an organic manner.
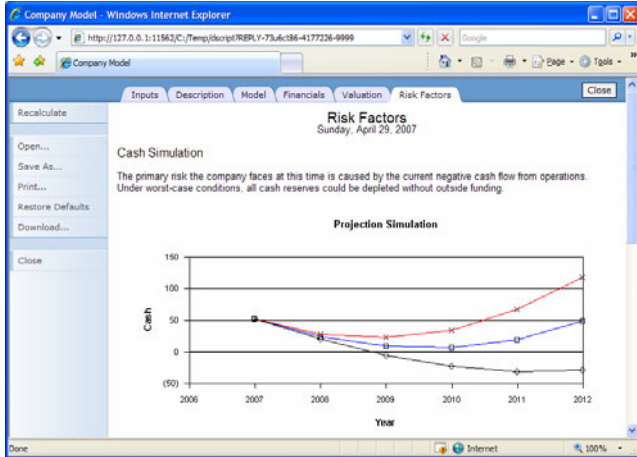

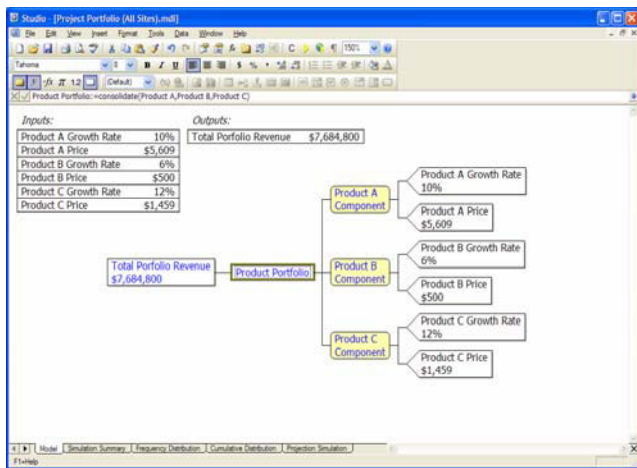Figure 4: Instant Web-based applications

Figure 5: A component-based model

5 KNOWLEDGE CAPTURE

The Vanguard System is the first software available that can capture the knowledge of a large group of individuals and merge this knowledge into a collective system that simulates business systems too complex for any single individual to understand.

Business management systems are evolving in a manner that closely mirrors the *Data-Information-Knowledge-Wisdom* (DIKW) hierarchy used to explain human thinking (see Figure 6). Raw Data is the foundation. By adding

context to the data, you get Information. Information explains *What* the Data represents; Knowledge explains *How* the Information is used; and finally, Wisdom explains *When* the Knowledge should be applied.

Early business management systems focused on automating the lowest level of the DIKW hierarchy. The result is the Data Warehouse. Next, OLAP and other Business Intelligence products evolved to automate the transformation of Data into useful Information. The next step in the evolutionary process is to capture and process business Knowledge.

Data and Information are only useful in business management if the remaining levels of the DIKW hierarchy (Knowledge and Wisdom) are present. These top two levels have been traditionally the domain of humans and off limits to computers. However, if Knowledge can be brought into the computer world, then managers can rely on the collective Knowledge stored in the company knowledgebase and focus their efforts on the Wisdom level-- *When* to apply business tactics and strategies.
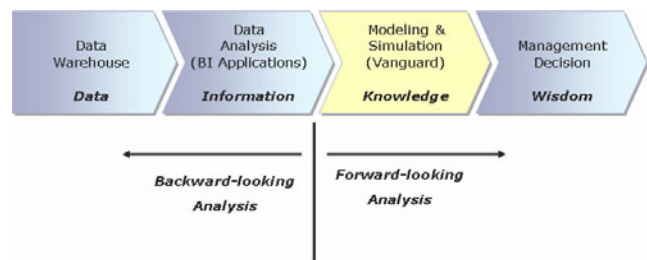

Figure 6: DIKW hierarchy

The Vanguard System has taken a very novel approach to Knowledge capture. Instead of using documents to store Knowledge, Vanguard uses models. Models have the advantage of explaining not only *How* something is done, but in the context of business analysis, they can also DO the thing they explain. This active nature of models makes it possible for a computer-based system to merge automatically models designed for specific purposes into new models that perform entirely new tasks.

The concept of using models to capture business knowledge is simple; however, the details of how one makes such a system work are quite complex and Vanguard has invested over 10 years of research in this area.

Some of the complexities the Vanguard System overcomes involve ways to get large groups of people to act as a single online community, sharing the responsibility of capturing and maintaining knowledge in the system. To do this, Vanguard has incorporated many emerging Web technologies such as Wikis, Web Services, Knowledge Portals, mashups, etc.

6   GRID COMPUTING

Another complexity was finding the computational power required to make such a system work. To his end, Vanguard has incorporated Grid computing technologies, which allow many computers to work in tandem on a single problem. Vanguard maintains a computer Grid available to Vanguard System users that can perform Monte Carlo simulations on the order of 1,500 times the speed of similar spreadsheet models--a one-day simulation is reduced to one minute.
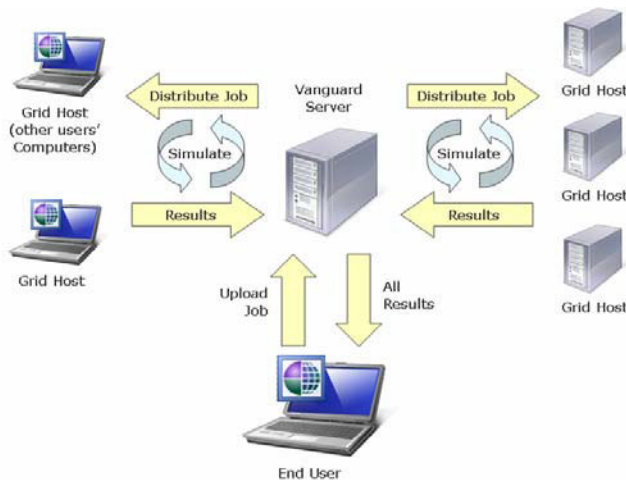

Figure 7: Grid computing for very fast simulations

7   VANGUARD SYSTEM COMPONENTS

The Vanguard System consists of three key parts:

- Vanguard Studio™,
- Vanguard Server™, and
- any Web browser.

Model builders use Vanguard Studio to capture knowledge in the form of models which Vanguard Server manages. End users interact with models using either Studio (for power users) or a standard Web browser (for general users).

7.1   Vanguard Studio

Vanguard Studio is a graphical modeling tool that allows users to build any type of model in the form of hierarchical trees. The user interface is designed around the *Divide and Conquer* concept. That is, to solve complex problems users simply divide it into two or more simpler problems. To solve these problems, they apply the same process again, breaking them down into still finer elements. The result is a hierarchical tree that clearly displays the relationships inherent in your model.

This interface not only provides a great way to manage complex problems, it also provides a great deal of visual feedback that makes their models more open or transparent to others. Someone who is not familiar with their model can quickly navigate its assumptions and provide feedback on its accuracy and completeness.

Every business problem, process, and decision is unique and requires unique analysis. Relying on Vanguard System's layered analytic capabilities architecture, users not only have access to a complete toolbox of analytic techniques including Monte Carlo simulation, forecasting, optimization, decision tree analysis, but Studio also provides an open and flexible modeling environment (for entirely custom techniques).

7.2   Vanguard Server

Models built using Studio are published to the Vanguard Server. The server acts simultaneously as a Library Server, an Application Server, and a Licensing Server.

7.2.1 Library Server

The Vanguard Server makes models available to other model builders as components through the Wiki-style Knowledge Portal. For example, to build a model to calculate the expected profit for a new product, a user might link to models others have generated to reflect potential sales and production costs. The original designers of the sales and cost component models can maintain their models independently from the user's profit model and the server manages all interaction between the components.

The server also keeps track of version information so you can roll back all components to the state they were in at any time in history. The server supports password protections, enforces policy restrictions, provides search capabilities, and offers a host of other features required to maintain the integrity and usefulness of your library.

7.2.2 Application Server

The Vanguard Server makes all models available as Web-based applications that anyone in an organization can access from the Knowledge Portal. This makes it possible to leverage the knowledge captured in the system by making it available to a large user group. The Web-based interface is simple enough to use that no training is required. Yet, the interface provides users with access to all internals of a model, contributing further to the openness and transparency required for users to understand and trust the models.

7.2.3 Licensing Server

The Vanguard Server lets users share a limited number of Studio licenses among many individuals in a company. Most users will find the Web-based interface sufficient for their needs. However, if a user wants to interact with a model using Studio to gain greater control, they can access a floating license for a day rather than purchase a dedicated license.

8 CONCLUSIONS

The Vanguard System helps companies with their most valuable business questions. Questions such as:

- What are the major risks we face now?
- How much cash do we need to be sure we can cover all planned activities?
- In which projects should we invest to maximize the portfolio effect and cancel risk?
- Should we go forward with a planned expansion?
- How will acquiring a competitor affect our expected profits and risks?
- Should we sell an under-performing division?

The inputs used to answer these questions include management estimates, knowledge about markets, suppliers, manufacturing techniques, etc. These questions are framed, analyzed, and answered using the Vanguard System to combine the knowledge contained throughout an organization into cohesive, enterprise models.

APPENDIX

The Vanguard Global Knowledge Portal is a free-access, shared library of example models in different application areas that range from simple calculators to complex algorithms to sophisticated enterprise simulations. Through continued use and contribution by the Vanguard System user community, the Global Knowledge Portal has become a key resource for professional modelers. It reaches a world-wide audience of academic, business, and government users. The Web address is <wiki.vanguardsw.com>.

Additional information about the Vanguard System and free software trials can be found on the Vanguard Software Website <www.vanguardsw.com>.

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