Spreadsheet Simulation
Development and Business Benefits

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Abstract/Introduction

Using simulations as a medium of learning and planning has been gaining widespread acceptance in several organizations. Companies investing in simulations have access to a variety of choices in terms of technology. Technologies such as Flash, .NET, JAVA although suitable for graphics rich (using FLASH) and data intensive simulations (using .NET and JAVA) are not the only choices. In contrast, spreadsheet software provides a better medium for customizable simulations. Software such as MS Excel® is globally used for number crunching and analysis due to its ease of use, hassle-free installation, and management. Based on Tata Interactive Systems’ (TIS) experience of developing simulations, we posit that most customizable standalone simulations developed in spreadsheet software offer the advantages of lower costs, reduced development timeline, flexibility in experimentation, and elegant Graphical User Interface (GUI).

Simulation Development

Development of a simulation involves a specialized team that has detailed systemic and mathematical knowledge and intuition of how systems can be simulated. This team classifies the complexity of the simulation under the following three broad areas:

1. Model:
   This comprises the core of a simulation. Simply put, it specifies the inputs required in the simulation—the decisions and the data; the outputs—reports in the form of charts, tables etc; and the mathematical linkages between the inputs and the outputs. Simulation boundary is also decided here—for example, is it a strategic, tactical, operational, or conceptual level model. In addition, the virtual time frame for decision making and reporting is also specified. The level of detail (abstraction) required in the model defines the complexity level of the model. In general, as the number of variables increases the complexity also increases, at most times, exponentially.

1 There are other detailed taxonomies for classifying simulation’s complexity. However, for the purposes of this paper, these are the three focus areas.
2. Usage Scenario:
This defines whether the simulation will be standalone or multiplayer. It also defines if it will compute outputs real time on submitting decisions or through an offline mechanism by transferring files. These usage scenarios can be combined together to create the desired features for a simulation.

3. Graphical Interface and Interactivity:
This specifies the simulation's visual appearance. It defines the color scheme, method to navigate, user screen layout, and usability aspects.

Spreadsheet software can, in most occasions, manage the requirements that drive a simulation's complexity. It can address varying levels of abstraction and compute thousands of variables. In cases where data storage requirements are significant, MS Excel® can function as a computational gateway while using a database (for example MS Access or SQL Express/Server) at the back end. However, an increasing number of variables and iterations also mean an increase in computation time, which may or may not be significant.

In terms of Usage Scenario, an MS Excel® based solution can easily handle standalone simulations that are independently used by a single user. In standalone simulations, decisions and results of decisions both reside on the users’ system. Alternatively, decisions can be taken in one location and results can be made available through an offline mechanism. Multiplayer scenarios can be enabled by using offline file sharing. In this case, results of several players are computed at one single location in automated batches by player decisions in separate files. In addition, security features to protect the model from third party viewing can be enabled through password protection or by separating decision and model files.
As for the Graphical Interface, MS Excel® can easily provide aesthetically appealing look and feel (see examples in the last section). Tabbed layouts, drop-down selections, link based pages, graphs, or checkboxes etc. are either natively available or can be created. However, animation capabilities in MS Excel® are limited and can be created only at a rudimentary level.

Business Benefit

These technical benefits cited above, eventually offer several business benefits in terms of project management and execution.

Team Synergies

Simulation development requires Subject Matter Experts (SME) to transfer domain knowledge to math-modelers who then translate the language of the expert into the language of variables. This combination keeps the team lean and agile. With the added advantage of familiarity with MS Excel® and modelling methodologies, communication is streamlined and output maximized. In contrast, using other technologies complicates the knowledge transfer process by adding a team of technical specialists including programmers, graphic designers, and software architects. Reduced communication layers along with the use of MS Excel® increases team synergy thereby allowing rapid implementation while avoiding the need to translate the requirement to another technology.

Experimentation Flexibility

MS Excel® is widely used by SMEs and analysts as a tool to quickly translate ideas into models. In fact, due to its pervasive use some parts of a model may be already available with SMEs and can be plugged in directly into a simulation with minor changes. Its flexibility generates avenues to validate untested ideas that can be rapidly adapted into the final solution with comparatively reduced rework and changes.
Spreadsheets Ease-of-Use

MS Excel® offers an optimal structure and easy-to-use formulas to jump start creation and implementation of mathematical logic required for simulation models. Content and formulas within MS Excel® can be easily edited by an authorized user, thereby removing the fundamental problem that we all face with software—analyzing the code to make changes!

Reduced Development Timeline

MS Excel® eliminates the need to create complex scratch up structures as needed in other technologies. Model structures and frameworks can be easily and rapidly built on top of the default features making it a logical choice for many experts who choose to create simulation models. These advantages over other technologies provide MS Excel® an edge that results in reduced development timeline.

Reduced Costs

The above benefits boil down to one fundamental point: reduced cost of development. Given the reduction in timeline, benefits of symmetric and streamlined communication, and use of experimented or readily available models in MS Excel® format, the cost of developing a simulation reduces. This makes it economical to invest in simulations for a variety of purposes. It provides additional leverage to think of other avenues for learning rather than reducing project scope and/or diluting business requirements.

Simulation Examples

TIS has significant experience in developing spreadsheet based simulations. To demonstrate the breadth of spreadsheet simulations, here are a few examples.
Portfolio Management Simulation

After experiencing risks during the sub-prime crisis, one of our client's wanted to ensure that customer focused approaches are used while managing a credit portfolio throughout the consumer credit life cycle—Acquisition, Maintenance, and Collection phases. Decisions related to acquiring customers from target markets, maintaining customer accounts by managing benefits, and collection strategies to improve portfolio performance were to be simulated.

To meet this need, an MS Excel® based simulation was created with a virtual time frame of 2 years that is split in 6-month decision making periods. It performs on an average 700 iterative calculations in each period. Each period takes on an average 5 to 20 minutes for generating portfolio data depending on the decisions. The results are displayed in 10 exhaustive reports. All this was implemented using MS Excel® as a decision making and computational tool with a database at the back end to store portfolio data. As for the timeline, this was implemented over a period of 2 months after finalizing the design over a month’s time.

Industrial Engineering and Planning

Another client in the logistics industry required its planners to develop dispatch plans to determine optimal cost scenarios for a particular delivery and pickup day. TIS created an MS Excel® based planning tool that enables this planning process. The result of this tool includes costs of the plan viewable in a series of customizable views and charts.

The simulation allows planners to import dispatch data from the forecasting model. It then allows the planner to perform detailed what-if analysis on this data. The planners can then create plans by modifying variables to understand impact on costs and compare different plans. An administration module allows the senior planner to create linkages between variables and set a scenario (e.g. setting up thresholds for costs in order to teach planners the concept of optimizing time parameters).
Post Merger Integration (PMI)

Last but not the least, TIS has developed an in-house simulation for executives to understand merger and acquisition (M&A) activity dynamics. The Post Merger & Integration (PMI) simulation helps executives form a mental model (decision making framework) of M&A dynamics. Specifically, executives learn about transferring capabilities between the merged entities by managing:

- Cultural differences between the merged entities
- Employee perceptions of the merger
- Interfacing mechanism between the merged entities

The simulation runs for a virtual time period of 2 years with three phases from the first thirty days up until two years after the merger. Over these different phases, users make critical decisions in the various areas, such as integration team, integration of business processes, alignment of compensation structure, alignment of reporting hierarchies, layoffs, and communication strategy. The simulation also provides performance tracking using the balance score card and includes a “Know How” feature that explains the linkage between decisions and key performance indicators captured in the Scorecard.

Summary and Conclusion

So, does TIS believe that spreadsheet simulations can be used as an effective format for training purposes? We believe ‘Yes’, it can in certain areas of application that lend themselves very well. We believe that spreadsheet simulations can address functional requirements for creating various types of simulation and planning tools. These simulations make no compromises either on look and feel or the mathematics of the model and are simultaneously cost effective. We recommend that organizations should consider using spreadsheet based software to meet their training and planning requirements to some extent.