

WITNESS Power with Ease 3 Release Notes

Welcome to the Manufacturing Performance Edition of WITNESS Power with Ease Release 3.

This release is a true modeler's release in that it contains many new features to make WITNESS modeling more flexible and easier. The release reflects wide reaching consultation with WITNESS customers in identifying the improvements that are the most helpful in making simulation modeling more productive. Please read these notes to learn about the new functionality included. Full details can be referenced in the WITNESS help system.

The new items of functionality include a wide range of major and minor improvements as listed below:

- ☞ New Option to output a part when a machine breaks down
- ☞ New Option to perform a machine setup when there is no part present at the machine
- ☞ New Direct Excel functionality for Part Arrival Profiles
- ☞ New REPLICATION System Variable
- ☞ Improved Naming in Interact box and Error messages
- ☞ Time displays to 3 decimal places
- ☞ Improved Replace functionality in Actions
- ☞ Full RGB color definition for fluids
- ☞ For the first time access to the WITNESS Event Queue
 - Access Machine event times
 - Change Machine event times for Cycle, Breakdown and Setup
 - Schedule and De-schedule New events
- ☞ The ability to add, move and delete sensor positions on conveyors by functions
- ☞ Multiple Select and Change for attributes in explode report filters
- ☞ New Options for VR Animations
 - VR automatic actions on paths enabling 'Walking people' and more
 - New VR Part animations at any point in a model
- ☞ Major improvements to path definition and use
 - Multiple Sources and Multiple Destinations
 - Faster calculation of possible routes
 - Caching of routes in memory and in file saves
 - New source and destination functions for paths
- ☞ New direct output to Excel of the Random number usage report
- ☞ SIM files now save window status when saved at the end of experimental runs
- ☞ Improved Module Superlock and group graphics alignment
- ☞ Further VR Improvements
 - 3D window update control
 - Walk Speed Adjustment
- ☞ New Workbook

New Option to output a part when a machine breaks down

WITNESS historically has had just two options available to a modeller when a machine breaks down:

- The option to retain the part in the machine and when the repair is complete to begin the cycle again with the same part
- The option to scrap the part and when the repair is complete to begin a new cycle with a new part

Options to divert the part elsewhere in the model were difficult as they involved other dummy events and/or complex cycle time functions and/or additional interactive breakdowns.

The option to divert a part elsewhere has been made easy in this release with a new optional output rule that may be set against each defined breakdown for a machine.

Detail Machine - Milling											
General Setup Breakdowns Fluid Rules Shift Actions Costing Reporting Notes											
	Description	Check Only At Start Of Cycle	Breakdown Mode			Breakdown Duration				Output	
			Mode	No. of Operations	Time Between Failures	Actions on Down	Labor Rule	Repair Time	Actions on Resume	To	Actions on Output
1	Component 1	<input checked="" type="checkbox"/>	No. of Operations	UNIFORM (50,100)		N	N	55.0	N	Y	N
2	General wear	<input checked="" type="checkbox"/>	Available Time		NEGEXP (100)	N	N	UNIFORM (5,	N	N	N

The output rule is a one-shot rule. It will be fired off when the breakdown occurs. If the output is blocked then the rule will fail and the machine will retain the part(s) and begin the cycle with the same part (s) again after the repair.

Therefore if you wish to be sure that the output will be successful you may wish to define a dedicated buffer for this purpose.

Only 'PUSH' and 'IF' constructs may be used in this output rule.

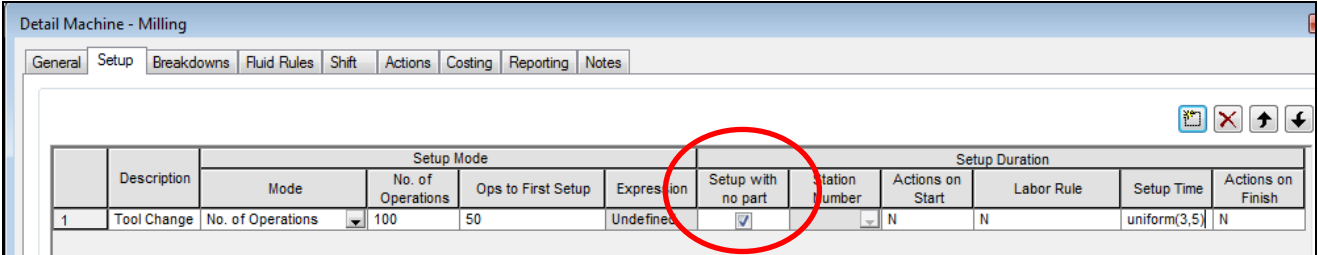
Note that there is a new actions block too that is run when parts are output.

The existing 'Scrap part' tick box has been removed. When models using this option are read into the latest release a rule "Push to Scrap" will be defined where this option was chosen.

New Option to perform a machine setup when there is no part present at the machine

WITNESS historically has always required that a part be present at a machine during a setup. In the vast majority of cases this has been a good way to model as many setups depend on the next part to be processed and also in most cases machines are not usually starved of parts and hence no delay is caused.

However this release improves this situation by giving a new option whereby for some types of setup a part does not have to be present for the setup to occur. The option is set by checking the tick box against the chosen setup as shown below.



	Description	Setup Mode				Setup Duration					
		Mode	No. of Operations	Ops to First Setup	Expression	Setup with no part	Station Number	Actions on Start	Labor Rule	Setup Time	Actions on Finish
1	Tool Change	No. of Operations	100	50	Undefined	<input checked="" type="checkbox"/>		N	N	uniform(3,5)	N

This option can be chosen for the following setup modes:

- Number of Operations
- Value Change

(Sensibly it can NOT be used for the Part Change mode)

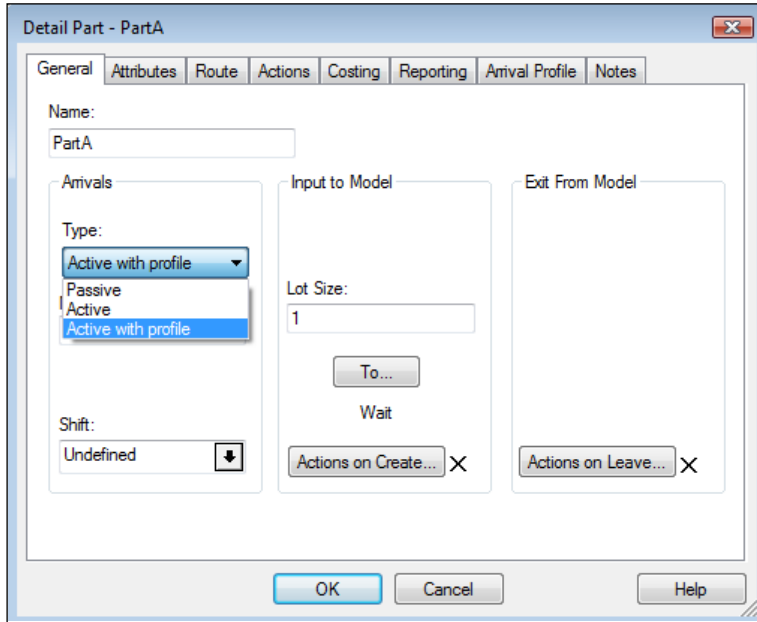
Additional Important Logic DURING a setup

1. During the setup parts may continue to arrive at the machine.
2. Input rules defined for the machine being setup will operate as normal pulling parts into the machine during the setup
3. Output rules defined for elements outputting to the machine being setup will operate as normal with pushed parts being allowed into the machine during setup.
4. Labor rules (except for Match rules) will not request labor until the setup is complete and the cycle is ready to commence.

New Direct Excel functionality for Part Arrival Profiles

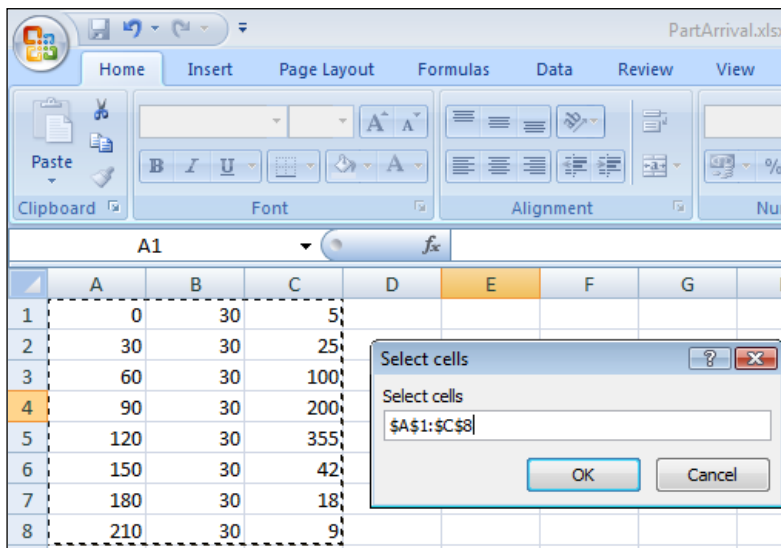
This helps to make things easier when storing data for part arrival profiles in Excel files. For the first time this data can be read directly and fully into the chosen part element. There is a wizard to help set this up and a function that will do the job each time a model starts running.

- Immediate Reading of Part Arrival Profile data

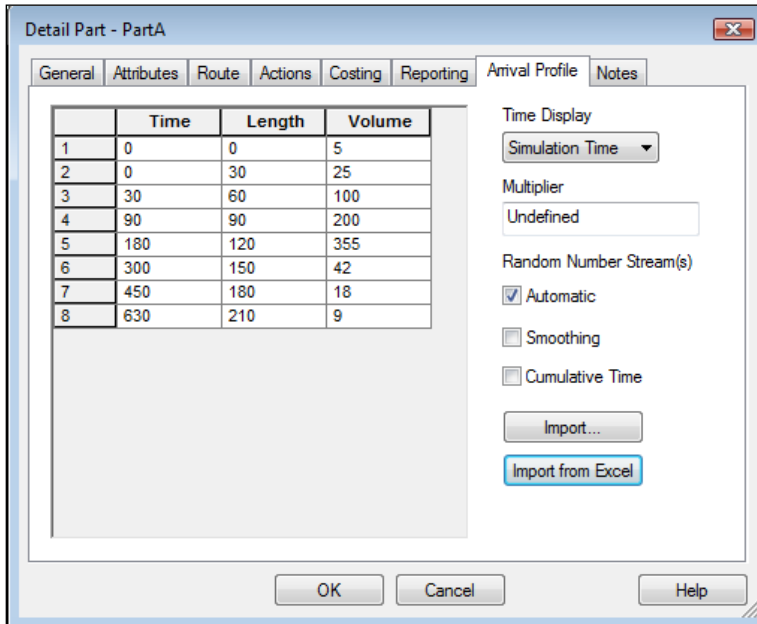


To use Part Arrivals part must first choose Active with Profile arrivals on the general tab of the detail dialog. A new tab is then available on this dialog – that of arrival profile.

Using the Import from Excel button on the Part Arrival Profile tab a spreadsheet is chosen with suitable values and the mouse used to select the array.



Using the Import from Excel button above a spreadsheet is chosen with suitable values and the mouse used to select the array.



As soon as the OK button is clicked the profile data is read into the WITNESS element as seen left.

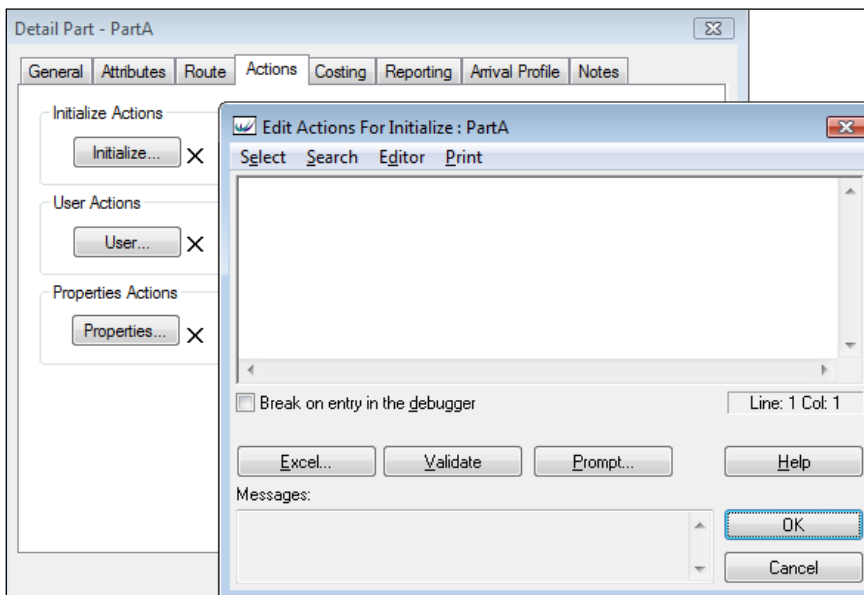
Make sure you select the correct option from the 'time display' pull-down before importing (some require just one column of data, some 2 and some 3 columns).

Don't worry about the number of rows defined where the options are flexible (e.g simulation time) the grid will adjust as shown to the data read in.

- Setting up an arrival profile to be read each time a model starts

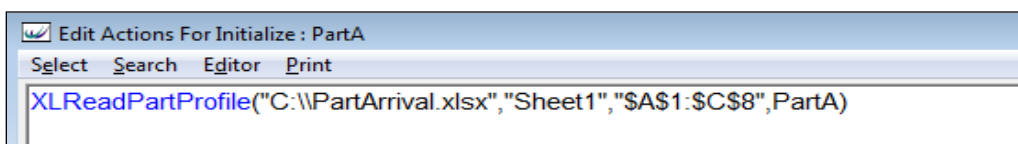
This is setup on the Actions tab of the part element detail dialog. The selection wizard again is used but this time instead of reading in the data a function called XLReadPartProfile is set up to read the data in.

From the Actions tab the Initialize button should be chosen – this will display the following dialog:



The Excel button leads to the same choice of array as before from the chosen Excel spreadsheet.

This time a function is created in the Initialize actions for this element so that the data will be read in each time the model starts.



New REPLICATION System Variable

REPLICATION is a new system variable that returns the number of the replication being run when WITNESS is run from:

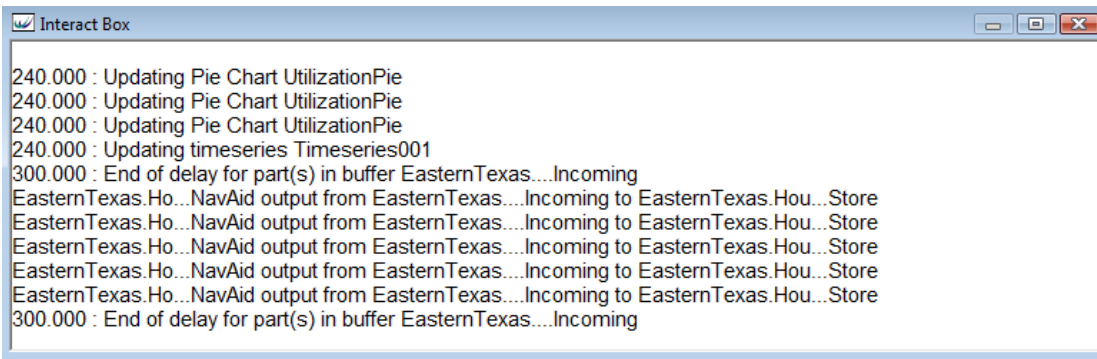
- The Model/Experiment menu
- The WITNESS Optimizer
- The WITNESS Scenario Manager

In these cases the value of REPLICATION is set to an integer value 1,2,3,4,5 etc.

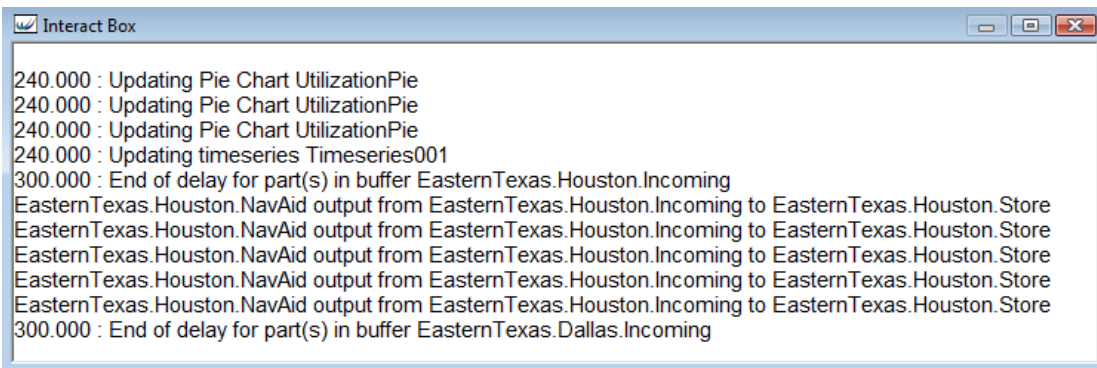
At all other times when WITNESS is being run REPLICATION is set to return 0.

Improved Naming in Interact box and Error messages

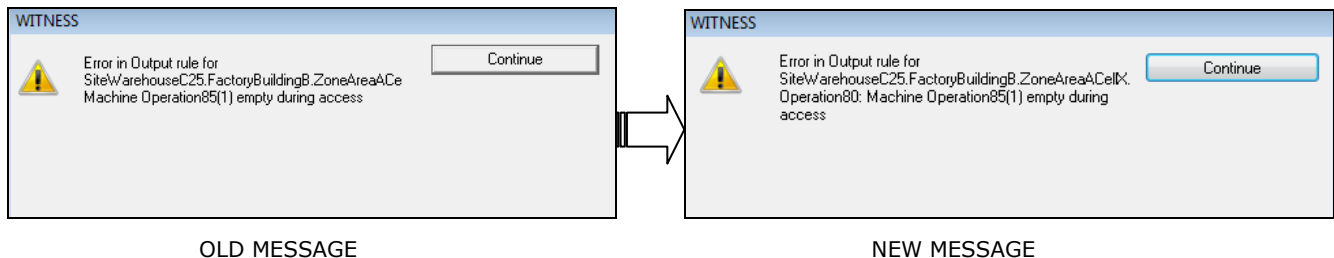
An example in the interact box



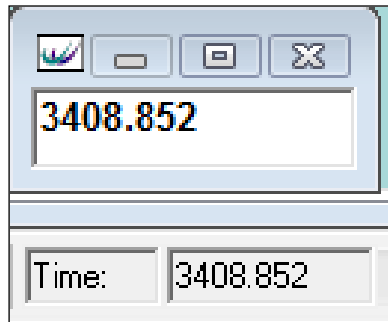
Becomes



An example of better error messaging

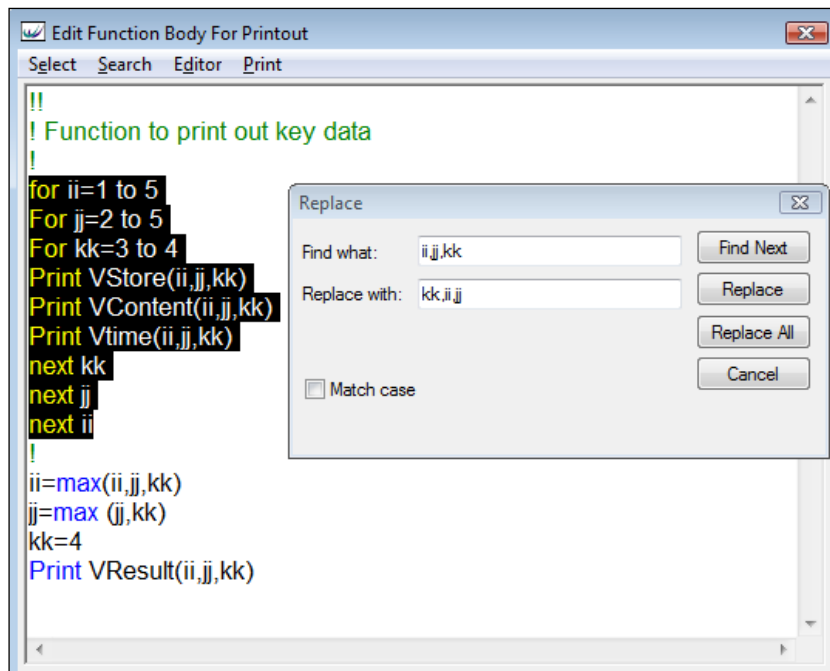


Time displays to 3 decimal places



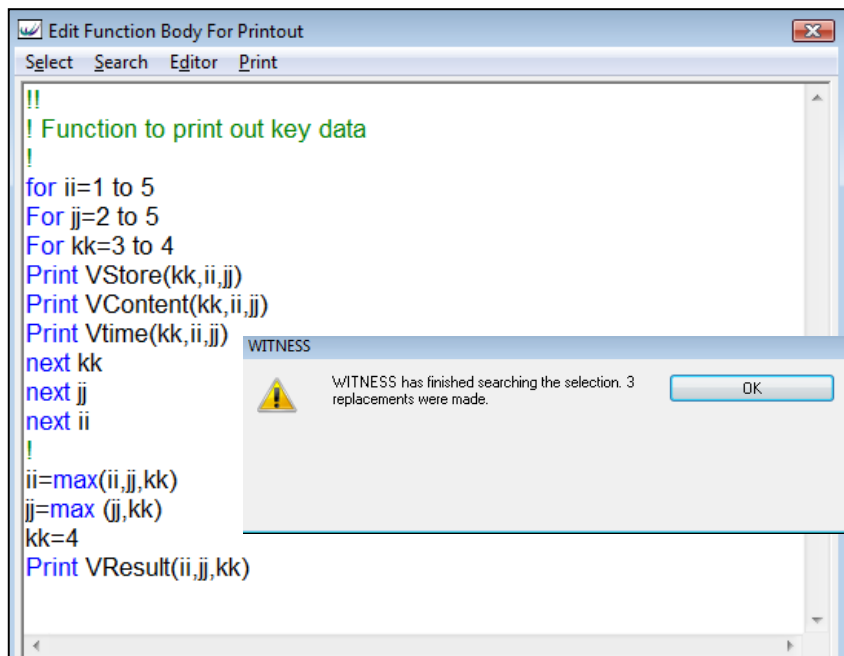
This is a general increase in the granularity of the time display in the toolbar and in the time window when the decimal display option is chosen.

Improved Replace functionality in Actions



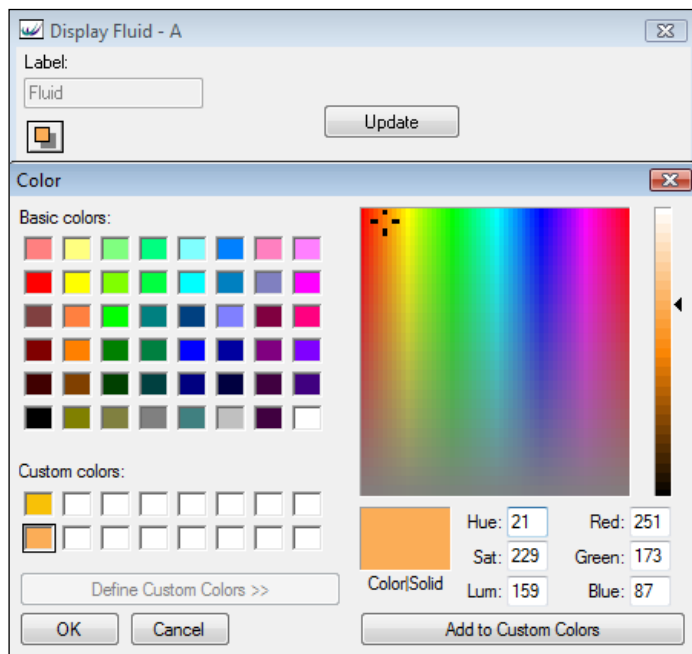
When the Replace option is chosen from the Search menu in any actions box it now takes more notice of the selection of code made.

In this example some of the code in the actions is selected in black. When the Replace All option is chosen just the code in the selection is changed as overleaf.



As you can see WITNESS now also reports on the number of changes made.

Full RGB color definition for fluids



A full range of colors is now available for fluid displays. Simple set from the color palette on the fluid display dialog and optionally set on tanks and processor dialogs on input and output fluid change dialogs.

For the first time Orange liquids!!



For the first time access to the WITNESS Event Queue

This is an exciting new development for WITNESS – one that may lead to all manner of new approaches to modelling. For the first time there is access to the event queue and the timings in the event queue for machine events.

The time of any scheduled end of cycle, planned breakdown, end of repair and end of setup can be accessed.

Not only that but it can be changed too.

Therefore

- If during a breakdown repair an extra resource becomes available the repair time can be shortened to take account of the extra available manpower.
- If during a voyage there a storm whips up at sea, the timing of the voyage can be increased at that time to take account of the delay

There are 4 new functions that can be used:

1. **GetEventCount(Element Name)**

Returns an integer number of events scheduled against a machine

In WITNESS is it possible for more than one event to be scheduled against an element at any one time. For example an end of cycle event may be scheduled but a breakdown event may also be scheduled.

A single machine may have five separate breakdown events scheduled and an end of setup event.

The situation is complicated by the fact that WITNESS breakdowns can be have a flag set that only checks for breakdowns at the start of a cycle. These events are not scheduled a long time in advance but do however leave possibilities of multiple scheduled events at some time in the model.

Note that the element name **MUST** include an index number – even if the quantity of the machine is 1.

EXAMPLE: `II = GetEventCount(MachineA(1))`

2. **GetEventTime(Element Name, Event Index)**

Returns a real number – the time of the event specified by the index value

Again the element name **MUST** include an index number – even if the quantity of the machine is 1.

EXAMPLE: `RTIM=GetEventTime(MachineA(1), 2)`

3. **GetEventBreakdownNo(ElementName, Event Index)**

Returns the integer number index of the breakdown (if any) of the indexed event

It is only possible to have one non-breakdown event scheduled at any time. This function will return 0 for any non-breakdown event (including repairs for a breakdown). Scheduled breakdowns will return the number of the breakdown (as defined on the machine dialog – breakdowns tab). This ensures that you know which event you are referring to.

EXAMPLE: `II = GetEventBreakdownNo (MachineA(1),2)`

The 'count' function ensures that you only refer to event indexes which exist.

4. **SetEventTime(Element Name, Event Index, Time Expression,)**

This sets a new time for the specified event – it is a void function in that you do NOT need to put anything before it with an equals sign.

EXAMPLE: `SetEventTime(MachineA(1),1,TIME+10)`

This will change the scheduled event (index number 1) for MachineA to a time ten time units from now.

An invalid time expression, e.g. one that has already occurred, will create a run time error in the model.

Note that for many models (those without particular types of breakdown) it may be possible to assume that the first event is the one of interest. i.e. the end of cycle, end of repair or end of setup.

Schedule and De-schedule New events

In addition to being able to change timings for machine events this latest release also allows the scheduling of NEW events. The type of event that can be scheduled is one that will run a section of actions code at a specified time in the future. As this action can also schedule an action interesting 'chains' of events can be set in place.

This again is an exciting development with much modelling applicability. For example a tank can set a check event each minute to see whether a flow rate needs adjustment, a report can be generated at a key interval without the need for dummy simulation elements, parts waiting for a machine can decide after x minutes of a breakdown whether to wait for repair or divert elsewhere, etc, etc.

There are two new functions – one to schedule these events and a corresponding De-schedule function.

1. ScheduleExpression(Tag String, Actions String, Time)

This schedules an event that will be labelled with the tag string in the events list at the time specified.

An invalid time expression, e.g. one that has already occurred, will create a run time error in the model.

The actions string can be an immediate action OR a function name in which case all the actions in the function will be run at the time specified.

EXAMPLE: `ScheduleExpression ("Event to add one","II=II+1",43)`

This schedules an event called "Event to add one" at time 43. In this example an integer variable II will be incremented at that time.

2. DescheduleExpression(Tag String, Actions String, Time)

This function will deschedule an event with the appropriate tag string name.

Please note that only actions that have been scheduled with ScheduleExpression function can be descheduled in this way.

EXAMPLE: `DescheduleExpression ("Event to add one")`

The ability to add, move and delete sensor positions on conveyors by functions

There are five new functions that apply to sensors on Continuous conveyors.

These allow the manipulation of sensors in actions code. This would allow for example the configuration of sensor positions to be set differently for different experiments as defined in a data file.

AddSensor – allows sensors to be added

DeleteSensorByIndex – allows a specified sensor to be deleted

GetNumSensors – returns the number of sensors on a conveyor

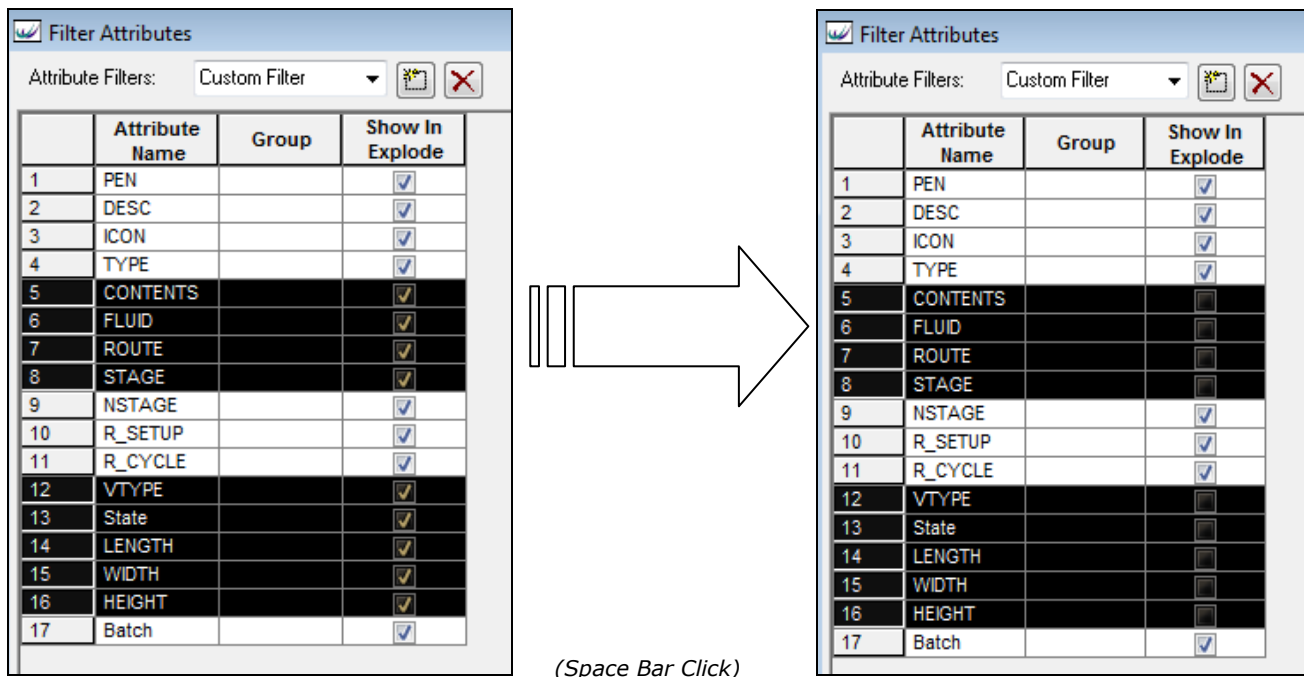
GetSensorPosByIndex – returns the position of the specified sensor

MoveSensorByIndex – moves the position of the specified sensor to a new position

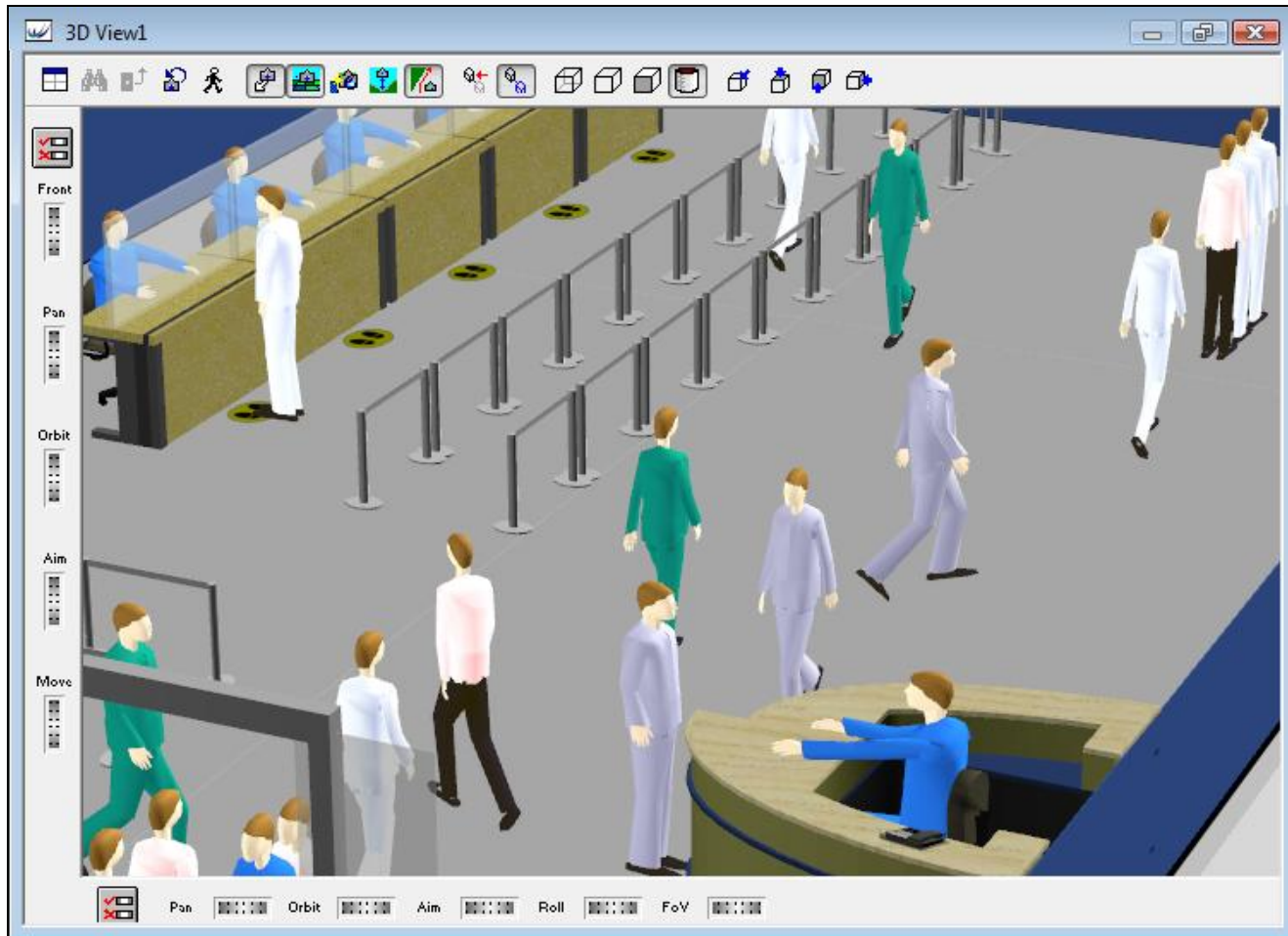
For the full detail on these functions please reference the online help system.

Multiple Select and Change for attributes in explode report filters

In the Attribute Filter on the Explode report there is now easier multiple selection of attributes. Now multiple lines may be selected (click or click/drag and using Ctrl and Shift too) and a single press on the space bar will toggle the whole of the selection as shown below.



New options for VR animations



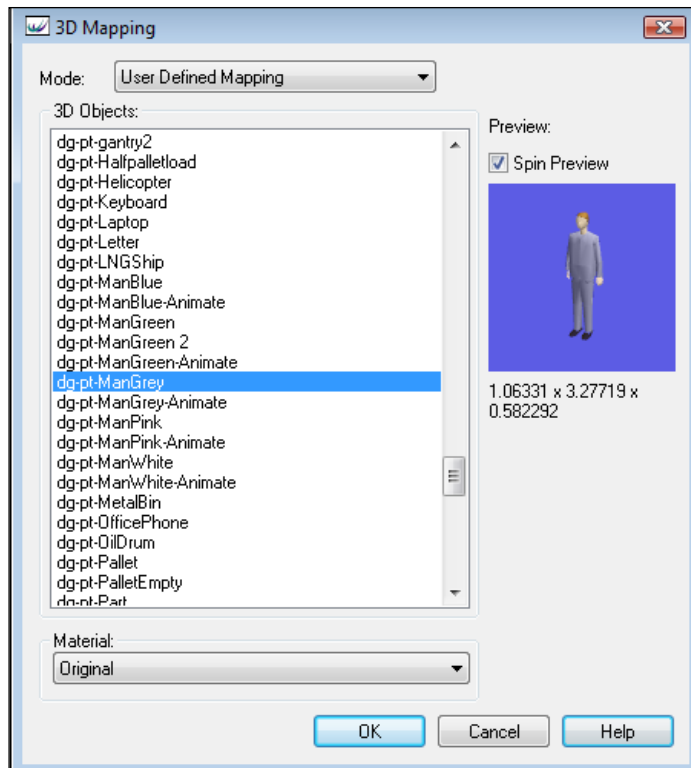
(A screenshot from a new model called *BankQuick3D* where people walk when they move on paths and also the icons for the staff at the desks change to show the staff only when they are on shift. All users of WITNESS may view this model by opening *BankQuick3D.mod* and using the *Model/Quick3D* menu command)

There are two NEW options for animation in a VR view

1. New VR automatic actions on paths enabling 'Walking people' and more

In Mantra4D two copies of each geometry need to be created – one with the name "-Animate" at the end of the name. E.g. **dg-pt-man** and **dg-pt-man-Animate**.

In WITNESS in the 3D selection dialogs (whether from the picture gallery or the individual style) select the name without animate and the animate version (with actions attached) will automatically be set to be substituted when the element is on a path. This works with both parts and labor elements. Remember to set a plugin update interval (from the model/options menu on the plugins tab) in order to see the animation updated properly at your choice of frame rate.



Here the selection of **dg-pt-ManGrey** will automatically make the man walk on paths – as this is the animation programmed into the **dg-pt-ManGrey-Animate** geometry.

2. New VR Part animations at any point in a model

When parts are generated in a model they now automatically generate a ID for any linked VR geometry. This ID can be used to apply an animation at any point in a model. For example a part can rotate as it passes down a conveyor – or move up or down at a vertical lift operation.

There are three functions

VRGetPartID() – returns the ID of the VR representation for the currently referenced part

VRAddActToID (Integer ID, Name of action) – adds the specified action (string) to the VR ID for the part

VRRemActFromID (Integer ID) – removes any added action from the specified VR ID for the part

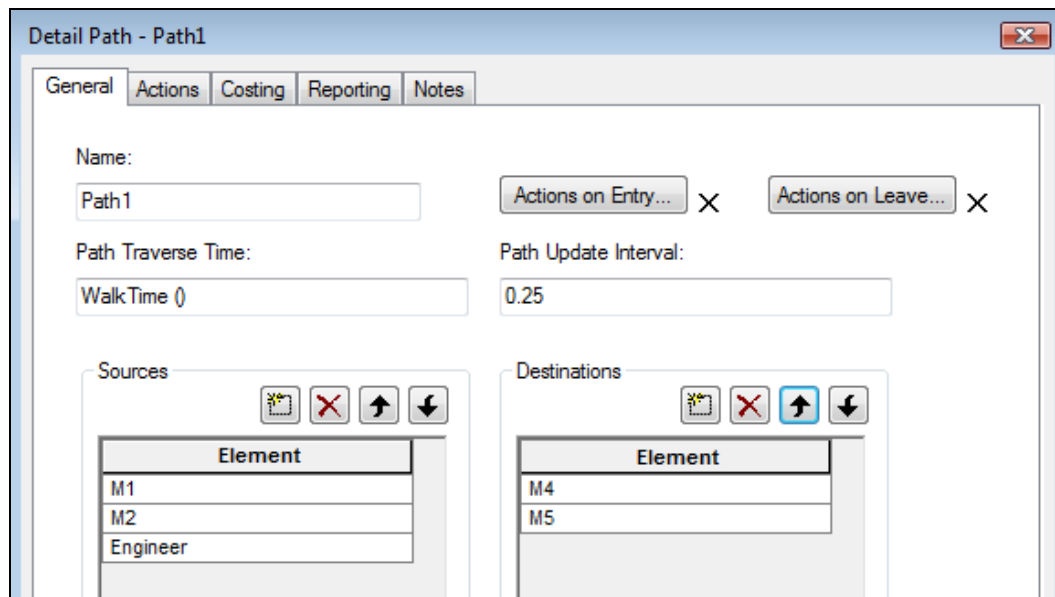
Major improvements to path definition and use

This release contains a major upgrade of path functionality in a number of areas:



- a) Multiple Sources and Multiple Destinations
- b) New source and destination functions for paths
- c) Faster calculation of possible routes
- d) Caching of routes in memory and in file saves

a) Multiple Sources and Multiple Destinations

Path elements can now be defined with multiple sources and multiple destinations. This allows in many cases path networks to be defined with many fewer paths than before – quicker and more convenient.



As can be seen in this example this path has been defined with 3 sources and 2 destinations.

Rows are added to the grid as elsewhere in WITNESS using the  button and deleted using 

Selections are made using the pull down lists in each grid position

A single path can now show and model the movement between two banks of 3 machines where 9 may have been used before.

b) New source and destination functions for paths

There are two new functions to help set timings and more

PathSource() and **PathDestination()**

These two functions can only be used in context – i.e. in the actions on entry or leave for a path element and will return the name of the element that the particular part OR Labor element is travelling to or from (local to this path).

c) Faster calculation of possible routes

When path routes are defined WITNESS processes them to create a list of all possible routes from each defined source to each defined destination. Networks can be complex and this calculation can be significant. In this release the algorithm has been reworked to rule out routes that travel along a selected path one way and then another – which is clearly not an efficient route. In this way the calculation is much faster than before.

d) Caching of routes in memory and in file saves

In the previous release routes were always recalculated whenever a model run was begun – in order to ensure an up-to-date set of routes. This is now done selectively whenever routes are changed but not otherwise. In addition this information is stored in the MOD and SIM file save formats.

It is important that the distinction is made between the calculation of routes described here and the automatic shortest route calculations performed in WITNESS as the model runs. The calculation described here merely creates a list of possible routes from A to B. These options are then used as the model runs to evaluate shortest routes at the required time.

New direct output to Excel of the Random number usage report



The random number usage report is obtained using the toolbar button or via the **Report/Random Numbers** menu option.

It looks like this:

Stream,Substream	Usage	Antithetic	Initial skip	No samples	Mean	St. Dev.	Min	Max
1034,1	Inter arrival time for GreenPart	No	0	1898	0.509847	0.291276	0.000661	0.999931
1036,1	Cycle time for Annealer	No	0	2209	0.511540	0.289884	0.000233	0.999858
1048,1	Inter arrival time for NoxiousPart	No	0	330	0.516837	0.299109	0.002082	0.994570
1068,1	Repair time 1 for Annealer	No	0	75	0.494522	0.308275	0.002710	0.992918
1076,1	Breakdown interval 1 for Annealer	No	0	76	0.490154	0.313974	0.000566	0.997020

The new option in this release is an easy way to output this report to Excel. This may facilitate analysis of the random steams used and satisfy a modeller that different parts of the model have had sufficient traffic or sampling.

In this latest release there is a new function

XLReportRandomNumbers(XL File Name,Sheet Name, Start Cell)

All parameters are string parameters

This outputs the entire grid above to the specified sheet.

EXAMPLE: XLReportRandomNumbers ("book9.xls","Sheet1","B2")

This will output the report as shown below beginning at cell B2 on the specified sheet in the specified file.

	A	B	C	D	E	F	G	H	I	J
1	Report									
	Here in B2									
2		Stream,Substream	Usage	Antithetic	Initial skip	No samples	Mean	St. Dev.	Min	Max
3		1034,1	Inter arrival time for GreenPart	No	0	571	0.5031594	0.2917591	0.0032908	0.9999306
4		1036,1	Cycle time for Annealer	No	0	643	0.5044399	0.2853977	0.0020296	0.9992184
5		1048,1	Inter arrival time for NoxiousPart	No	0	97	0.5702448	0.2868256	0.0065999	0.9944564
6		1068,1	Repair time 1 for Annealer	No	0	21	0.3817084	0.27838	0.0602275	0.8773796
7		1076,1	Breakdown interval 1 for Annealer	No	0	22	0.536013	0.3080202	0.1269383	0.9925843

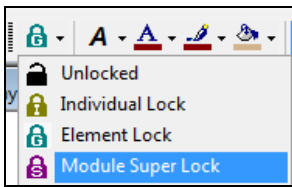
(here we show xls files – but as elsewhere in WITNESS xlsx formats are fine too).

SIM files now save window status when saved at the end of experimental runs

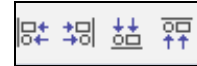
When SIM files are saved at the end of experimental runs from the Model/Experiment menu in WITNESS the open windows in the model at the start of the run are maintained in the SIM files. Previously all windows were closed.

Improved Module Superlock and group graphics alignment

This latest release includes more natural levels of graphical locking and alignment. The four modes remain the same but offer more consistency.

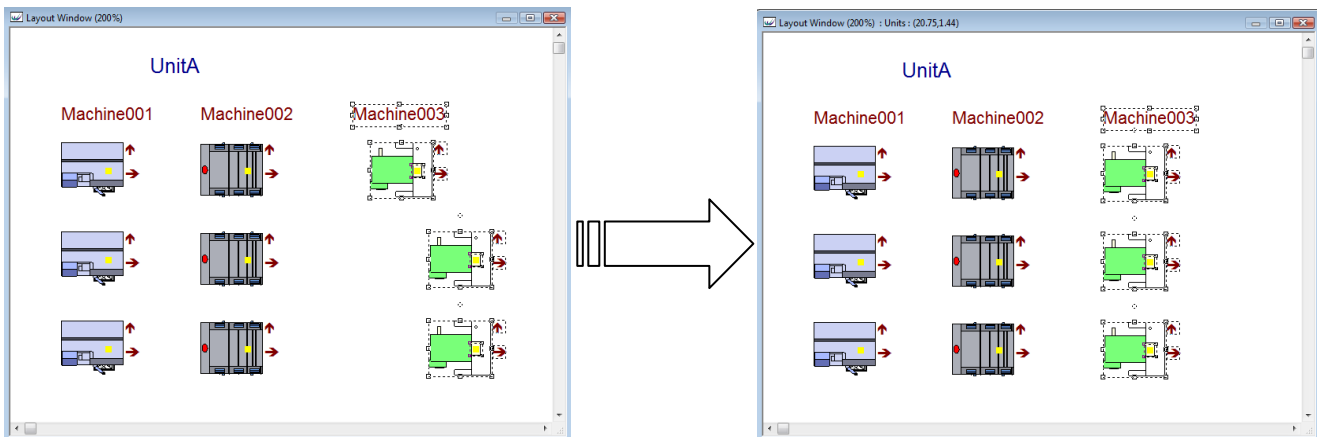


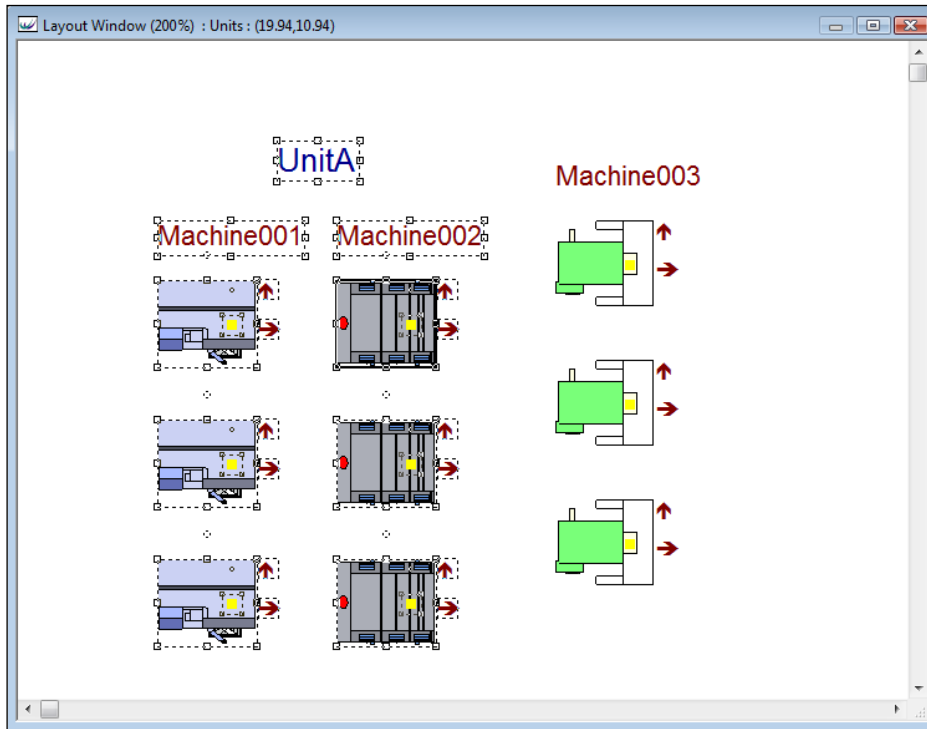
Module Super Lock for the first time locks a whole module when a child element is selected (this includes elements at the top level too).



The selections are treated as 'groups' at each level and the alignment buttons align to the border of the first selected item.

The example below shows individual lock selection for this group of one machines with a quantity of 3. With the display items chosen in top down order (in this case with a net) all the machine display items retain their individual layout but align with the first chosen display item – the name.





With Module Superlock chosen all the display items outlined are selected and move whichever of the individual items are clicked on.

Further VR Improvements

Two items that improve the running of VR models are included in this release.

1. 3D window update control

If the Model/Options/Plugin interval is set this will affect the updating of a model 3D display. In previous releases this option added in extra updates (for animations only) at the set intervals. In this release this update interval is used as the only time that the 3D window is updated in normal model running. Therefore larger intervals means less updating of the 3D display and a faster representation is achieved.

2. Walk Speed Adjustment


In this release the 3D window walk speed range has been made wider. 3D walks (in zero simulation time) can now be much slower and faster as desired.

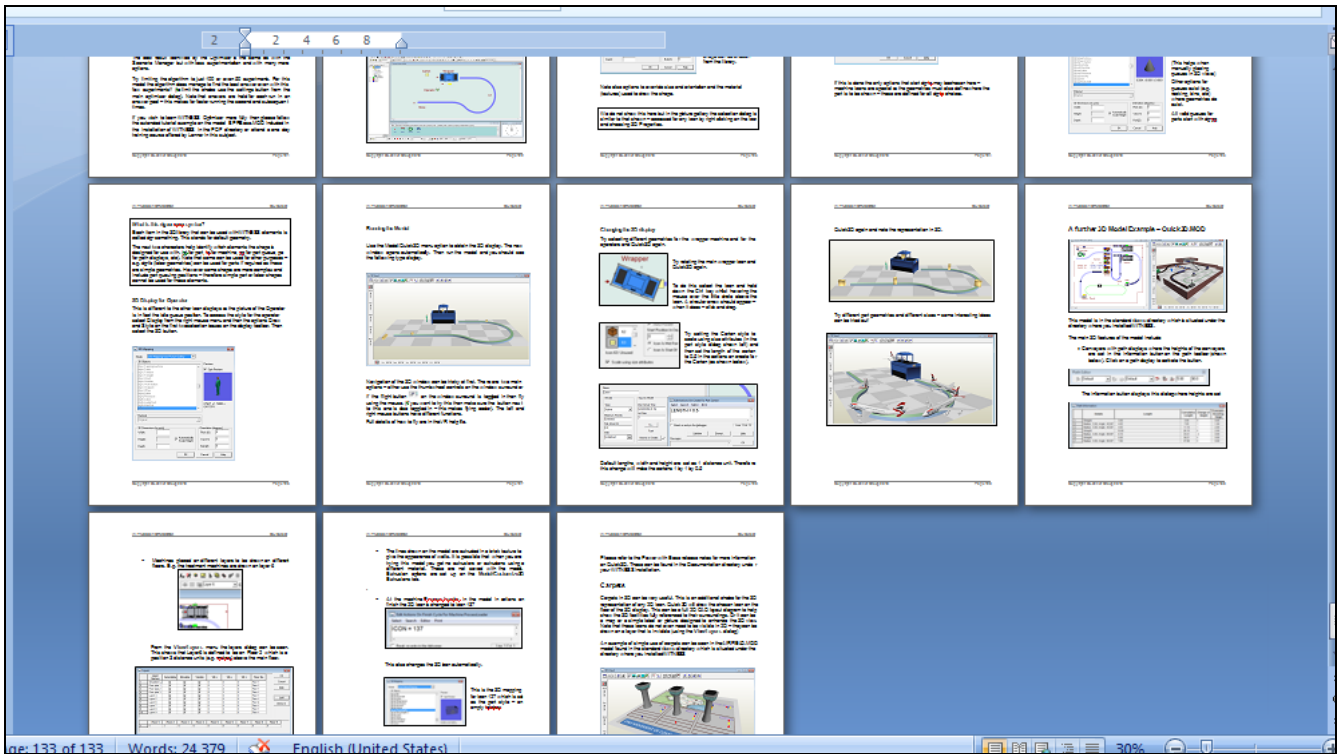
Tip: if 3D walk is on it is better to turn off any 2D walk when the 3D window is being viewed. 2D and 3D walks are displayed consecutively and not concurrently – therefore 2D walks cause delays and stuttering in the 3D display.

New Workbook

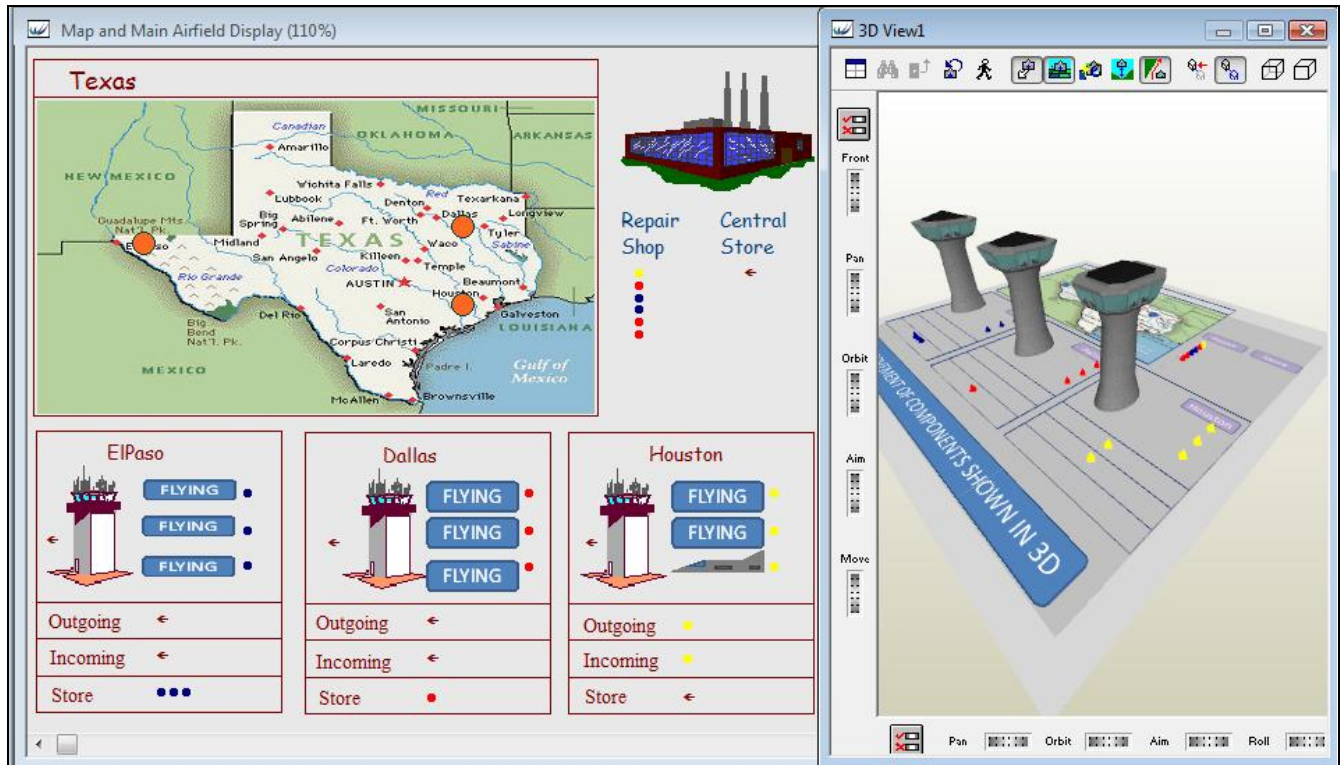
The latest release introduces a new version of the WITNESS Workbook. This can be found in the Demo/Tutorial Directory under your WITNESS installation.

This latest release includes a new chapter on Quick3D.

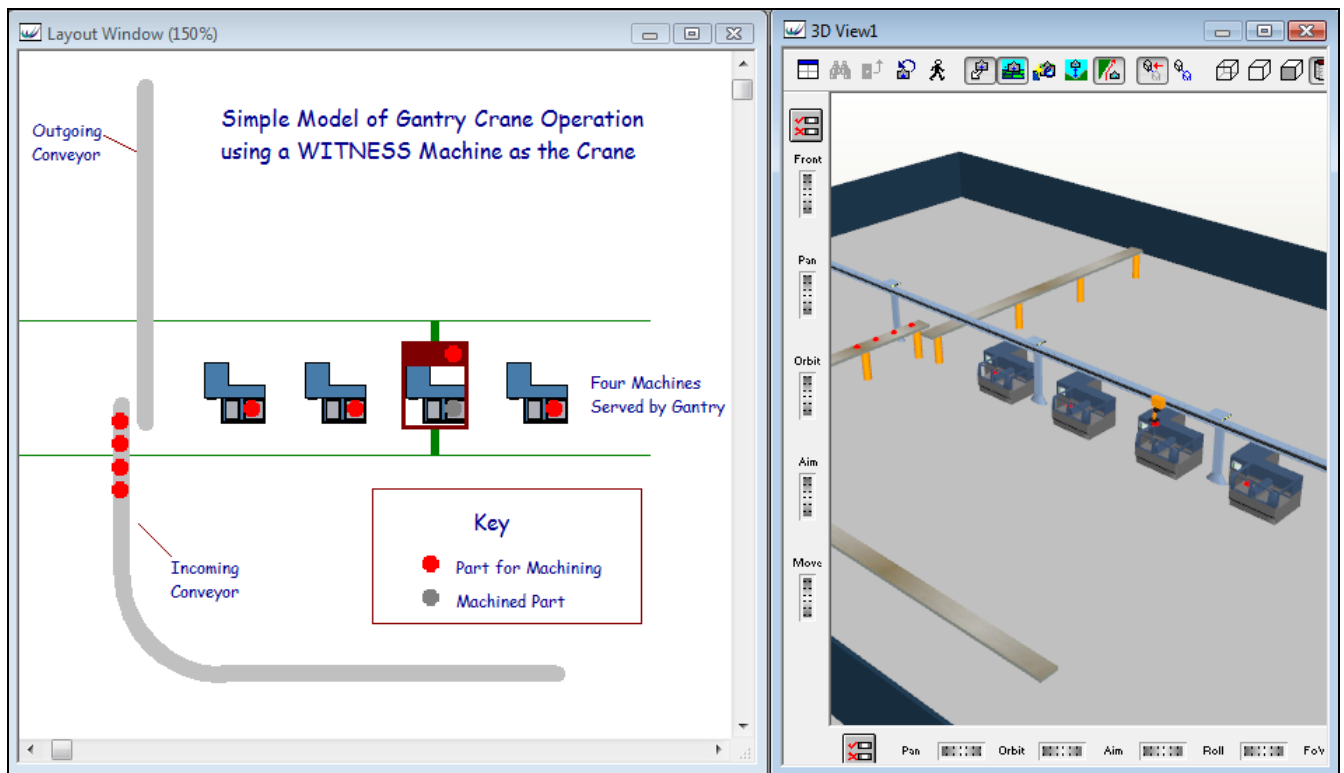
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Many demonstration models are also upgraded (for example Airfield.mod shown below). There is also a new example model of a crane transfer process using a multi cycle machine to model the crane including crane movement using SETPOSN.



Upgraded Airfield model



New Crane Transfer Model