Proceedings of the 2002 Winter Simulation Conference
E. Yücesan, C.-H. Chen, J. L. Snowdon, and J. M. Charnes, eds.

FLEXSIM SIMULATION ENVIRONMENT

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ABSTRACT

Flexsim is an object-oriented software environment used to develop, model, simulate, visualize, and monitor dynamic-flow process activities and systems. Flexsim is a complete suite of development tools to develop and compile simulation applications. There are 3 levels of use within the Flexsim environment: 1) The Flexsim Compiler, 2) The Flexsim Developer, and 3) Flexsim Application products. The Flexsim environment is completely integrated with the C++ compiler and uses flexscript (a C++ library that is pre-compiled) or C++ directly. All animation is OpenGL and boasts incredible virtual reality animation. Animation can be shown in tree view, 2D, 3D, and virtual reality. All views can be shown concurrently during the model development or run phase. Flexsim has been used to model manufacturing, warehousing, material handling processes, semiconductor manufacturing, marine container terminal processes, and shared access storage network (SANS) simulation. This paper briefly describes the uses and benefits of the Flexsim Simulation Environment.

1 FLEXSIM – MODELING, SIMULATING, VISUALIZING, AND MONITORING DYNAMIC FLOW SYSTEMS

Information and knowledge are the thermonuclear competitive weapons of our time. Knowledge is more valuable and more powerful than natural resources, big factories, or fat bankrolls. Success will come to organizations that have the best information or wield it most effectively (Stewart 1997).

As a result, companies are spending more time and resources to generate and capture information and knowledge about their dynamic-flow systems. By "dynamic-flow" we mean the discrete flow of products, people, data, paper, or information through a system. Examples of such a flow include automobile bumpers flowing through a paint line, orders being picked at a distribution center, electronic data flowing through an information network, or the flow of people through an amusement park ride.

The two major challenges to gaining knowledge about dynamic-flow systems are complexity and uncertainty. With an increasing number of components in a system, it becomes more and more difficult to understand the system or to describe the relationship of the components in the system mathematically. Moreover, when uncertainty is introduced to the same system (machines breaking down, varying cycle times, changes in batch sizes, or the sickness of a key employee) most analytical methods fail.

For dynamic-flow systems characterized by complexity and uncertainty, Flexsim can be a powerful tool to gaining insight and knowledge about the system. When – and only when – the relationship of a system's components are understood can the system be improved.

Using Flexsim to gain insight and knowledge about complex and uncertain systems usually starts with building a model.

2 FLEXSIM SIMULATION ENVIRONMENT-COMPILER

Flexsim does not compare to most of today's simulators on the market because it is a completely new approach to simulation modeling and boasts of a completely new simulation engine that has been completely redesigned and programmed over the last year. At the heart of Flexsim is a powerful simulation application compiler that allows users to completely develop new simulation applications to include unique graphic user interfaces, object libraries, and menu structures for any niche market. Simulation development projects are then compiled into simulation applications that are sold and distributed by the developer as a new and unique application much like current simulation software is sold in today's market. Thus, Flexsim is not a simulation software package in the traditional sense, it is a comprehensive development environment, complete with powerful development tools to create simulation software applications that are true object oriented (with inheritance for classes and class instances). Every application has fully integrated 2D and 3D virtual reality animation. All 3D animation graphics are displayed in real time using Flexsim advanced virtual reality graphics engine that is included in every simulation application that is compiled (The Flexsim graphics engine has been developed to optimize simulation animation and has video game realism and graphic quality). All graphics used in any Flexsim product are industry standard objects such as 3D .DXF, .WRL, and .STL images. Flexsim uses the C++ compiler and FlexScript (a C++ function library) for development. Therefore, all C++ libraries and functions can be utilized for application development. As a result of this unique approach, Flexsim simulation applications are extremely flexible and contain a user-friendly environment for model development. Third party applications such as Expert Fit, OptQuest, and VISIO can be compiled into the application to add flexibility and ease-of-use for modelers building simulation models. Flexsim will link to any ODBC database (such as Oracle or Access), data structure (text, Excel, or Word files), and virtually any hardware device that can be connected to a computer.

3 FLEXSIM SIMULATION ENVIRONMENT-DEVELOPER

The Flexsim Developer is used to develop simulation applications and to customize the general purpose Flexsim simulation application. The Flexsim Developer contains tools and interfaces that allow developers to quickly build simulation objects (queues, workstations, conveyors, transporters, etc.) to be used in Flexsim applications. Custom GUI interfaces can be designed and built with GUI building tools. Once developed, a user can compile all objects, interfaces, industry specific development, and simulation engine into a complete product using the Flexsim Compiler or add the development to an existing application. The Developer allows users to create new functionality for an application as well as build models. The developer combines the ease-of-use of a simulation application with the power and flexibility of a complete simulation development tool all using the Visual C++ compiler and code format.

4 FLEXIM SIMULATION ENVIRONMENT-APPLICATIONS

Flexsim simulation applications are used to build discrete event simulation models using the Flexsim simulation engine, objects, and interfaces. All Flexsim applications are stand alone products and may have a variety of names. Current Flexsim application include **Flexsim GP** for general purpose simulation, **Flexsim Fabmodeler** for semiconductor manufacturing, **Flexsim Port** for marine container terminal simulation, and **Flexsim SANS** for simulation of shared access network storage systems. Each application has been specifically designed to each market to make the model building process quick, efficient, and effective. As stated earlier, all applications come with tree view, 2D, 3D, and virtual reality animation.

5 FLEXSIM MODEL DEVELOPMENT

There are five basic steps to building a model in Flexsim. 1) Develop a layout, 2) Connect objects, 3) Detail the objects, 4) Run the model, and 5) Review the output.

5.1 Develop the Layout

Model layout is accomplished by selecting objects from the library by click-and-drag and placing them in the layout window. The model layout window is a 3D spatial view. Once the object is placed in the layout the user can rotate the object in the x, y, z axis and change the elevation in the z axis using the mouse for proper orientation. This process is repeated until the modeler has completed the layout.

5.2 Connect Objects

Flexsim will automatically connect objects in the order that they were placed in the model layout. Each object will have one input port, one output port, and one central port. If an object needs to send to more than one object Flexsim will automatically add ports when the user clicks and drags a line from one object to another. An object can have an unlimited number of input, output and central ports. Central ports are used as reference nodes for other objects. Objects are connected to visualize all possible routing options for the model.

5.3 Detail the Objects

Once the layout has been created and the connections made the modeler will add logic and data to the objects. This is accomplished by double clicking on an object in the layout window. Information such as cycle times, capacities, speeds, routing logic, downtimes, statistics, and graphic options can be entered in the object GUI. The use of flexscript or C++ can be entered directly for user defined or complex logic inputs. All object input fields will have picklist options as well as user defined inputs. Since objects can be created with robust defaults and intelligence, model detailing has been greatly simplified and yet maintains extreme flexibility.

5.4 Run the Model

Once a model is created and logic is assigned to the objects, the modeler can begin to simulate the model by running conditional scenarios in condensed time. Flexsim will capture and compare the data generated from each run. In addition to single runs, the modeler can define multiple runs and, if wanted, multiple scenarios. Flexsim includes both an experiment, and an OptQuest Optimizer, which allow users to define the conditions, variables and constraints to be tested, the number of times each condition is to be run, the length of each run, and the performance measure(s) against which the results of each scenario can be compared or optimized.

5.5 View the Output

Results from each simulation run can be viewed dynamically in 2D, 3D, and VR animation while the model is running. Flexsim's animation includes a mouse navigator that allows the modeler to view multiple windows of the same model simultaneously, to pan through each model, to zoom in and out of the model, and to rotate the view angle of each model while in 3D. In addition, a special mode allows users to "flythrough" their models using the mouse. All of these model view manipulations can be done without influencing the run-speed of the model.

In addition to the model's animation, results of each of the model's runs can be viewed through accessing predefined reports, user-defined reports, predefined graphs, and user defined graphs. Results may also be exported to external software programs through DDE, DLL, ODBC, SQL, or Windows Sockets connections.

Historically, the lifecycle of a simulation model was as follows: a model was created of a real-life system, simulation scenarios were run, an analysis of the results was conducted, and, depending on the results, changes were made to the real-life system. At this point the modeler moved on to the next simulation project and the lifecycle of a new model was begun again. All a modeler could bring forward from one model to the next was the knowledge gained on how to build models.

As previously described, the hallmark characteristics of Flexsim are that objects can be created, they can be reused, and they can be shared. This characteristic is one of the ways in which Flexsim extends the lifecycle and increases usefulness of simulation projects and models. Another important Flexsim feature that extends the lifecycle and increases usefulness of simulation projects and models is Flexsim's ability to monitor real-time flow systems.

Flexsim monitors real-time systems by linking to external programs to read and write information through DDE, DLL, ODBC, SQL, or Windows Sockets connections. For most simulation and analysis purposes, data transferred to and from Flexsim is run in condensed time, meaning the model is running years worth of time and data in only seconds or minutes of actual time. HoweverFlexsim can also synchronize the run with real-time. With the ability to connect to external systems, such as real-time databases, ERP systems, and warehouse management systems, real-time information can be fed to a Flexsim model and used to monitor (or even control) the system in real-time.

6 SUMMARY

Flexsim simulation environment is an object-oriented software system used to model, simulate, visualize, and monitor dynamic-flow process activities. The Flexsim simulation environment consists of the Flexsim compiler, the Flexsim developer, and Flexsim applications.

This concept makes model building and analysis easier and more powerful. The Flexsim concept also increases the value and lifecycle of models because Objects are reusable and the models can be used on an operational basis for either defining or for monitoring real systems. Users can use C++ or flexscript and the internal languge for development or model building. This eliminates the need for users to learn a specialized simulation language that is not used in other applications.

Organizations who (1) Develop simulation products, (2) build models, (3) simulate models, (4) visualize the relationships of the model's components, and (5) monitor real-time processes will generate greater insight and knowledge about their complex and uncertain systems – and success will come to organizations that have the best information and wield it most effectively.

REFERENCE

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AUTHOR BIOGRAPHY

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