

Simulation Software Selection



INCONTROL
Simulation Solutions

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1. Introduction

1.1 What is Enterprise Dynamics?

Enterprise Dynamics® is a leading simulation platform to design and implement simulation solutions. It allows a problem solver to model virtually any problem and, by experimentation, look for a solution for a given problem or an answer to a specific question in a virtual 3D, VR environment.

Most of the problems or questions for which simulation is used are:

- Capacity investigations
- Investment evaluations
- Time-to-Market vs. Costs evaluations

To be able to perform simulation studies, a good simulation platform is required. A good simulation platform does not only provide fast modeling capabilities and good visualization features, but it also provides the possibilities for the re-use of previous made models, segments of models, and components used in previously made models.

This document describes numerous aspects of the Enterprise Dynamics Simulation Platform. The purpose of this document is to give the reader with little knowledge of simulation and Enterprise Dynamics, a good understanding of how Enterprise Dynamics is build, and what the key-factors are that makes this simulation platform the right choice.

1.2 Product Structure

Enterprise Dynamics is the brand name for a group of products. All functionality described in this document is included in the Enterprise Dynamics Engine. Enterprise Dynamics has abandoned the one-license-fits-all philosophy. There are 3 license types of General Purpose Simulators: ED VIEWER, ED BUILDER and ED DEVELOPER. Depending on requirements and number of licenses, one of these products will fulfill the needs. Below a short guideline to the 3 license types:

- VIEWER: the ability to view ready-made simulation model runs.
- BUILDER: the ability to construct simulation models based on provided simulation objects.
- DEVELOPER: BUILDER + the ability to create simulation libraries

This document will deal with all aspects of the software.

These General Purpose Simulators are offered with any of the available Enterprise Dynamics Suites, Enterprise Dynamics Applications or Enterprise Dynamics Products. They are not described in this document because they serve a certain branch or purpose.

1.3 History

Enterprise Dynamics is developed based on the experience of the development and sales on another simulation package called Taylor II. For more than 10 years, Taylor II was one of the leading simulation software packages available developed and sold by F&H Simulations from Utrecht.

However, at one point in time, the package reached the end of its life cycle. The expansion of the program was increasingly only possible with great alterations to the existing program. Due to the success of the program, with a large customer base world wide, new features were more than ever required.

In 1997, the decision was made to design and develop a new solution that would take all the strong points of Taylor II, all the signaled demands of the customers, but would keep the flexibility for expansions in the years to come. After many months of development Taylor Enterprise Dynamics was introduced in the year 1998.

By the year 2000 F&H Simulations was taken over by the consulting company and Arena distributor Incontrol Business Engineers. The new company name is INCONTROL Simulation Solutions and Taylor ED has been renamed to Enterprise Dynamics.

2. Simulation Software selection criteria

2.1 Manufacturer

Topic	Enterprise Dynamics
Manufacturer name	INCONTROL Simulation Solutions
Address	Papendorpseweg 77 3528 BJ Utrecht The Netherlands
Sales Point of Contact Name	Jan Thiermann
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Technical Point of Contact Tel No	+31 (0) 30 670 40 15
Founded	1984
Manufacturing simulation software since	1984
Historical and other developed products	Taylor II, Taylor for Windows, Time Machine, Taylor Enterprise Dynamics (TED), ShowFlow
Location	Utrecht, The Netherlands Wiesbaden, Germany
Product URL	www.IncontrolSim.com
Number of Engine Developers	4
Number of Product Developers	30

2.2 Software

Topic	Enterprise Dynamics
Current version used for this document	8
Product Age	10 years
Date of last Major version update	April 2009
Date of next Major version update	2011
Date of next Minor version update	May 2010
Software Development	Continuous
Software Development / Life Cycle Methodology	Enterprise Dynamics development is a mixture of the Waterfall and Spiral methodologies. Major developments are managed through the Waterfall methodology, but we plan development time for our customers. This time is managed via the Spiral methodology.
IEEE 1516 (High Level Architecture) standard compliance	Enterprise Dynamics is object oriented and therefore prepared for HLA. Several steps of FEDEP (Federation Development and Execution Process Model) have been taken.
Runtime	Enterprise Dynamics does not compile into a stand-alone executable. For third place execution, Enterprise Dynamics provides a Runtime version of the software or Viewer.
Nr. Of licenses sold	5,000
% Educational market	50%
% Commercial market	50%
Total market share (Independent)	9%
Demonstration / Evaluation	A free evaluation version can be downloaded from the website: www.IncontrolSim.com . Together with a tutorial that can be downloaded this will give a first impression of the software. Also on-site demonstrations or internet demonstrations can be scheduled.

Application Branches	Automotive, Electronics, Production, Logistics & Distribution, Airports, Material Handling, Harbors, Rail, Banking & Finance, Contact Centers, Educational, Healthcare, Sports & Events, Public & Service
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2.2.1 Maintenance & Support

Topic	Enterprise Dynamics
Maintenance & support purchased separately	Yes, licenses are offered where it is possible to purchase this as an option annually
Maintenance include updates	Yes, updates are included in the yearly maintenance & support fee
Available updates	We target 2 minor releases and 1 major release every year
Efforts to update the software	A separate file, provided through download or on a CD-ROM contains an automatic installation to update the software
Application for new developments	Licensees with a valid M&S contract can provide input for new developments. The manufacturer determines if and when developments are implemented. New developments are in general for all similar licensee holders
Possibilities for customized solutions	Next to the possibilities the software offers standard for complete customization, it is possible to have custom developments implemented.
Available support channels	Support is provided through: <ul style="list-style-type: none"> - Website - Issue Tracker (JIRA) - Email - Phone - On-site
Support rating	In 2002 the support was rated excellent by the Enterprise Dynamics users.
Background and experience of the support team	The support team consists of simulation experts and core developers.
Time to respond	24 hours
Time to present a workable solution	48 hours
Global coverage	Yes
Possibilities 24h/7d support	On request, 2 days in advance
Regular telephone support times	08:30 – 20:00 (GMT +1, EST + 6, PST +9)
Regular Email Support times	08:00 – 00:00
Website support	Yes, only for contract holders
Internet discussion	Yes, on request provided by WebEx or GotoMeeting

2.2.2 Training

Topic	Enterprise Dynamics
Available trainings	<ul style="list-style-type: none"> - Basic - Advanced - Expert - Teacher - Simulation (workshop) - Visualization (workshop) - Features (workshop) - Many other courses such as Simulation for Managers, in Education, in Airports, in Transport, in Harbors, in Contact Centers and in Healthcare
Training levels	Trainings are offered for non-simulation experts, starting simulation engineers, advanced simulation engineers and simulation experts
Available training materials	Cases including description and software models, sheets, hand-outs and tutorials in different languages
Training locations	Utrecht, Wiesbaden, at reseller location or on-site

2.2.3 Implementation

Topic	Enterprise Dynamics
Consult	On request, depending on needs
On-site assistance	On request, depending on needs
Co-development	On request, depending on needs
Complete simulation studies	Yes
Global simulation experts	The Enterprise Dynamics global network offers more than 100 simulation experts
Partner locations	<ul style="list-style-type: none"> - Utrecht, The Netherlands - Wiesbaden, Germany - Augsburg, Germany - Beijing, China - Steyr-Gleink, Austria - St-Martens-Latem, Belgium - Aalborg, Denmark - Tampere, Finland (2) - Versailles, France - Bibertal, Germany - Maintal, Germany - Nagpur, India - Tehran, Iran - Jerash, Jordan - Stockholm, Sweden - Gothenburg, Sweden - Naarden, The Netherlands - Warrington, United Kingdom - Dearborn (MI), United States - Austin (TX), United States - Houston (TX), United States - Rochester (NY), United States

2.2.4 Documentation

Topic	Enterprise Dynamics
Software supplied documentation and manuals	Because of environmental preservation, only the tutorial and necessary documentation is supplied in paper form. Manuals, tutorials, quickstarts and other documentation is supplied in a digital format.
Tutorials	Proven tutorial (written with multiple tutors at universities). The tutorials are provided in the English, German, Dutch and French language (versions vary, principles remain)
Help files	Online help system with more than 2,000 4DScript commands, 2,200 topics and 5,500 help jumps. Help system with language descriptions, simulation object descriptions, detailed what's new, frequently asked question section, and tutorials. Also a printed tutorial is provided
Available examples provided	More than 50 example models included in the software to demonstrate various possibilities of the software (ranging from novice to expert samples). Available in English and German.
Troubleshooting facilities	Online help, Error reporting facility, debugger, tracer

2.3 Model and input

Topic	Enterprise Dynamics
Pre modeling	Before starting modeling it is common to create a concept first, create a functional model and technical design. Hereafter the implementation, verification and validation have to be done. Many organizations have software systems in place that should carefully be examined to deliver (historical) input data for the simulation model
Libraries / objects	Many objects and libraries are available to serve a certain branch or purpose. The ED products can be extended with this functionality easily. A separate overview of available objects can be presented on request
Input and control	Many input and control devices can be included into the functionality of ED such as keyboard, mouse, (barcode) scanner, trace ball, touch screen and a 3D mouse
Model building	A model can be built in various ways: drag & drop, generated from a database, ActiveX, completely manual via programming, etc. The program comes with a trace and an error window. A debugger (like in C++, Delphi) is also available
Compilation	Not with internal programming language.
Model Capacity	The maximum capacity of a model is unlimited. Simulation models with more than 500,000 simulation objects simultaneously are already implemented
Distance Modeling	Enterprise Dynamics has the capability to create model with scaling distance & layout. ED uses world coordinate systems in which objects are defined by their length, width and height
Input of data	Enterprise Dynamics provides the following ways to supply simulation models with data; read from file, global variables which need to be set, interactive with menu's, automatically read from database, testing on correct input
Statistical distributions	Enterprise Dynamics comes with an internal autofit tool that is able to generate distributions from a random number of observations. There are 25 various distribution functions standard available, and the user is able to add own distributions. The seed values for the distributions can be set by the user or generated by the program, and there are at default 1,000 random generators available, which the user can also set lower or higher. The maximum number of random generators is 2,147,483,647.
Coding aspects	Enterprise Dynamics is a simulation environment with which the user is able to modify anything. This can be done via 4DScript (internal simulation language in platform environment) or C++, Delphi, and other programming languages directly or via DLL's. The 4DS simulation language has over 2,200 functions/procedures.
Queuing policies	Enterprise Dynamics supports FIFO, LIFO, Min, Max, Random, Based on Object value, Based on Model Status and User Defined queuing policies

2.3.1 Database issues

Issue	Answer
Which databases does ED support?	<p>ED supports ODBC and ADO. This means that if there is an ODBC-driver available for a database, ED is able to communicate with it. Nowadays all major database systems support ODBC:</p> <ul style="list-style-type: none"> • MS Access • Oracle • Sybase • Informix • Paradox • SQL Server • ... <p>With ADO you can build up a connection string to any kind of database (either on your local computer or somewhere on the network).</p>
What is ODBC?	ODBC is the Microsoft standard for database communication.
What is ADO?	ADO (ActiveX Data Objects) is a method to read and write data from and to databases. The main advantage of using ADO is the fact that you don't need an ODBC alias to connect to a database.
Can you change or add data in a database?	Yes. There are 4DScript commands and simulation objects available to perform this task.
Does ED support database transactions?	Yes. There are 4DScript commands available to handle transactions.
Can ED display queries?	Yes. There is a database window in which you can display any subset from a database.
Can models be generated from a database?	Yes. Of course ED needs to be explained what to do with the data, but there are 4DScript commands available to assist the user in generating models.
Can data from a database be used real-time?	Yes. There are 4DScript commands and simulation objects available to perform this task.

2.3.2 Connectivity issues

Issue	Answer
In what way is ED able to communicate with external sources?	<p>There are various options available depending on the goal of the desired communication:</p> <ul style="list-style-type: none"> • DDE • ActiveX • Comm. ports • TCP/IP • Databases • Text files • CSV files • Excel • Word • OPC • CAD Wizard • DLL's • XML (read and write)
What internet/intranet functionality is included?	ED supports TCP/IP. Also POP, SMTP, HTTP and XML are supported.
Can the user influence the communication?	Yes. Communication is done via simulation objects, which can be completely modified to personal need.
Can ED communicate via the Internet/Intranet?	Yes. There are 4DScript commands and simulation objects available to perform this task.
Can ED import AutoCAD / dxf drawings?	Yes. There is an add-on available to import a dxf file, which is the standard exchange file format for graphics programs. With this add-on complete simulation models can be generated from a drawing file
How many calls per second are possible with external DLL's?	On a Pentium 4, 2 GHz, roughly 1 million calls per second in with 25 parameters are passed, and 5 parameters are returned.
Why should someone use the DLL Kit?	When time is of ultimate essence and heavy calculations need to be performed, or when already existing systems perform these calculations.
What is OPC?	OPC (OLE for Process Control) is a Microsoft standard introduced to standardize communication with machines.
Does ED interface integrate with other modeling/simulation software?	Yes. Suitcase 2.0 – Complete integration ShowFlow 1.0/2.0 – Complete interface
Does ED interface easily with third party visualization software?	Yes. Vista: has no version (Virtual Reality software developed by the RWTH Aachen)
Can ED export models in XML format?	Yes.
Can ED export simulation results in XML format?	Yes.

2.3.3 Simulation Objects

Issue	Answer
Which simulation objects are standard available?	Separate Atom Overview available on request
Can you define your own simulation objects?	Yes. ED comes with a comprehensive development environment for the modification of existing simulation objects, and the creation of completely new simulation objects. All supplied objects are open source
Does ED support inheritance?	Yes. ED is a full object-oriented simulation package with the support of inheritance.
How many simulation objects can you put in a model?	There is no limit to the number of simulation objects you can put in your model. However, the more you put in, the more powerful your computer should be. ED has a proven track record with simulation models with more than 250,000 simulation objects at the same time.
Do simulation objects contain spatial information?	Yes. ED is a full 3D simulation package.
Can you control simulation objects from other simulation objects?	Yes. There are 4DScript functions available to perform these tasks.
Does ED contain a good report environment?	ED has a very flexible report environment.
Can simulation objects retrieve data from Excel or write data to Excel?	Yes, there are standard objects that can do this and some functions that you can use anywhere in the model.
Does ED contain a good experiment environment?	Yes. ED has a complete and flexible experiment environment.
Does ED contain a Scenario Manager to setup multiple experiments?	Yes.
Does ED contain an optimizer?	No, not at the moment. Research is done for ED to contain an optimizer module that uses Genetic Algorithms to optimize models. Third party optimizer, OptQuest, is available.
Is it possible to step back in time during a simulation run?	No, this is no option in ED

2.3.4 Simulation Language

Issue	Answer
Does ED contain a language?	Yes. The language is called 4DScript and is a powerful, flexible easy to learn simulation language
Why does ED not support Visual Basic for Applications?	It serves no purpose. VBA does not have functions like MoveAtomInto. And it is those functions that you need in simulation. The syntax of the standard commands is relatively easy.

Can you create your own functions?	Yes. In fact, many functions that are available in ED are defined in the same way a user would do. ED uses softcoding for procedures and has many open-source functions included.
Has ED an interpreter or a compiler?	ED uses a mix. It is an interpreter, but after the code is compiled once, the compiled code is used. In this way ED offers the best of both methods.
What statistical measures does 4DS provide?	Minimum, maximum, mean, standard deviation, throughputs, cumulative distributions, measure and recording of parameters including signals, event time-stamping, etc.
Event generators	Poisson, Exponential, Uniform, delay and service centers, FIFO, LIFO, product dependent, scheduled, prioritized, etc.
Random number generator	The source code of all statistical distributions is published.

2.4 Execution

Topic	Enterprise Dynamics
Multiple runs	It is possible to execute a simulation replication several times without user interference. This is a standard feature. Enterprise Dynamics comes with an extensive Experiment Wizard in which you can control replications, and the performance measurements can be defined. These settings can also be saved in a separate file to be used with other simulation models.
Automatic batch run	Enterprise Dynamics provides the functionality to execute several simulation runs with different sets of parameters, for several replications without user interference. This is a standard feature. Enterprise Dynamics comes with an extensive Scenario Manager in which multiple experiments can be defined and controlled.
Warm-up period	Enterprise Dynamics provides the functionality to start gathering data after the simulation has been started. Data can be gathered dynamically (databases, files, Excel, TCP/IP, OPC, etc.).
Reset capabilities	Enterprise Dynamics provides the possibility to stop the simulation during a run and restart.
Start in non-empty state	Enterprise Dynamics provides the possibility to start with a simulation model in which already objects or entities are included.
Speed control	Enterprise Dynamics provides the possibility to change the speed of the simulation, link to a real time clock, stop and start and save model during run.
Execution Speed for Large Model	It takes Enterprise Dynamics about 1 minute to build a simulation model with approximately 200 servers. To simulate 1 week takes less than 1 minute (on a P4 2Ghz 256Mb) (= Small model).
Executable models	Enterprise Dynamics provides the possibility to create pack and go versions, which can be shown at any location on any PC, just with a part of the simulation. Runtime versions serve this purpose. It is also possible to create animations (2D and 3D).
Discrete, Continuous, Ergonomic	Enterprise Dynamics is a discrete event simulation environment. Continuous simulations have been created (Continuous simulation made discrete). Developments for ergonomic simulations are being examined.
Parallel	It is possible to create distributed simulation models. Simulation farms can also provide outcome when simulations need to be processed parallel.

2.5 Animation

Topic	Enterprise Dynamics
Integrity	Animation comes as an integral part of the package. 2D and 3D animation are standard features of the software. 3D animation is real-time (not post-processing). Turning off animation will improve the simulation speed.
Icons	<p>Enterprise Dynamics supports the following formats:</p> <ul style="list-style-type: none"> - Microsoft Windows Bitmap: <i>.bmp, .rle, .dib</i> - (Enhanced) Windows Metafile: <i>.emf, .wmf</i> - Joint Photograph Experts Group: <i>.jpg, .jpeg, .jpe, .jff</i> - Drawing Interchange File: <i>.dxf</i> - Graphics Interchange File: <i>.gif</i> - Targa Graphics Adapter File: <i>.tga, .win, .vst, .vda, .icb</i> - Portable Map Graphic: <i>.pgm, .pbm, .ppm</i> - Tag Image File: <i>.tif, .tiff, .fax</i> - Adobe Photoshop File: <i>.psd, .pdd</i> - Paintshop Pro File: <i>.psp</i> - Portable Network Graphics File: <i>.pgn</i> - Windows Icon: <i>.ico</i> - PCX, RLE encoded image: <i>.pcx, .scr, .pcc</i> - AutoDesk Image: <i>.cel, .pic</i> - Kodak PhotoCD: <i>.pcd</i> - 3D Studio: <i>.3ds</i> - Lightwave: <i>.lwo</i> - VRML 1.0 and 2.0: <i>.wrl</i> <p>Enterprise Dynamics is also an ActiveX server and client and is capable to display OLE objects in OLE containers.</p>
Features (zoom, pan, speed, movement, interaction)	Enterprise Dynamics provides 3D, color, resizing, zooming and pixels-vector support. Also complete 3D support is provided and export to Virtual Reality software ViSTA is available.
Development	2D and 3D animation is available for each and every simulation object. You don't have to do anything for it. However you have complete control to modify it and use your own 2D and 3D models (see also above for the list of supported formats).

2.5.1 Common Visualization Issues

Issue	Answer
What kind of visualization is possible with ED?	2D 3D/VR
Can you “fly” through the 3D visualization during a simulation run?	Yes, all visualization is real-time generated.
Does ED support VRML?	ED supports VRML 2.0.
Are there visualization examples provided?	Yes. Part of the standard installation.
Are you able to create your own visualization objects?	Yes. You can either use internal drawing commands or use an external drawing program and import the drawing objects into E.D.
Can you create movies (.AVI, .MPG)?	Yes. Various 4DScript commands and an AVI Create atom are available to create any kind of movie.
Which image files does ED support?	.bmp, .wmf, .jpg, .jpeg, .emf, .ico. and many more. ED supports more than 35 different types of file formats.
Does visualization influence my simulation speed?	Yes. Although ED visualization supports the OpenGL standard, visualization will influence the simulation speed. To have maximum simulation performance, closing the visualization windows is required.
How many frames per seconds is the visualization refreshed?	Completely adjustable. 24 frames per second (TV quality) is easily met. At default the refresh rate is 30 frames per second.

2.6 Testing and efficiency

Topic	Enterprise Dynamics
Verification and validation	On-line help, on-line error messages, on-line tutorial, logical error checks and clear error handling are some of the features that make testing possible and are therefore present. The debugger makes it complete with which you can step through all the code (even animation handlers). It comes complete with a performance counter that keeps track of the number of times a command is used with a percentage of the processor time (very useful for high-speed simulation models).
Multitasking	It is possible to execute several tasks at the same time (as user) for example build a model and run replications. Running replications will loose simulation speed.
Interaction	Enterprise Dynamics provides the functionality to interrupt the simulation model, change of the model and continuing the executing of the model. You can change any parameter of the simulation object during a simulation run and this change will be updated immediately.
Step function	Enterprise Dynamics allows running the model event by event, letting the user observe the changes in each state. The best way to do that is to use the debugger that has some special features to achieve this (watches, complete list of event list, and list of most used simulation objects).
Backward clock	Running the model backward would help debug the errors which occurred during the model normal run, and which the program did not detect or could not stop at that time. ED does not support backward simulation, but there is a conditional stop available, and it is possible to jump into the debugger based on a condition.
Breakpoints	See above
Display features	Enterprise Dynamics supports dynamic display of variables, attributes and functions, during run and during debugging. There are even special simulation objects to display variables, and attributes in 3D animation.

2.7 Output

Topic	Enterprise Dynamics
Reports	Standard reports (with various templates) are available to report about queue lengths, waiting times etcetera. The user can also define own templates.
Delivery	Creating your own reports with extra information, or direct send the output to a printer is possible. Enterprise Dynamics even supports the use of multiple sizes of paper to be used in the reports.

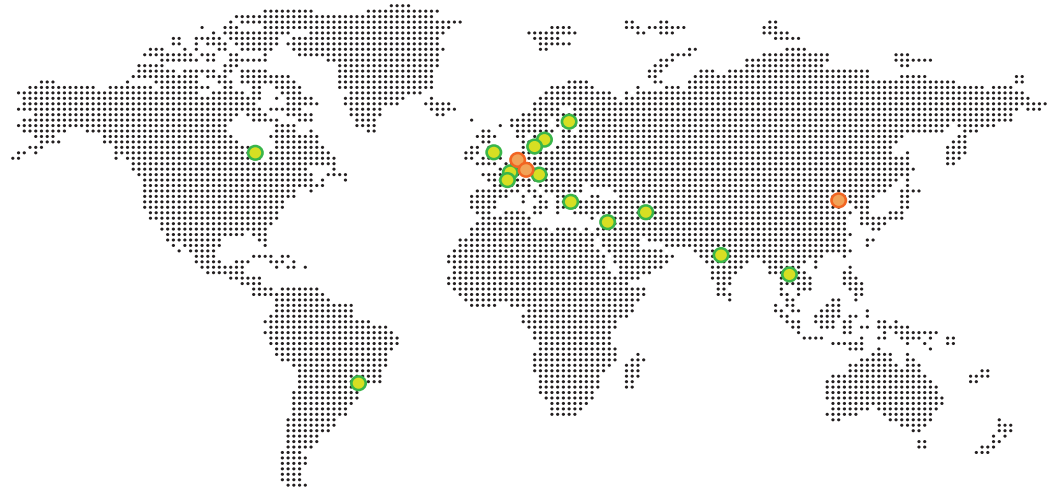
Integration	Enterprise Dynamics can be linked with any program. ED has standard links to OptQuest (optimization), StattFit, Oracle, and many more. Enterprise Dynamics can even be integrated with other software.
Database	Enterprise Dynamics is fully ODBC32 and ADO compatible and therefore supports any type of database that has an ODBC driver or can be accessed via an ADO connection string. Proven track record with all major database vendors (Oracle, SQL Server, Access, FoxPro, Dbase, etc.).
Graphs	Enterprise Dynamics supports many formats such as graphs, plotters, histograms and more at default and options to generate own format.
Analysis	Statistical calculations such as means, variances, half width and t-test are present (even in variants for biological statistics).
Optimization	An optimization tool can be bought as integral part of the package or can later be added. Enterprise Dynamics supports many optimization tools (OptQuest, ISSOP, etc.).
Output file formats	Microsoft Excel .csv format

2.8 User

Topic	Enterprise Dynamics
Hardware	Enterprise Dynamics requires at least a Pentium III, but for good performance (also with 3D animation) we recommend the following configuration: <ul style="list-style-type: none"> • modern x86 processor • 1 Gb+ • Expert OpenGL video card (128Mb+, non shared) Enterprise Dynamics Graphics prefer Graphics Adapters with NVidia or ATI chipsets
Operating system	Windows 2000, XP, Vista and Windows 7
Network version	Network versions are supported with any kind of desired number of licenses.
Required experience	With all simulation packages basic knowledge of queuing theory will help.
Financial (SW, HW, Training, service, learning time)	Software and service pricing can be provided on request. The hardware requirements are depending on the number of licenses and the selected system (see above). The learning time is depending on the capabilities of the user.
Security device	Enterprise Dynamics works with software licensing only.
Engine written in commonly available and maintained development platform	The Front-end is developed in Delphi version 7, a common and maintained development platform. The core engine of Enterprise Dynamics is written in assembly (for memory management and speed issues).

GUI model representation	Enterprise Dynamics allows users to modify the GUI. A complete GUI building environment makes it possible to develop dedicated simulation applications – also to be used by non-simulation experts.
“Microsoft Windows” style GUI interface	We follow Microsoft Guidelines in GUI development and keyboard control.
Object and model manipulation	Full control is possible through customized menus, button bars and direct interaction in 2D or 3D models. Interaction can also be during execution of a simulation run (without restarting).
Source code provided	Enterprise Dynamics comes with two types of source code. The engine is written in Delphi and this source is privately owned. The objects, models and examples are written in 4DScript. This source code is open source so users are free to use or change it. Enterprise Dynamics provides tools to secure 4DScript code to protect this intellectual property.

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