

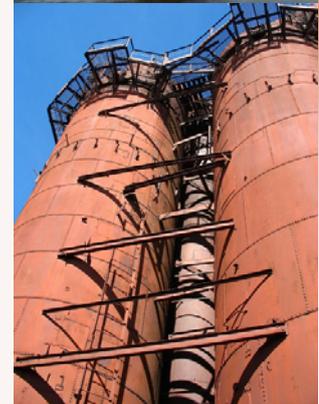
# Mutual Consultants



CSM0906

## Computer Simulation Modelling

### CSM



*“Constructing and running a computer program that imitates the operation of an existing or proposed system/process in order to provide an understanding of the ‘real’ system and how it reacts to change”*

CSM

## Overview of Computer Simulation Modelling (CSM)

### The Need

A Simulation Modelling Application is a computer application that imitates the operation of an existing or proposed real-life system/process. Models are built in order to provide an understanding of how the corresponding 'real' system would behave in certain situations. This is often essential particularly where experimenting with the real system would be too costly, too disruptive, impractical or even impossible.

### Why Simulation Modelling

Simulation Modelling is a very powerful way of investigating (and hence understanding) the complex relationships between a large number of variable factors in, for example, a production process or the operation of a complex organisation. Most systems, and the questions we ask about them, are far too complex for us to attempt to model them analytically - the only solution is simulation (which mimics reality) on a computer.

### Minimising Risk

By constructing a computer simulation of your system/process we can help you to identify and test ideas (and even fine tune them to your best advantage), with the minimum financial risk (ie before incurring the cost of implementation and without making expensive mistakes). You can find out about your real system "safely" and without costly trial and error.

### Example Simulation Modelling Application

Our Simulation Modelling Application called GenMod is capable of modelling almost all activities at most railway vehicle maintenance depots. It helps clients predict the impact of depot development on both fleet and depot performance. The client provides data which fully describe train running, the depot and the fleet(s) which are to be simulated. GenMod uses this data to model depot and fleet activity for as many simulated days as the user requires.

### Mutual Consultants' Role

Our role is to work closely with the client both during the development of the Simulation Modelling Application and downstream to ensure that the resulting application imitates the real life system/process and that the application continues to evolve in line with the business needs.

### Benefits

Simulation Modelling Applications yield the following benefits:

- Avoiding costly mistakes - The cost of developing an application is small compared with what can be lost in a real life experiment
- Iterate to the best solution - You can test different ideas again and again with different inputs ie. iterate towards the best solution
- Time saving - You can simulate years of operation in minutes
- Interaction of Random Events - You can build randomness into your system/process and see the effects. This allows you to describe events and timings as they occur in real life.

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# Computer Simulation Modelling

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## WHAT IS COMPUTER SIMULATION MODELLING?

A Simulation Modelling Application is a computer application that imitates the operation of an existing or proposed real-life system/process. In general terms, models are built in order to provide an understanding of how the corresponding "real" system would behave in certain situations. This is often essential particularly where experimenting with the real system would be too disruptive, too costly, impractical or even impossible (such as the case of a system or process which does not yet exist).

If the real system/process is simple then it may be possible to use mathematical methods (e.g. algebra, calculus, etc.) to build a precise model which will give exact answers - this is "analytical modelling". Such models can be readily constructed using a spreadsheet.

**However, most systems, and the questions we ask about them, are far too complex for us to attempt to model them analytically. The only solution is simulation - in which case it is best performed by writing a Simulation Modelling Application on a computer.**

**Simulation Modelling is a very powerful way of investigating (and hence understanding) the complex relationships between a large number of variable factors in, for example, a production process or the operation of a complex organisation.**

Most simulation models are time based and take into account all the resources and constraints involved, and the way these things interact with each other as time passes. Simulation also builds in the randomness you would see in real life. For example, it does not always take exactly 5 minutes for particular operation to be performed, process equipment can breakdown unexpectedly with varying amounts of downtime etc.

**This means that a Simulation Modelling Application can mimic reality – in this way the model can be used to predict behaviour of, say, a process to see how it would perform in real life (with all its uncertainties).**

## WHAT CAN BE SIMULATED?

There are many scenarios that can be simulated; in general, systems that can be summarised using a flow chart (ie a process flow with discrete events) can be simulated. Areas in which we have worked include staff utilisation modelling, shift modelling and process reliability - the scope is endless.

**The processes where most benefit may be gained are those that involve change over time, randomness and where there are complex relationships between large numbers of variable factors.**

Realistically, such systems can only be analysed by constructing and running a Simulation Modelling Application.

## WHY SIMULATE?

By constructing a Simulation Modelling Application of your process we can help you to identify and test ideas (and even fine tune them to your best advantage); this is at a fraction of the cost of trying your ideas "for real" and with the minimum financial risk (ie before incurring the cost of implementation and without making expensive mistakes). Once the model has been developed, ideas can be tested very quickly (for example, the model may be able to simulate years of operation in a matter of minutes) which in turn will generate many more ideas. By using the model you will gain insights into how to run the process or organisation more effectively.

**The Simulation Modelling Application will automatically record performance measures as the model runs so that you can get representative numerical results to validate the value (or otherwise) of your ideas.**

Simulation provides you with a deep insight into how your process works (or does not work!). The mere process of developing a Simulation Modelling Application can reveal solutions that will make your process work better.

## SIMULATION v OTHER TECHNIQUES

One alternative to simulation is to test your ideas in real life (ie trial and error that relies on gut feel!). Trial and error has serious shortcomings:

- **Cost** - Experimenting in "real life" can be very costly. It is not just the cost of introducing change but the cost of making a bad decision.  
**The cost of writing a Simulation Modelling Application is small compared with the money that can be lost in a "real life" experiment**
- **Iteration** - In real life you only get one chance to experiment and collect the results and so you cannot test different ideas under identical circumstances.  
**With simulation you can test the same system repeatedly with different inputs - ie you can iterate to the best solution**
- **Time** - It takes time to conduct a real life experiment - it may be years before you find out whether or not your idea worked.  
**With a Simulation Modelling Application you can simulate years of operation in a matter of minutes - ie. you get the answer now instead of when it is too late.**

Another alternative to simulation is to create an analytical model of your process or system; this also has limitations:

- **Interaction of Random Events** - Analytical models can model a steady state scenario but only simulation modelling lets you build in randomness, for example machine failures, absenteeism etc, and allow you to see the effects.  
**Simulation Modelling is the only way of investigating (and hence understanding) the complex relationships between a large number of variable factors.**
- **System Complexity** - Analytical modelling can precisely describe a system and accurately predict its behaviour but it is usually only attempted if the system is relatively simple.  
**For complex systems (such as a manufacturing facility), only simulation gives you the flexibility to describe events and timings as they actually are in real life.**

### EXAMPLE OF A SIMULATION MODELLING APPLICATION

**GenMod** is a Simulation Modelling Application which is capable of modelling almost all activities at most railway vehicle maintenance depots. We use this application to help clients predict the impact of depot development on both fleet and depot performance.

The effective development and management of a railway depot involves a regular re-evaluation of how best to respond to changing engineering, commercial and operational pressures.

These changes may include:

- increased depot workloads
- revised depot layouts
- different staffing skills, mix and levels
- different fleet sizes
- new vehicle maintenance schedules
- changing failure rates, etc.

The client provides data which fully describe train running, the depot and the fleet(s) which are to be simulated. **GenMod** uses this data to model depot and fleet activity for as many simulated days as the user requires.

By making minor alterations to the data files and re-running the simulation, users can investigate many "what if?" scenarios.

Without **GenMod**, the only ways to assess the impact of depot development are:

- guesswork/"gut feel"
- build, and play with, scale models

- write an analytical model (eg a spreadsheet)
- try it for real and see what happens.

With the help of **GenMod**, we can give clients an opportunity to test ideas for change, and even fine tune them to best advantage (by running a series of simulations), before committing financial and other resources to them. Many parameters can be varied (either simultaneously or individually) allowing clients to investigate many "what if?" scenarios.

**GenMod** presents the results of each simulation run (such as predetermined key performance indicators) identifying, say, the effects of various staffing levels, which allows the client to determine which areas of change look the most promising for subsequent implementation.

### **BENEFITS OF SIMULATION MODELLING**

By constructing a computer simulation of your system/process we can help you to identify and test ideas (and even fine tune them to your best advantage), with the minimum financial risk (ie before incurring the cost of implementation and without making expensive mistakes).

Simulation started in manufacturing where it was used as a "check the design will work" approach. Experience showed that simulation is best applied early in the design project because the design will only be right if the design process itself takes into account how all the resources and rules will interact to impact the process flows.

The following is a summary of the benefits that simulation modelling can bring:

- **Avoiding costly mistakes** - The cost of developing a Simulation Modelling Application is usually small compared with the money that can be lost in a real life experiment
- **Iterate to the best solution** – With a Simulation Modelling Application you can test different ideas again and again with different inputs; in this way you can iterate towards the best solution.
- **Time saving** – With a Simulation Modelling Application you can simulate years of operation in a matter of minutes – in short, you get a deep insight into how your system/process works, revealing solutions that will make your process work better
- **Interaction of Random Events** – Simulation modelling lets you build in randomness into your system/process and allow you to see the effects. Simulation Modelling is the only way of investigating (and hence understanding) the complex relationships between a large number of variable factors. Only simulation gives you the flexibility to describe events and timings as they occur in real life.

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**MUTUAL  
CONSULTANTS'  
ROLE**

Our role is to work closely with the client both during the development of the Simulation Modelling Application and downstream to ensure that the resulting application imitates the real life system/process and that the application continues to evolve in line with the business needs.

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**CONCLUSION**

By constructing a computer simulation of your system/process we can help you to identify and test ideas (and even fine tune them to your best advantage), with the minimum financial risk (ie before incurring the cost of implementation and without making expensive mistakes.

Simulation modelling is particularly powerful (and the only realistic solution) if you wish to identify opportunities for change and but are held back by the complex relationships between a large number of variable factors in your system/process.

By applying a Simulation Modelling Application you can find out about your real system "safely" and without costly trial and error.

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*For More Information  
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