

2.1 The learning perspective This tutorial teaches beginners to find their way through the Enterprise Dynamics (ED) simulation package. Later on, two servers are added in order to show the concept of "channels". The atoms used in this instance are Source, Queue, Server and Sink. Chapter 6 shows different methods to observe the results of a study. We use an example of a carpenter's factory, to explain the batching of products in Enterprise Dynamics. The user learns to use the: Monitor, the Summary Report, the new Experiment Wizard and displaying various graphics. Furthermore, the steps to go through in a simulation study are practiced at a beginner's level: model building, validation, experiment layout and analysis of results. In Chapter 7, the emphasis is placed on observing the pre-programmed methods through which products get access to a next atom (input strategy), are placed in a queue (queue discipline), or are redirected after use (send to). Chapter 8 introduces eight new atoms including the Assembler and the Conveyor atom, while Chapter 9 is dedicated to the link between Enterprise Dynamics and Excel. This chapter also provides a start in 4DScript and an introduction into labels. Chapter 9 is dedicated to the Human Resource atoms and Chapter 10 to Transporters. Besides this tutorial another important the tutorial is available: 'A first start in 4DScript'. This tutorial forms the starting point for learning the underlying programming language in Enterprise Dynamics.

2.4 Learning Simulation

Simulation is not a simple technique. The sensible use of a simulation program requires knowledge about the theoretical background of discrete simulation such as probability distributions, the model building process including validation techniques and the design of experiments. Although the tutorial gives insights in this field, it is not a textbook regarding simulation in itself. For this, one can refer to existing books or lecture notes about discrete simulation. Developing a feeling for simulation and model building in particular are for the better part a matter of lots of practice. Examples of the models in this tutorial are also included in Enterprise Dynamics. Use them when in doubt whether your own models are correct.

Enterprise Dynamics Tutorial 4.3 Enterprise Dynamics's Background

Enterprise Dynamics is an object-oriented software program for modeling, simulation, visualization, and control of dynamic processes. The users can pick up objects – called atoms – from standard libraries in order to build their own model. Enterprise Dynamics is based on this concept of atoms as modeling objects in each model. An atom can represent a machine, a counter or a product but it can also have a non-physical character like a graph. As far as the difference in the type of atoms is concerned, we will mention basic atoms (five atoms often used: product, source, sink, server and queue), transport atoms (relating to transport such as conveyors or transporters), results atoms, etc. Thanks to the open structure of Enterprise Dynamics, the advanced user can build new atoms, for example to model a machine with very specific characteristics. At the moment, Enterprise Dynamics includes 100 standard atoms, but this number is ever increasing. The beginner may typically only need to select from around 30 frequently used atoms to have enough material for his or her applications. Atoms are predefined modeling objects used to build models quickly and to carry out studies. Enterprise Dynamics also has a built-in programming language called 4DScript, which can be used for setting specific conditions from reality in the model. In this tutorial we will address 4DScript only briefly. Thanks to the open structure of Enterprise Dynamics, the user can create its own library that should be loaded when Enterprise Dynamics is started using the packages structure of Enterprise Dynamics. It is also possible to create a new menu structure and layout.

Enterprise Dynamics 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. Advantages of using Enterprise Dynamics within industry and logistics are: The ability to test a future system in an early design stage. Testing and improving proposed modifications resulting from e.g. Lean Manufacturing or Six Sigma studies, without impacting the operational environment. Modeling and analysis of several scenarios, such as Rough-Cut Capacity Planning, to be prepared for the future. Optimization and safeguarding of investment planning for production and transport equipment. Estimating the influence of uncertainties and variations, like failures and variable process times on system performances. Analysis and visualization of operational systems in 2D and 3D animation. Enterprise Dynamics Educational is our offering for educational purposes, consisting of a combination of the Enterprise Dynamics software with a number of elaborated case studies which the teacher can use for student assignments. This tutorial can be used to learn the basic skills necessary to work with Enterprise Dynamics. Furthermore it addresses topics and questions that typically arise in simulation studies and is therefore an important part of Enterprise Dynamics Educational. INCONTROL Simulations Solutions is a simulation solution provider: in addition to building, developing and selling the Enterprise Dynamics software, it also provides extensive services in the field of computer simulation, such as training and consulting. The consulting services involve carrying out simulation studies as well as application building.

4 Getting Familiar with Enterprise Dynamics

4.1 Starting Enterprise Dynamics

Enterprise Dynamics can be started from the Windows Start Menu. During the startup a splash screen appears, see Picture 4-1. Enterprise Dynamics Tutorial 5

Picture 4-1: Splash screen When you start Enterprise Dynamics for the first time you are presented with the Example Wizard. The wizard offers a selection of the available example models that come with Enterprise Dynamics. Switch to the Examples page to view all the available models, see Picture 4-2. Later on, you can also open the Wizard from the Help menu. Just click on one of the models to open the example. Picture 4-2: Example page of the Example Wizard

4.2 The window sections

As soon as Enterprise Dynamics is started up completely, the opening window should be approximately similar to Picture 4-3. Enterprise Dynamics Tutorial 6

Picture 4-3: Layout of the opening window in Enterprise Dynamics The window is divided into the following sections: A menu bar: among others for opening and saving files. Section 4.3 covers the menu structure more thoroughly. The library: The library includes all atoms a user can place into a model. Each atom has a certain function. By combining the right atoms, it is possible to re-create ('model') a business process in Enterprise Dynamics. Model building is described in chapter 5. The model layout window: this is where the model is being built. The run control: use this to reset and start the model and to regulate its execution speed. The clock displays the simulated time already elapsed during the simulation (not the real time!).

4.3 The menu structure

The function and the appearance of the menus are similar to those in other Windows applications, such as Word and Excel. The most used menu options are explained in the table below. The main menu is to be found in the menu bar, which is subdivided as follows: File Make, open or save files, to set preferences and to control standard functions such as printing. Display Open viewer and layout windows to display models and to open the library windows with modeling objects. Simulate Open a Run Control or Clock window. Design and perform an experiment. Results To generate reports and

graphics of a single simulation run or evaluate results of an experiment. Tools Contains tools such as the 4DScript interact and Autofit to fit a distribution to given data. Help Open the documentation, the Example Wizard as well as to find company and version information. Developer Tools useful for developer to create libraries and attribute functions. Each main menu item is divided into groups. See the documentation for a complete description.

4.4 Structure of the library and the model

Enterprise Dynamics uses a tree structure to visualize the organization of atoms. With this structure the user can easily see which atoms contain which other atoms. The main tree gives a complete overview of the application, the library and the opened model. Two important trees are: Enterprise Dynamics Tutorial 7

The Library Tree (see Picture 4-4)

which lists all atoms a user can insert into the model. The atoms are divided into groups, for example a transport group and a human resource group. By selecting an atom and dragging it into the model window (the 'Model Layout' or '2D Builder'), the atom is added to the model. The Model Tree, where all the atoms used in the current model are listed. Press F5 to refresh the list. Picture 4-4: The Library Tree & Model Tree of Example 1

The 2D Builder or Layout window and the Library Tree

can be opened from the Display section of the main menu. The shortcuts are shown in Picture 4-5. Picture 4-5: Buttons to open the Library Tree and 2D Builder window.

5 Model Building Basics

In the previous chapter, the theoretical aspects of Enterprise Dynamics have been discussed. In this chapter, we will start by building a simple model in Enterprise Dynamics. The objective here is to learn about Enterprise Dynamics, not to fully complete a simulation study. At the end of this chapter, the user should be able to develop a model in which several machines are used simultaneously.

5.1 Dragging atoms into the model

The first step in the creation of a model is selecting the required atoms and placing these into the model. In this section, we will start by building a simple model that consists of the following four parts, see Picture 5-1:

- Source: The function of this atom is generating products into the model.
- Queue: This atom is a waiting area for customers or products.
- Server: The function of this atom is that of a machine or of a counter. Atoms entering a server undergo a process and remain in this atom for a certain time (the process time).
- Sink: The products or customers leave the model through this atom.

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Example 1

An average of 20 customers per hour come into a post office. The assistant has on average two minutes to help a customer. Of course, the number of customers may vary from one hour to another. The two-minute time that the assistant has to help a customer can vary as well. A customer who only wants to buy stamps will need less time than a customer who wants to open a new account. The customers are served on a first-in first-out basis. A few customers complained about the queues and because the post office manager is very concerned about the service to his customers, he wants to inquire into this problem.

Questions and assignments

1. How high is the utilization of the post office assistant? What does that mean?
2. Can you make an estimate of the average queue length?
3. Which characteristics would you measure for the post office manager?

Simulation is a tool to gain insight into the average queue length. Because this model is the first one we are going to build, it will be dealt with step by step. We therefore use the four atoms mentioned in the beginning of this section and put them into the model in the above-mentioned order. The first one is thus the Source, then the Queue, the Server and finally the Sink. These atoms and many others can be found in the Library. Just select an atom and drag it onto the Model Layout window. The

four atoms that are required for this model can all be found in the first category "BASIC MODELING". In the Run Control window check the option "Run until stop time". Set the stop time on 8 and measurement on hours. If you now start the simulation it will stop after exactly 8 hours. Questions and assignments 3. Perform this a few times and note the number of windows produced. Does this correspond to the analysis carried out previously? What is the bottleneck in this process? 2. Results atoms The use of the results atoms is quite simple. The Library Tree (and not the Model Tree) has to be opened. Look for the StatusMonitor atom and the Generic Monitor atom in the Results group and drag them into the model. Note that the Generic Monitor can be found in the group Status within the Results group. To use the StatusMonitor, it is sufficient to connect its input channel to the central channel of the atom to be monitored. When the simulation is reset and started, the status monitor atom will automatically begin displaying the status statistics. In this case connect it to one of the bench vices, reset the model and press Start. Examine which proportion of its time the bench vice spends on waiting for timber to arrive, on collecting timber after the first arrived, and on actually processing the timber. If the channels are switched on, the atom should look like Picture 6–4. Enterprise Dynamics Tutorial 18 Picture 6–4: Part of the model with (already connected) Result atoms; left a StatusMonitor on the right a Generic Monitor. Configuring the Generic Monitor atom takes more work. Again, the first step is to connect the monitor with the atom you want to observe. In this case, we want to know how many windows are leaving the factory per hour. As a result, the monitor has to be connected with the Queue before the Sink. Connect the input channel of the monitor to the central channel (the information channel) of the Queue. You can also double-click or right-click the monitor atom and then press the button "Select Atom" select from the list that appears the atom that is going to be observed.

7.2 Changing the Queue Discipline The purpose of this section is to change the Queue Discipline of the last queue and to observe theSelect "NegExp(10)". A 4DScript window will appear. Adjust the cycle time in such a way that the assistant needs an average of two minutes to help one customer. Picture 5–4: Input window Server Reset and restart the simulation with the Run Control. Because we have increased the time between two arrivals, it is a good idea to increase the simulation speed. By zooming in sufficiently, you can see how many customers are waiting in the queue. You can replace the blue dot, representing a customer in our example, with another icon. To do so, double click the blue dot to the left of the source. Double-click on the edit field of the "2D Icon" that can be found on the "Visualization" tab. The model with this experiment is supplied under the name timber2.mod Enterprise Dynamics Tutorial 29 7 Playing with Strategies In this chapter, the emphasis lies on the pre-defined strategies with which products get access to a next atom (input strategy), are selected out of a queue (queue discipline) and are re-directed after processing (send to). It consists of three Sources, three Locks (an atom regulating the products' supply), five Servers, four Queues and one Switch, which is a self-built atom (Enterprise Dynamics offers this flexibility). Tutorials.2.3.2.2.3.4. 1.3. 1.2.3.4.5.6.