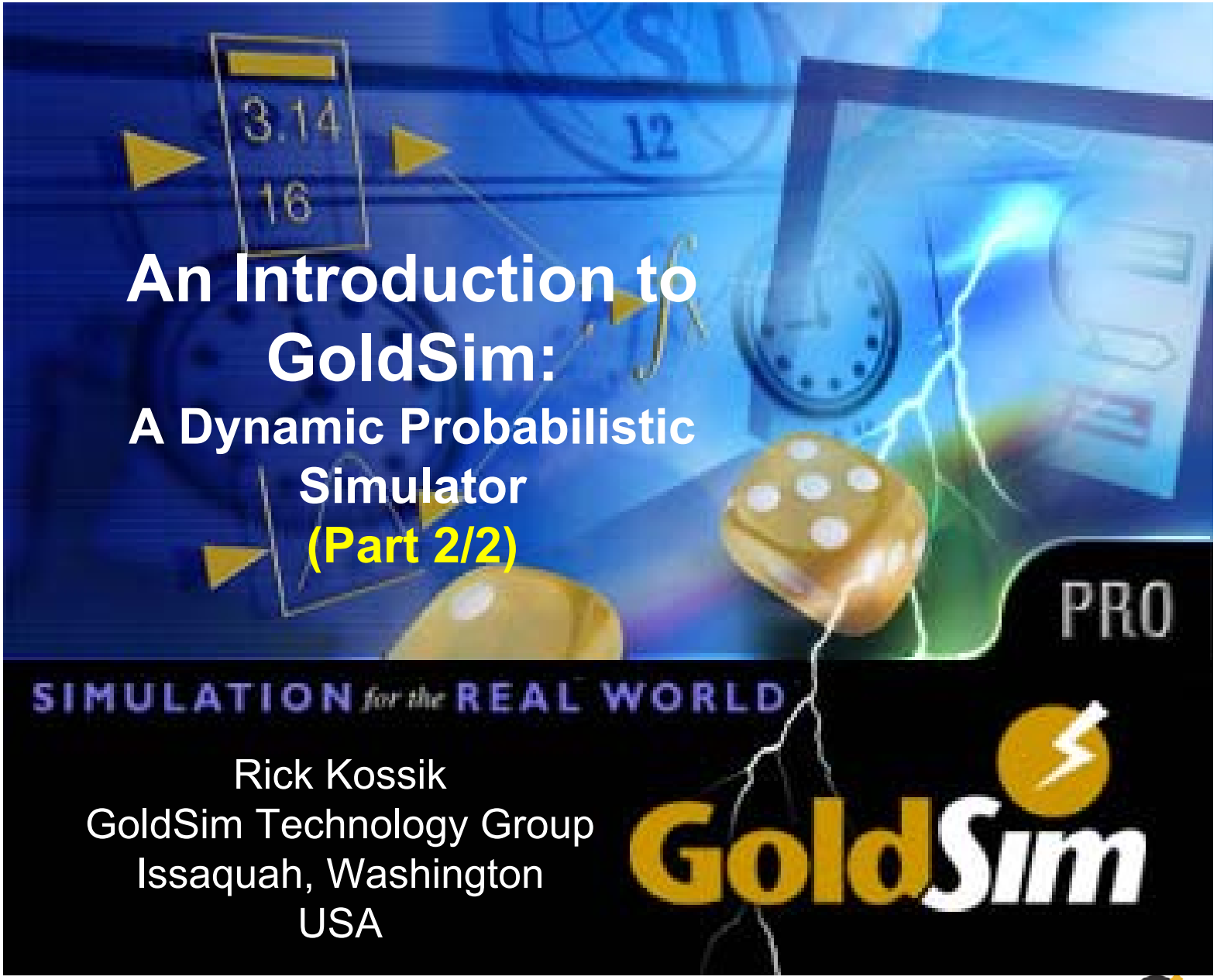
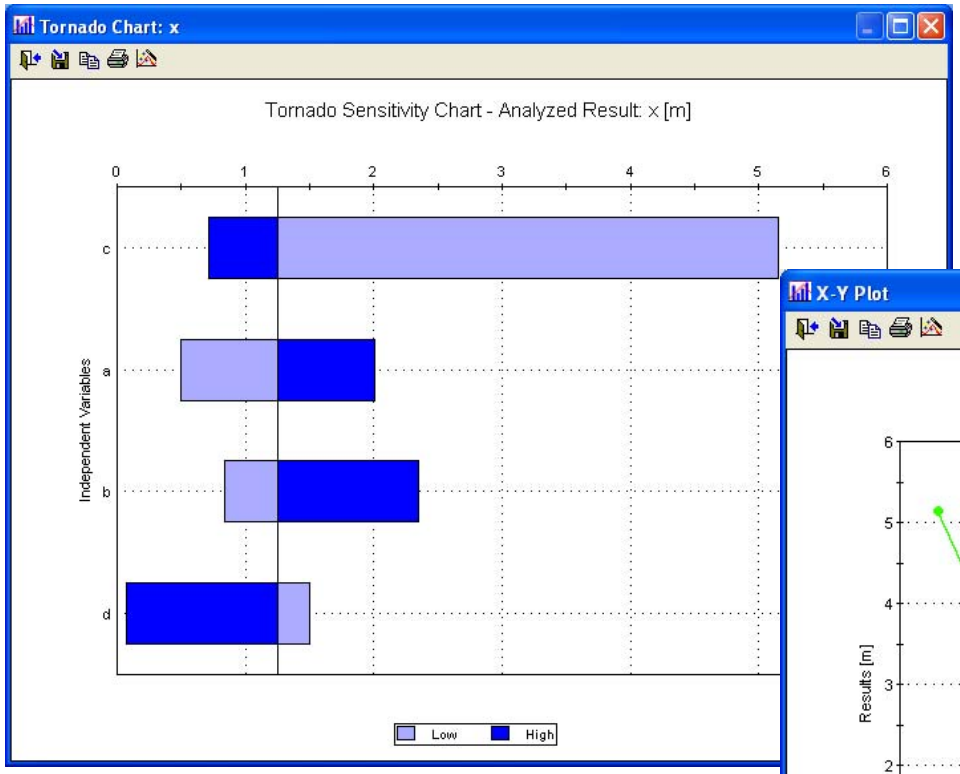
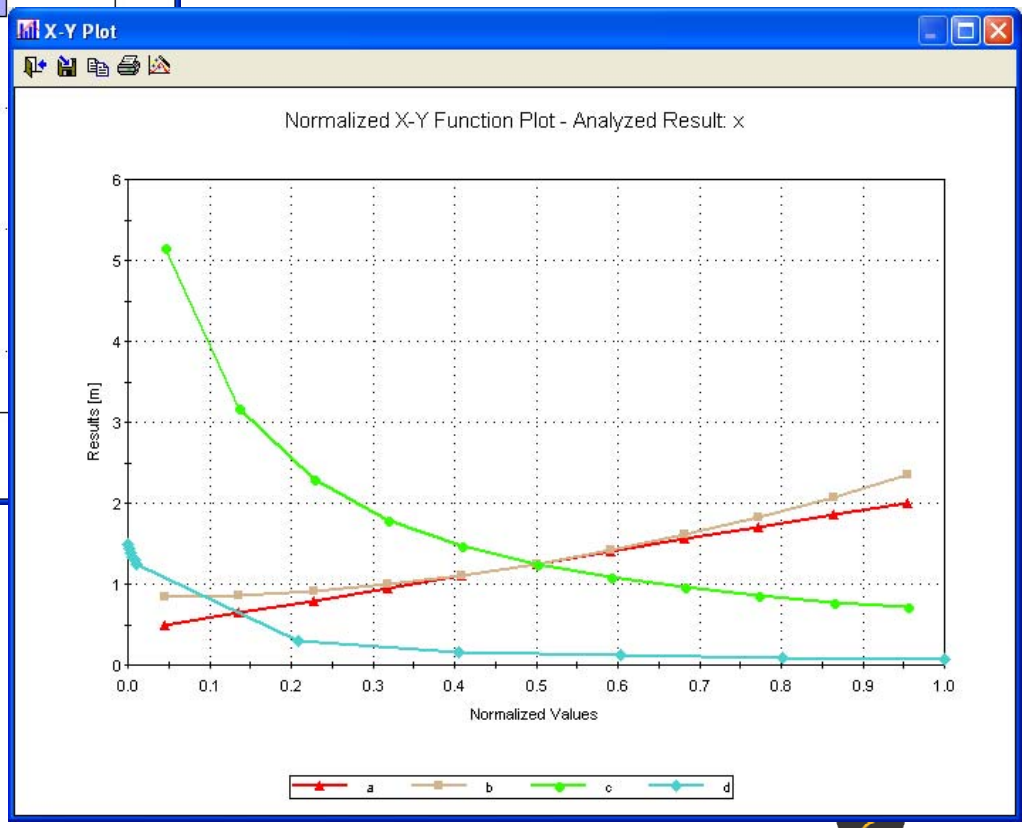


An Introduction to GoldSim:
A Dynamic Probabilistic Simulator
(Part 2/2)

Rick Kossik
GoldSim Technology Group
Issaquah, Washington
USA

Graphical Sensitivity Analysis





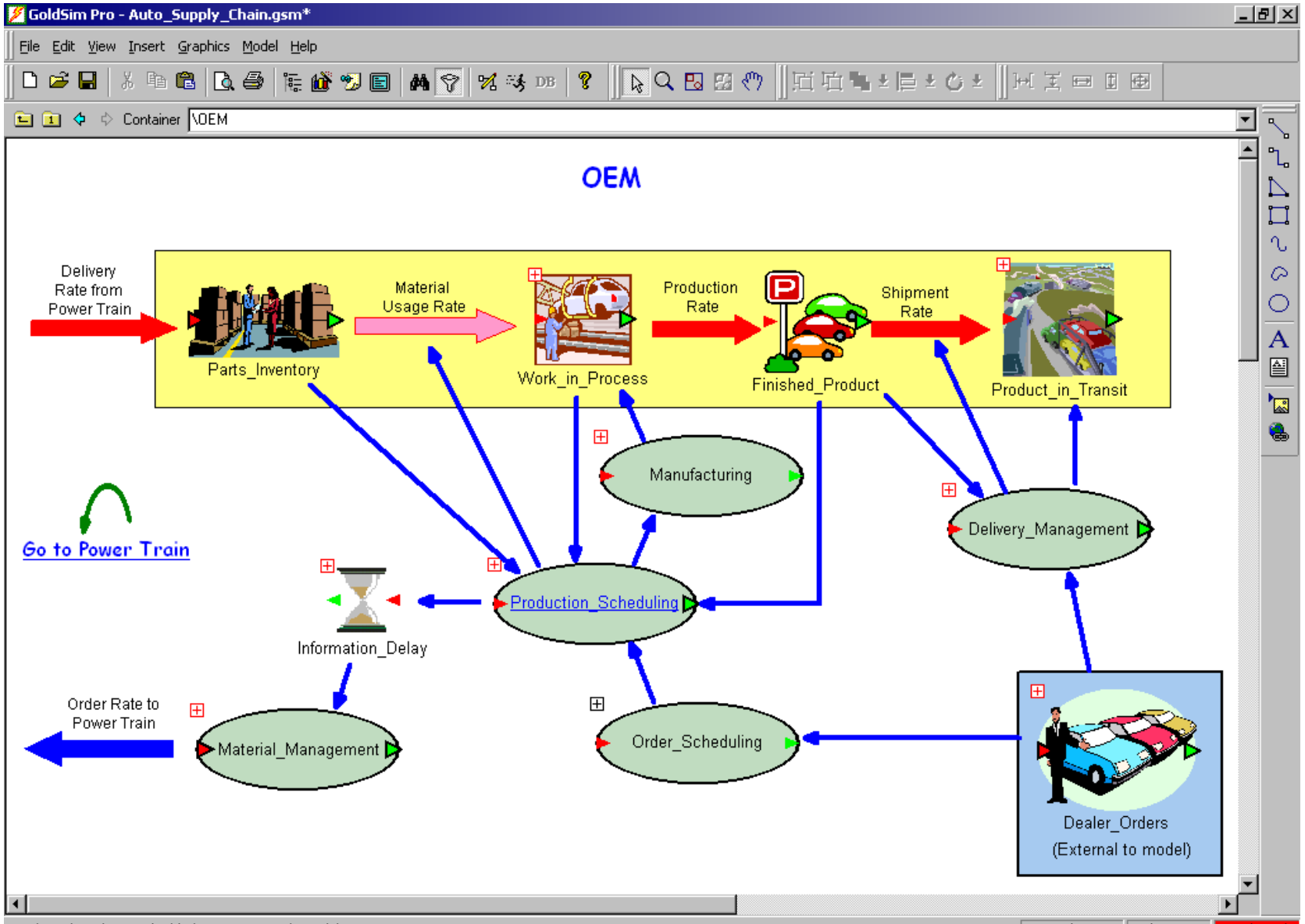
Optimizing Your Model

- **GoldSim provides the ability to carry out a special type of run to facilitate optimization of your model. You specify:**
  - an objective function (a specific result that you would like to minimize or maximize),
  - an optional constraint (a condition that must be met), and
  - one or more optimization variables (variables in your model that you have control over).
- **GoldSim then runs the model multiple times, systematically selecting combinations of values for each of the optimization variables.**
- **Applications:**
  - Optimizing a design or plan
  - Calibrating to historic data

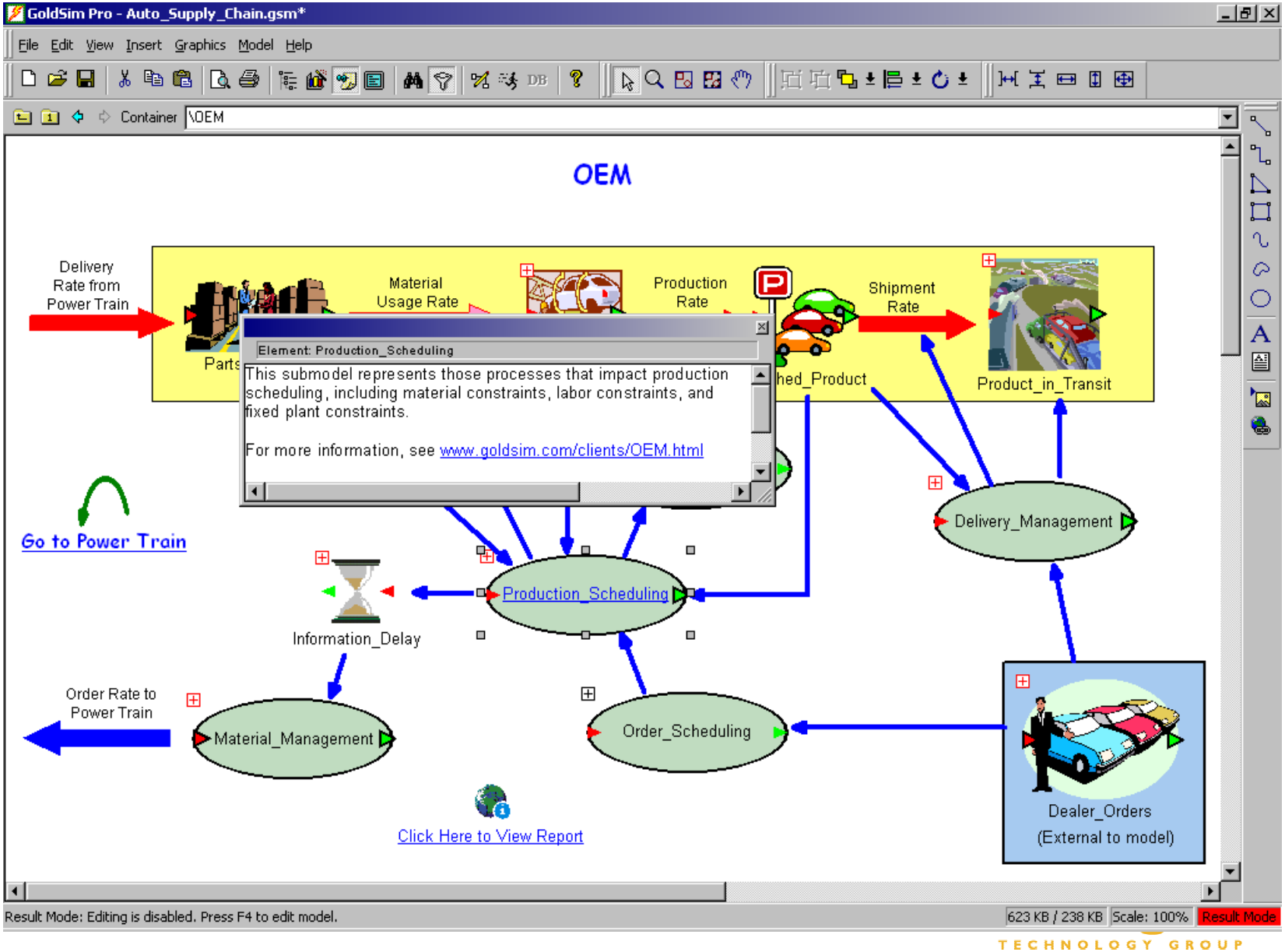
Presentation and Documentation Features

- GoldSim allows you to incorporate graphics, text, images and hyperlinks into a model.
- By using these tools, you can create a visual information management system in which the model, the model documentation, and the presentation of the model results are one and the same.
- These capabilities, coupled with GoldSim's ability to create hierarchical "top-down" models, allow you to describe your model at different levels of detail to different audiences

Adding Images, Graphics and Text

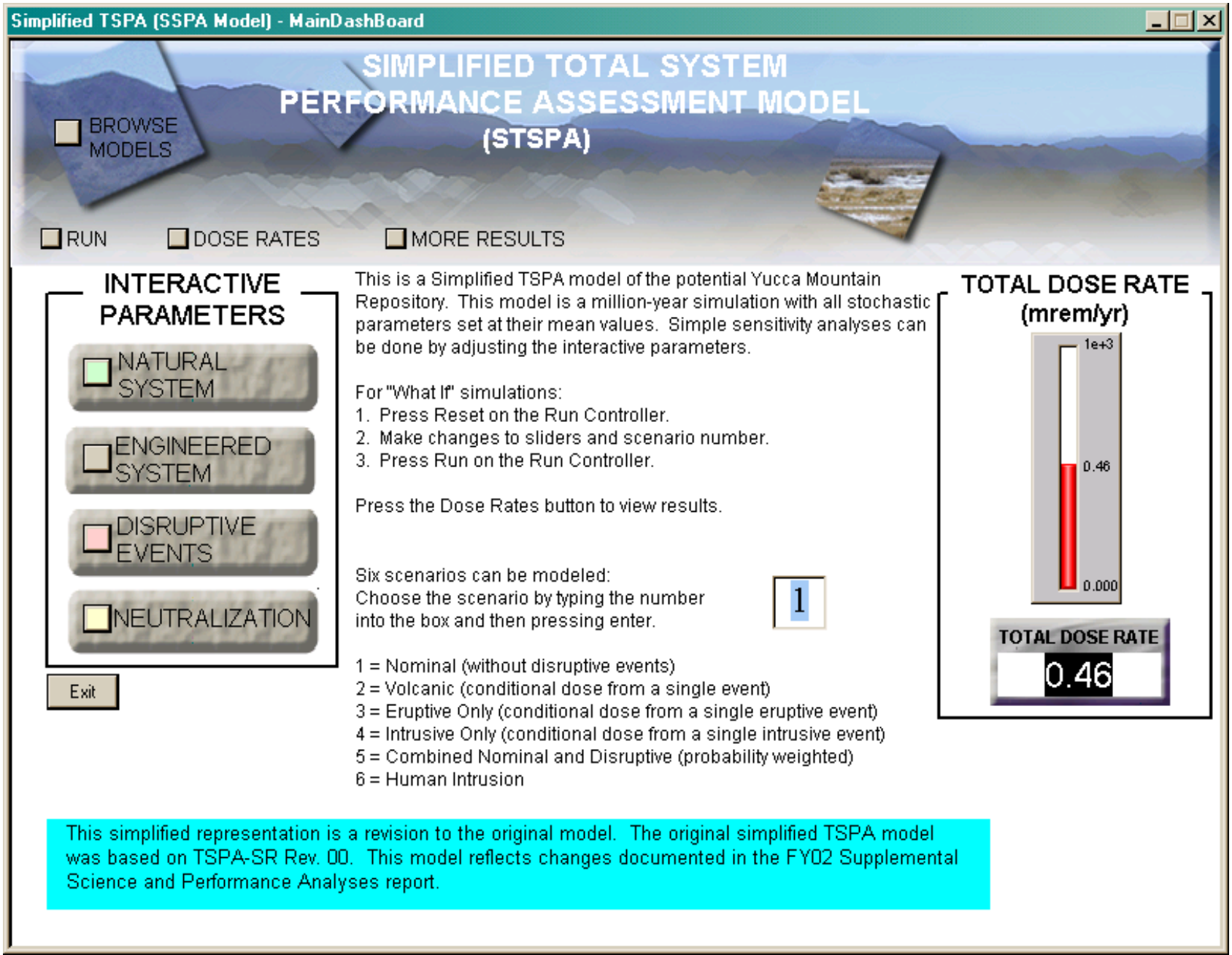


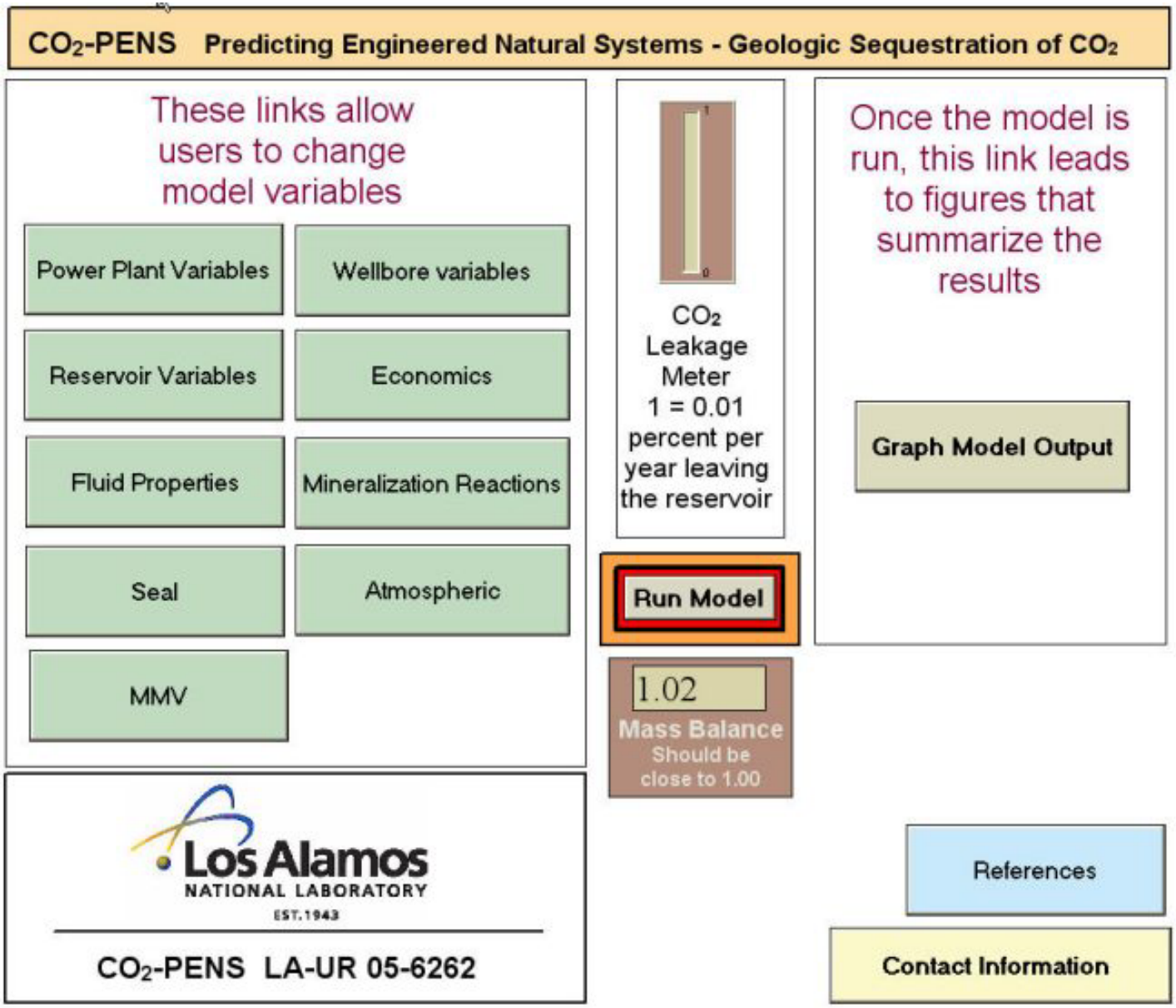
Adding Notes and Hyperlinks to Documents and Web Sites

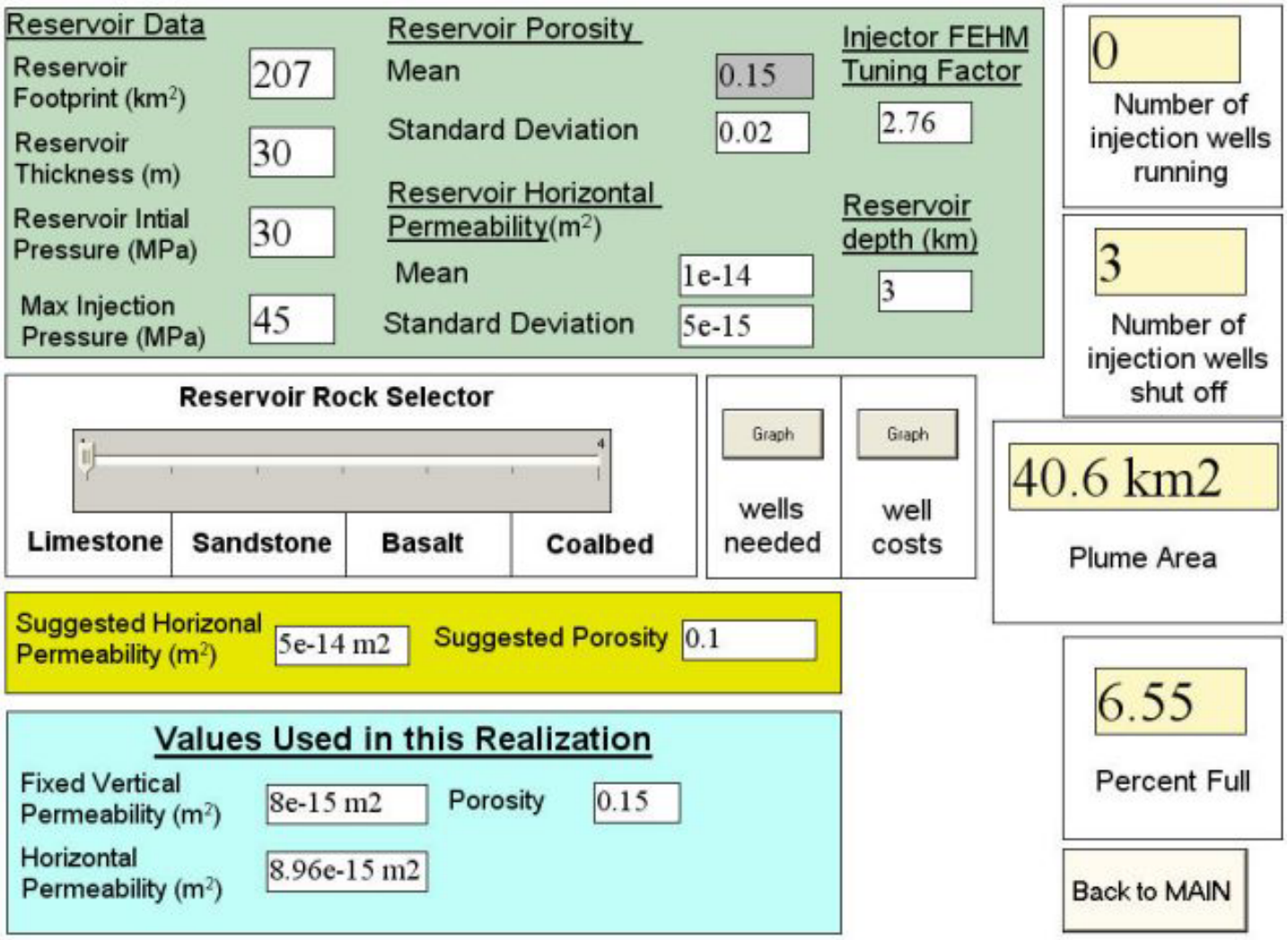


Building Dashboards and Viewing Models in the GoldSim Player

- **You can design and construct a "dashboard" interface for models.**
- **A “dashboarded” model can be viewed and run using the free GoldSim Player.**


Simplified TSPA (SSPA Model) - MainDashBoard
SIMPLIFIED TOTAL SYSTEM PERFORMANCE ASSESSMENT MODEL (STSPA)
BROWSE MODELS
RUN
DOSE RATES
MORE RESULTS
INTERACTIVE PARAMETERS
NATURAL SYSTEM
ENGINEERED SYSTEM
DISRUPTIVE EVENTS
NEUTRALIZATION
Exit
This is a Simplified TSPA model of the potential Yucca Mountain Repository. This model is a million-year simulation with all stochastic parameters set at their mean values. Simple sensitivity analyses can be done by adjusting the interactive parameters.
For "What If" simulations:
1. Press Reset on the Run Controller.
2. Make changes to sliders and scenario number.
3. Press Run on the Run Controller.
Press the Dose Rates button to view results.
Six scenarios can be modeled:
Choose the scenario by typing the number into the box and then pressing enter.
1
1 = Nominal (without disruptive events)
2 = Volcanic (conditional dose from a single event)
3 = Eruptive Only (conditional dose from a single eruptive event)
4 = Intrusive Only (conditional dose from a single intrusive event)
5 = Combined Nominal and Disruptive (probability weighted)
6 = Human Intrusion
TOTAL DOSE RATE (mrem/yr)
1e+3
0.46
0.000
TOTAL DOSE RATE
0.46
This simplified representation is a revision to the original model. The original simplified TSPA model was based on TSPA-SR Rev. 00. This model reflects changes documented in the FY02 Supplemental Science and Performance Analyses report.


CO2-PENS Predicting Engineered Natural Systems - Geologic Sequestration of CO2
These links allow users to change model variables
Power Plant Variables
Wellbore variables
Reservoir Variables
Economics
Fluid Properties
Mineralization Reactions
Seal
Atmospheric
MMV
CO2 Leakage Meter 1 = 0.01 percent per year leaving the reservoir
Run Model
1.02
Mass Balance
Should be close to 1.00
Once the model is run, this link leads to figures that summarize the results
Graph Model Output
Los Alamos
NATIONAL LABORATORY
EST.1943
CO2-PENS LA-UR 05-6262
References
Contact Information


Reservoir Data
Reservoir Footprint (km²)
207
Reservoir Thickness (m)
30
Reservoir Intial Pressure (MPa)
30
Max Injection Pressure (MPa)
45
Reservoir Porosity
Mean
0.15
Standard Deviation
0.02
Reservoir Horizontal Permeability(m²)
Mean
1e-14
Standard Deviation
5e-15
Injector FEHM Tuning Factor
2.76
Reservoir depth (km)
3
0
Number of injection wells running
3
Number of injection wells shut off
Reservoir Rock Selector
Limestone
Sandstone
Basalt
Coalbed
Graph
wells needed
Graph
well costs
40.6 km2
Plume Area
Suggested Horizonal Permeability (m²)
5e-14 m2
Suggested Porosity
0.1
6.55
Percent Full
Values Used in this Realization
Fixed Vertical Permeability (m²)
8e-15 m2
Porosity
0.15
Horizontal Permeability (m²)
8.96e-15 m2
Back to MAIN

Outline

- What is GoldSim and where did it come from?
- A summary of the major differences between GoldSim and traditional SD codes
- Basic GoldSim Features
- Overview of Advanced GoldSim Features
- **Overview of GoldSim Extension Modules**
- Can GoldSim complement traditional SD codes?
- Questions and Discussion

Specialized GoldSim Modules

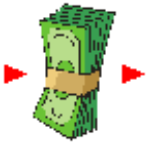
- **GoldSim was specifically designed to facilitate the incorporation of additional modules (program extensions).**
- **These either add additional capabilities:**
  - Distributed Processing Module
- **Or they add new components to address a specific type of simulation application:**
  - Financial Module
  - Reliability Module
  - Contaminant Transport Module

Distributed Processing Module

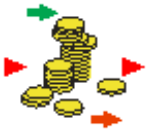
- **Monte Carlo simulation is the perfect parallel processing application**
- **One machine acts as the Master**
- **Other machines on the network can act as Slaves**
  - They must be launched in “slave mode” from a command line
- **The Master sends realizations to each of the Slaves, then assembles them at the end of the realization**

Financial Module

- **A module for simulating financial systems. Provides 5 elements:**



– Fund: Simulates accounts with interest, deposits and withdrawals.



– Cash Flow: Computes the NPV and IRR of a series of cash flows. Used to model the future return of projects and business ventures

– Investment: Simulates investments with purchases and sales

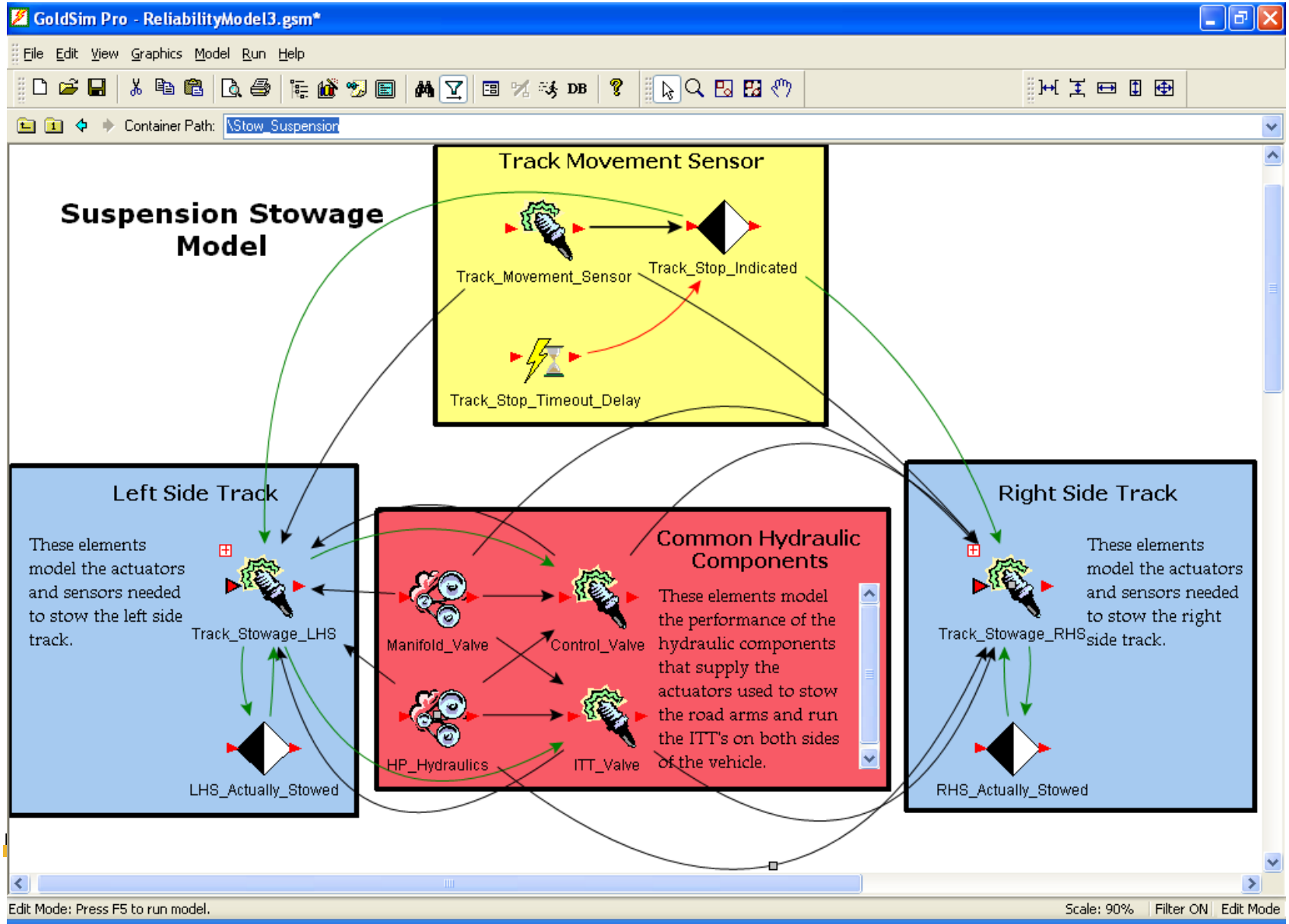
– Option: Simulates different types of financial options

– Insurance: Simulates claims against an insurance policy

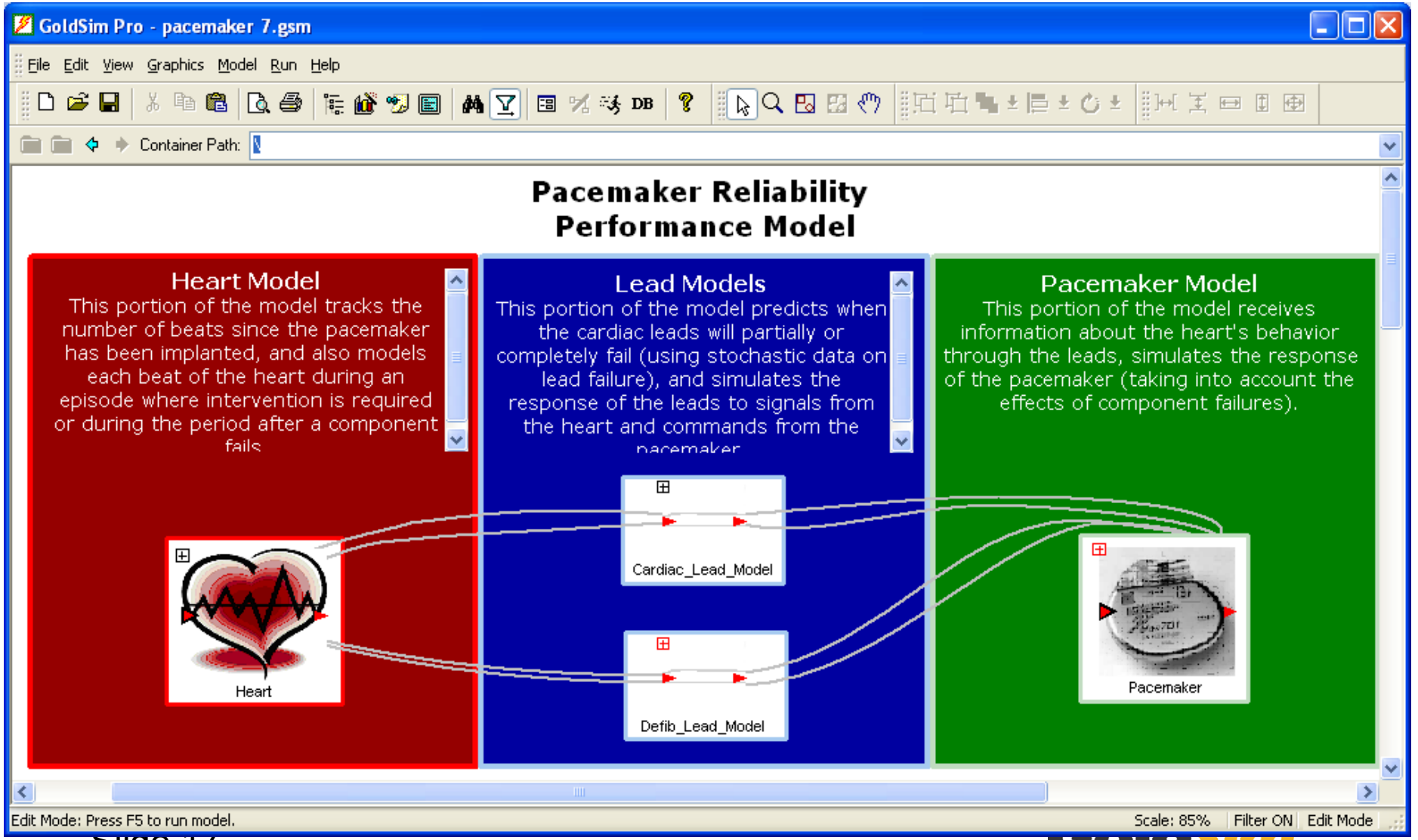
Reliability Module

- **Facilitates reliability modeling and risk analysis for complex engineered systems**
- **Specialized elements allow you to define failure and repair rates and functional dependencies**
- **Outputs:**
  - Reliability and availability of systems and components
  - MTTF, MTTR, analysis of failure causes, etc.
  - Overall system throughput
  - Costs and other metrics can be modeled

Reliability Analysis for a Machine

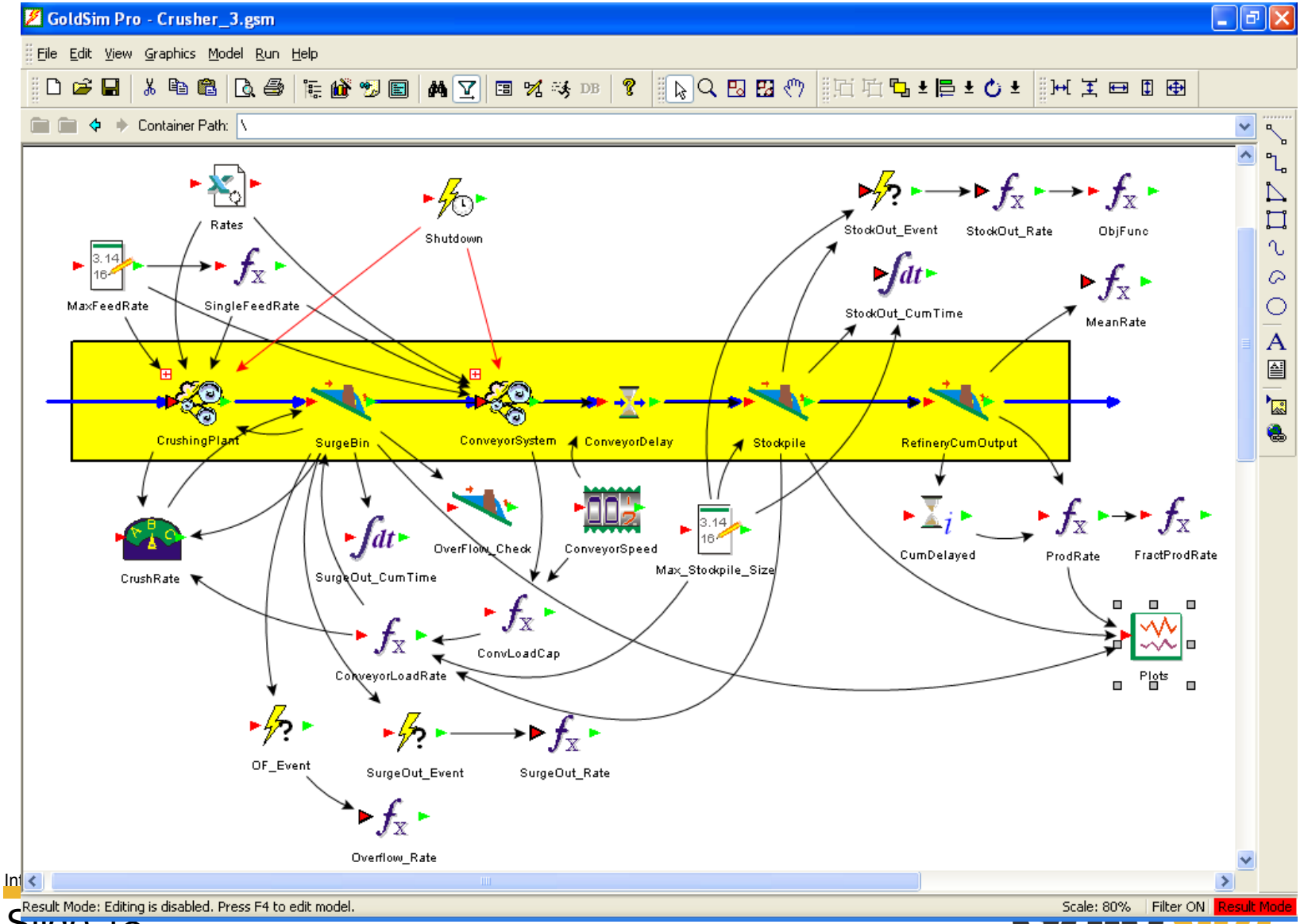


Simulation of a Pacemaker



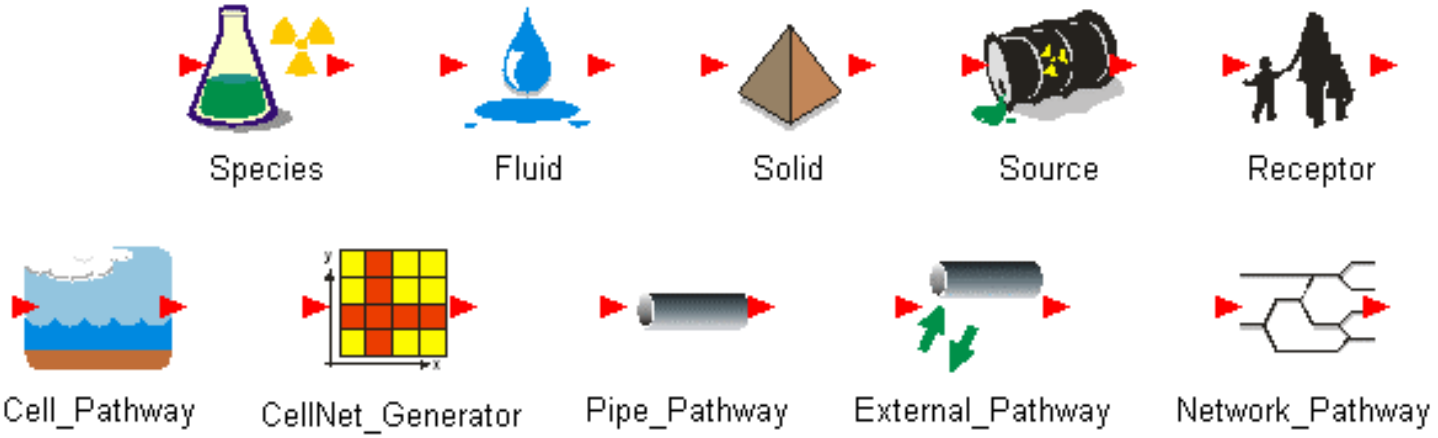
GoldSim TECHNOLOGY GROUP

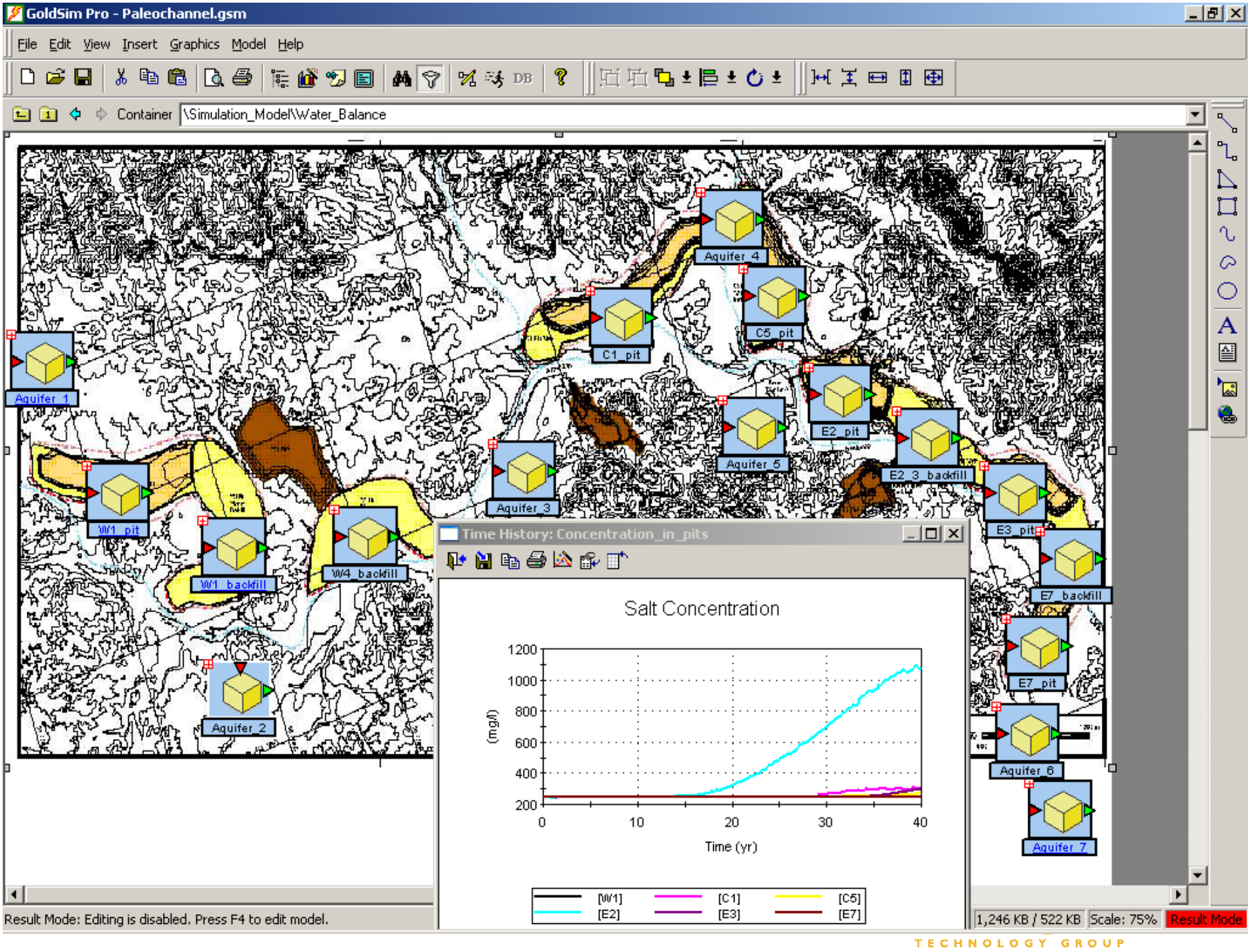
Throughput Analysis For an Industrial Process



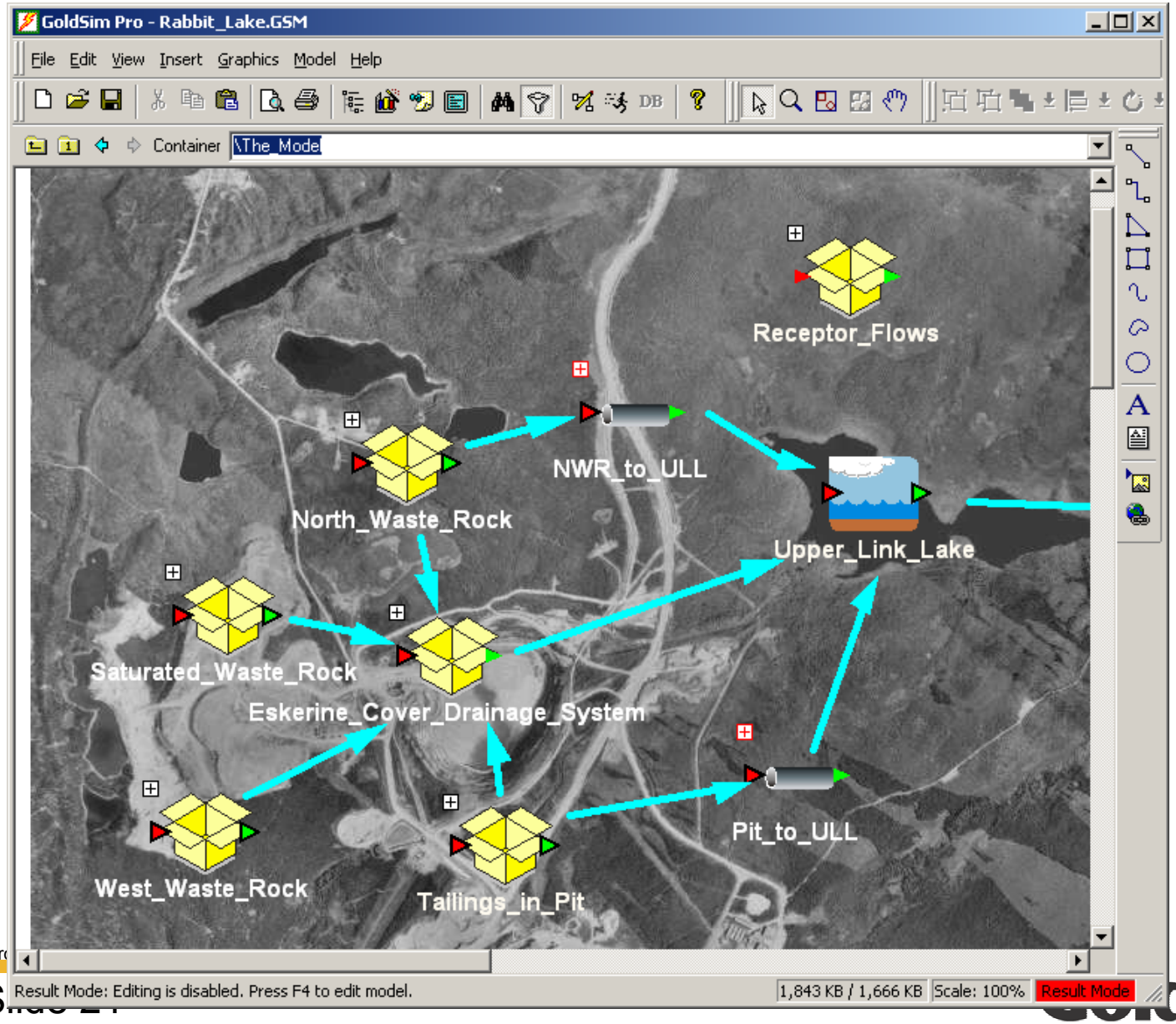
The Contaminant Transport Module

- **Adds specialized elements to facilitate simulation of contaminant transport through engineered and natural environmental systems**
  - Species and Media
  - Pathways
  - Sources
  - Receptors




GoldSim Pro - Paleochannel.gsm
File Edit View Insert Graphics Model Help
Container \Simulation_Model\Water_Balance
Aquifer_1
Aquifer_2
Aquifer_3
Aquifer_4
Aquifer_5
Aquifer_6
Aquifer_7
W1_pit
W1_backfill
W4_backfill
C1_pit
C5_pit
E2_pit
E2_3_backfill
E3_pit
E7_backfill
E7_pit
Time History: Concentration_in_pits
Salt Concentration
1200
1000
800
600
400
200
(mg/l)
0
10
20
30
40
Time (yr)
[W1]
[C1]
[C5]
[E2]
[E3]
[E7]
Result Mode: Editing is disabled. Press F4 to edit model.
1,246 KB / 522 KB
Scale: 75%
Result Mode

Surface Water Quality Modeling



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How can GoldSim complement traditional SD codes?

- **GoldSim does not use standard "stock and flow" syntax**
- **Large, complex models are not necessarily be easy to explain to a non-technical audience (with a limited attention span)**
- **Feedback loops are not as readily apparent when models get very large and hierarchical**
- **Possible complementary use:**
  - Use traditional stock and flow approach to initially gain understanding of dynamics and explain model
  - Use more complex probabilistic model for predictions (if required)

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