

## **Vision: A Business Planning Simulator**

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## **Vision<sup>1</sup>: A Business Planning Simulator**

### **Abstract**

“Past performance may not be a not true indicator of future performance.” Everyone has seen this disclaimer at one time or another. Although this may certainly be true, past performance should certainly be considered when planning for the future. Executives are always seeking ways to make decisions that will help their company to perform better. This paper examines a model that was developed to take a company’s financial records and transform them into easy to understand trends and long-term predictors. In addition, it allows the user to adjust system parameters to see the long-term effects to performance.

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## Introduction

Compiling financial records is a requirement for every company. They are needed for filing their taxes each year as well as for business transactions. For most companies that is where their usefulness ends. They file their taxes and go on their merry way operating the company. However, these financial records should be viewed as a company asset. After all, they cost the company to compile them (and usually not a trivial amount). The data that abounds in the financial records should be of some value if there were only an easy way to extract the information and use it for deciding future decisions.

Business management is fraught with uncertainty because of changes in consumer behavior, market performance, and inherent delays in the system. Most managers rely on their mental models, i.e. intuition, of the system to make fundamental decisions. Unfortunately, the reliance on intuition to enforce the logical consistency of dynamic theories is fundamentally at odds with the well-established limitations of human cognition. Numerous studies show that human ability to reliably infer (or mentally simulate) the behavior of even low order dynamic systems is exceedingly limited<sup>2,3</sup>. In addition, it is very difficult to critique and resolve inconsistencies in someone's mental model. Mental models are vague and ever changing. They change with every new piece of information we compile.

Due to its complexity, the development of a comprehensive understanding of the long-term dynamic behavior of a business in response to potential change is difficult. Fortunately, an analytical approach known as system dynamics allows for the

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<sup>2</sup> Simon, H. (1957) *Administrative Behavior; a Study of Decision-Making Processes in Administrative Organizations*, 2<sup>nd</sup> Ed. New York: Macmillan.

<sup>3</sup> Diehl, E. and J. Sterman (1995) Effects of feedback complexity on dynamic decision making, *Organizational Behavior and Human Decision Processes* 62(2), 198-215.

development of a powerful model that can lead to increased understanding and potentially better management of business programs. A well-constructed system dynamics computer model allows users to explore multiple policy and economic scenarios over extended periods of time. This can result in a comprehensive understanding of both the potential impact of and the soundest possible response to the economic changes that modify the success or failure of the company.

System dynamics is designed around discovering and representing the structure of a system through a series of feedback loops in a system. System structure is what drives system behavior. This paper examines a new program that was developed to extract the information from the financial data for a company and through a system dynamics model examine the effects of management decisions and changing economic conditions on business behavior.

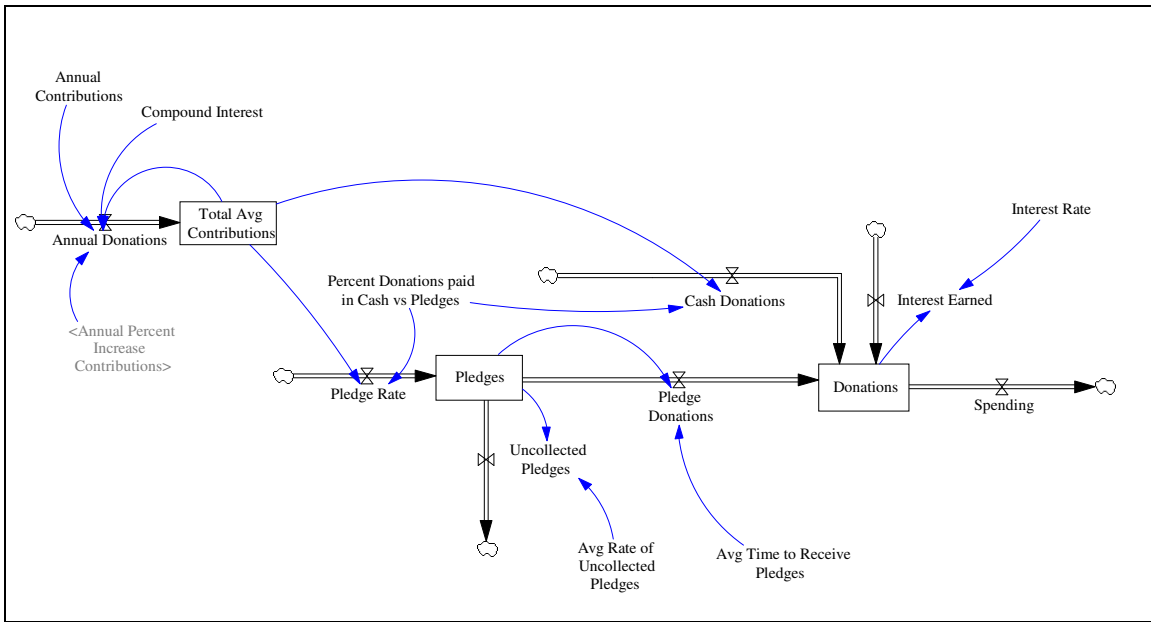
The business operation that was used for this initial test case is a private, non-profit organization. Their work is supported from gifts and grants. The organization supplies a variety of services including research, education and clinical work. The program was designed around their business model. The model tracks revenue, which includes donations, grants and contracts, investment returns and clinical services. The model also tracks expenses such as salaries and wages, professional fees and contracts, taxes and benefits, occupancy fees and travel and conference fees.

## **MODELING PROCESS**

The modeling process involves developing a series of sub-models each based on a particular phenomenon or process and then linking the sub-models into a full model that captures the dynamics of the entire system. This process allows for development of simple (when compared to the full model) sub-models and verification that those sub-models are working properly before linking them to create the full model. The Sub-models developed as part of this study include a: 1) Donations Sub-model; 2) Expenses Sub-model; 3) Revenue Sub-model; and 4) a composite Sub-Model that summarizes the individual pieces.

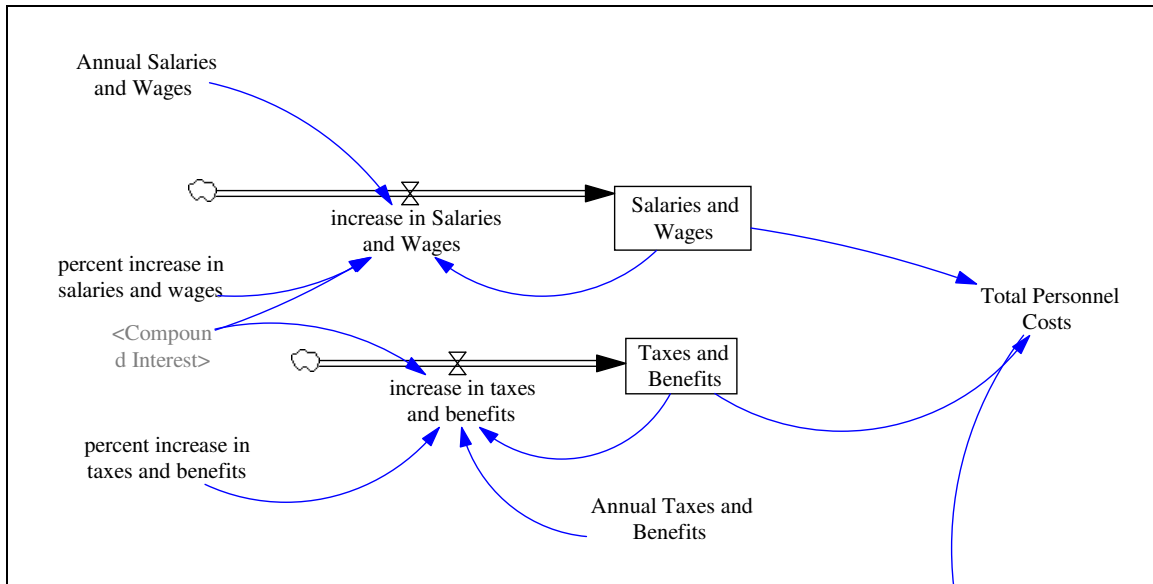
The first system being modeled is a donation sub-model. The structure tracks donations that are made, interest made on the donations and distributions of the funds. There are three different types of donations that can be made and they must be tracked separately. First, unrestricted donations are funds that can be used at the company's discretion. Next, temporarily restricted donations are funds that have some short-term restrictions on their usage. And finally, permanently restricted donations, such as endowments, are funds that cannot be used directly but the interest from this money can be used.

The structure is very simple thanks to the array structure available in Vensim (Figure 1). Donations are received and tracked. Donations are distributed as necessary. Interest is accumulated on those donations that remain in the account.



**Figure 1:** This figure shows the structure of the donations tracking model component.

The next sub-model that was developed was for the expenses component Figure 2. This structure is again an array structure. The array elements correspond to the different sectors in the company that need to be tracked, Management, Research, Education and Fundraising. Each of these sectors requires the same structure but have different parameters. Therefore, while they need to be traced separately but can be done so with the same structure that simplifies the model structure. Instead of having to develop 4 similar structures to track the different sectors, it can be done in a single structure. The parameters include a stock for tracking the salaries, a flow for changing the salaries annually and parameters for changing the rate of increase.



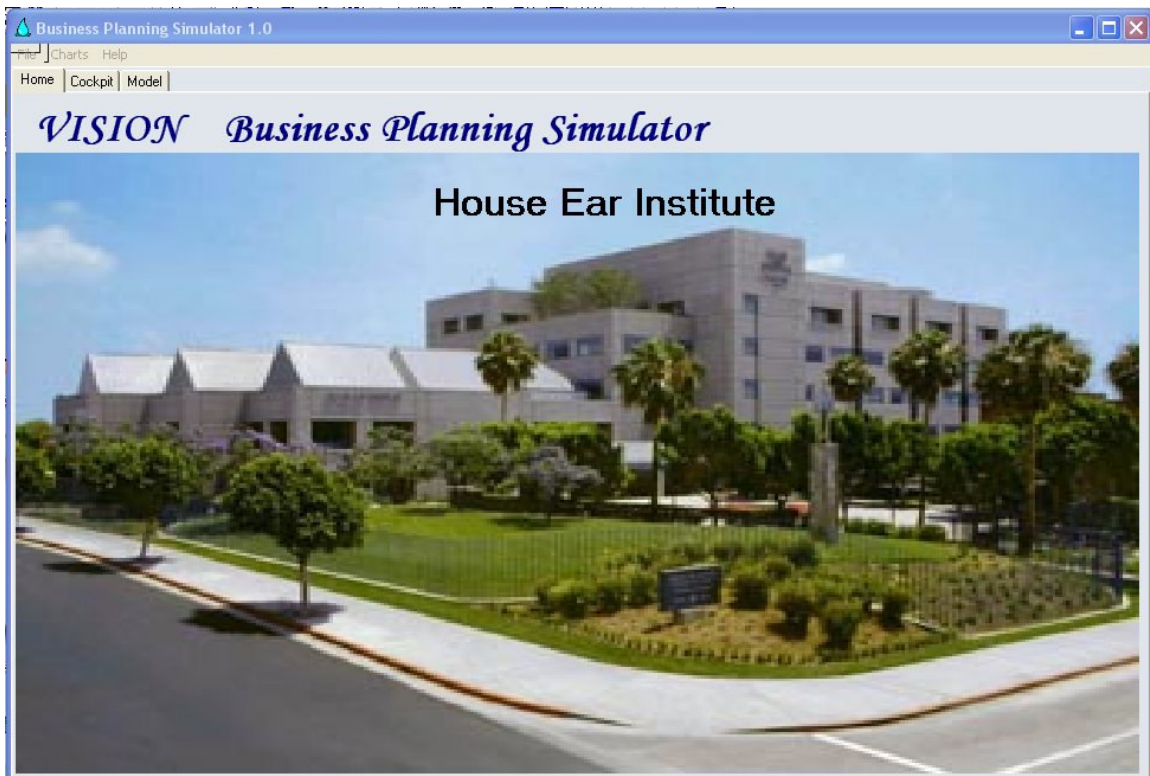
**Figure 2:** This figure shows an example of the expense tracking components. This example shows the tracking of employee data (salaries, wages and the associated taxes and benefits.).

Figure 2 shows the structure for 2 of the 12 different components that compile the entire expense profile for the company. Different companies would require different expense components that could be added very easily into the model structure. The system dynamic model can easily be adapted to different business models. The model structure is relatively simple. The power of the model is in exercising the model changing the parameters and getting immediate feedback as to the effects to the overall system performance. A user interface was developed to make exercising the model quick and easy.

## **FLIGHT SIMULATOR**

A significant part of our modeling effort was spent on designing and developing a user interface that was both comprehensive and user friendly. One of the criteria for this research project is to design a model that can be easily understood and manipulated by stakeholders that may not possess a deep understanding of computers or simulation

systems. It was understood early on that without a good user interface the functionality of the model would not be fully realized. The interface design is based on graphical input screens that have slider bars, drop down selection lists, tabbed screens and spin buttons for manipulating the model input parameters. The output results are displayed on temporal charts that show performance parameters over time. These types of model interfaces are often times referred to as flight simulators since they allow the user to test-drive designing and managing a complex system. Figure 3 shows the home page of the model interface. The user can navigate around the interface by clicking on the page tabs at the top of the screen.

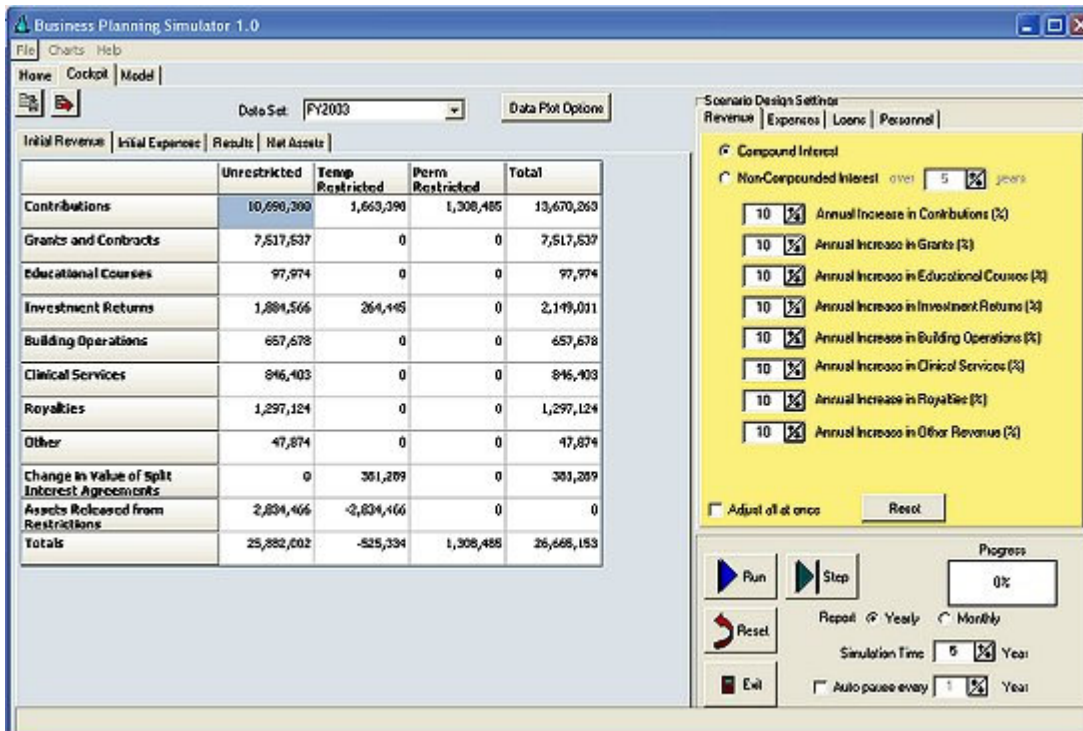


**Figure 3:** This figure shows the home page for the business simulator. The user can select different screens by clicking on the tab buttons at the top of the screen. The options include the Home page (current view), the Cockpit, and the Model page.



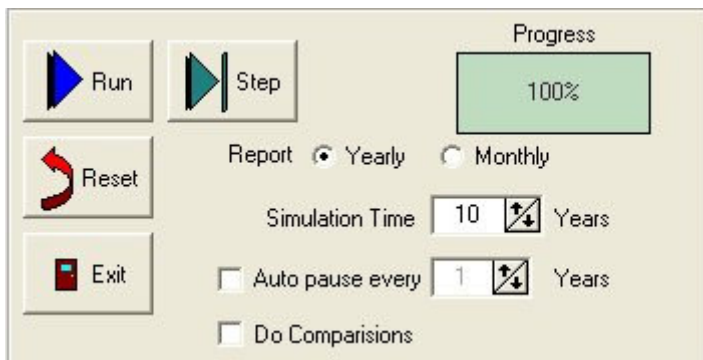
The flight simulator front end allows the user to experiment with different cap designs as well as environmental parameters and run the simulation to see the effects on cap performance over time.

The user can change a variety of parameters from changing the input data in the tables to adjusting the annual increases for any or all of the expense and income parameters (Figure 4). The user interface allows the user to change various options by adjusting slider bars, spin edits (The spin edit control allows your users to view and change integer and float values using a familiar up/down button combination), and drop down lists (The drop down control provides an intuitive interface for users to select values from pre-defined lists presented in a drop-down window). When the user is ready to run a simulation they click the run button in the simulation control screen (Figure 5).



**Figure 4:** This figure shows the layout of the cockpit. The user can select different data sets for the initial data, edit the data in the tables, adjust parameters and run the simulation from this screen.

The user can select several run options from the simulation control screen such as adjusting the time frame to run the simulation. The default time length is 5 years but the user could select a shorter or longer time frame if desired. The user can also select whether to view the results in yearly time steps or in monthly time steps. Also, the user can elect step through the simulation 1 time step at a time with the step button. And lastly, the user can elect to run the simulation for a set number of years and then pause the simulation to view results and even change parameters before continuing the simulation.



**Figure 5:** This figure shows the simulation controls. The controls use familiar stereo button to control the simulation.

Another powerful feature of the interface is the ability to add new datasets to the database. As the company continues to collect data on company performance the data can be added easily through the interface. In addition, several of the datasets can be combined to produce a normalized set of data. This would allow the user to run a scenario based on the average of several years worth of data rather than data from a single year.

The Graphic User Interface (GUI) is designed to run on a Windows<sup>®</sup> operating system. The program uses standard mouse/keyboard inputs and displays the results in charts and data tables. The emphasis is to design a program that stakeholder can take with

them and install and run on their own desktop system. As the old adage “Tell me and I will forget, show me and I may remember, involve me and I will understand” states, the model will allow involving stakeholders in designing and managing a cap system. By exploring the system, users will gain a deeper understanding of the complex relationships that interplay to affect how a cap will perform. A better understanding of the system should lead to better design and management decisions.

### **Simulation Results**

The real power of System Dynamic models lies in learning insights into total system behavior as time, key parameters, and different scenarios are considered. This is more valuable (and more credible) than attempting to make design and management decisions on the basis of single-parameter point estimates, or even on sensitivity analyses using models that assume that the structure of the system is remaining constant. Only System Dynamic models allow designers and stakeholders to explore long-term behavior and performance, especially in the context of dynamic processes and changing scenarios. When comparing different management/design scenarios did the system perform better or worse over the long term?

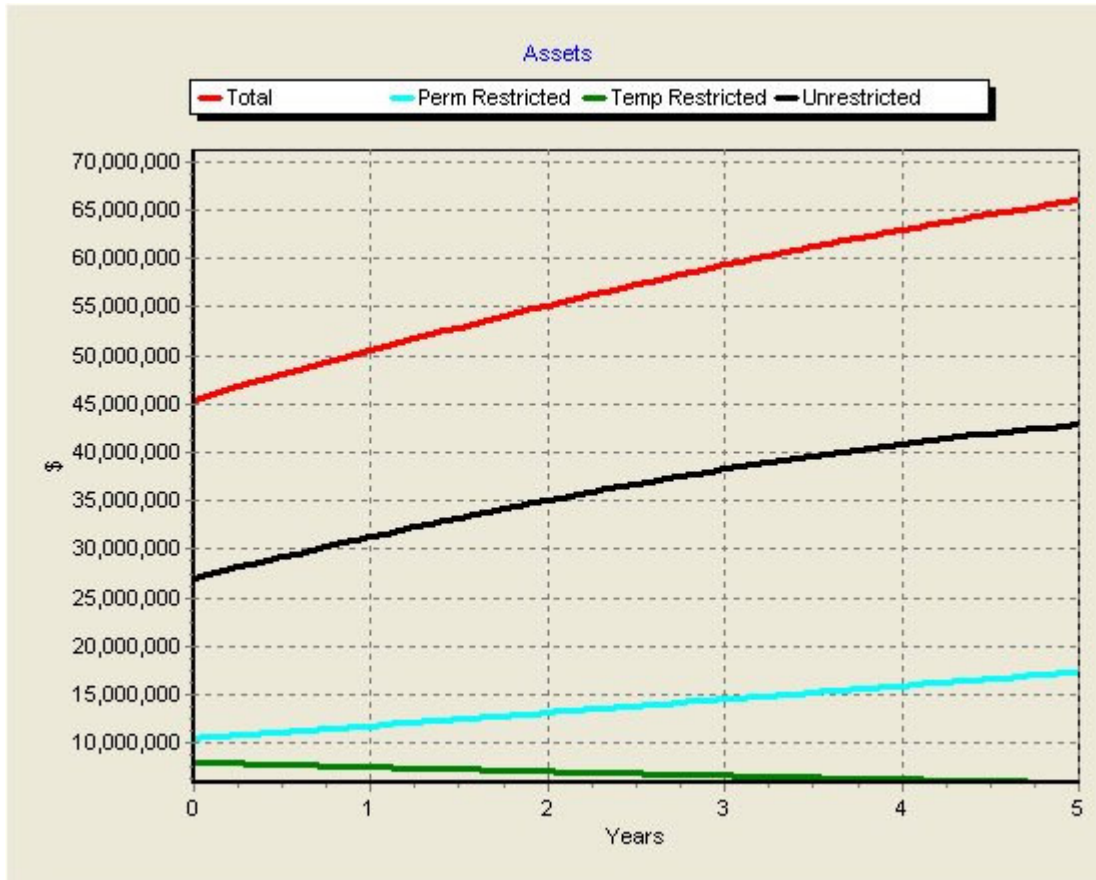
Indeed, the reason the user interface is described, as a “cockpit” is that such a model allows the designer/stakeholder to simulate management of the system over time. Instead of simulating an aircraft flight, we simulate a business system with as many of its dynamic characteristics as possible. After repeated simulations, a student pilot gains deeper understanding of how the aircraft systems will respond to various perturbations (none of which will exactly match a real flight) – without the expense and risk of gaining such experience solely in real flights. Similarly, the business simulator allows the

business manager to learn how the system may respond to time and various perturbations – without having to wait months or even years to obtain results. Furthermore, as business information is collected and becomes available, this can be used in the simulation model to provide a more accurate understanding of system behavior.

The interface includes a variety of options for charts and tables. The user can select which data to chart from a dropdown list. The results appear on the charts that can be viewed in a 3 dimensional or a typical flat 2 dimensional display (Figure 6). The user can then export the charts for incorporation into a document or report. The user also has the option to view the data in a table rather than a chart but simply clicking on the table button located on the interface screen (Figure 7).

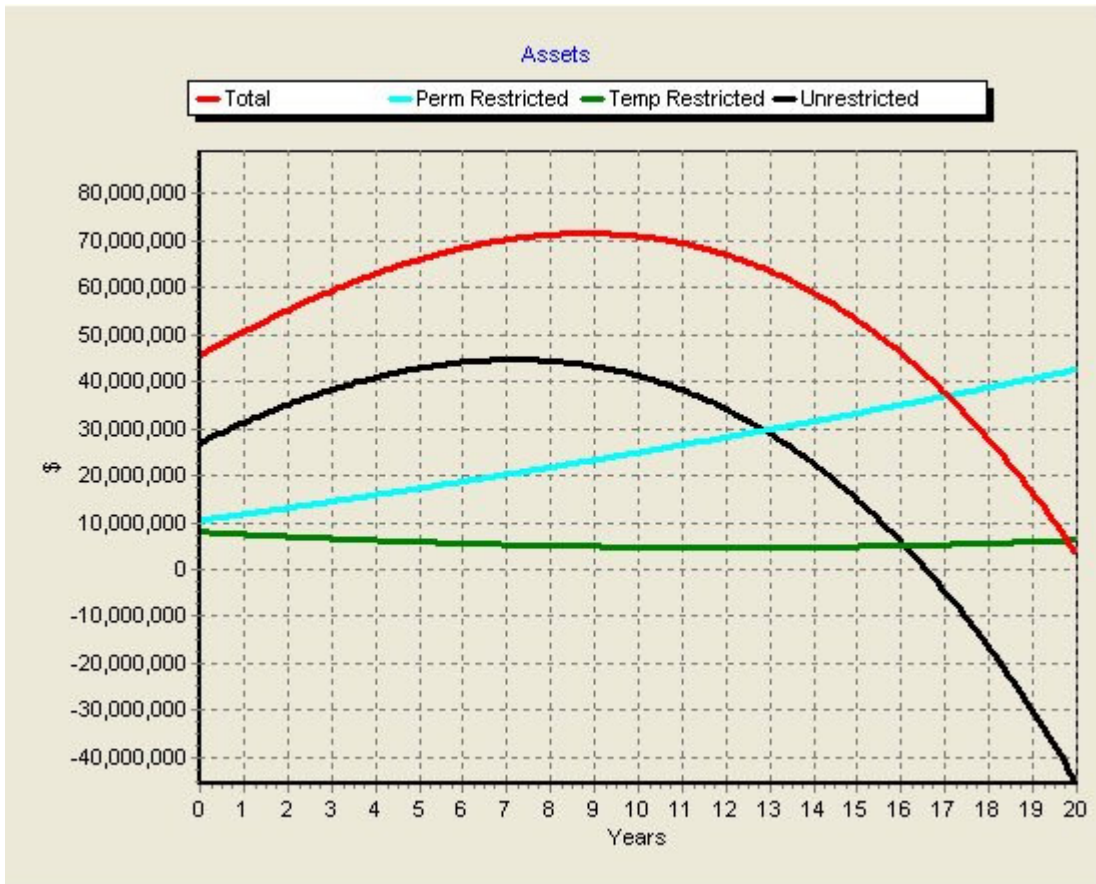
When you develop system dynamic models you are looking for the “Aha!” factor. Something that jumps out and provides insight that was not visible by simply looking at the data. This model did produce such a result for one set of parameter. All the revenue parameters were set at 2% growth rate. All revenue parameters were set at 5% growth rate. The simulation was run for 5 years. The results are shown in figure 6. The lines all show positive growth. This would be bonus time for the management team. However, lets extend the simulation for 20 years. The results are shown in figure 8. The long-term trend paints a significantly different picture. Permanently restricted assets continue to rise but all other revenue streams show a downward trend especially unrestricted income which is the financial stream for running the company. Permanent restricted assets continue to rise because the funds in this account cannot be accessed only the interest earned can be spent. The unrestricted income rises for a while but soon expenses

override income and the slide begins. So to get the big picture you have to look out past the near term and look at the long term pattern.



**Figure 6:** This figure shows an output chart for a simulation run. This simulation was run for 5 years. The user can select to view the results in a 2 dimensional view or click the 3 dimensional button to view the results in a 3 dimensional chart.





**Figure 8:** This chart shows the original simulation case but for 20 years instead of the 5 year base case.

## **Conclusion**

The business simulation model is still in development but is already proving to be helpful in examining business practices. Managers are able to quickly understand how to manipulate the model through the model interface and experiment with different management scenarios. The model structure is very simple but is proving to be very useful. The case above was a real simulation that was performed and the company is responding to the insight that it provided. The ability to quickly extend the analysis from 5 years to 20 years provided valuable information that would otherwise not have been identified.

## **References**

- Diehl, E. and J. Sterman, 1995. Effects of Feedback Complexity on Dynamic Decision Making, *Organizational Behavior and Human Decision Processes* 62(2), 198-215.
- Simon, H., 1957. *Administrative Behavior; a Study of Decision-Making Processes in Administrative Organizations*, 2nd ed. New York: Macmillan.