WITNESS

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Tipus De Fitxers (I)

- ***.Mod: conté els elements del model. No conté el estat del model.**
- ***.Sim: conté el estat del model, així com el model en si.**
- *.Des: conté una col·lecció de elements de disseny.
- *.Lst: fitxer text que conté una completa descripció de tota la informació en el model.
  - Per transferir models entre diferents ordinadors.
  - Per produir documentació sobre el model.

Tipus De Fitxers (II)

- *.Sub: una part del model que es vol guardar com a fitxer a part.
- *.Mdl: conté els elements de un módul de witness.
  - Password,
- *.Dxf: fitxer de autocad 2d.
- *.Wcl: comandes per construir i executar un model automàticament.

Elements (I): Bàsics

- **Part**: es mouen de forma individual a través del model. Típicament les entitats.
- **Buffer**: per emmagatzemar parts.
- **Machine**: elements que ens permeten representar qualsevol cosa que agafa parts d'alguna part, i les envia a ala seva propera destinació.
- **Conveyor**: mouen parts de un punt fixat del model a una altre amb un període de temps de retard.

Elements (II): Bàsics

- **Labor**: un recurs necessari per poder realitzar algunes operacions.
- **Vehicle**: representen camions, trens, o qualsevol cosa que transporti parts.
- **Track**: els camins que segueixen els vehicles.
- **Modules**: contenen un grup de elements que han estat gravats junts.

Elements (III): Continus

- **Fluid:** Representen els fluids que passen a través del sistema.
- **Tanks:** elements en els que els fluids es poden guardar.
- **Processors:** Són el equivalent a les màquines.
- **Pipes:** Connecten els Processors i els Tanks.

Elements (IV): Sistemes de Transport

- **Networks**: Per agrupar Sections, Carriers i Stations.
- **Sections**: Camins per els que els Carriers es mouen.
- **Carriers**: Porten les Parts de una Station a una altra a través de les Sections.
- **Stations**: Punt al principi o al final de les seccions, en els que pots executar accions o carregar parts en un Carrier.

Elements Lògics

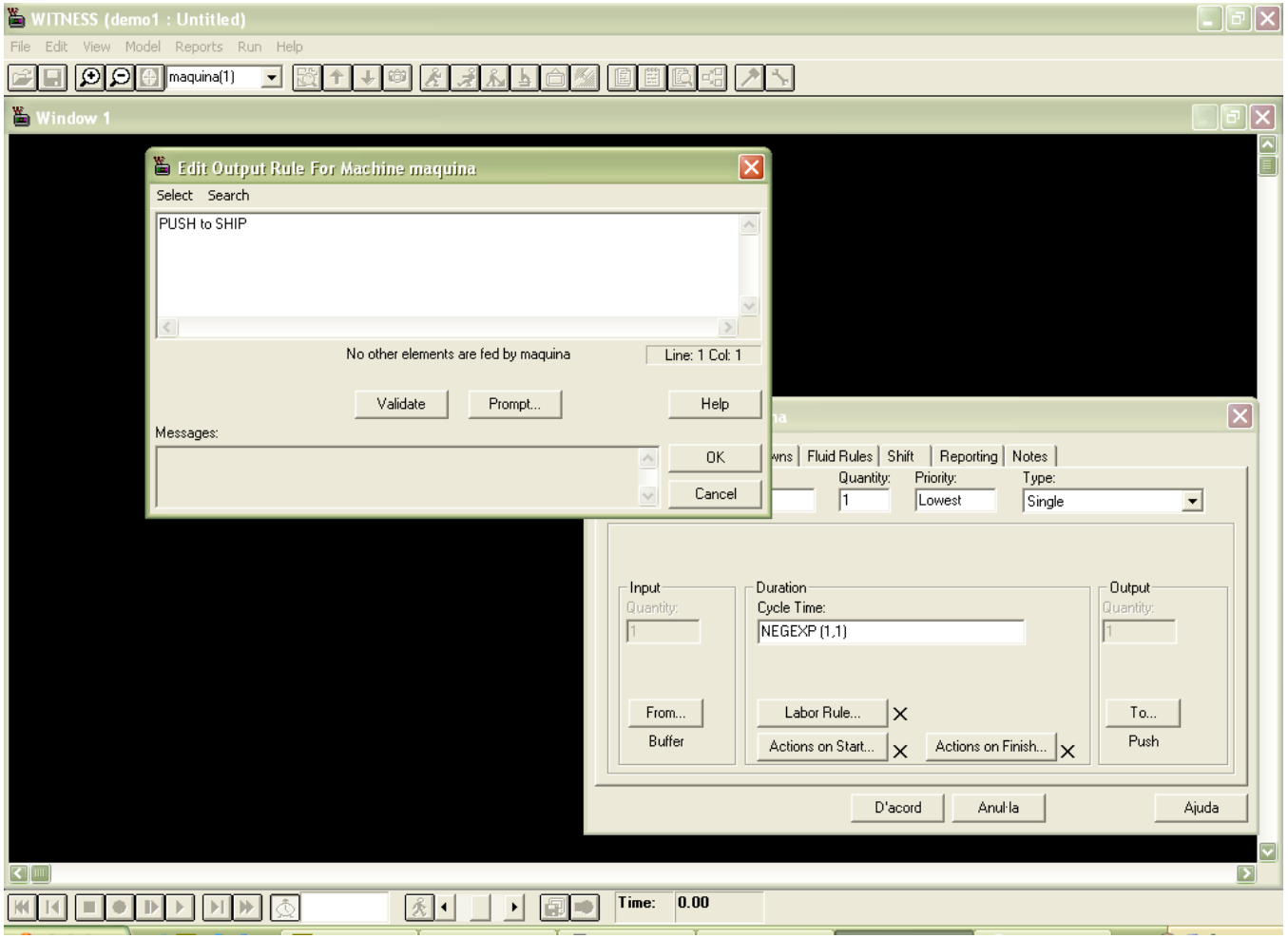
- **Attributes:** Atributs de les entitats i dels operaris.
- **Variables:** Permeten guardar valors aliens a cap element de la simulació.
- Distributions: Permeten generar distribuciuons pròpies
- **Files:** Fitxers, permeten llegir valors cap al model o exportar valors de la simulació.
- **Functions:** Permeten crear funcions pròpies.
- **Shifts:** Horaris

Elements lógics

- Part file:
  - Un fitxer que conté una llista de parts(entitats).
  - Per cada part en el fitxer s'especifica:
    - La mida del lot (cuantes parts arriben alhora). Els atributs per cada part (per exemple, icona, color i mira)
    - El temps d'arribada de cada part al model.

Regles

- Permeten definir el encaminament de les entitats.



Regles De In/Out

- **Wait:** quant un element no participa activament de cap procés a la peça.
- **Push, Pull:** la regla més simple de entrada és la regla Pull. La més simple de sortida és la Push.
  - **PULL from MACHINE,** provoca que una entitat sigui agafada de la maquina identificada per MACHINE.
  - **PUSH to MACHINE,** provoca que una entitat sigui enviada a MACHINE.
  - Són les regles bàsiques de Witness.

Regles De In/Out

- **Least, most:** Poden ser aplicades per a elements discrets i elements continus.
  - LEAST PARTS, agafa o exporta peces del element que conté menys peces.
  - LEAST FREE, agafa o exporta del element que té menys espai lliure.
  - MOST PARTS, dels elements que tenen mes peces.
  - MOST FREE, dels elements que tenen mes espai lliure.

Regles de In/Out

- **Select:** SELECT {on} value element {, element ...}
  - Value: enter que indica on saltar.
  - Element: llista de'elements on saltar.

Regles De In/Out

- Match: Per esperar una determinada peça.
  - MATCH/ANY<location list> Permet a la màquina seleccionar qualsevol part.
  - MATCH/ATTRIBUTE<attribute_name.
  - {(<attribute_index_exp>)} <location list>: Selecciona només aquelles peces que tenen un valor en determinat atribut.
  - MATCH/CONDITION <condition> <location list>: Selecciona aquelles peces que compleixen certes condicions, normalment basades en atributs.
  - <location list>:
    - <location1> { #qty1} {[AND | OR] <location2>{#qty2}} {...}.

Regles De In/Out

- Sequence: quan el enrutament necessita una seqüència cíclica.
  - SEQUENCE/WAIT element#(qty){,element#(qty)...}.
    - Espera fins que la peça pot entrar.
  - SEQUENCE/NEXT element#(qty){,element#(qty)...}.
    - Si no pot aconseguir la peça pasa al següent element.
  - SEQUENCE/RESET element#(qty){,element#(qty)...}.
    - Si falla algun element torna al principi.
- Percent: PERCENT /57 MEN 47, WOMEN 53.
  - /57 (stream [0-1000]).
  - MEN, WOMEN part.

Regles De In/Out

- Buffer: Per indicar un buffer de entrada o de sortida a la màquina.
  - BUFFER 10.
  - 10 és la capacitat.

Regles per element

Element {AT position}: Attribute = Value

- **Element**: Es el nom del element de Witness que pot contenir les parts. Position: Es la posició de la "part" requerida del element. Position 1 es en el front, Posistion 2 es la segona posició, i així succesivament. Position 0 es la posició de la cua. Si no s'especifica cap posició, Witness assumeix la primera posició.
- **Attribute**: Es el nom del atribut de Witness.
- **Value**: Es el valor, del tipus apropiat, (es a dir, integer, real, name o string).
- Per exemple, per posar el atribut "color" d'una caixa que ocupa la tercera posició en la cinta "belt1" a vermell, caldria incloure la següent acció:
  - **BELT1 AT 3: COLOR = VERMELL**

Llocs especials

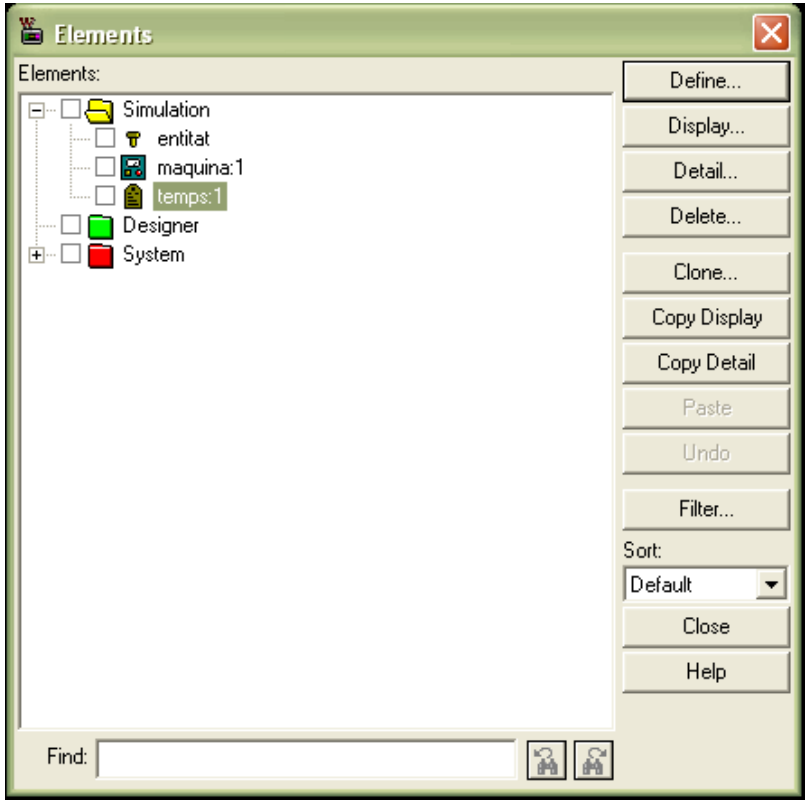
- Bàsicament per introduïr i eliminar parts del model.
- Llocs d'entrada:
  - PULL PECA from WORLD

Llocs especials (sortida)

- SHIP: Per destruir la peça.
- SCRAP: Trencar la peça.
- ASSEMBLE: Incloure una peça dintre de una altra. Per fer assemblatge.
- WASTE: Contaminar el fluid.
- CHANGED: Els fluids poden canviar.
- ROUTE: Push a la propera destinació de la ruta.

Diàleg elements

- **Define:** Permet crear un nou element.
- **Detail:** Mostra les finestres de detall de cada un dels elements.
- **Delete:** Per eliminar els objectes seleccionats del arbre.
- **Display:** Per canviar la forma com els elements es mostren en el model.



Diàleg elements

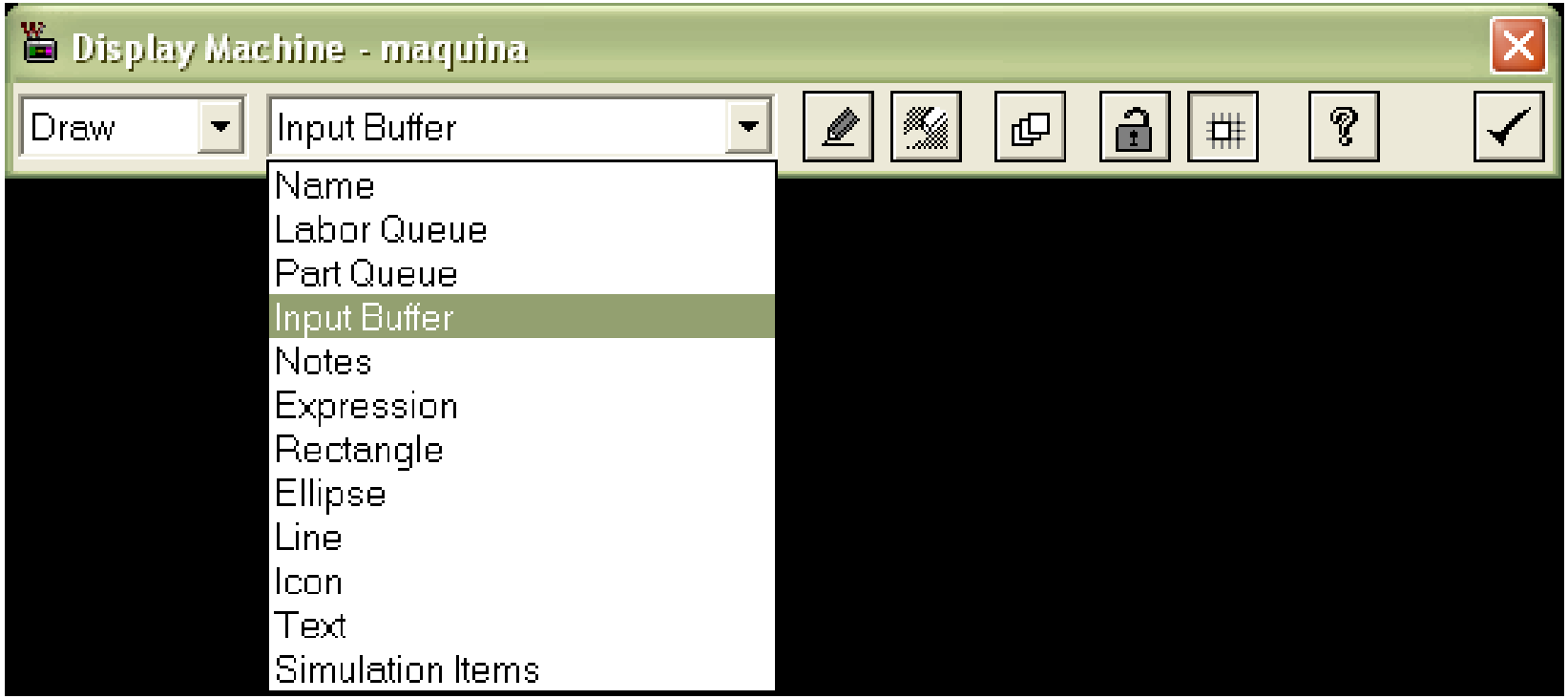
- **Clone**: Crea rèpliques exactes dels objectes de simulació seleccionats:
  - Robot1, robot2...
- **Copy Display**: Per copiar la forma de representar el element.
- **Copy Detail**: Per copiar les característiques del element.
- Filter, Find, Sort,...

Elements del arbre

- **Elements de simulació:** Elements que el dissenyador ha incorporat al model.
- **Elements de disseny:** Elements preparats que es poden emprar en el model.
- **Elements del sistema:** Time, World, Ship, Scrap, Assemble, None, Route, i Backdrop.

Display Bar

- Per poder mostrar característiques de tots els elements del Model.

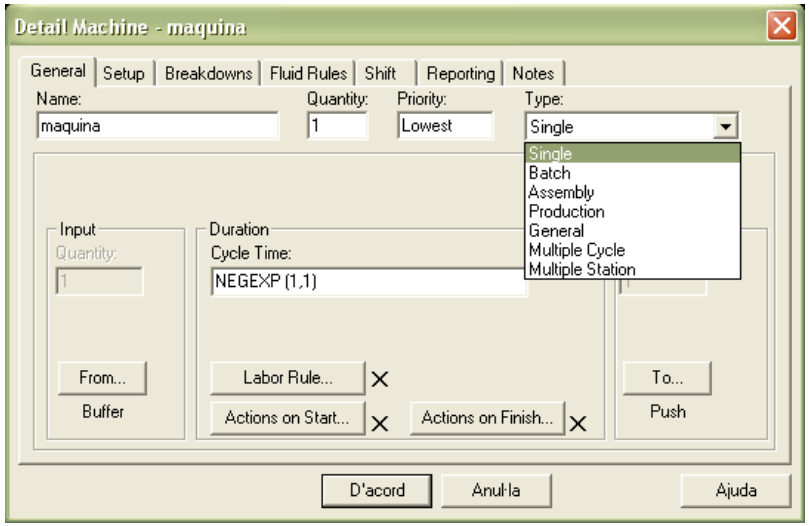


Parts

- **Passives**: permeten donar infinits elements al sistema.
- **Actives**: un nombre prefixat definides d'una forma.
- **Actives amb patró**: arriben al model a partir de un patró.

Machine (I)

- **Single:** maquina que processa una part per unitat de temps.
- **Batch:** maquina que processa un conjunt d'entitats per unitat de temps.
- **Assembly:** maquina que agafa un nombre de parts i treu únicament una.



Machine (I)

- **Production:** maquina que agafa un única part i produeix n parts.
- **General:** màquina que agafa un conjunt de parts i treu un conjunt de parts. El nombre de parts de sortida pot ser diferent del mombre de parts de entrada.

Machine (I)

- **Multi-cycle**: màquina que permet definir diferents cicles de treball.
- **Multi-station**: màquina que treballa esencialment com un conjunt de màquines unides en série. Es pot especificar el nombre de posicions, i cada part es mou de una posició a una altra. A més cap altra part progresarà fins a la següent estació fins que una part estigui disponible per alimentar l'estació prèvia.

Buffer (I)

- Es pot especificar en quina posició encuem els elements:
  - **Rear of the buffer**: i.e. La primera posició no ocupada.
  - **Front of the buffer**: , i.e. La primera posició en el buffer. Les altres parts es mouran cap a darrera per acomodar les noves arribades.

Buffer (II)

- En una posició específica (**opció At**): At <expressió>, on aquesta expressió serà una expressió vàlida que retronarà un valor enter entre 1 (el front) i la capacitat del buffer. El darrera del buffer pot ser indicat per 0.
- Subjecte a una **ordenació**: a través de un atribut es poden ordenar les parts i les adicions en ordre ascendent o descendent.

Funcions de Witness de tipo enter

- NPARTS(element): retorna el nombre de entitats que estan en un determinat element.
- NAVAIL(labor): indica el nombre de operaris disponibles.
- MSGDLG(title, icon_id, dialog_text, button_text, default_button) : Permet mostrar una finestra de diàleg.

Funcions de tipus real

- TIME: Retorna el temps de simulació.
- NORMAL(mean,SD,prns): retorna una distribució normal de μ=mean i de σ=SD. Cal passar-li prns que serà la tira de nombres aleatoris.
- NEGEXP(mean,prns): Retorna una distribució exponencial.
- UNIFORM(min,max,prns): Distribució uniforme.
- RANDOM(prns): genera un nombre aleatori.

Funcions de Witness de tipo String

- INPUTDLG(title, dialog_text,field_default, field_width, type_id) : Permet agafar una dada introduïda per el usuari.
- STR(number): Conversió de nombre a cadena.

Exemple MM1

- Generar un exemple en el que tenim un únic lloc de servei al que arriben elements segons una exponencial de temps entre arribades de 2.
- El temps de servei es de una unitat de temps, també segons una exponencial.
  - Exemple demo1.mdl

Conveyor (I)

- **Fixed conveyors:** Cintes fixes que mantenen una distància constant entre les parts que hi entren. Si la cinta s'atura, la distància no varia.

Conveyor (II)

- **Queuing conveyors:** Cintes del tipus “de rodets”, que permeten que les parts s’acumulin. Si la cinta es bloqueja les parts continuen el seu moviment fins que la cinta s’omple.

Exemple

- Màquina simple, agafa peces i les processa.
  - Temps mitja 2 seg segons una exponencial.
- Buffer. Acumula les peces. Capacitat màxima 20 peces.
- Cinta. Capacitat 10 elements. Fixes
  - Modificar la velocitat (IndexTime) 10 i 1.
  - Demo2.mdl

Avaries

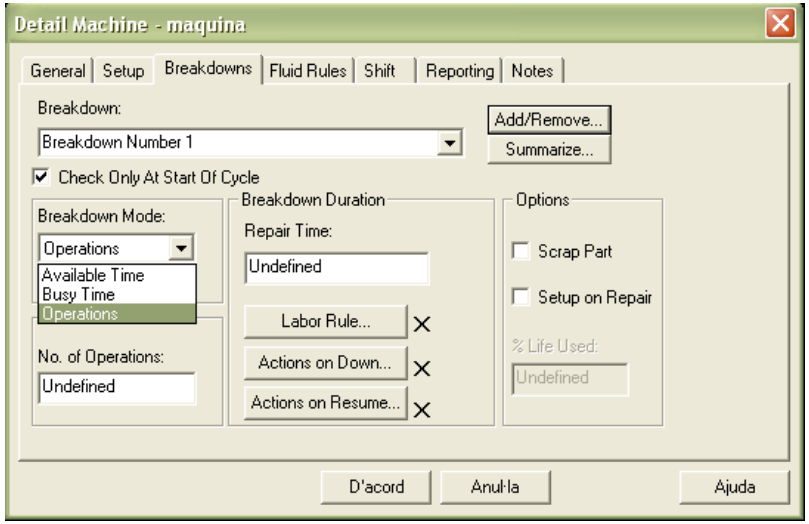
- **Model d'avaries:** Interval entre avaries.
- **Model de reparacions:** temps per reparar-la i recursos necessaris.
- **Avaries interactives:** forçar avaries o reparacions.

Avaries Maquines (Definició)

- Es poden definir les averies a partir dels següents temps entre averies.
  - **Temps disponible**: Pren en consideració tots els estats de la màquina, excepte quan està fora de horari. Usat per modelar **maquines que requereixen manteniment** encara que no estiguin en servei.
  - **Temps ocupat**: Temps acumulatiu de quant la màquina està en estat ocupat. Màquines que necessiten un **reajustament periòdic**.
  - **Nombre d'operacions**: Pren nota del nombre d'operacions fetes. Màquines que es trenquen per l'ús.

Averies Maquines

- Temps entre avaries (Temps disponible, Temps Ocupat).
- Número d'operacions abans de l'avaria (Nombre d'operacions).
- El primer interval es calculat en el instant 0, fins llavors no hi han avaries, o no se saben calcular.



Averies Maquines

- **Duració:** Temps de reparació pot ser qualsevol expressió vàlida.
- **Regla de operari:** Per identificar qualsevol operari necessari per poder completar la reparació. Els operaris estan subjectes a la prioritat i la lògica de captura usual.
- **Actions on down:** Especifiquen accions que tindran lloc quan ocorre una avaria.
- **Actions on repair:** Especifiquen accions que passen quan la reparació termina.

Exemple

- Afegir a la màquina Averies per operacions.
  - Cada 15 operacions.
  - 10 de temps per reparar.
  - Demo3.mdl

Operaris I

- La regla d'operari en Witness especifica el tipus de operari (recurs) necessari per poder completar la tasca.
- Les tasques que poden requerir un operari son:
  - Màquines
  - Setup, cicle o reparació
  - Cintes
  - Reparacions
  - Canonades
  - Netejar, purgar, omplir, buidar..
  - ...

Operaris II

Una regla d'operari pot prendre les següents formes:

1. NONE
2. Labname {OR Labname...}
3. IF Condition
   Labname {OR Labname}
   {ELSE
   Labname {OR Labname}}
   ENDIF
4. IF Condition
   Labname
   ELSE
   WAIT
   ENDIF

Operaris III

- Labname ha de ser el nom de un operari DEFINIT. Seguit per el símbol "#" indica quina es la quantitat requerida.
- Es poden crear construccions del estil:

  OPERATOR#2

  or

  MAN AND WOMAN

  or

  OPERATOR OR NONE

Operaris IV

Exemples:

1. NONE

   No es requereix un operari (opció per defecte)

2. ERIC

   Es requereix una unitat del operari definit amb nom ERIC, La quantitat es de 1.

3. DOCTOR#1 AND NURSE#3

   Un doctor i tres infermeres es necessiten per poder fer la tasca.

4. BO#1 OR REGULAR#2

   Es necessita un recurs bó o dos regulars.

Operaris V

1. NOVICE AND AUTO OR EXPERT AND MANUAL

   Es necessita un NOVICE i un AUTO sinó un EXPERT i un MANUAL, NOVEIDE i AUTO es la primera opció.

2. IF NPARTS(pinta) = 2

   OPERATOR AND TOOL

   ENDIF

   Si el nombre d'entitats de pinta es de 2 es requereix OPERATOR i TOOL.

Operaris VI

```
IF X=1 OR X=2 AND Y=3
    ALF OR BERT AND FRED
ENDIF
```

- La expressió lògica es avaluada de la forma:
  - (X=1 OR X=2) AND Y=3
- La regla d'operari es avaluada:
  - ALF OR (BERT AND FRED)
  - Podem reescriure per tenir (ALF OR BERT) AND FRED:
    - ALF AND BERT OR BERT AND FRED

Exemple

- En el model anterior, es requereix un operari per poder reparar les averies.
- A més es modela també el fet que aquest mateix operari es el que treu les caixes de la cua i les posa a la cinta amb un temps distribuït segons una uniforme de 0.5 a 1 unitat de temps.
  - Demo4.mdl

Horaris (Shift)

- Es poden especificar horaris principals, per exemple **mes1**, en els que poden estar referenciats sub-horaris, per exemple **setmana1**, **setmana2**, i així successivament.

Horaris (Shift)

- Períodes horaris.
- Fins a 99 series.
- Temps treballant (on-shift time).
- Temps descansant (off-shift time).
- Temps “d’overtime”.

Horaris (Shift)

- Overtime no pot superar el temps de descans.
- Initial offset. Per al temps 0.
  - Working Time.
  - Temps de descans.
- Si hi ha període de overtime s'agafa del temps de descans.

Exemple

- La reparació necessita un operari per poder efectuar-se.
- Sempre disponible.
- Disponible amb un horari que té dos períodes:
  - 1 temps lliure a 12 altres a 0.
  - 1 temps de treball 12. Altres a 0
  - DEMO5.mdl

CALL

- CALL vehicle, load_track, unload_track,priority
  - CALL AGV, TLOAD, TULOAD, 1
- VSEARCH track {, track}
  - Taxis amb centraleta.
- work search list (vehicle control) method
  - Taxis sense centraleta.

Vehicles

- Capacitat: de parts.
- Velocitats: Per carregar i descarregar el vehicle.
- Time delay: Per simular acceleració i desceleració.
- Entry rule: PUSH to track. (on està del model).
- Actions: Aplicades al entrar.

Vehicles

- Representen els vehicles que mouen entitats per el sistema.
  - Definir vehicles.
  - Definir rutes.
  - Especificar con satisfan les demandes de transport.
    - Passive (AGV system).
    - Active (taxi).

Vehicles

- Visualitzar
  - Nom icona, descripció, número de entitats.
  - Llista de demanda.

Tracks

- Camins que segueixen els vehicles al transportar les entitats.
- Permet definir els punts en els que els vehicles es carreguen i es descarreguen o aparquen.
- Objectes unidireccionals.

Tracks (load)

- La quantitat a carregar "**Quantity to Load**" especifica quantes entitats han de ser carregades. Pot ser qualsevol expressió vàlida, o l paraula ALL per indicar que la capacitat del vehicle es el que s'usarà.
- El temps per carregar "**Time to Load**" permet especificar el temps necessari per carregar les entitats.
- La regla d'entrada "**Input Loading Rule**" pot ser especificada per detallar d'on s'obtenen les entitats. No es pot per un PUSH a un vehicle o a un track.

Tracks (Unload)

- The **Quantity to Unload** especifica quantes parts han de ser descarregades. Pot ser qualsevol expressió vàlida, o la paraula ALL, per especificar tota la capacitat del vehicle.
- El **Time to Unload** permet especificar el període de temps per descarregar.
- La **Output Unloading Rule** especifica on es descarreguen les parts. Una màquina no pot descarregar el vehicle a partir de fer PULL d'ells.

Exemple

- Afegir un buffer a la sortida.
- 2 tracks de capacitat 10
- 6 vehicles. Totes velocitats a 1.
- Al final un buffer, per veure com arriben les entitats.

Creació de Funcions

- Element function
  - Paràmetres Integer, Real, name, string.
  - Return paràmeters Integer, Real, Name, String, Void.
  - Actions: per definir el cos de la funció.

Creació de Variables

- Integer, Real, Name, String
- Si Qtt>1 és un array.

Creació De Atributs

- Integer, real, Name, String
- Per parts
  - Fixed Atr=1..10
  - Variable
- Labors [0]
  - Sempre variables
  - Labor_name: Attribute = Value
  - WORKER(3): SKILL = 1

Resultats

- TimeSeries
- Histograms
- PieCharts

TimeSeries

- Per determinar cicles.
- Proporcionen una història de un valor específic.
- Mitja.
- Desviació estàndard.

TimeSeries

- Eix Y: valors.
- Eix X: temps.
- Agafa els valors en determinats intervals.
- Línia discontínua representa els valors de Overflow.

TimeSeries

- En cada série, fins a 7
  - NPARTS (TOPS) + NPARTS (BOTTOMS) + NPARTS (SCREWS) * 0.5
- Permet la visualització dinàmica de la modificació de una variable.

Histograms

- Diagrama de barres.
- Podem modificar els valors a través de:
  - DRAWBAR.
  - Record.
  - ADDBAR.

ADDBAR

- Afegeix una barra per afegir valors.
- ADDBAR Histo_Name value Increment {color}
  - Histo_Name: Nom del histograma.
  - Value: columna a omplir
  - Increment: Increment per cada valor registrat.
  - Color: Color de la barra:

Color ADDBAR

- 0: black
- 4: blue
- 8: gray
- 12: dark blue
- 1: white
- 5: cyan
- 9: dark gray
- 13: dark cyan
- 2: red
- 6: yellow
- 10: dark red
- 14: dark yellow
- 3: green
- 7: magenta
- 11: dark green
- 15: dark magenta

RECORD

- Afegeix un valor a la barra.
- RECORD value in histogram
  - Value: Columna de histograma.
  - Histogram: A quin histograma.
- S'incrementa el valor indicat a ADDBAR.

DRAWBAR

- Dibuixa una barra.
- DRAWBAR histogram,value,height{,color}
  - Histogram: nom del histograma.
  - Value: columna.
  - Heigth: Altura a partir de la que es dibuixa en una altre color.

PieCharts

- Per mostrar els estats de les màquines.
- Es pot personalitzar per mostrar allò que vulguem.

Disseny d'experiments

- Cada experiment pot tenir diferents punts de partida.
  - Definició de "SITUATIONS"
  - Fitxer de situació: *.MOD, *.SIM
  - Fitxer de comandes *.WCL

Disseny d'experiments (II)

- Per cada experiment es defineix:
  - DURADA de una RÈPLICA.
  - DURADA del període de CÀRREGA.
  - Si tornem a començar al final de cada rèplica.

Disseny d'experiments (III)

- Definir la rèplica inicial.
- Definir el control del stream aleatori per cada rèplica.
  - Individual: Per indicar per cada rèplica el stream aleatori a usar.
  - All: Automàticament el simulador assigna streams de nombres aleatoris de forma cíclica.

Disseny d'experiments (IV)

- Reporting control: Per retornar el valor dels estadístics que haguem guardat.
  - Podem indicar cada quant guardar els estadístics.
  - Format per guardar els estadístics:
    - *.CSV
    - *.CSV múltiple, un per cada tipologia d'element.
    - Fitxer
    - Impressora
    - *.DIF
  - Podem guardar el *.SIM

Disseny d'experiments (V)

- Podem usar variables aleatòries normals o antitètiques.
- Per cada rèplica:
  - Stream a usar.
  - Offset a partir del que substituirem amb un altres stream.

Models Continus

- Fluids
- Pipes
- Processors
- Tanks

Regles Continuu

- FLOW element RATE (flow rate)
  - FLOW pipe RATE 10.0
  - Serveix com a regla de push o de pull.
  - Els fluxos

Fluids

- Arribades Actives.
  - Volum.
  - Horari.
  - Flux d'arribada.
- Arribades Passives.

Pipes

- Avaries
- Regles d'entrada i de sortida.
- Neteja.
- Capacitat.

Processors

- Similar a la màquina.
  - Definir avaries
  - Horaris
- Fluid inicial
- Processos de manteniment i neteja del ***processor***.
- Nivells de perill.

Tanks

- Tipus inicial de fluid.
- Volum inicial.
- Regles de fill, Empty, Flowing.
  - FLOW pipe RATE 10.0.
  - Flowing→ labor Rule.
- Fluid Change.
  - Canviar el fluid en entrada o en sortida.
  - Accions al canviar el fluid.

Tanks

- Netejar
  - Buit
  - Valor Canvia
  - Fluid canvia
  - Temps disponible
- Labor Rule
- Actions on Start i on End.

Tanks

- Warning Levels
  - Mostrar com a percentatge o com absolut.
  - Definir nivells i accions per cada un d'ells.
    - Al superar cap dalt.
    - Al passar cap avall.

Exemple

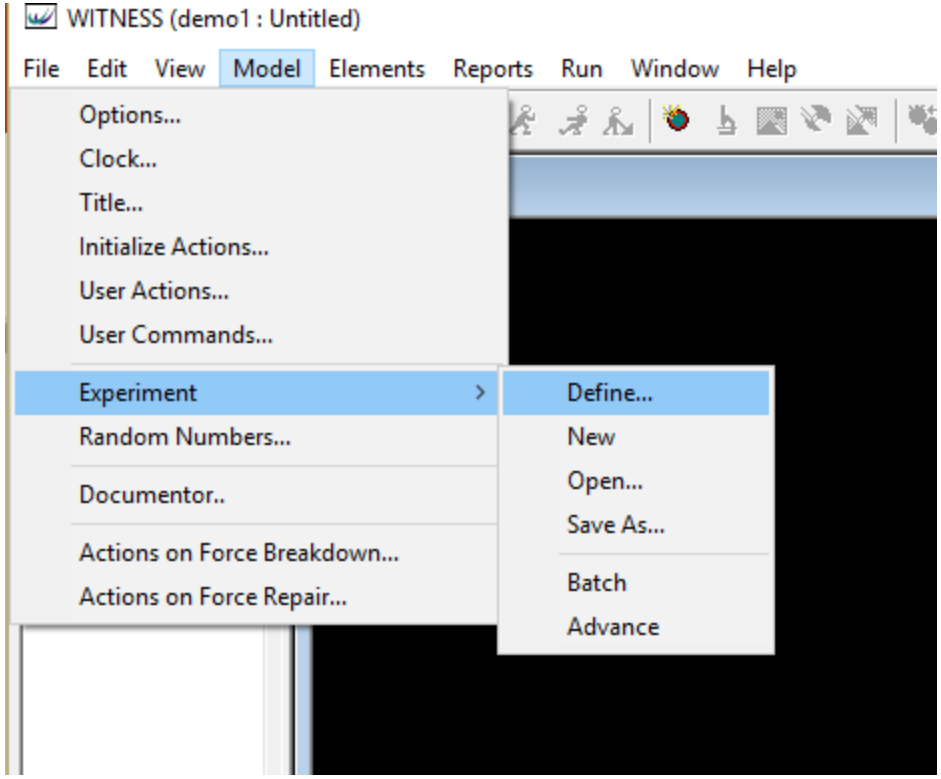
- Presa
  - Simular el comportament de una presa en la que podem tenir fins a 20000 litres, i en la que comptem inicialment amb 1000 litres.
  - Sabem que l'aigua prové de un riu en el que el fluxe es constant.
  - Volem agafar aigua de la presa i usar-la per a ús propi.

Exemple

- Presa 2
  - Ara volem simular que la presa s'omple a partir de bombar aigua de un canal subterrani.

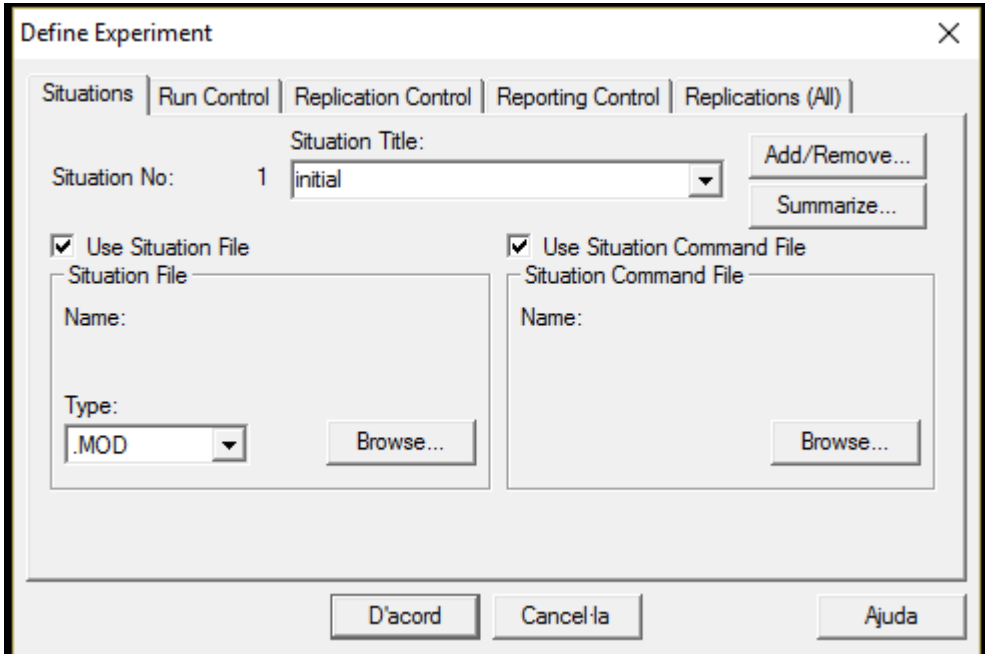
Experimentation

Definint un nou experiment



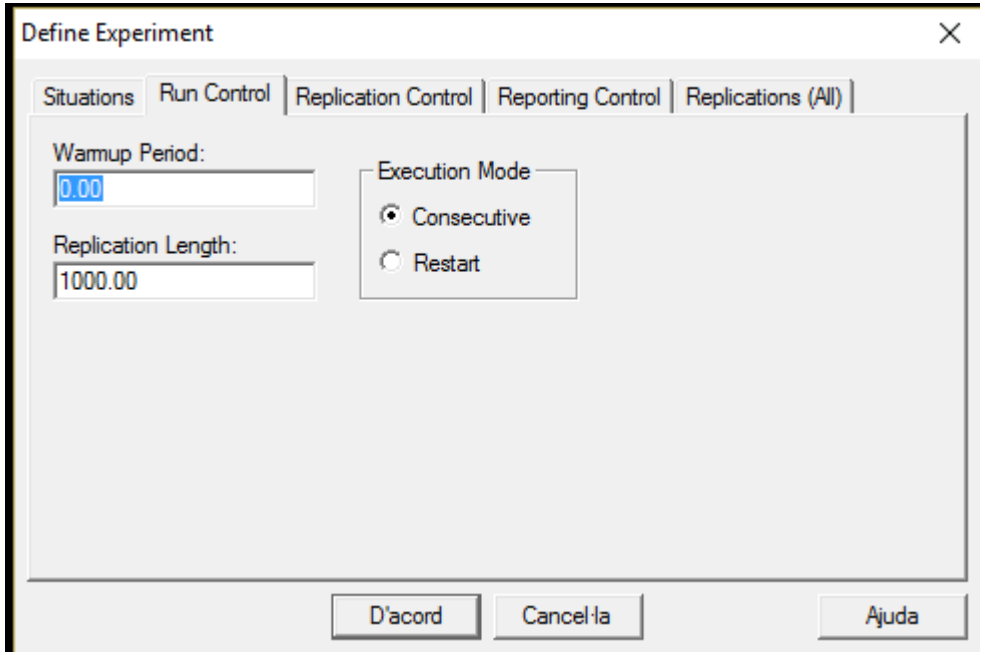
Punt de partida

- Podem definir “n situacions” inicials, que poden estar definides per models diferents.



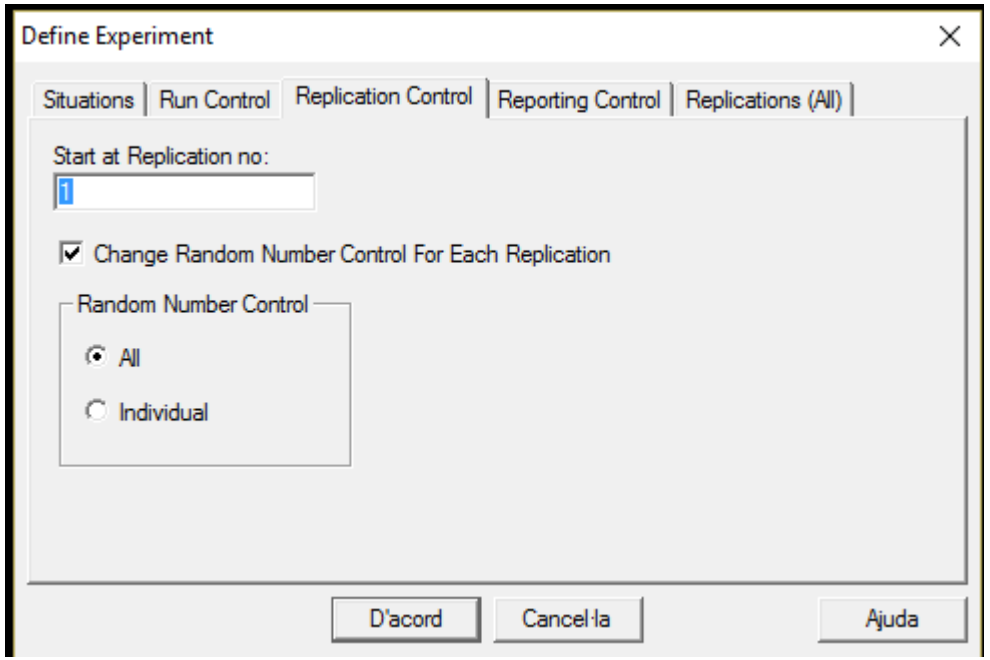
Run control

- Podem especificar el període de càrrega del model i la longitud de cara una de els diferents rèpliques.
- Podem indicar si per cada rèplica tornarem a començar des del principi o les executarem de forma consecutiva.



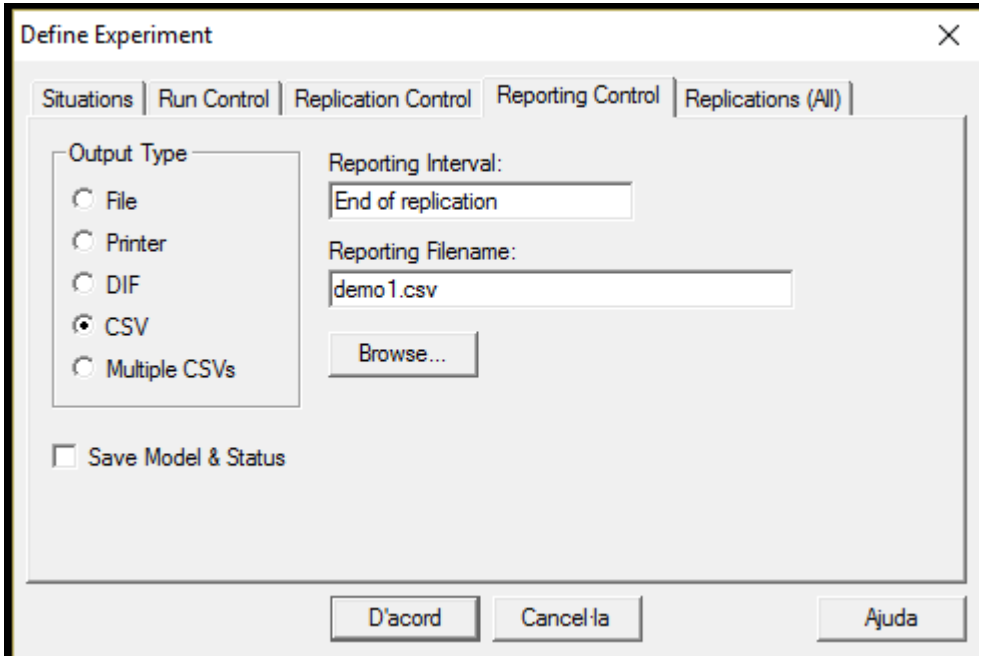
Replication control

- Podem especificar la posició de la tira de nombres que començarem a usar, si volem canviar el GNA per cada rèplica i si volem un control de la tira diferent per cada rèplica.



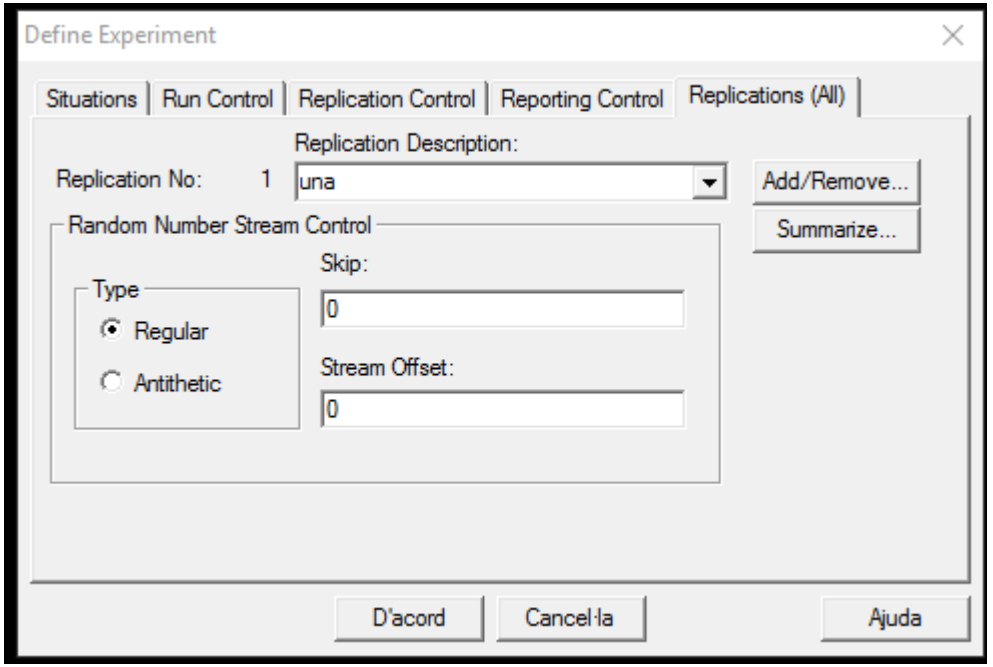
Reporting control

- Permet especificar com recollim la informació estadística del model.



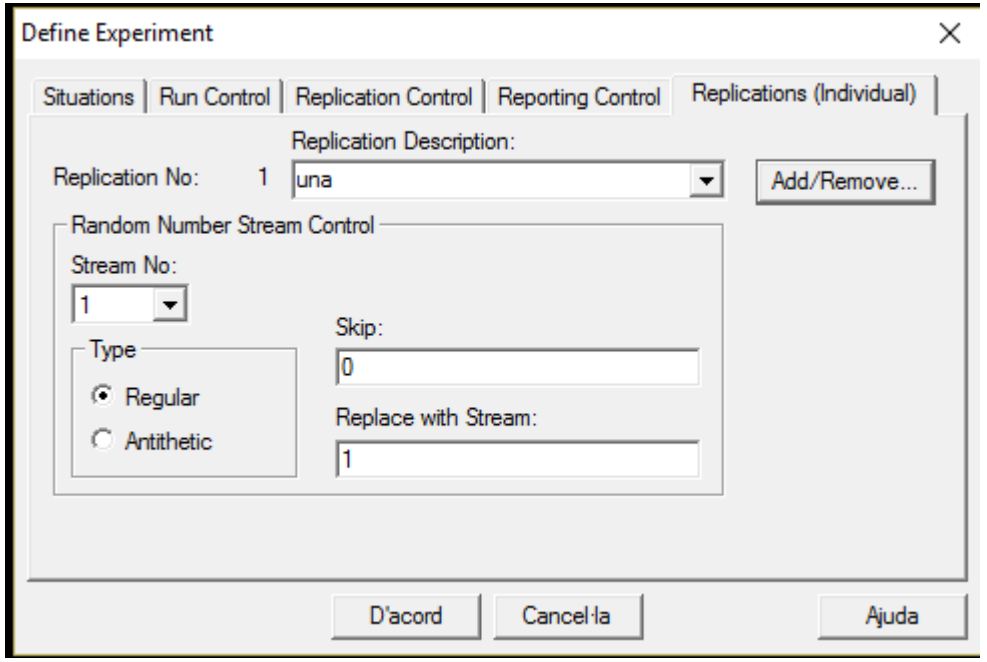
Replications (All)

- Especifica si per totes les rèpliques del model prescindirem d'algunes posicions de la tira.
- Permet especificar el nombre de rèpliques a executar i si volem emprar variables antitètiques.



Replications (Individual)

- Permet a més, especificar per cada rèplica la tira de nombres aleatoris a emprar.



Fitxers de resultats

Capçaleres dels fitxers CSV.

CSV output for parts

Col No.	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The part's name
6	0 (as parts cannot have an index).
7	The number of parts of this type that have entered the model.
8	The number of parts of this type that have been shipped from the model.
9	The number of parts of this type that have been scrapped from the model.
10	The number of parts of this type that have been assembled.
11	The number of parts of this type that have been rejected from the model.
12	The number of parts of this type that are still being processed in the model.
13	The average time that this type of part takes to be processed in the model.
14	The average amount of time that this type of part spends in the model.

CSV output for carriers

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The carrier's name
- 6 The index number of this carrier if the quantity is greater than 1 and you have set the carrier's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 Number of parts now on the carrier.
- 8 The total number of parts that have been carried by the carrier.
- 9 The average amount of time that the carrier has spent in a powered state.
- 10 The average amount of time that the carrier has spent in a blocked state or waiting for labor.
- 11 The average amount of time that the carrier has spent carrying parts.
- 12 The average amount of time that the carrier spent in a parked state.
- 13 The average amount of time that the carrier spent loading parts.
- 14 The average amount of time that the carrier spent unloading parts.
- 15 The average amount of time that the carrier spent in a free state on a section (plus the time it spends before entering the model).
- 16 The average amount of time that the carrier spent in a parking state.

CSV output for carriers

- Col No. Data
- 17 The average amount of time that the carrier spent in an unparking state.
- 18 The average amount of time that the carrier spent in a processing state.
- 19 The percentage time that this carrier spent on-shift (if you selected the report by total simulation time option when you generated the report).
- 20 The percentage time that this carrier spent in a parked state.
- 21 The percentage time that this carrier spent parking.
- 22 The percentage time that this carrier spent unparking.
- 23 The percentage time that this carrier spent in a free state on a section (plus the time it spends before entering the model).
- 24 The percentage time that this carrier spent being processed.
- 25 The percentage time that this carrier spent in a loading state.
- 26 The percentage time that this carrier spent in an unloading state.
- 27 The percentage time that this carrier spent in a moving state.
- 28 The percentage time that this carrier spent in a broken down state.
- 29 The percentage time that this carrier spent in a blocked or waiting for labor state.

CSV output for conveyors

Col No.	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The conveyor's name
6	The index number of this conveyor if the quantity is greater than 1 and you have set the conveyor's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
7	The number of parts now on the conveyor.
8	The total number of parts that have been on the conveyor.
9	The average number of parts on the conveyor.
10	The average amount of time that a part spent on the conveyor.
11	The percentage time that the conveyor was empty.
12	The percentage time that the conveyor was moving at least one part freely.
13	The percentage time that the conveyor was blocked.
14	The percentage time that a queuing conveyor had parts queuing on it.
15	The percentage time that the conveyor was broken down.
16	The percentage time that the conveyor was off-shift.

CSV output for fluids

Col No.	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The fluid's name
6	0 (as a fluid cannot have an index).
7	The volume of this fluid that has entered the model.
8	The volume of this fluid that has been shipped from the model.
9	The volume of this fluid that has been sent to waste.
10	The volume of this fluid that has been changed.
11	The volume of this fluid that has been rejected from the model.
12	The volume of this fluid that is currently in the model.
13	The average volume of this fluid that has been in the model.
14	The average amount of time that this fluid has spent in the model

CSV output for histograms

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The histogram's name
- 6 The index number of this histogram if the quantity is greater than 1 and you have set the histogram's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The number of observations in this histogram.
- 8 The mean value of the observations in this histogram.
- 9 The standard deviation of the observations in this histogram.
- 10 The lowest value that has been recorded in this histogram.
- 11 The time that the lowest value was recorded in this histogram.
- 12 The highest value that has been recorded in this histogram.
- 13 The time that the highest value was recorded in this histogram.

CSV output for labor

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The labor unit's name
- 6 The index number of this labor unit if the quantity is greater than 1 and you have set the labor unit's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The quantity of this labor unit.
- 8 The number of jobs that this labor unit has started.
- 9 The number of jobs that this labor unit has finished.
- 10 The number of jobs that this labor unit is currently working on.
- 11 The number of jobs that have pre-empted this labor unit.
- 12 The average duration of a job completed by this labor unit.
- 13 The percentage time that this labor unit has spent in an idle state.
- 14 The percentage time that this labor unit has spent in a busy state.
- 15 The percentage time that this labor unit has spent off-shift.

CSV output for machines

Col. No	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The machine's name.
6	The index number of this machine (if the quantity is greater than 1 and you have set the machine's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
7	The number of operations or cycles that this machine has completed.
8	The percentage time that the machine spent in an idle state.
9	The percentage time that the machine spent in a blocked state.
10	The percentage time that the machine spent in a busy state (that is, cycling).
11	The percentage time that the machine spent waiting for labor to cycle.
12	The percentage time that the machine spent setting up.
13	The percentage time that the machine spent waiting for labor to set it up.
14	The percentage time that the machine spent in a broken down state.
15	The percentage time that the machine spent waiting for labor to repair it.
16	The percentage time that the machine spent filling with parts.
17	The percentage time that the machine spent emptying.
18	The percentage time that the machine spent off-shift.

CSV output for parts

Col No.	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The part's name
6	0 (as parts cannot have an index).
7	The number of parts of this type that have entered the model.
8	The number of parts of this type that have been shipped from the model.
9	The number of parts of this type that have been scrapped from the model.
10	The number of parts of this type that have been assembled.
11	The number of parts of this type that have been rejected from the model.
12	The number of parts of this type that are still being processed in the model.
13	The average time that this type of part takes to be processed in the model.
14	The average amount of time that this type of part spends in the model.

CSV output for pie charts

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The pie chart's name.
- 6 The index number of this pie chart if the quantity is greater than 1 and you have set the pie chart's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name)
- 7 The segment description.
- 8 The value of the segment.
- 9 The value of the segment expressed as a percentage.

CSV output for pipes

Col No.	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The pipe's name
6	The index number of this pipe if the quantity is greater than 1 and you have set the pipe's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
7	The volume of fluid that has entered this pipe.
8	The volume of fluid that has left this pipe.
9	The volume of fluid that is currently in this pipe.
10	The average volume of fluid that has been in this pipe.
11	The average amount of time that fluid has spent in this pipe.
12	The percentage time that this pipe has spent in a flowing state.
13	The percentage time that this pipe has spent in a stopped state.
14	The total percentage time that this pipe has spent in a flowing state or waiting for labor to flow.
15	The percentage time that this pipe has spent waiting for labor to flow.
16	The percentage time that this pipe has spent being repaired.
17	The percentage time that this pipe has spent waiting for labor to repair it.
18	The percentage time that this pipe has spent being cleaned.
19	The percentage time that this pipe has spent waiting for labor to clean it.
20	The percentage time that this pipe has spent off-shift.

CSV output for processors

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The processor's name
- 6 The index number of this processor if the quantity is greater than 1 and you have set the processor's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The volume of fluid that has entered this processor.
- 8 The volume of fluid that has left this processor.
- 9 The volume of fluid that is currently in this processor.
- 10 The number of processes that this processor has completed.
- 11 The percentage time that this processor has spent in an empty state.
- 12 The percentage time that this processor has spent in a filling or flowing state.
- 13 The percentage time that this processor has spent in a filling or stopped state.

CSV output for processors

- Col No. Data
- 14 The percentage time that this processor has spent in an emptying or flowing state.
- 15 The percentage time that this processor has spent in an emptying or stopped state.
- 16 The percentage time that this processor has spent in a filled or filling state.
- 17 The total percentage time that this processor has spent filled, filling or waiting for labor to fill it.
- 18 The total percentage time that this processor has spent empty, emptying or waiting for labor to empty it.
- 19 The percentage time that this processor has spent emptying or waiting for labor to empty it.
- 20 The percentage time that this processor has spent processing.
- 21 The percentage time that this processor has spent processing or waiting for labor to assist processing.
- 22 The percentage time that this processor has spent in being cleaned.
- 23 The percentage time that this processor has spent in being cleaned or waiting for labor to clean it.
- 24 The percentage time that this processor has spent being repaired.
- 25 The percentage time that this processor has spent being repaired or waiting for labor to repair it.
- 26 The percentage time that this processor has spent off-shift.

CSV output for sections

Col No.	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The section's name
6	The index number of this section if the quantity is greater than 1 and you have set the section's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
7	The number of powered carriers that are currently on this section.
8	The number of free carriers that are currently on this section.
9	The total number of loaded carriers that have entered this section.
10	The total number of carriers that have entered this section.
11	The average amount of time that a carrier spent in a powered state on this section.
12	The average amount of time that a carrier spent in a free state on this section.
13	The percentage time that this section is on-shift (if you have selected to report by total simulation time).
14	The percentage time that this section spent in an idle state.
15	The percentage time that this section was running normally.
16	The percentage time that this section spent in being repaired.
17	The percentage time that this section spent waiting for labor to repair it.

CSV output for shifts

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The shift's name
- 6 The index number of this shift if the quantity is greater than 1 and you have set the shift's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The amount of time that this shift has spent in an on-shift state.
- 8 The amount of time that this shift has spent in an off-shift state.
- 9 The total number of shifts that this shift has completed.

CSV output for situation titles

- Col No. Data
- 1 Situation number
- 2 Situation title

CSV output for stations

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The station's name
- 6 The index number of this station if the quantity is greater than 1 and you have set the station's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The total number of carriers that have entered this station.
- 8 The total number of parts that this station has loaded (for loading stations) or unloaded (for unloading stations). If this station is an action station or a parking station, this column contains a 0 value.
- 9 The percentage time that his station has spent on-shift (if you are reporting by total simulation time).
- 10 The percentage time that this station has been operating normally.
- 11 The percentage time that this station has spent in a blocked state.
- 12 The percentage time that this station has spent in an idle state.
- 13 The percentage time that this station has spent in a broken down state.
- 14 The percentage time that this station has spent waiting for labor to repair it.
- 15 The percentage time that this station has spent waiting for labor to execute an action (for an action station). For loading, unloading or parking stations, this column contains a 0 value.

CSV output for tanks

Col No.	Data
1	Situation number
2	Replication number
3	Report number
4	Time
5	The tank's name
6	The index number of this tank if the quantity is greater than 1 and you have set the tank's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
7	The volume of fluid that has entered this tank.
8	The volume of fluid that has left this tank.
9	The volume of fluid that is currently in this tank.
10	The average volume of fluid that has been in this tank.
11	The average time that fluid has spent in this tank.
12	The percentage time that this tank has spent in an empty state.
13	The percentage time that this tank has spent in a full state.
14	The percentage time that this tank has spent in a partially full state.
15	The total percentage time that this tank has spent in a flowing state.
16	The percentage time that this tank has spent flowing or waiting for labor to assist the flow.
17	The percentage time that this tank has spent being cleaned.
18	The percentage time that this tank has spent being cleaned or waiting for labor to clean it.
19	The percentage time that this tank spent off-shift.

CSV output for timeseries

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The timeseries' name
- 6 The index number of this timeseries if the quantity is greater than 1 and you have set the timeseries' reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The timeseries' plot number.
- 8 The plot's mean value.
- 9 The plot's standard deviation.
- 10 The lowest value recorded by the plot.
- 11 The time that the lowest value was recorded.
- 12 The highest value recorded by the plot.
- 13 The time that the highest value was recorded.

CSV output for tracks

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The track's name
- 6 The index number of this track if the quantity is greater than 1 and you have set the track's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The number of times that the track has been used by vehicles.
- 8 The percentage time that this track spent in an empty state.
- 9 The percentage time that this track spent in a busy state.
- 10 The percentage time that this track spent in a blocked state.

CSV output for variables

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The variable's name
- 6 The composite member number.
- 7 The index number of this variable if the quantity is greater than 1 and you have set the variable's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 8 The second index (if this is a two-dimensional variable). If this is a one-dimensional variable, the column contains a –1 value.
- 9 The value of the variable.

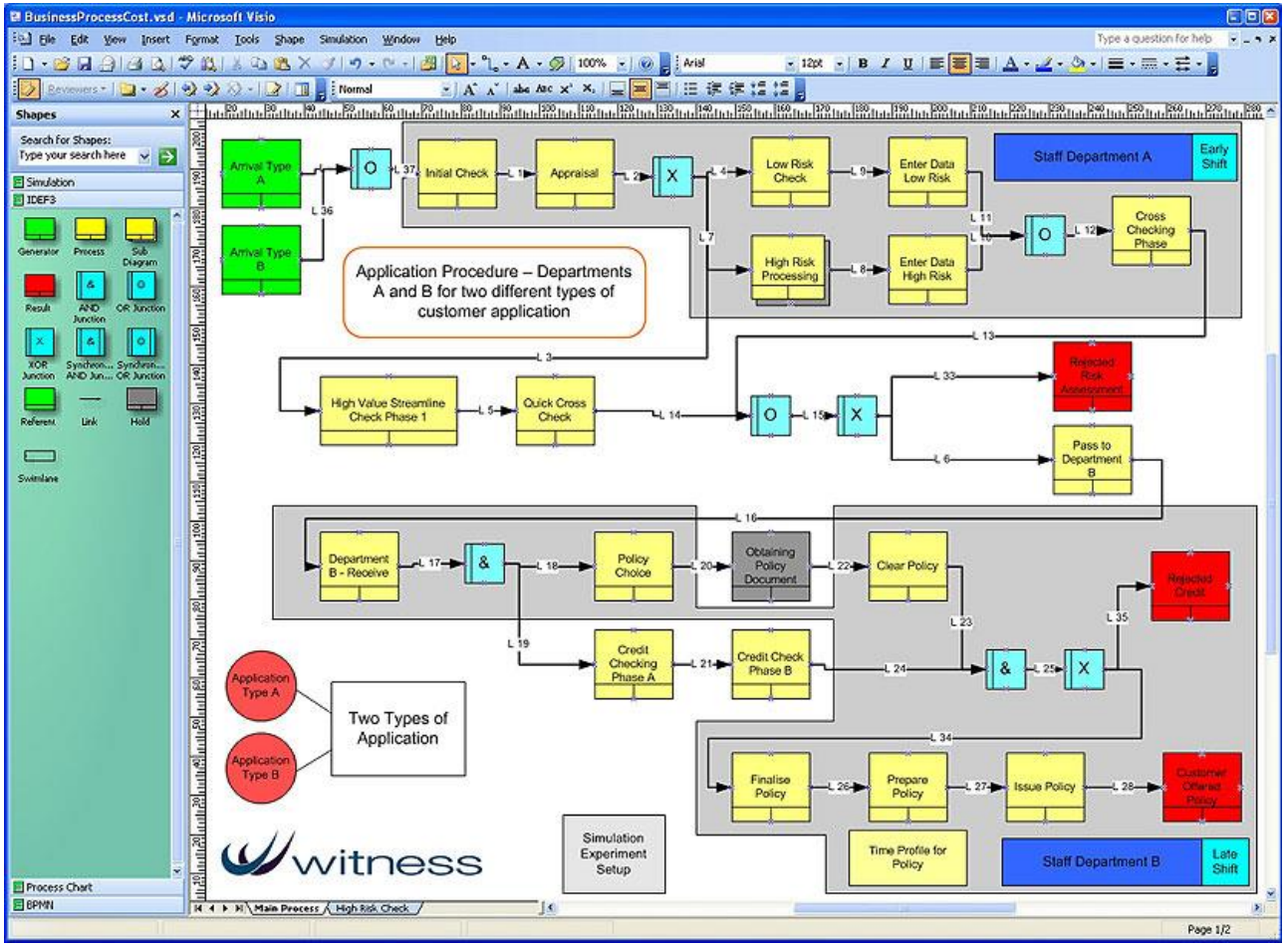
CSV output for vehicles

- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The vehicle's name.
- 6 The index number of this vehicle (if the quantity is greater than 1 and you have set the vehicle's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The total physical distance traveled by the vehicle.
- 8 The number of times that the vehicle has successfully loaded parts.
- 9 The percentage time that the vehicle was idle, including time during which the vehicle was parked.
- 10 The percentage time that the vehicle was in demand (that is, traveling to respond to a CALL action).
- 11 The percentage time that the vehicle spent loading and unloading, including time spent attempting to load or unload parts.
- 12 The percentage time that the vehicle was loaded with parts.
- 13 The percentage time that the vehicle spent in a stopped state because it was waiting to go on to the next track. The vehicle can only do this if you set a stop time (and a stop condition, if necessary) on the vehicle detail dialog.
- 14 The percentage time that the vehicle was in a blocked state.
- 15 The percentage time that the vehicle spent in an off-shift state.

CSV output for buffers

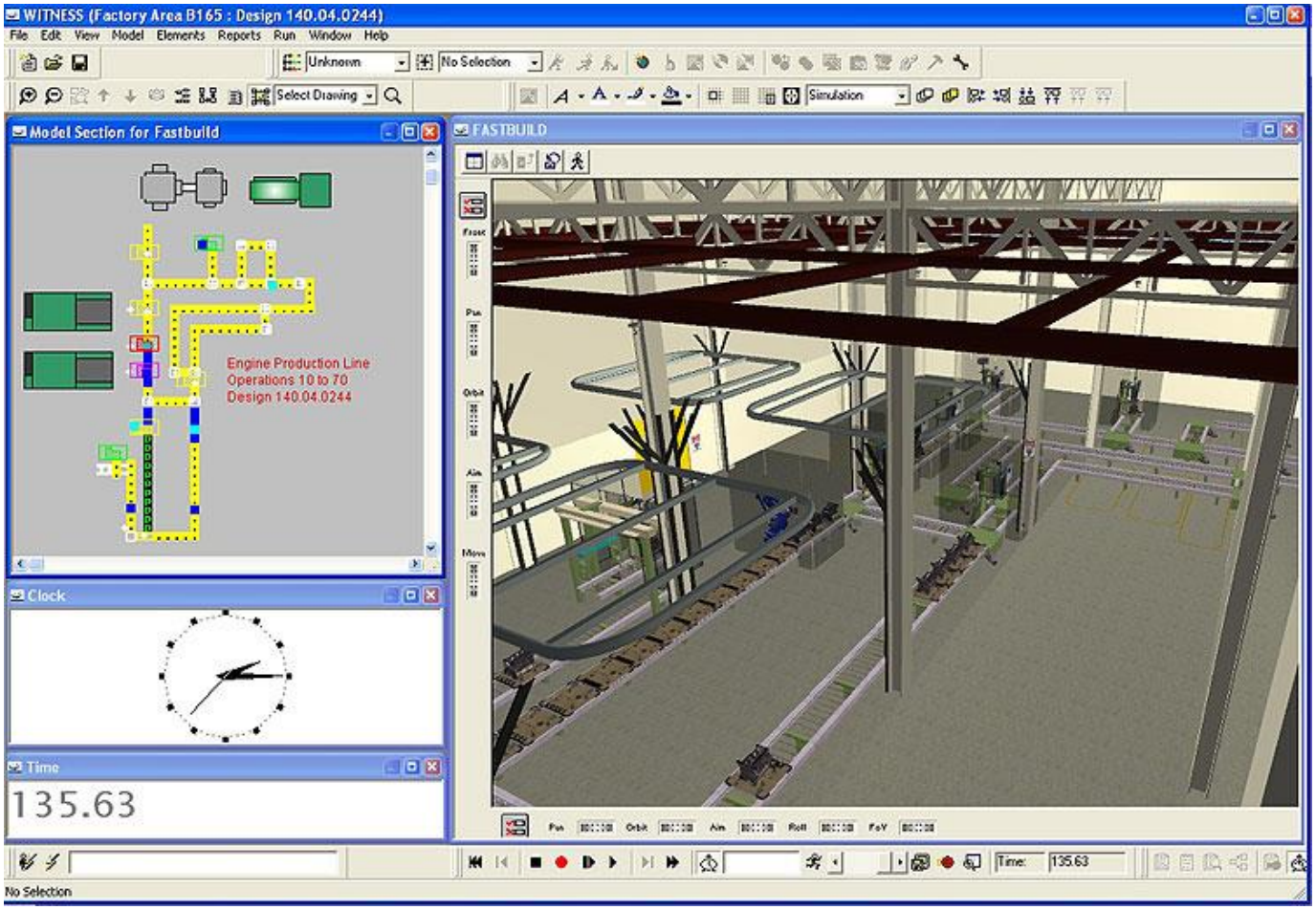
- Col No. Data
- 1 Situation number
- 2 Replication number
- 3 Report number
- 4 Time
- 5 The buffer's name.
- 6 The index number of this buffer if the quantity is greater than 1 and you have set the buffer's reporting to individual. If you have set reporting to by group, –1 indicates all elements of this name).
- 7 The total number of parts that have entered the buffer.
- 8 The total number of parts that have left the buffer.
- 9 The number of parts currently in the buffer.
- 10 The greatest number of parts that have been in this buffer at the same time.
- 11 The fewest number of parts that have been in this buffer at the same time.
- 12 The average number of parts in the buffer.
- 13 The average time that parts spent in the buffer.
- 14 The average number of parts in the buffer after the delay time has elapsed (if you have set a delay time for the buffer).
- 15 The average time that parts spent in the buffer after the delay time has elapsed (if you have set a delay time for the buffer).

Witness i MS Visio

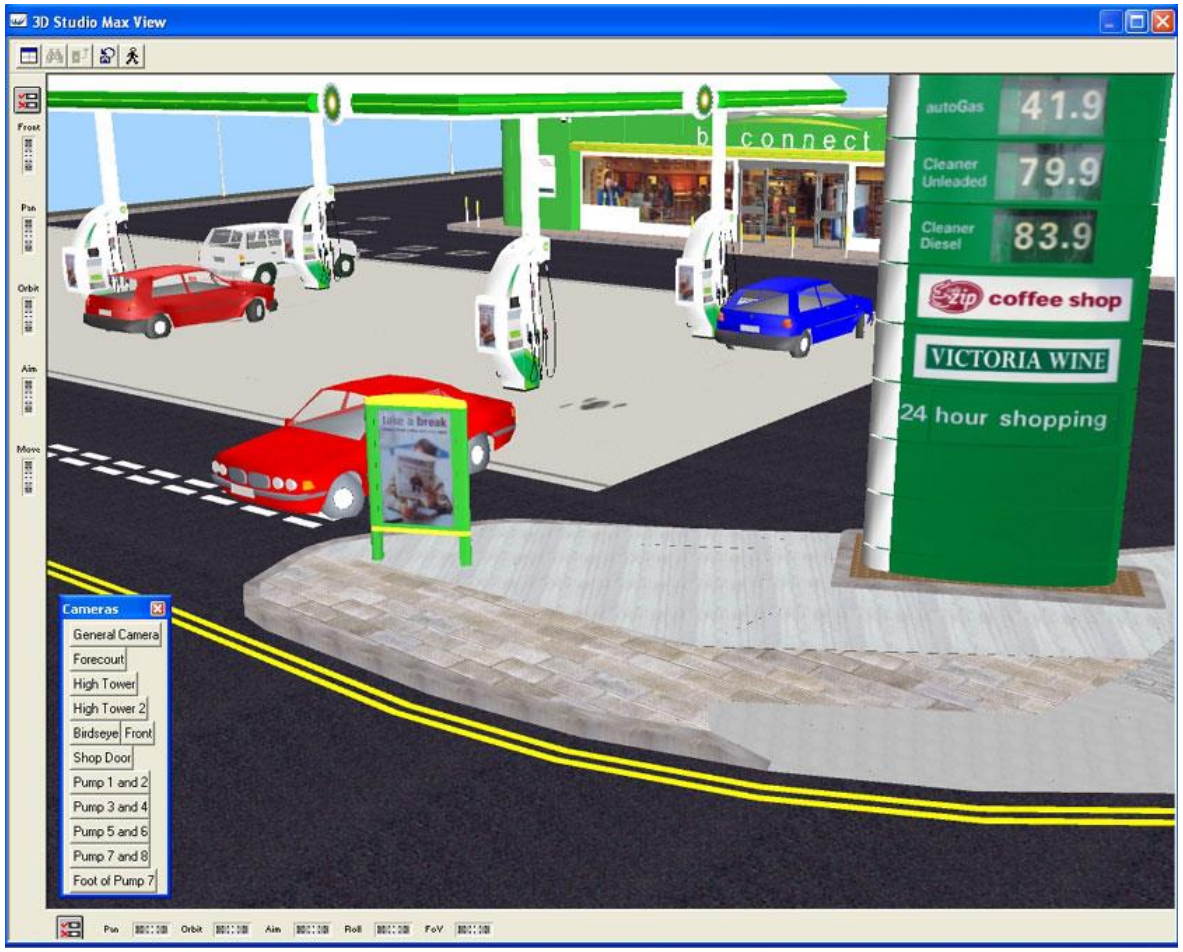


Witness VR 1

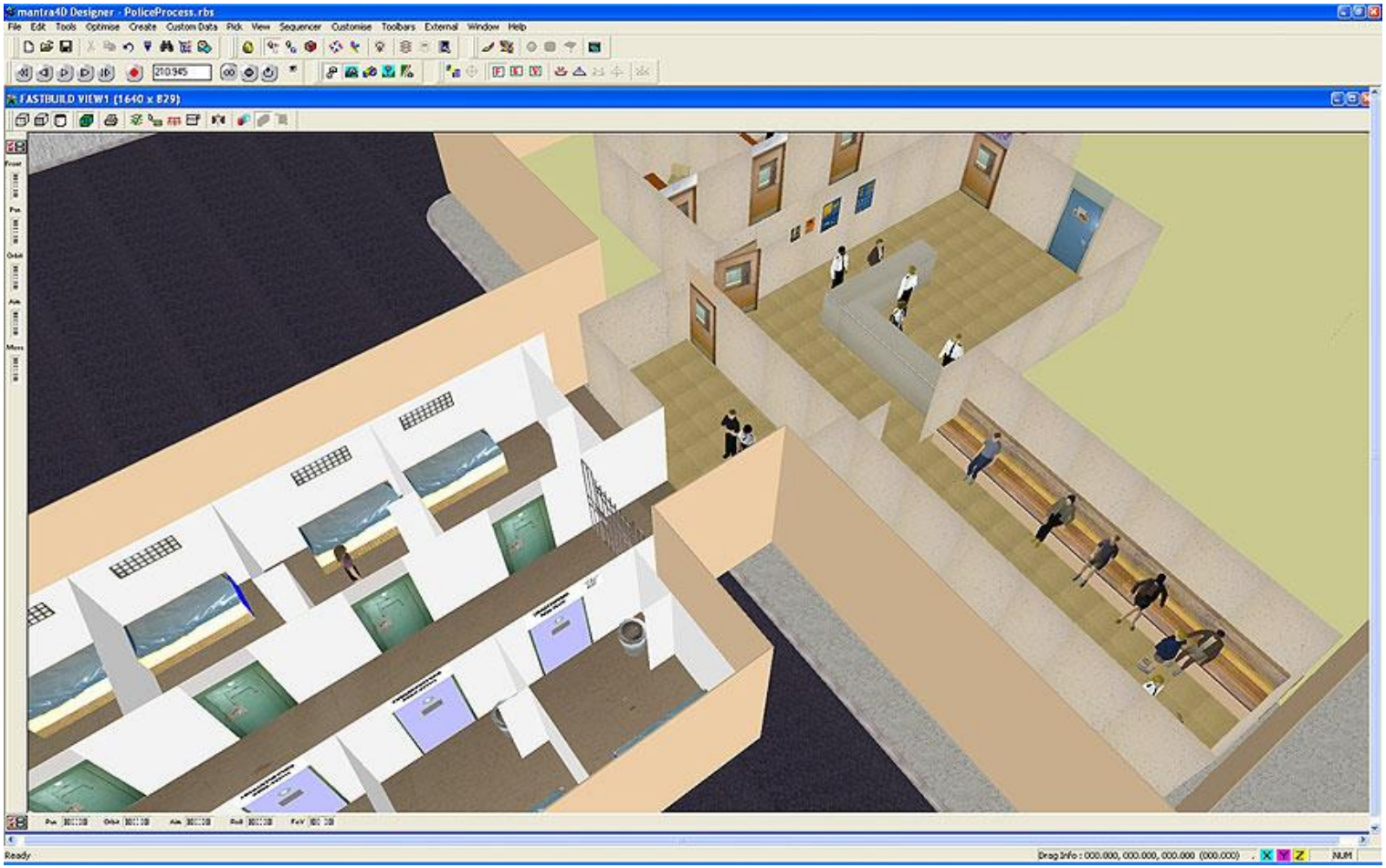
Witness VR 2


WITNESS (Factory Area B165 : Design 140.04.0244)
File Edit View Model Elements Reports Run Window Help
Model Section for Fastbuild
Engine Production Line
Operations 10 to 70
Design 140.04.0244
Clock
Time
135.63
FASTBUILD
No Selection

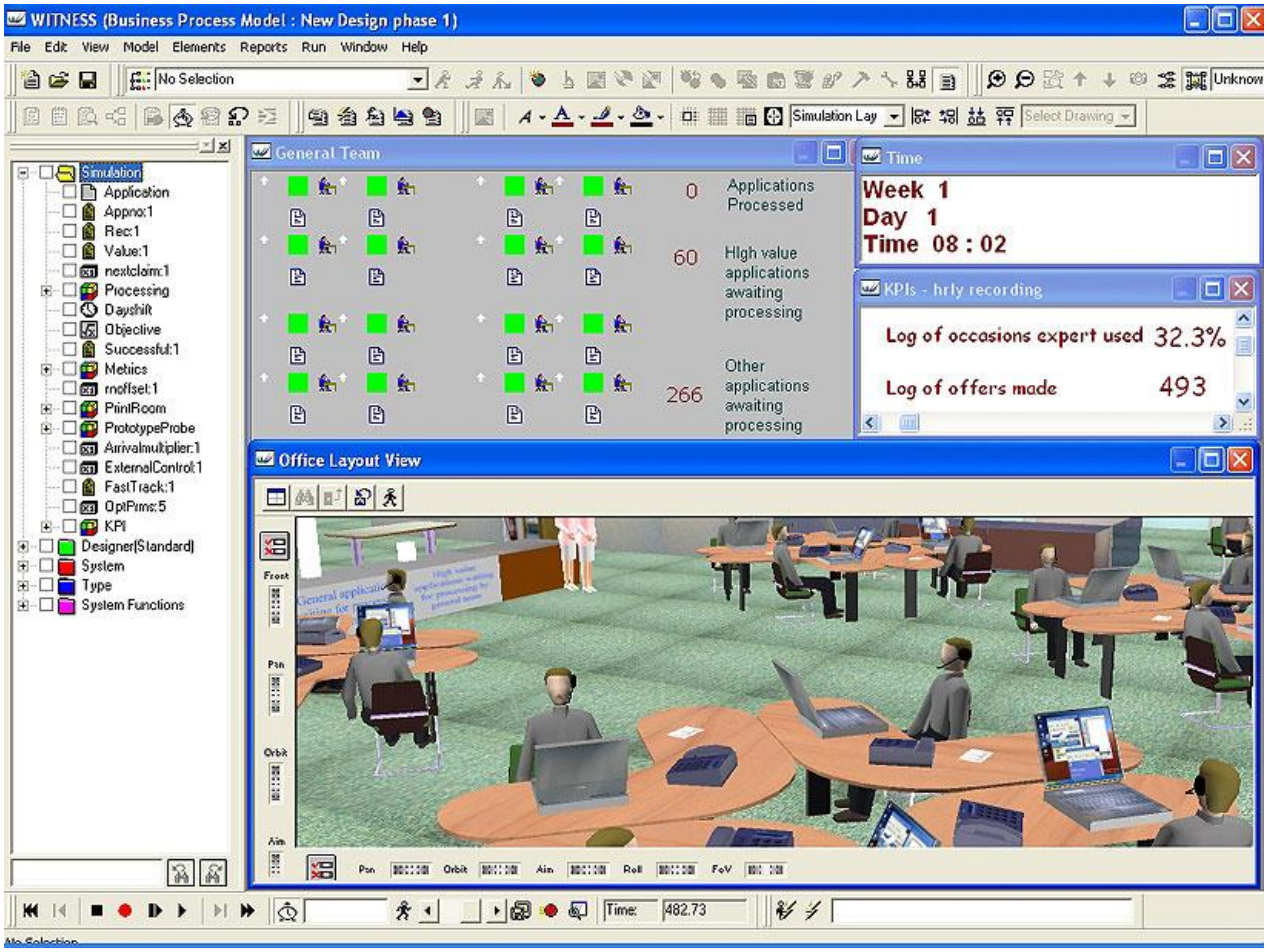
Witness VR 3


3D Studio Max View
connect
autoGas 41.9
Cleaner Unleaded 79.9
Cleaner Diesel 83.9
coffee shop
VICTORIA WINE
24 hour shopping
take a break
Cameras
General Camera
Forecourt
High Tower
High Tower 2
Birdseye
Front
Shop Door
Pump 1 and 2
Pump 3 and 4
Pump 5 and 6
Pump 7 and 8
Foot of Pump 7
Pan
Orbit
Aim
Roll
FoV

Witness VR 4


mantra4D Designer - PoliceProcess.rbs
File Edit Tools Optimise Create Custom Data Pick View Sequencer Customise Toolbars External Window Help
FASTBUILD VIEW1 (1640 x 829)
Ready

Witness VR 5


WITNESS (Business Process Model : New Design phase 1)
File Edit View Model Elements Reports Run Window Help
No Selection
Simulation Lay
Select Drawing
Simulation
Application
Appno:1
Rec:1
Value:1
nextclaim:1
Processing
Dayshift
Objective
Successful:1
Metrics
rnoffset:1
PrintRoom
PrototypeProbe
Arrivalmultiplier:1
ExternalControl:1
FastTrack:1
OptPrms:5
KPI
Designer(Standard)
System
Type
System Functions
General Team
0
Applications Processed
60
High value applications awaiting processing
266
Other applications awaiting processing
Time
Week 1
Day 1
Time 08 : 02
KPIs - hrly recording
Log of occasions expert used 32.3%
Log of offers made 493
Office Layout View
Front
Pan
Orbit
Aim
Pan
Orbit
Aim
Roll
FoV
Time:
482.73