WITNESS 13

Welcome to WITNESS 13. This release enables easier and better experimentation with your WITNESS models. From the novice user to the WITNESS specialist a new range of powerful scenario building and analysis is unleashed. The release also includes many other features to make WITNESS more intuitive and productive and to support the learning of WITNESS knowledge and techniques.

Release Summary

WITNESS Experimenter

The stand out highlight of WITNESS 13 is the new Experimenter. This option replaces the old Experiment menu and the WITNESS Optimizer, combining new methods and analyses with the best of the old. Within a modern design all users now benefit from a simple line by line option to define scenarios – setting parameter values and responses, easy running, and instant results comparison tables and charts. Also included are the sophisticated options from WITNESS Optimizer, where parameter ranges and sets can be defined, constraints set and different algorithms applied, all ending up at the same wide range of tables and charts. Responses set the results you want to see and can be either defined as WITNESS functions OR as simple expressions entered directly in the Experimenter.

The results tables and charts in Experimenter all offer easy copy/paste to other applications and many include box zoom options to aid clarity and focus in on important results. Brand new to WITNESS are Box Plot options to show result ranges recorded for replication sets – including a classic quartile option PLUS options to extend the box percentile range using the two alternative methods of calculation offered by Microsoft Excel. The chart range also includes Radar charts, column results and bar charts of confidence intervals.

Friendly scenario naming, dockable windows, output to MINITAB, Stability Analysis, and more, the WITNESS Experimenter makes running your model and finding results easy and fun.

Experimenter API

For power users there is a full API to direct and control the Experimenter. This opens up a multitude of possibilities to embed experimentation and optimization in the interface and application of your choice. It also allows a full design of experiments in any way you choose through designing a customer line by line grid. You direct the experimentation in terms of setting up experiments, running experiments, saving/reloading experiments and outputting the results.

Drag and Drop

WITNESS 13 offers Drag and Drop designer elements. Multiple define options are there too with key control, simply drag and then click in multiple locations, ending with a right mouse button click. This change makes WITNESS easier to pick up for new users, a key result of our usability analysis.

Modeling – Variables

Other new options in WITNESS 13 include those at the modeling level. New flexibility in variable definition allows changes between real and integer after first use and a new flag offers the option for variables to retain their value when the Begin command or button is used. This allows data to persist between model runs and can avoid reloading of data from a database or Excel. It also allows results to be collected for many runs in the same table for internal model comparisons, and output when a set of results has been collected.

Modeling - Vehicle Unloading

Vehicles in WITNESS 13 have new Unload control options defined on relevant track unload tab. Front, Rear or Any are available as positions to unload from and the selection is guided by the rule. Using this it is now much easier to unload specific parts at specific locations.

Modeling – Indexes and Scheduling

Model indexes are maintained for variables in expressions when they are reduced to a single value in any dimension. The ScheduleExpression function in WITNESS has been upgraded to an ACTION. This allows function arguments for actions to be run in a way that is accessible in USED reports. The new actions are called SCHEDULE and DESCHEDULE.

AutoSave

Autosave in the new File/Options section optionally offers recovery from an automatic model save performed every x minutes.

New Learning WITNESS Book One and Book Two

The WITNESS workbook structure has been expanded and improved. There are now two "Learning WITNESS" books supplied as pdf's in the WITNESS installation. These books will also be available in print in selected languages for purchase through online retailers.

Learning WITNESS Book One now includes a "WITNESS Essentials" section that guides users through knowledge that is necessary before attempting a model of your own. Learning WITNESS Book Two contains a new chapter on Scheduling, showing the best ways to import schedules from Excel and incorporates the new Experimenter in the chapter on Experimentation.

New Demonstration Models

New demonstration models include SimpleJobShop.mod and PlaneArrivals.mod – these illustrate schedules in action and also use of tag attributes and variable path speeds. Added to updated models of simple assembly, simple logistics and simple workflow are minor upgrades to other demonstration models such as Jetty.mod.

New Academic Case Study

With WITNESS 13 there is a new case study exercise in eBook style for our academic customers. This provides a ready to use example which can be adapted as required. Faculty may have access to a model results report and the associated model. The exercise is centred around production in a fictional Steel Nuggets Inc. and is an interesting scenario of machines, conveyors, stacking, palletizing and delivery. Students are set a number of exercises that fit different timescales to complete and are provided with hints and tips to succeed. The model illustrates factors such as model validation and shows how some improvements can be brought about with no extra spend!

Release Detail

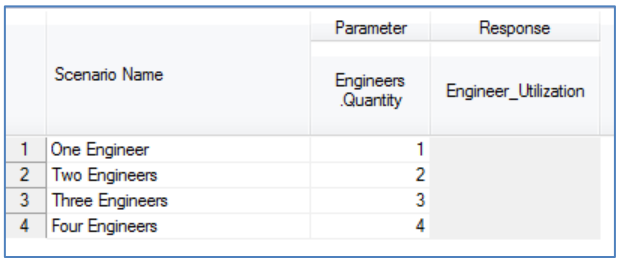
The WITNESS Experimenter

The new WITNESS Experimenter is accessed from the Model Menu and is available to all WITNESS users. In addition to this explanation the WITNESS Experimenter has its own help text that includes sections that guide through the process of setting up and running experiments. There is a chapter in the second "Learning WITNESS" book (accessible from the Start Page) that offers a worked example. In addition there is full one day training course on Optimization with the WITNESS Experimenter, suitable for self-study, installed in the Tutorial directory (accessed under the WITNESS Sample models directory – accessed from the Start Page).

Setting Up Experiments

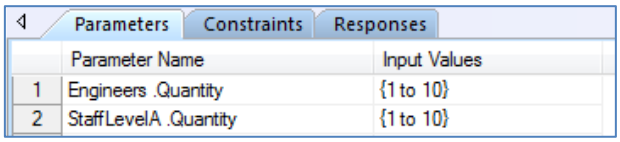
The WITNESS Experimenter offers two Experimental modes:

- Simple Experiment Mode – an ideal choice for a novice user of WITNESS. Scenarios are created in a simple line by line manner with simple parameter values and responses defined.



	Scenario Name	Parameter	Response
		Engineers .Quantity	Engineer_Utilization
1	One Engineer	1	
2	Two Engineers	2	
3	Three Engineers	3	
4	Four Engineers	4	

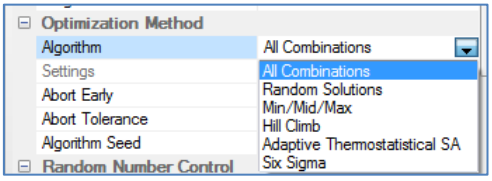
- Advanced Experiment Mode – offering parameter range definition and algorithms including optimization.



Parameters | Constraints | Responses

	Parameter Name	Input Values
1	Engineers .Quantity	{1 to 10}
2	StaffLevelA .Quantity	{1 to 10}

This experiment definition defines 100 experiments – all combinations of these different quantities – each from 1 to 10. Responses here are added on one of the other tabs.



The choice of algorithms in Advanced Experiment Mode

In both modes of operation responses can be selected from WITNESS function elements defined in the model – or simple expressions can be added directly in the Experimenter. (e.g. NSHIP(PartA) would be a valid response to evaluate throughput).

Run parameters are set in a properties grid offering run time, warmup, replications and random number control. For Optimization algorithms one of the responses is chosen as the Objective and a target of minimum or maximum set.

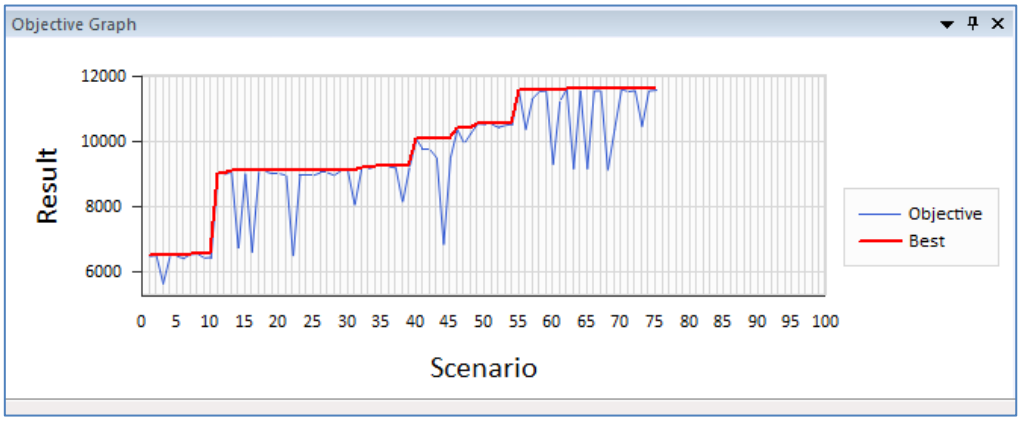
Running Experiments

Running Experiments is controlled through the toolbar controls 

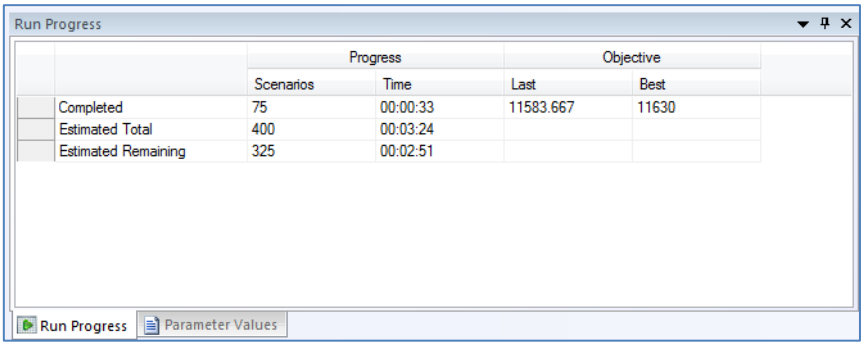
There are many views to show progress of an experiment. These include:

- A progress bar 

- An Objective Graph



- Run Progress window – and progress in the toolbar



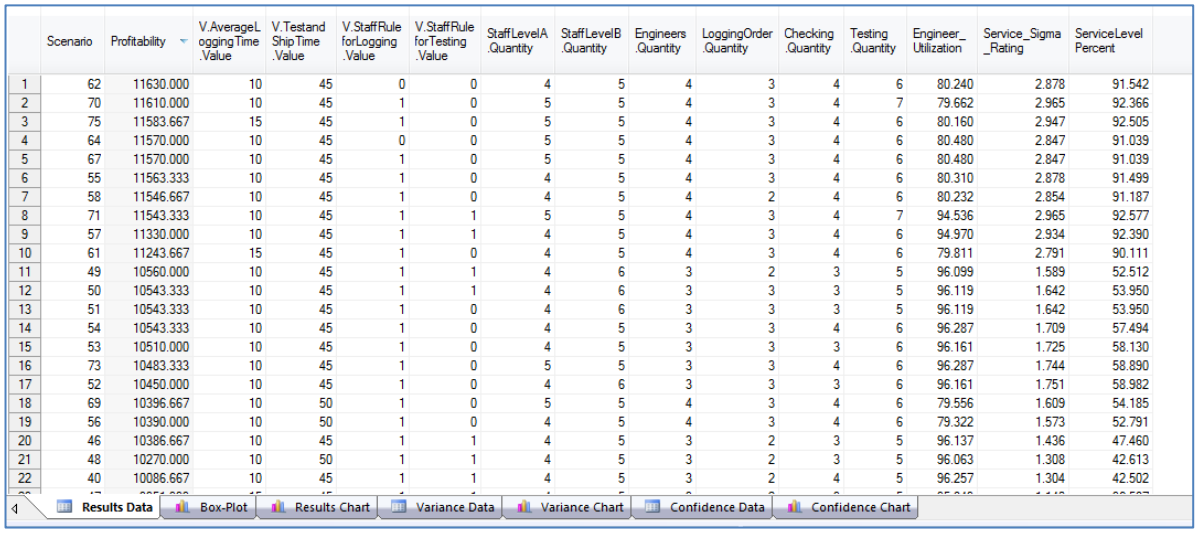
- In addition the full results tables and charts are available for viewing *as the experiment runs*. These are accessed through switching to the Results View using the results button.

- In this view all the progress windows and indicators are still available, the tabbed results area simply replaces the experiment setup grids.

Full Results Tables and Charts

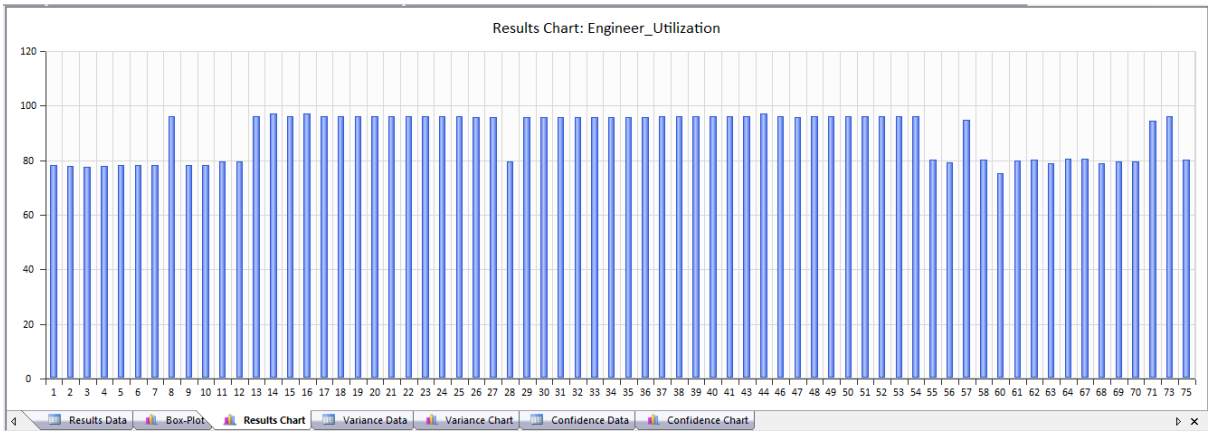
The tabbed results area gives access to the following reports:

- Full results data grid – a listing of each scenario (here sorted with a simple column header click) into profitability order. For each scenario the parameters and all defined responses are shown.



	Scenario	Profitability	V.AverageLoggingTime.Value	V.TestandShipTime.Value	V.StaffRuleforLogging.Value	V.StaffRuleforTesting.Value	StaffLevelA.Quantity	StaffLevelB.Quantity	Engineers.Quantity	LoggingOrder.Quantity	Checking.Quantity	Testing.Quantity	Engineer_Utilization	Service_Sigma_Rating	ServiceLevelPercent
1	62	11630.000	10	45	0	0	4	5	4	3	4	6	80.240	2.878	91.542
2	70	11610.000	10	45	1	0	5	5	4	3	4	7	79.662	2.965	92.366
3	75	11583.667	15	45	1	0	5	5	4	3	4	6	80.160	2.947	92.505
4	64	11570.000	10	45	0	0	5	5	4	3	4	6	80.480	2.847	91.039
5	67	11570.000	10	45	1	0	5	5	4	3	4	6	80.480	2.847	91.039
6	55	11563.333	10	45	1	0	4	5	4	3	4	6	80.310	2.878	91.499
7	58	11546.667	10	45	1	0	4	5	4	2	4	6	80.232	2.854	91.187
8	71	11543.333	10	45	1	1	5	5	4	3	4	7	94.536	2.965	92.577
9	57	11330.000	10	45	1	1	4	5	4	3	4	6	94.970	2.934	92.390
10	61	11243.667	15	45	1	0	4	5	4	3	4	6	79.811	2.791	90.111
11	49	10560.000	10	45	1	1	4	6	3	2	3	5	96.099	1.589	52.512
12	50	10543.333	10	45	1	1	4	6	3	3	3	5	96.119	1.642	53.950
13	51	10543.333	10	45	1	0	4	6	3	3	3	5	96.119	1.642	53.950
14	54	10543.333	10	45	1	0	4	5	3	3	4	6	96.287	1.709	57.494
15	53	10510.000	10	45	1	0	4	5	3	3	3	6	96.161	1.725	58.130
16	73	10483.333	10	45	1	0	5	5	3	3	4	6	96.287	1.744	58.890
17	52	10450.000	10	45	1	0	4	6	3	3	3	6	96.161	1.751	58.982
18	69	10396.667	10	50	1	0	5	5	4	3	4	6	79.556	1.609	54.185
19	56	10390.000	10	50	1	0	4	5	4	3	4	6	79.322	1.573	52.791
20	46	10386.667	10	45	1	1	4	5	3	2	3	5	96.137	1.436	47.460
21	48	10270.000	10	50	1	1	4	5	3	2	3	5	96.063	1.308	42.613
22	40	10086.667	10	45	1	1	4	5	3	2	4	5	96.257	1.304	42.502

- Results Chart (for any chosen response)

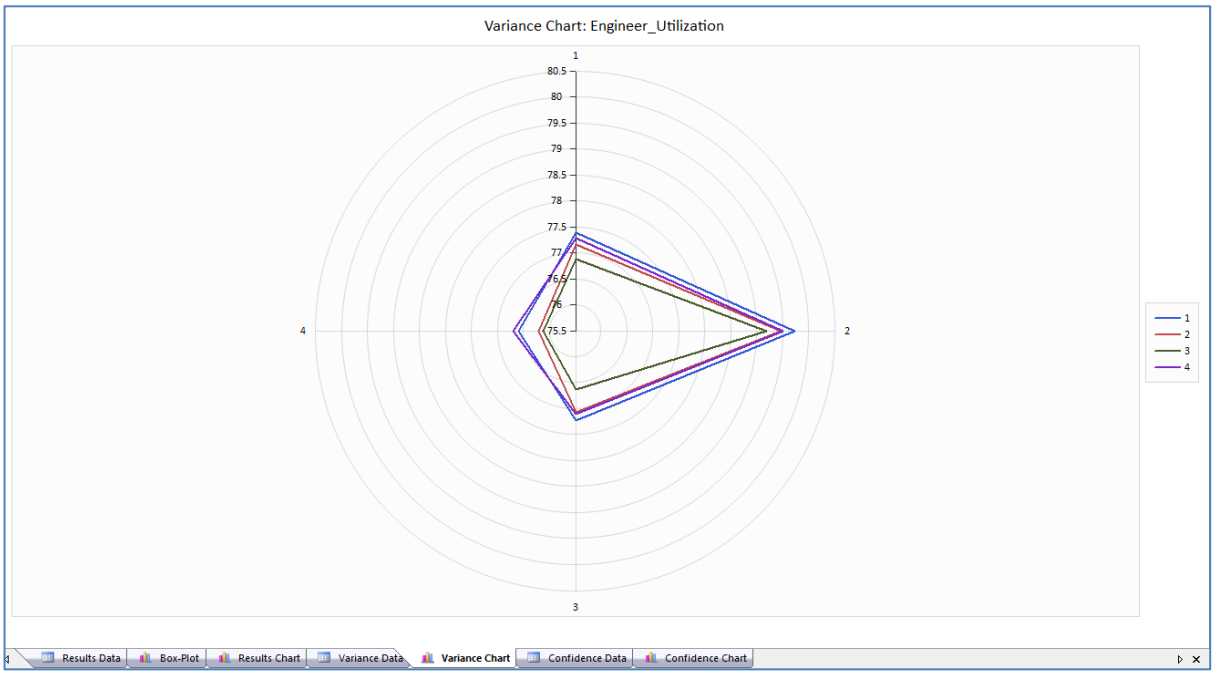


- Variance Data – List of individual replication results within each scenario

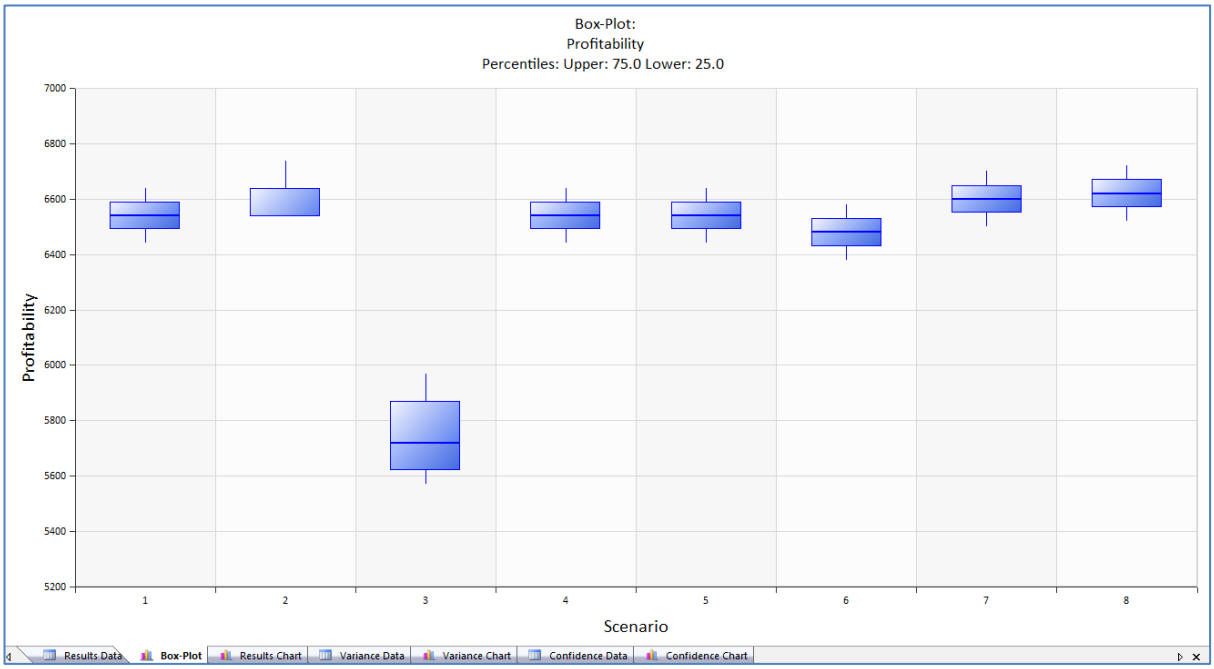
	Scenario	Mean	Std. Dev	Best	Run 1	Run 2	Run 3
1	1	6506.667	57.735	6540.000	6540.000	6440.000	6540.000
2	2	6538.000	0.000	6538.000	6538.000	6538.000	6538.000
3	3	5670.000	100.000	5770.000	5770.000	5670.000	5570.000
4	4	6506.667	57.735	6540.000	6540.000	6440.000	6540.000
5	5	6506.667	57.735	6540.000	6540.000	6440.000	6540.000
6	6	6446.667	57.735	6480.000	6480.000	6380.000	6480.000
7	7	6566.667	57.735	6600.000	6600.000	6500.000	6600.000
8	8	6586.667	57.735	6620.000	6620.000	6520.000	6620.000
9	9	6456.667	57.735	6490.000	6490.000	6390.000	6490.000
10	10	6473.333	57.735	6540.000	6540.000	6440.000	6440.000
11	11	9013.333	57.735	9080.000	9080.000	8980.000	8980.000
12	12	9013.333	57.735	9080.000	9080.000	8980.000	8980.000
13	13	9093.333	57.735	9160.000	9160.000	9060.000	9060.000
14	14	6706.667	115.470	6840.000	6640.000	6640.000	6840.000

Results Data | Box-Plot | Results Chart | Variance Data | Variance Chart | Confidence Data | Confidence Chart

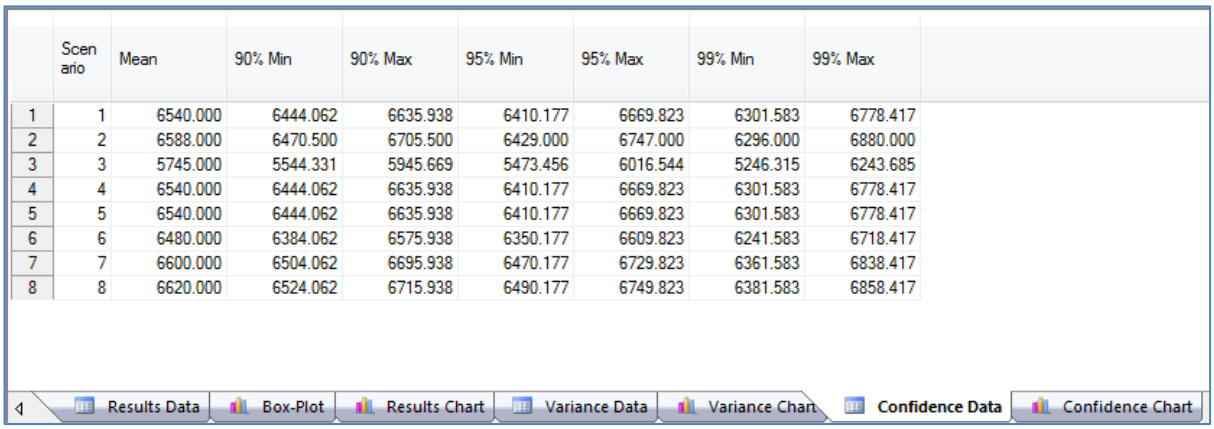
- Variance Chart – A radar chart to show selected scenario variation



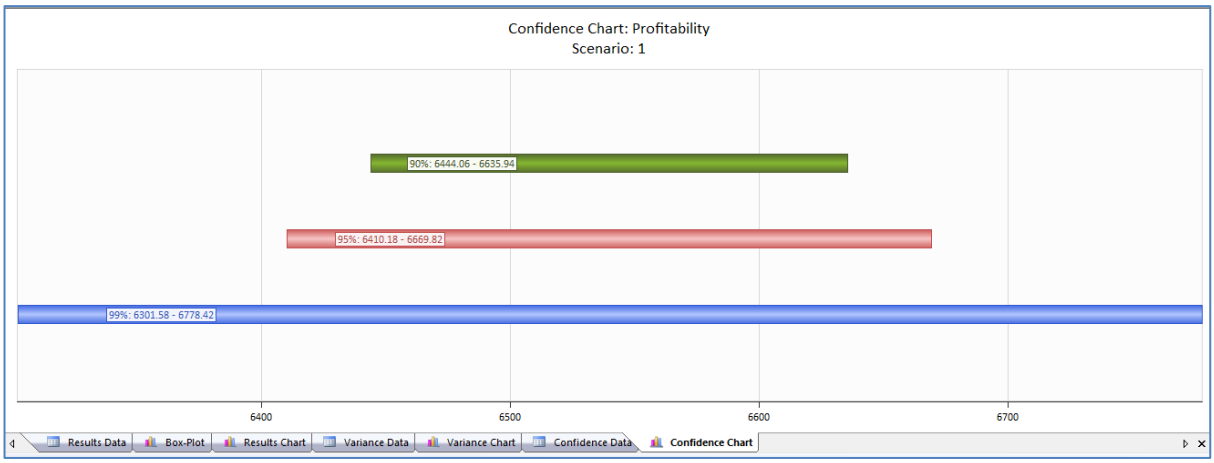
- Box-Plot Chart – Offering classic quartile or chosen percentage box and whisker plot of variance data



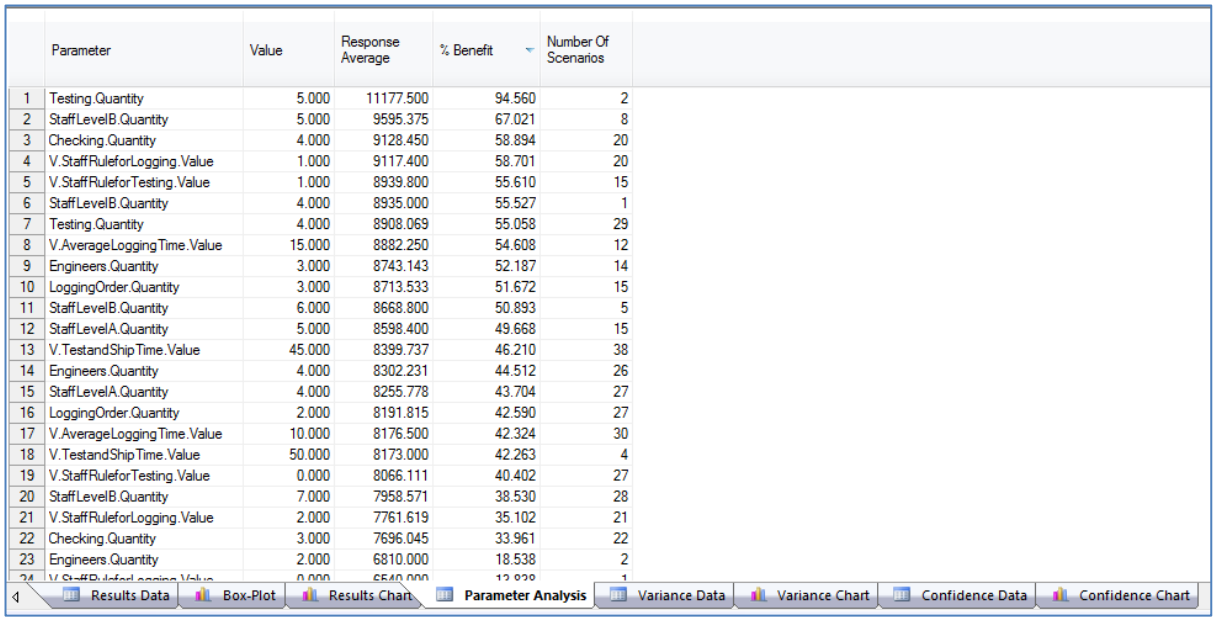
- Confidence Interval Data and Chart



	Scenario	Mean	90% Min	90% Max	95% Min	95% Max	99% Min	99% Max
1	1	6540.000	6444.062	6635.938	6410.177	6669.823	6301.583	6778.417
2	2	6588.000	6470.500	6705.500	6429.000	6747.000	6296.000	6880.000
3	3	5745.000	5544.331	5945.669	5473.456	6016.544	5246.315	6243.685
4	4	6540.000	6444.062	6635.938	6410.177	6669.823	6301.583	6778.417
5	5	6540.000	6444.062	6635.938	6410.177	6669.823	6301.583	6778.417
6	6	6480.000	6384.062	6575.938	6350.177	6609.823	6241.583	6718.417
7	7	6600.000	6504.062	6695.938	6470.177	6729.823	6361.583	6838.417
8	8	6620.000	6524.062	6715.938	6490.177	6749.823	6381.583	6858.417

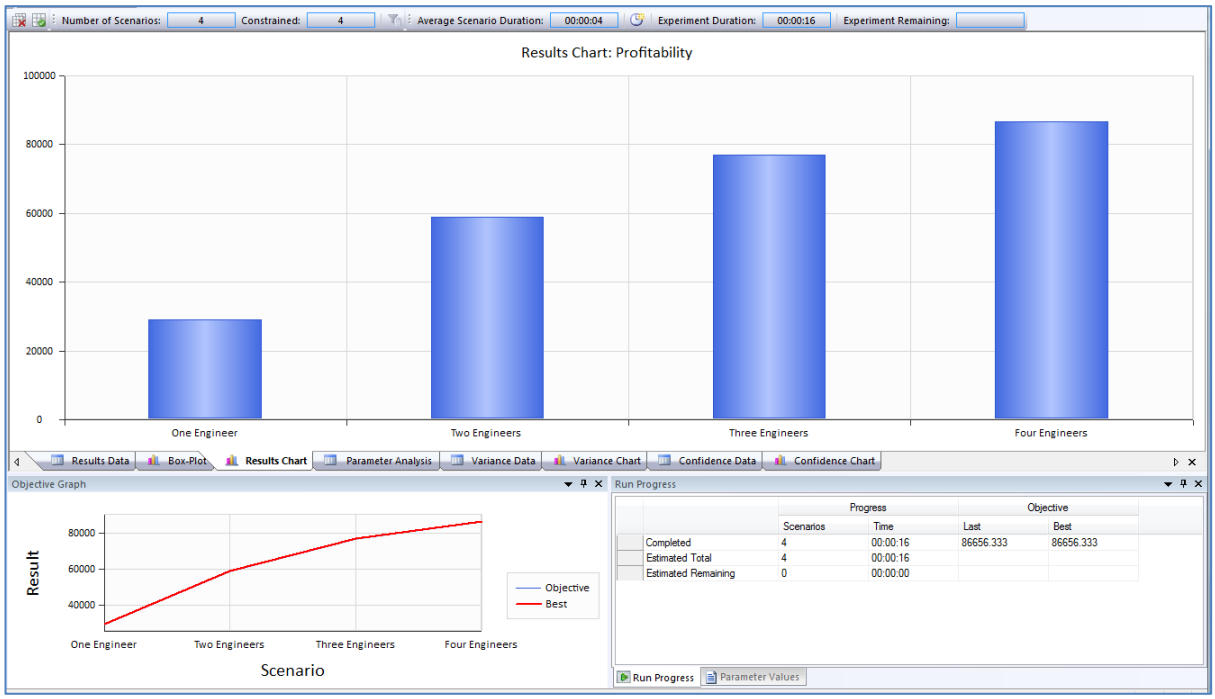


- When the run is complete a parameter analysis tab can be viewed offering sensitivity analysis. A listing of each parameter value used in experiments and an assessment of the impact of that value – again for any chosen response.



	Parameter	Value	Response Average	% Benefit	Number Of Scenarios
1	Testing.Quantity	5.000	11177.500	94.560	2
2	StaffLevelB.Quantity	5.000	9595.375	67.021	8
3	Checking.Quantity	4.000	9128.450	58.894	20
4	V.StaffRuleforLogging.Value	1.000	9117.400	58.701	20
5	V.StaffRuleforTesting.Value	1.000	8939.800	55.610	15
6	StaffLevelB.Quantity	4.000	8935.000	55.527	1
7	Testing.Quantity	4.000	8908.069	55.058	29
8	V.AverageLoggingTime.Value	15.000	8882.250	54.608	12
9	Engineers.Quantity	3.000	8743.143	52.187	14
10	LoggingOrder.Quantity	3.000	8713.533	51.672	15
11	StaffLevelB.Quantity	6.000	8668.800	50.893	5
12	StaffLevelA.Quantity	5.000	8598.400	49.668	15
13	V.TestandShipTime.Value	45.000	8399.737	46.210	38
14	Engineers.Quantity	4.000	8302.231	44.512	26
15	StaffLevelA.Quantity	4.000	8255.778	43.704	27
16	LoggingOrder.Quantity	2.000	8191.815	42.590	27
17	V.AverageLoggingTime.Value	10.000	8176.500	42.324	30
18	V.TestandShipTime.Value	50.000	8173.000	42.263	4
19	V.StaffRuleforTesting.Value	0.000	8066.111	40.402	27
20	StaffLevelB.Quantity	7.000	7958.571	38.530	28
21	V.StaffRuleforLogging.Value	2.000	7761.619	35.102	21
22	Checking.Quantity	3.000	7696.045	33.961	22
23	Engineers.Quantity	2.000	6810.000	18.538	2

All of the results screens and charts shown above are from the advanced experiment mode. The simple experiment mode also offers the full range of reports and with the scenario naming included:



The results tables and charts offer direct copy and paste (of values or pictures) and there are various zoom and print options.

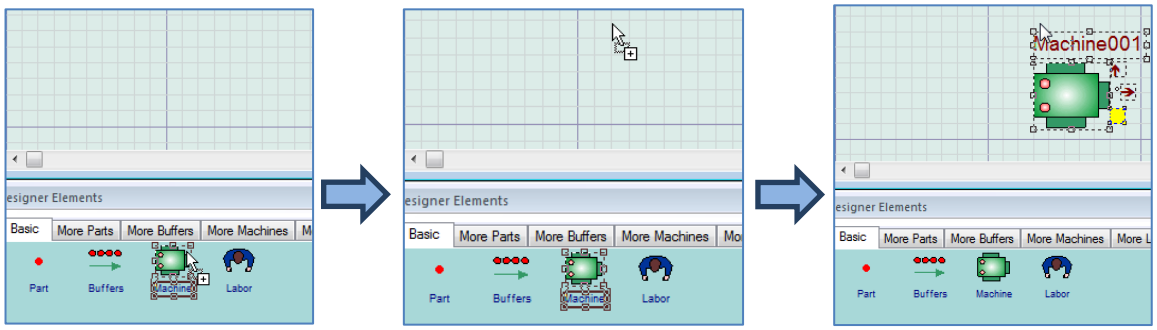
To learn more please access the Experimenter help text (from the Windows Start menu in the WITNESS 13 group) or look at the second Learning WITNESS book at the chapter on experimentation or at the full Optimization course included in the Tutorial Directory.

For program control of Experimenter through the Experimenter API please reference the Programmer's Guide. This is installed in the Documentation directory under the Program Files directory where WITNESS is installed. For Windows 7 by default this is located at C:\Program Files (x86)\Lanner Group\WITNESS 13\Documentation

Other WITNESS 13 Highlight Details

Drag and Drop

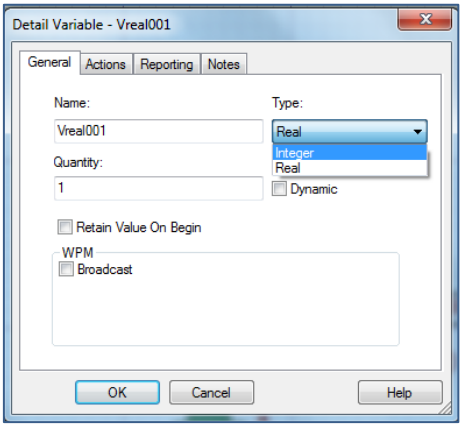
WITNESS 13 offers Drag and Drop designer elements. Just click on the element and keep holding down the left mouse button (a little symbol appears below the cursor to show the selection is made). Keep holding the mouse button down and move the cursor to the modeling window. Then release the button and the element is dropped onto the screen. Then go back for another – it's that easy!



Multiple define options are there too, simply hold the Ctrl key down when you make the initial selection (you can then release the key), then after dropping the first time if you click elsewhere in the modeling window another element will be defined, click again – another one! – and so on until you click the right mouse button.

Modeling – Variables

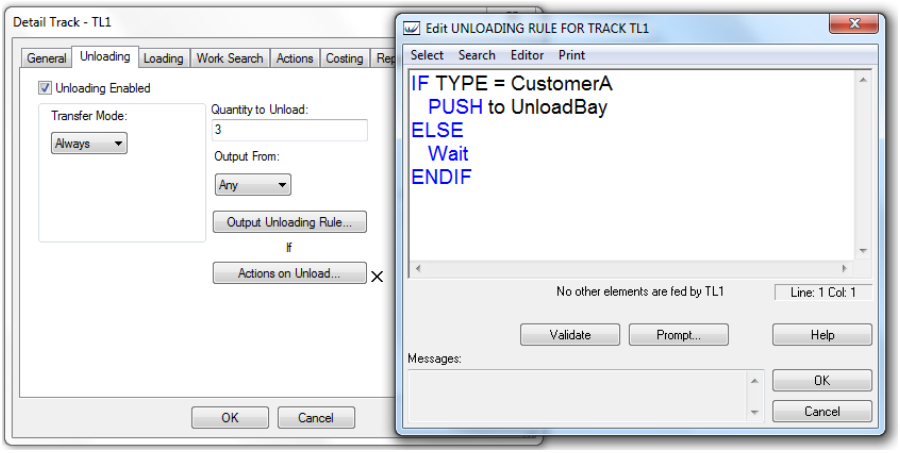
New flexibility in variable definition allows changes between real and integer after first use. Simply access the detail dialog for the variable and use the pull down selector:



A new flag also seen in the dialog above offers the option for variables to retain their value when the Begin command or button is used. This allows data to persist between model runs and can avoid reloading of data from a database or Excel. It also allows results to be collected for many runs in the same table for internal model comparisons, and output when a set of results has been collected.

Modeling - Vehicle Unloading

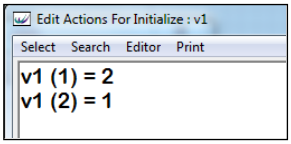
Vehicles in WITNESS 13 have new Unload control options defined on relevant track unload tab. Front, Rear or Any are available as positions to unload from and the selection is guided by the rule. Using this it is now much easier to unload specific parts at specific locations. In the example below 3 parts of type CustomerA are being output to the relevant unloading point from any position in the vehicle.



Modeling – Indexes and Scheduling

Model indexes are maintained for variables in expressions when they are reduced to a single value in any dimension.

The following expression would previously have stripped the bracketed indices IF the variable quantity had been changed to 1. This will no longer happen – a boon for generic models where the quantity may vary to 1 and back.



The ScheduleExpression function in WITNESS has been upgraded to an ACTION. This allows function arguments for actions to be run in a way that is accessible in USED reports. The new actions are called SCHEDULE and DESCHEDULE.

The syntax to be used is

- *SCHEDULE Event_name, Time expression, Actions Statements*
- *DESCHEDULE Event_name*

The actions statements can be a function in order to run several lines of actions code at the prescribed time.

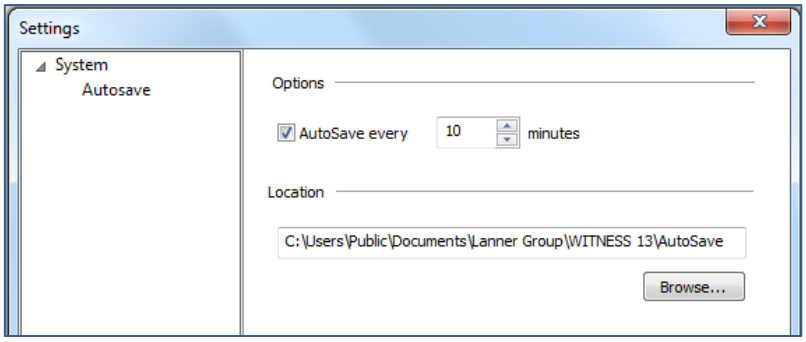
Example

```
SCHEDULE "New Event", 1450, Flag=1
```

This will schedule an event called "New Event" at time 1450 in the model. At that time the value of the variable Flag will be set to 1. Note that the time expression must evaluate to a time equal to or after the current time in the model or a run-time error will be generated.

AutoSave

Autosave offers recovery from an automatic model save performed every x minutes. Located in the File options menu the dialog specifies the directory where saved files will be stored.



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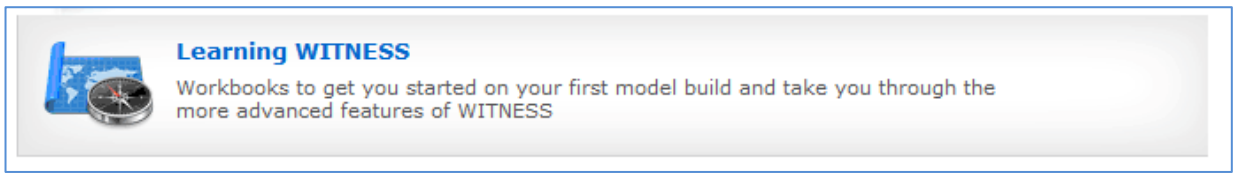

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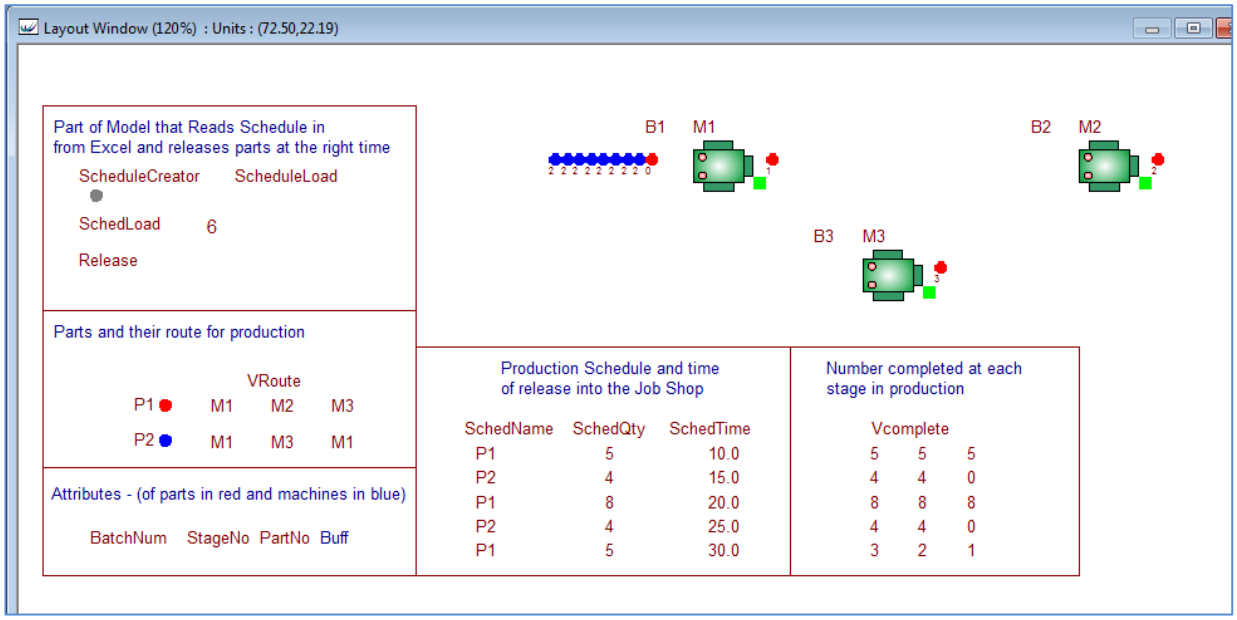
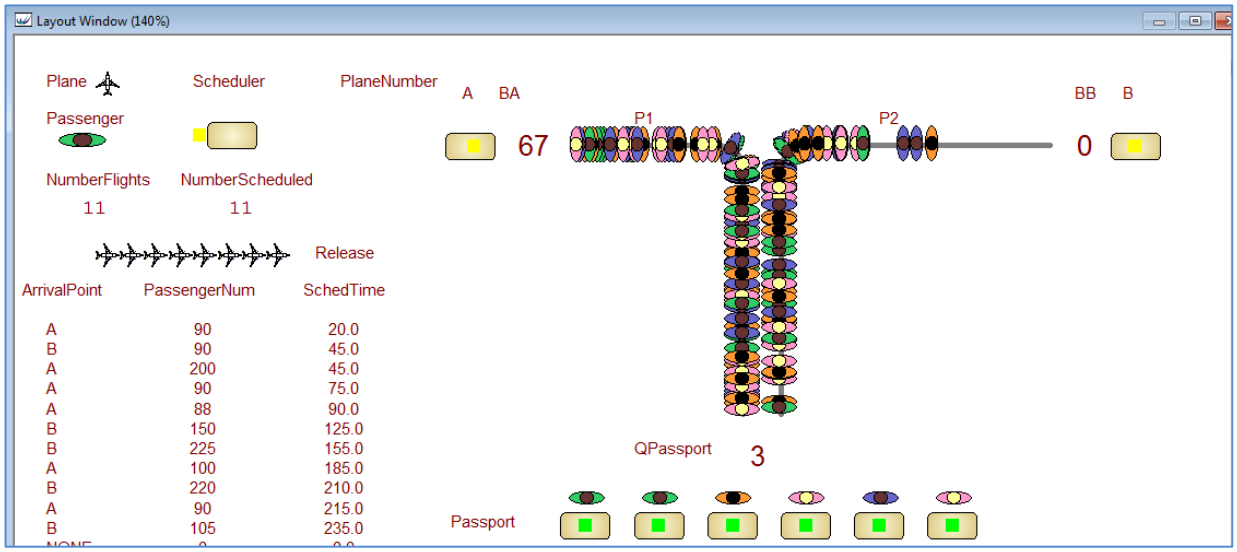
The new Job Shop model SimpleJobShop.mod



The new airport model PlaneArrivals.mod



New Academic Case Study

With WITNESS 13 there is a new case study exercise in eBook style for our academic customers. This provides a ready to use example which can be adapted as required. Faculty may have access to a model results report and the associated model. The exercise is centred around production in a fictional Steel Nuggets Inc. and is an interesting scenario of machines, conveyors, stacking, palletizing and delivery. Students are set a number of exercises that fit different timescales to complete and are provided with hints and tips to succeed. The model illustrates factors such as model validation and shows how some improvements can be brought about with no extra spend! The exercise is available to faculty on request.