

Licenciatura em Engenharia Informática

Simulação (Arena)

("cheirinho")

Fluxo de Processo (Process Flow)

- ▶ **Análise do Fluxo do Processo a Simular**
 - **Etapa executada tendencialmente em simultâneo com a construção do programa de simulação, usando uma Linguagem de Simulação (Arena)**

Fluxo de Processo

► **Fluxo de Processo - Procedimento**

- **Identificação de Entidades**

- **Descrever Comportamento de Entidades no Sistema**

- **Identificar fluxo**
 - **Identificar regras de operação**
 - **Identificar padrão de utilização de recursos**
 - **...**

A Quick Look at Arena

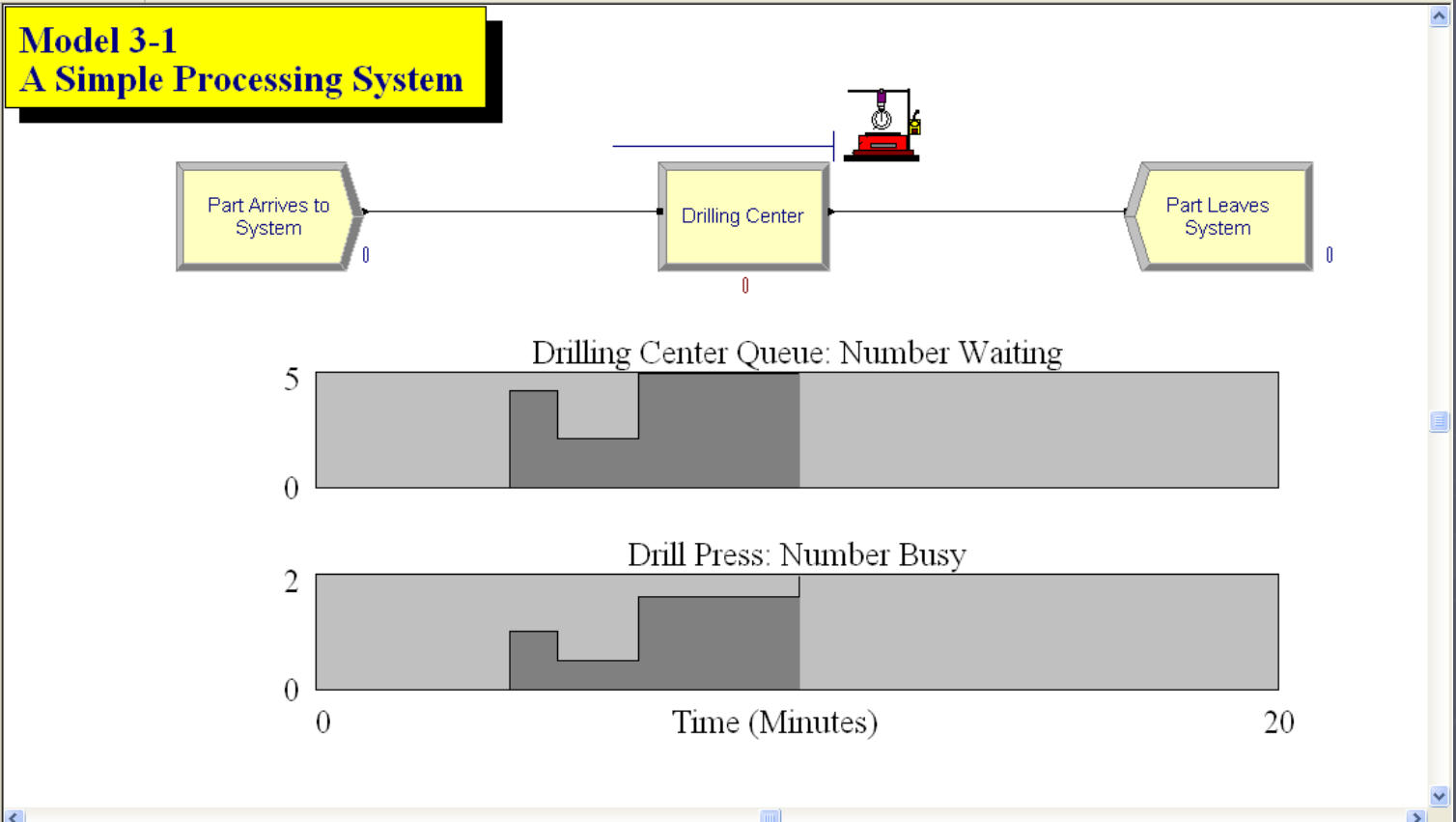
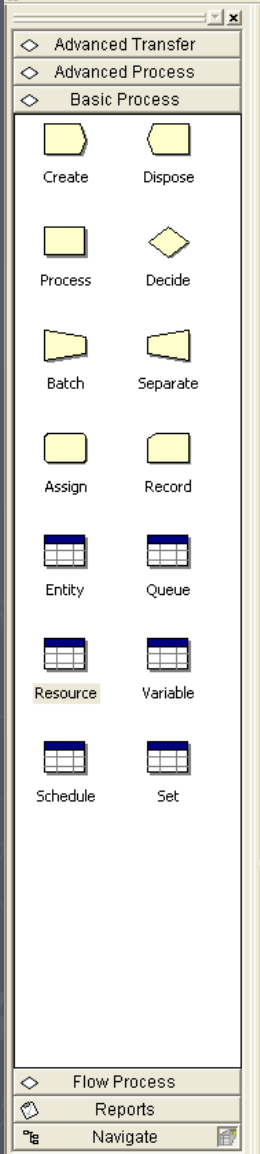
Book Example 03-01 A Simple Processing System
Painel Basic Process

► **Módulos (Fluxograma):**

- **Create**
- **Process**
- **Dispose**

► **Tabelas de Dados:**

- **Resource**



Resource - Basic Process

	Name	Type	Capacity	Busy / Hour	Idle / Hour	Per Use	StateSet Name	Failures	Report Statistics
1	Drill Press	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>

Double-click here to add a new row.

Arena - [Model 03-01.doe]

File Edit View Tools Arrange Object Run Window Help

94%

Model 3-1 A Simple Processing System

Create

Name: Part Arrives to System Entity Type: Part

Time Between Arrivals
Type: Random (Expo) Value: 5 Units: Minutes

Entities per Arrival: 1 Max Arrivals: Infinite First Creation: 0

OK Cancel Help

Number Waiting

Number Busy

Time (Minutes)

Create - Basic Process

	Name	Entity Type	Type	Value	Units	Entities per Arrival	Max Arrivals	First Creation
1	Part Arrives to System	Part	Random (Expo)	5	Minutes	1	Infinite	0

Create module from Basic Process panel selected.

(1530, 973)

start | Inbox - Mi... | Chapter 0... | SIM_Lectu... | SIM_Lectu... | Chapter 0... | Temp | Morten - C... | Arena - [M... | PT | 11:17

Arena - [Model 03-01.doe]

File Edit View Tools Arrange Object Run Window Help

94%

Model 3-1 A Simple Processing System

Part Arrives to System

Drilling Center

Part Leaves System

Process

Name: Drilling Center Type: Standard

Logic

Action: Seize Delay Release Priority: Medium(2)

Resources:

Resource, Drill Press, 1
<End of list>

Delay Type: Triangular Units: Minutes Allocation: Value Added

Minimum: 1 Value (Most Likely): 3 Maximum: 6

☒ Report Statistics

OK Cancel Help

Resources

Type: Resource

Resource Name: Drill Press Quantity: 1

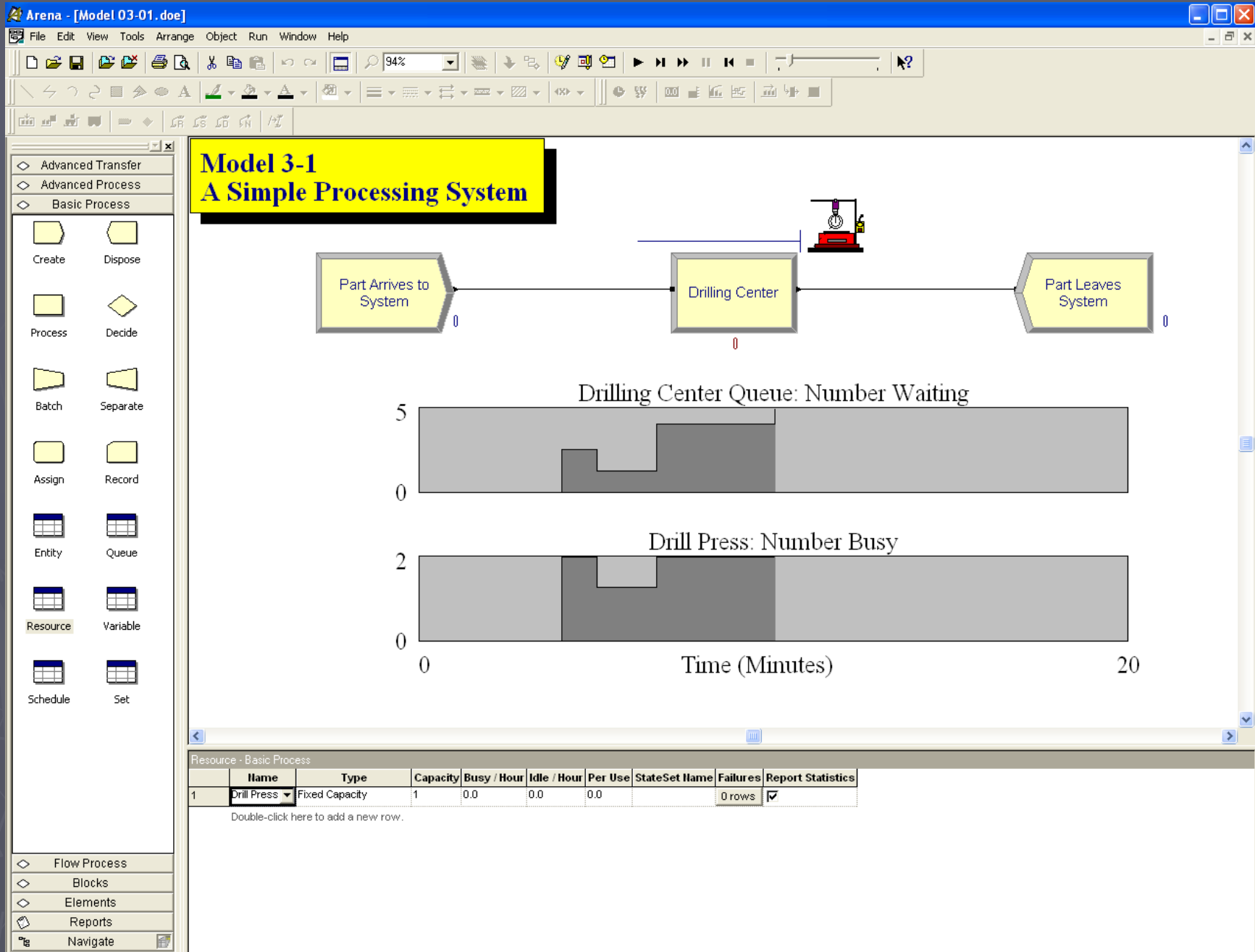
OK Cancel Help

Process - Basic Process																	
	Name	Type	A														
1	Drilling Center	Standard	Seize Delay Release	Medium(2)	1 rows	Triangular	Minutes	Value Added	<table border="1"> <thead> <tr> <th>Minimum</th> <th>Value</th> <th>Maximum</th> <th>Report Statistics</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3</td> <td>6</td> <td><input checked="" type="checkbox"/></td> </tr> </tbody> </table>	Minimum	Value	Maximum	Report Statistics	1	3	6	<input checked="" type="checkbox"/>
Minimum	Value	Maximum	Report Statistics														
1	3	6	<input checked="" type="checkbox"/>														

Process module from Basic Process panel selected.

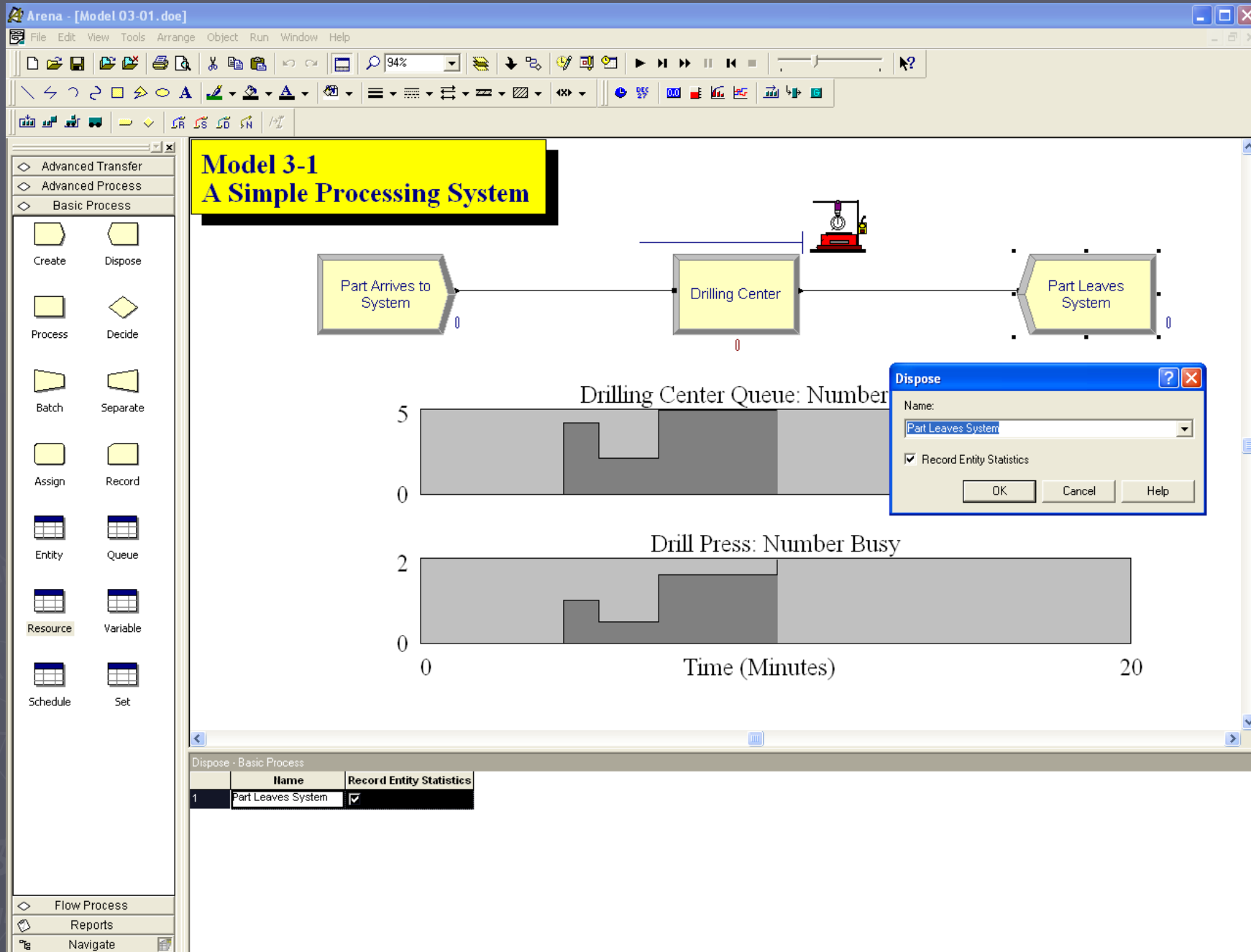
(2990, 947)

start | Inbox - M... | Chapter 0... | SIM_Lectu... | SIM_Lectu... | Chapter 0... | Temp | Morten - C... | Arena - [M... | PT | 11:19



Resource module from Basic Process panel selected.

{1111, 2791}



Dispose module from Basic Process panel selected.

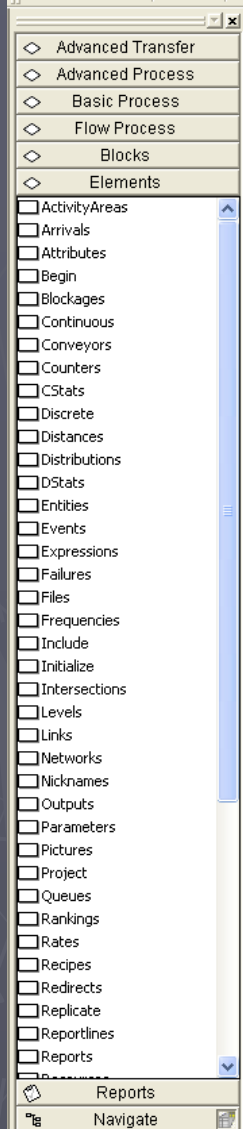
(4150, 750) to (4762, 1106)

A Quick Look at Arena

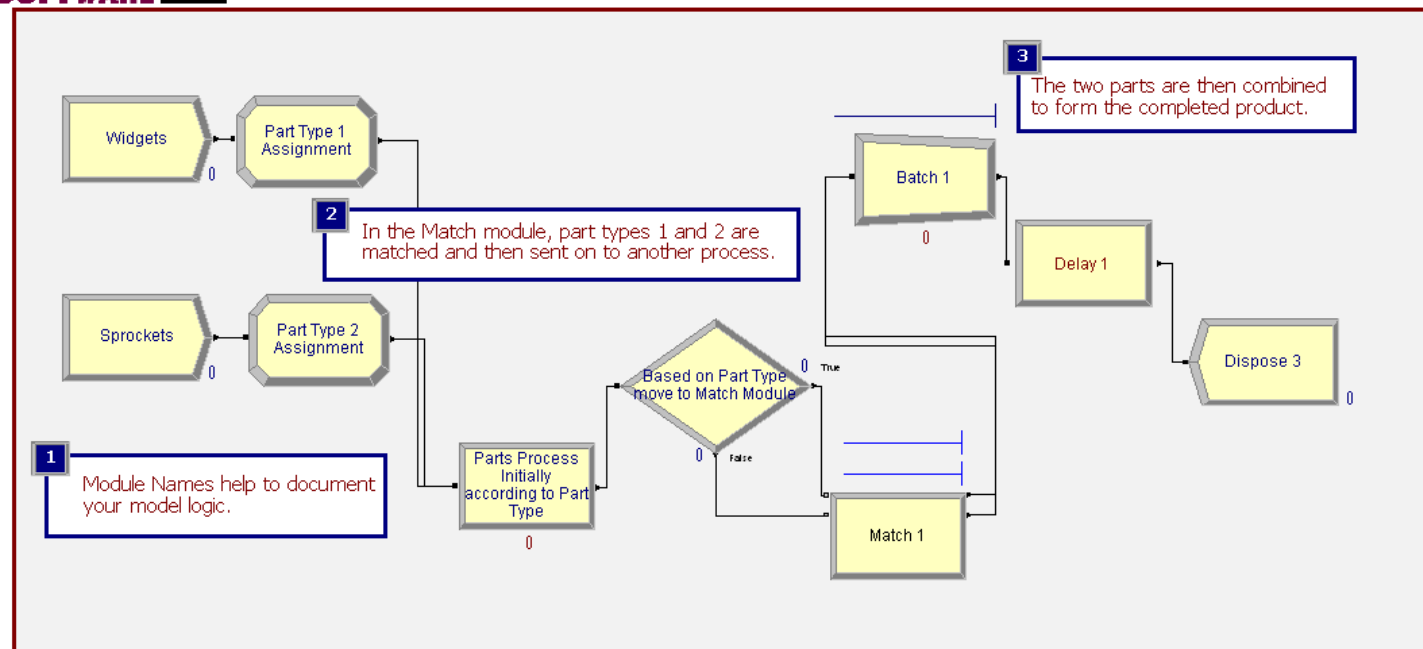
Smart 170 Matching Entities by Part Type

► **Módulos (Fluxograma):**

- **Decide** (Basic Process)
- **Match** (Advanced Process)
- **Batch** (Basic Process)



Matching Entities by Part Type



Arena - [Smarts170.doe]

File Edit View Tools Arrange Object Run Window Help

73%

ROCKWELL SOFTWARE

Matching Entities by Part Type

1 Module Names help to document your model logic.

2 In the Match module, part types 1 and 2 are matched and then sent on to another process.

3 The two parts are then combined to form the completed product.

```

graph LR
    Widgets[Widgets 0] --> PTA[Part Type 1 Assignment]
    Sprockets[Sprockets 0] --> PTA2[Part Type 2 Assignment]
    PTA --> Match{Based on Part Type move to Match Module}
    PTA2 --> Match
    Match -- True --> Batch1[Batch 1 0]
    Match -- False --> PPT[Parts Process Initially according to Part Type 0]
    Batch1 --> Delay1[Delay 1]
    Delay1 --> Dispose3[Dispose 3 0]
  
```

Decide

Name: Based on Part Type move to Match Module Type: 2-way by Condition

If: Attribute Named: Part Type Is: ==

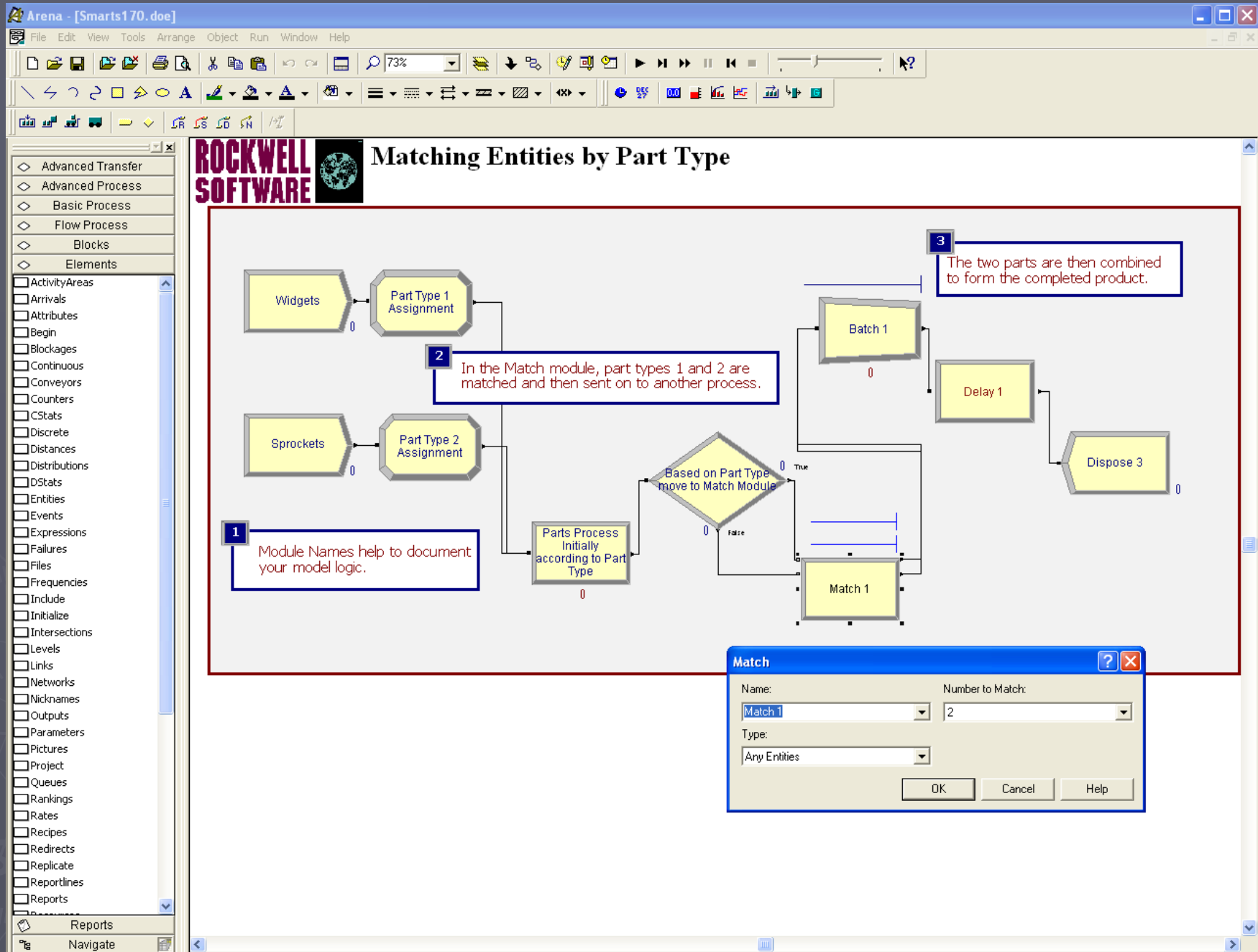
Value: 1

OK Cancel Help

Decide module from Basic Process panel selected.

(3622, 777)

start | Inbox - ... | Simulati... | SIM_Lec... | SIM_Lec... | Robot... | Robot... | Arena - ... | Dicionári... | Arena O... | PT | 19:25



Arena - [Smarts170.doe]

File Edit View Tools Arrange Object Run Window Help

73%

ROCKWELL SOFTWARE

Matching Entities by Part Type

1 Module Names help to document your model logic.

2 In the Match module, part types 1 and 2 are matched and then sent on to another process.

3 The two parts are then combined to form the completed product.

```

graph LR
    Widgets[Widgets 0] --> P1[Part Type 1 Assignment]
    Sprockets[Sprockets 0] --> P2[Part Type 2 Assignment]
    P1 --> P3[Parts Process Initially according to Part Type 0]
    P2 --> P3
    P3 --> D{Based on Part Type move to Match Module 0}
    D -- True --> B[Batch]
    D -- False --> D1[Delay 1]
    B --> B1[Batch 1]
    B1 --> D1
    D1 --> B2[Batch]
  
```

Batch

Name: Batch 1 Type: Permanent

Batch Size: 2 Save Criterion: Last

Rule: Any Entity

Representative Entity Type:

OK Cancel Help

Batch module from Basic Process panel selected.

(4358, -117)

Apoio à aprendizagem no Arena

- ▶ http://dl.dropbox.com/u/4519148/Arena_10CD.zip

- ▶ Menu HELP»Product Manuals»

7 livrinhos em pdf

1º » Arena Basic Edition User's Guide

- ▶ Menu HELP»Arena **Smart** Files

Depois é necessário abrir esses Smarts
em FILE»Open

tipicamente na pasta:

C:\Programas\Rockwell Software\Arena\Smarts

Índice completo dos Smarts em HELP»Arena Help

no conteúdo: 'SMART Files Library'

Construir animações

Transporte autónomo, contínuo e discreto

- ▶ Smart 73 - Stations e Routes
- ▶ Outras formas de animação, fora do âmbito de EES:
- ▶ Smart 101 - Conveyors (tapete/passadeira)
- ▶ Smart 146 - Transporters

Análise de Cenários e Decisões

- ▶ **Tipicamente** consiste em encontrar o **número mínimo de recursos** que permite que o sistema funcione sem atrasos (**filas**) consideráveis.
- ▶ Necessário analisar resultados dos **Reports**. Para isso definir primeiro o tempo de simulação (Simulation Length em menu Run>Setup).

Bibliography

- ▶ Kelton, W D; R P Sadowski and D J Sturrock, Simulation with Arena, New Yourk: McGraw-Hill, 2007
- ▶ Law, A M and W D Kelton, Simulation Modeling and Analysis, New York: McGraw-Hill, 2000
- ▶ Winston, W L, Simulation Modeling using @Risk, Belmont, CA:Wadsworth, 2000
- ▶ R B Chase, F R Jacobs and N J Aquilano, Operations Management for Competitive Advantage, McGraw-Hill/Irwin, 2006
- ▶ A Patchong, T Lemoine and G Kern, Improving Car Body Production at PSA Peugeot Citroën, Interfaces, 33, 1, pp 36-49, 2003

Contacts

@ Departamento de Produção e Sistemas

- ▶ Guilherme A B Pereira gui@dps.uminho.pt
- ▶ Luis M S Dias lsd@dps.uminho.pt