Metrics Plugin

Most BPM tools just provide you with a diagram drawing facility, which is hardly sufficient if you need to undertake a financial analysis of the processes you have drawn. Typically you need to determine the monetary cost of a business process, what the cost of an alternative process would be, how much you can improve it, how long it takes to perform the process and so on.

The Metrics Plugin provides you with the ability to instrument your BPMN process model with numeric data so that you can obtain this information from your process model. Summary information is available through the ***Volumes and Costs*** *report.*

Overview

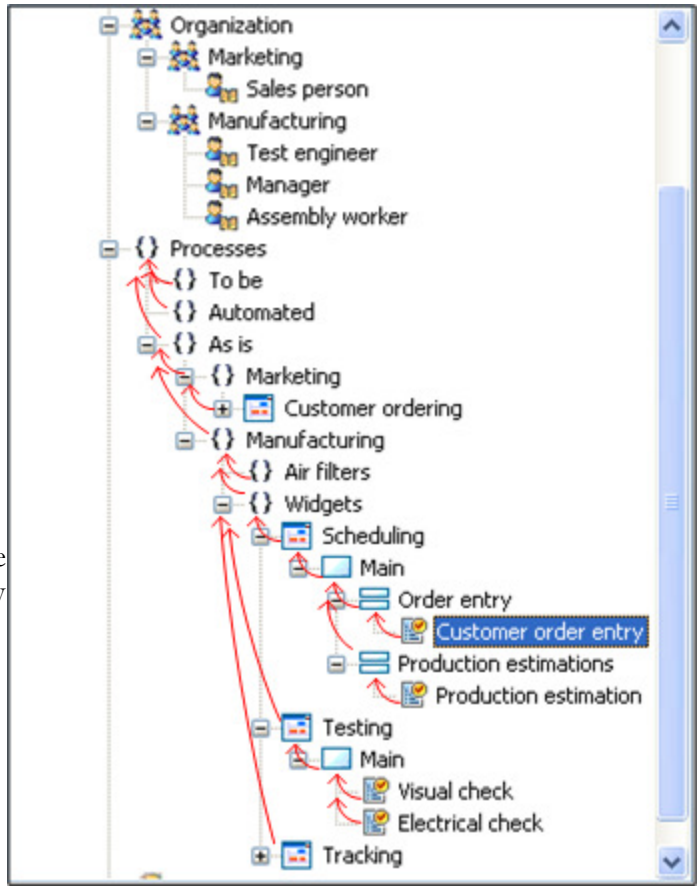
Certain kinds of BPMN objects are instrumented with metrics information. Because **Tasks** and **Events** are the active components of a process model (i.e. they perform or initiate work) they are metrics ***producers***.

The basic unit of work or load is ***Volume***. Volume flows following the route specified in your process flow diagram.

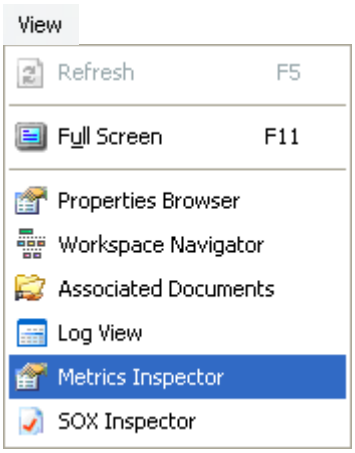
Other BPMN objects are containers of metrics producers. Containment is hierarchical (**Diagram** contains **Pools** which may contain **Swimlanes** and so on) and there is also the **SubProcess**.

Container objects publish the totals for all of the items they contain so summaries effectively *bubble up* through the process model's hierarchy.

Gateways switch and receive volume flow to and from **Sequence flows** (connecting links).



The Metrics Inspector



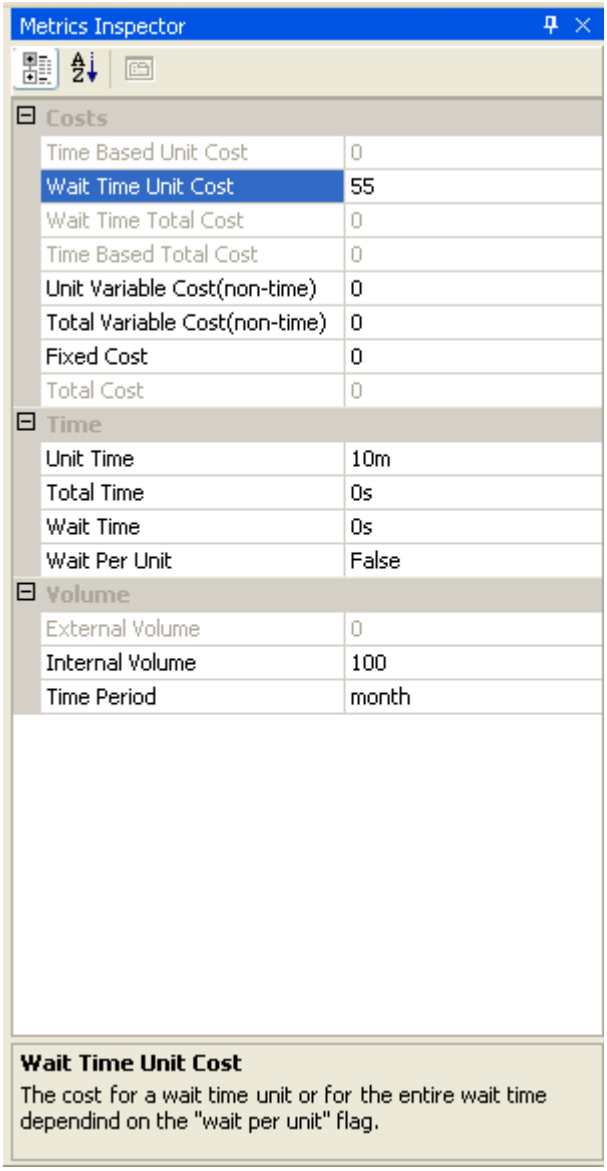
To view the Metrics Inspector choose the **Metrics inspector** item from the **Views** menu.

The Metrics inspector displays the metrics information for the currently selected object in the Navigator tree or the diagram editor window.

When you click on an object that does not participate in metrics the inspector pane is blank. Otherwise, it displays the metrics properties of that object.

Some properties are gray, because they are read-only and cannot be changed or because they are the product of a calculation or are derived from somewhere else in the flow. For example, the **External Volume** property is gray because it represents the volume being received from incoming connections.

You can however change the **Internal Volume** (which becomes some other object's external volume downstream from the selected object).



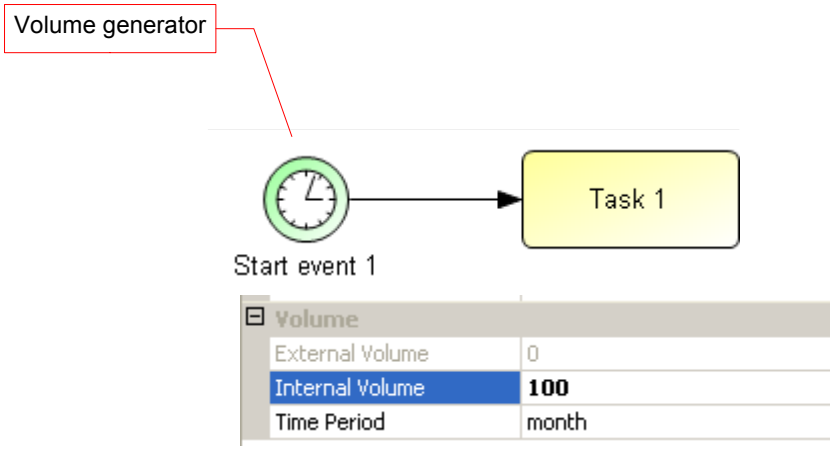
Volume

Volume represents the transaction load over a period of time. The measurement period is usually one month. Conceptually, volume "flows" through the process diagram like traffic on a rail network.

Volume generation

All Event and Task objects possess a volume generator property which is known as **`Internal Volume`** This volume can be injected into the flow to become part of the output flow volume that is passed on downstream.

Figure 1. Volume being produced by an event object



Usually, a single load generator is located at the very head of a process chain (as in the figure above) and this object supplies load to all of the downstream objects in the flow. This is not always the case however, sometime you need to ***decrease*** volume mid-flow. This is done by defining a *negative* Internal Volume at the point where you need to throttle the volume.

An example of this might be papers are bound in sets and then a set is the product of the transaction.

A task could reduce the volume e.g. the papers are bound in sets and then a set is the outgoing volume

Volume flow

Volume follows the graph of the process diagram. Connections (SequenceFlows) transport volume between activities. In other cases volume is inherited from an object's container (for example a SubProcess object implicitly passes its received volume to the first object it contains).

The primary object responsible for transporting volume is the connection object. A connection has an input volume and a scaling factor called **`Percent`**. The scaling factor can be used to inflate or deflate the output volume of the connection.

Figure 2. SequenceFlow volume

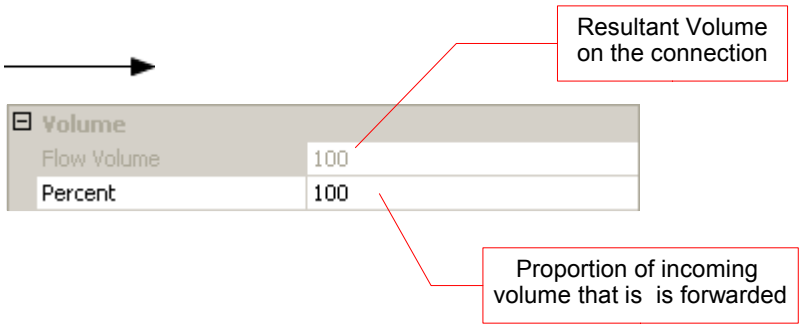
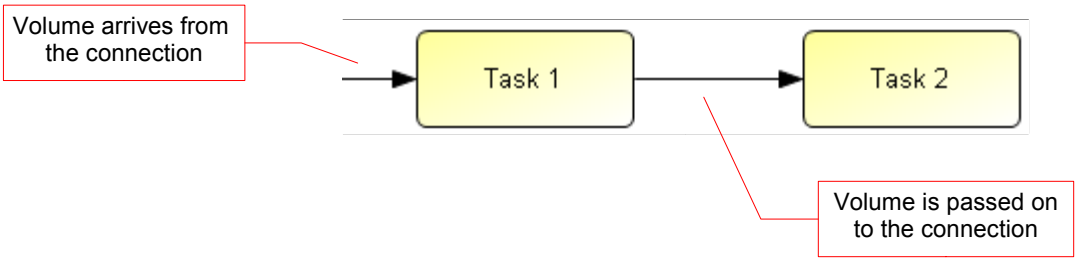
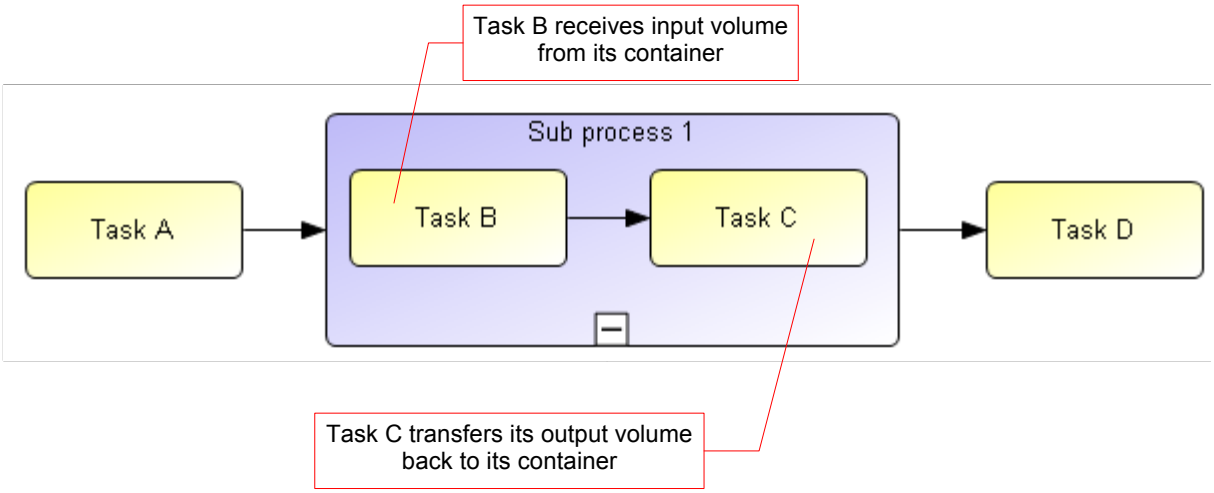


Figure 3. Volume forwarding between objects



Volume is also inherited from a container like in the figure below.

Figure 4. Transfer of volume from a container



Volume splitting

Volume will diverge (split) and recombine according to the way a process diagram is drawn. BPMN allows you to draw splits and merges with or without Gateway objects.

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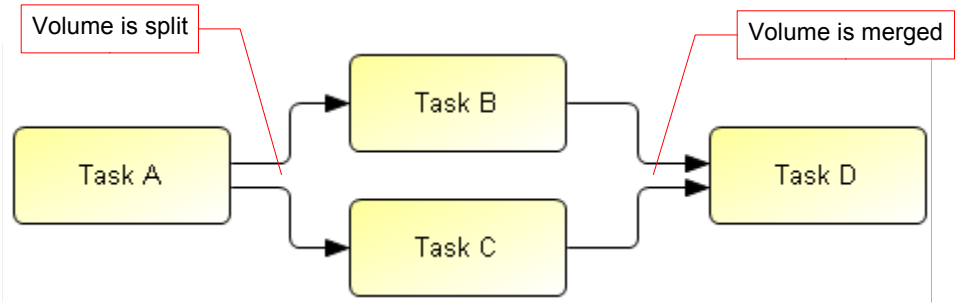
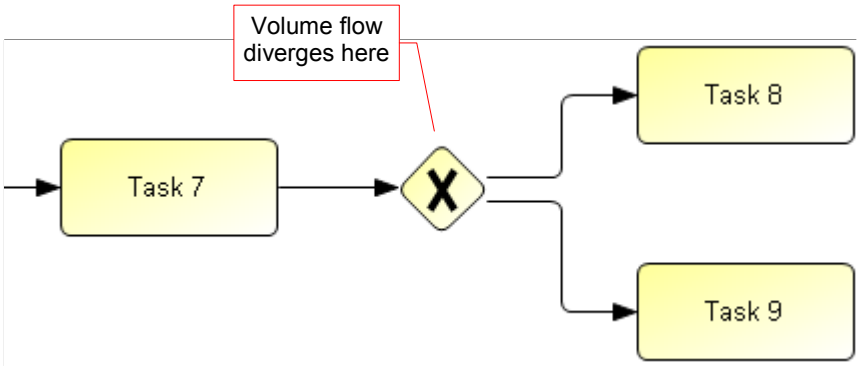
Figure 5. Volume split without a Gateway



When splitting flow without a Gateway volume follows OR rules. Each outgoing connection from the task carries a proportion of the available flow. The proportion can be changed by directly specifying the "Percent" property of each connection exiting from the object.

When a Gateway object is used to represent the split you have more flexibility in specifying the volume splitting rules.

Figure 6. Volume split with a Gateway

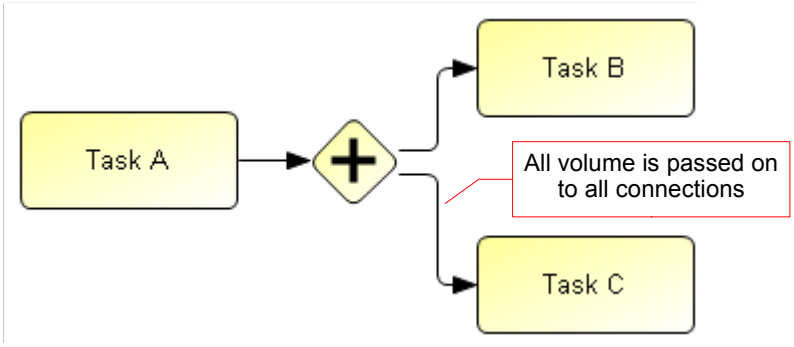


The AND type Gateway is handled differently. Instead of divvying up a proportion of the volume and distributing a proportion to each connection, each connection is sent the full quota of volume.

The default rule for divvying up the flow is to give each connection an equal proportion of the incoming flow.

You can change the proportioning by selecting a connection into the Metrics Inspector and directly editing its **`Percent`** property. The **`Percent`** property is gray if you are not allowed to change the it (for example if the Gateway is an AND type).

Figure 7. AND Gateway volume rules



This type of split is most often used to start multiple concurrent actiivities.

You should explicitly code an AND split for this type of transaction even if you do not intend to automate your process, otherwise the costings will not be in accordance with reality.

Volume merging

When incoming links feed *into* an activity they each normally contribute their volumes, so that the activity's **`External Volume`** is the sum of all incoming volumes.

Figure 8. Merging without a Gateway

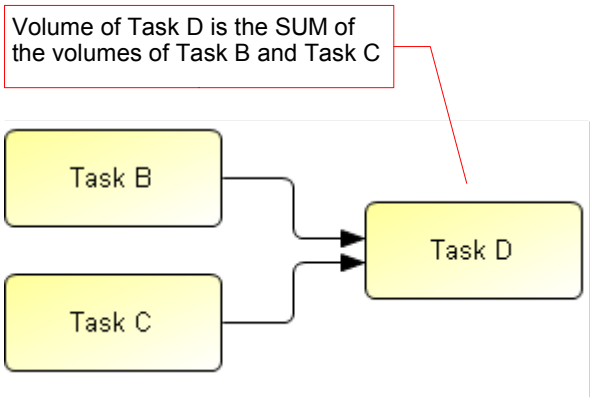
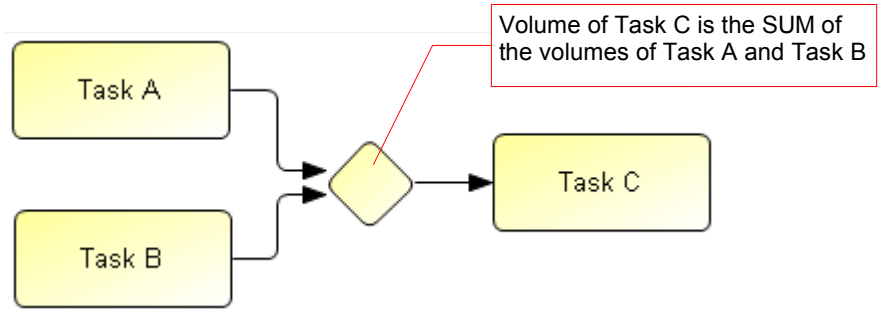


Figure 9. Merging with OR type Gateways

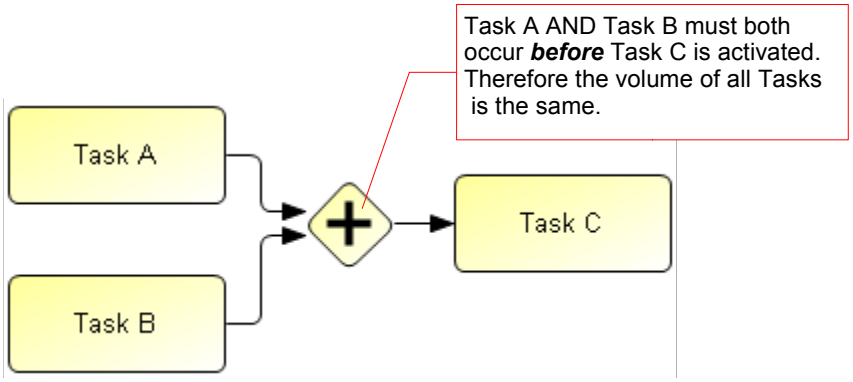


In order to ensure that your metrics costings are accurate it is important to explicitly code for waiting merges even if you do not intend to automate the process. This is easily done by specifying an AND gateway.

Waiting merges

It is common to start a transaction when a specific set of criteria have been attained. Each incoming connection provides a signal so that when all incoming connections have signaled then the transaction is started.

Figure 10. Synchronised merging



The basis of costing things

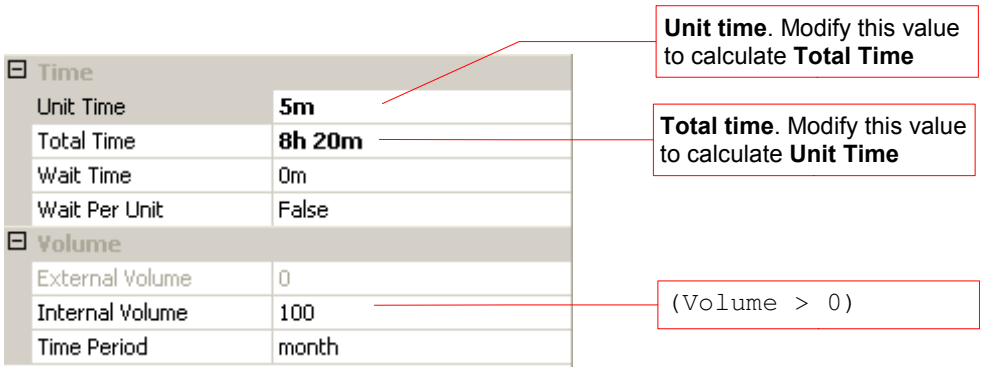
Earlier it was described how volume is used to represent transaction loading, and how the metrics plugin automatically determines the effective transaction load for activities in a process.

In order to calculate the financial costing of a transaction it is necessary to know the time that the transaction takes to complete and it is necessary to know who or what is actually doing it.

Time

The time that an activity takes is defined by its **`Unit Time`** property. This can be either entered directly into the inspector, or if its **`Volume`** is > 0 then you can enter the **`Total Time`** for the measurement period. Either way, as long as there is a **`Volume`** the plugin will calculate the dependent property automatically.

Figure 11. Metrics inspector time properties



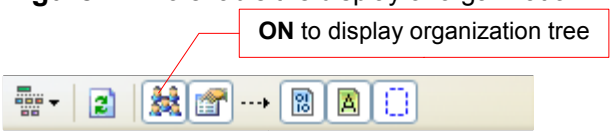
Many activities involve a waiting time as well. For example a manufacturing request to a configurable production facility will have a waiting time for the manufacturing plant to configure the line for the order. There will be a one-time wait in this case (Wait Per Unit is **false**). In other cases there will be waiting period for each transaction (Wait Per Unit is **true**).

Labor and organizational costs

Someone or something has to perform the activities that constitute the transaction. That someone has a Role and that Role occurs within an organizational hierarchy. Different kinds of jobs (Roles) have different costs.

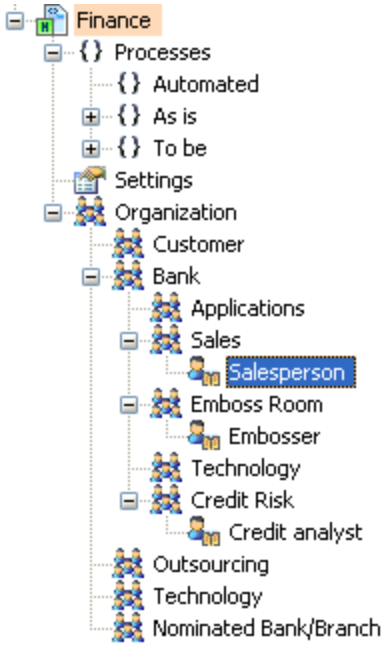
Avantage provides this organizational modeling in addition to the standard BPMN process model.

Figure 12. To enable the display of organization information for a model.



The Finance example in the Avantage Start contains a small pre-defined organizational structure.

Figure 13. Example organization structure



Organization units (**`Department`** and **`Role`** objects) can have costing lookup information associated with them.

For example, clicking on on a **`Role`** object will show this cost lookup information in the Metrics Inspector.

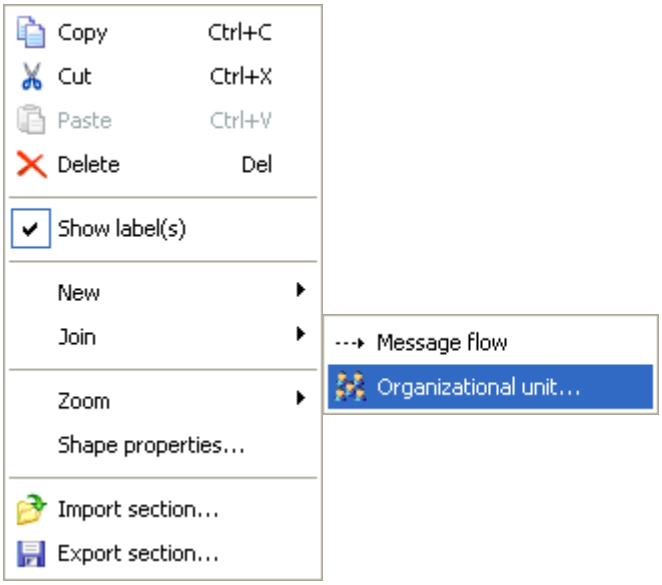
Rate based. This method is to base the calculation on a rate (for example a credit card embosser may cost $12 per hour). This can be directly entered into the Rate and Rate Unit properties.

Linking a Pool or Swimlane to an organization unit

You can link BPMN Pools and Swimlanes to organization model entities like Roles and Departments.

To make a link, using either the Diagram editor or the Navigator tree, right-click on the Pool or Swimlane you want to link from and Choose the **Join::Organization unit...** menu item.

Figure 14. The Join to organization unit action.



Reporting and Analysis

After you have instrumented a process model with metrics, the usual next step is to analyse the process model. There are two reports which are useful for this purpose.

- Volumes and Costs Analysis
- Categories Analysis

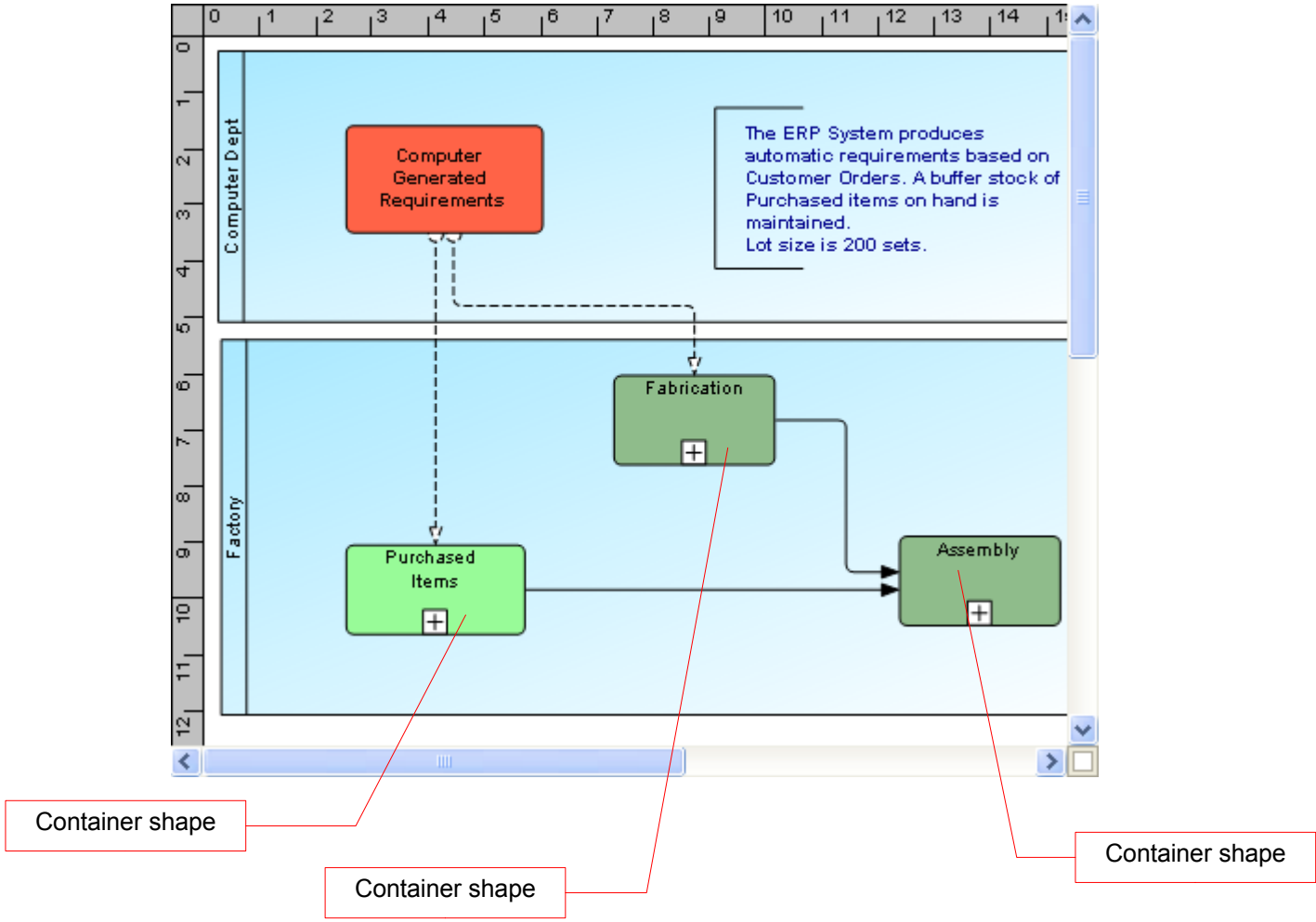
Both of these reports are output into an Excel Workbook, so it is necessary for you to have Excel XP (or a later version of Excel) installed on your computer in order to create these reports.

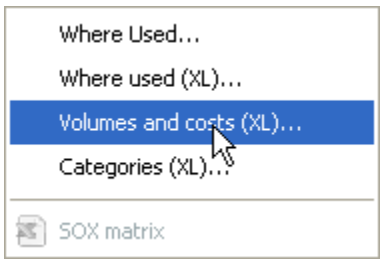
The Volumes and Costs Report

The Volumes and Costs analysis produces a report which starts at a nominated BP diagram (a 'top level' diagram).

This report creates a matrix listing of BPMN objects and their metrics properties.

Figure 15. A top level BP diagram





This BP Diagram can be found in the Manufacturing examples that were installed in your Workspace when you installed the Metrics plugin.

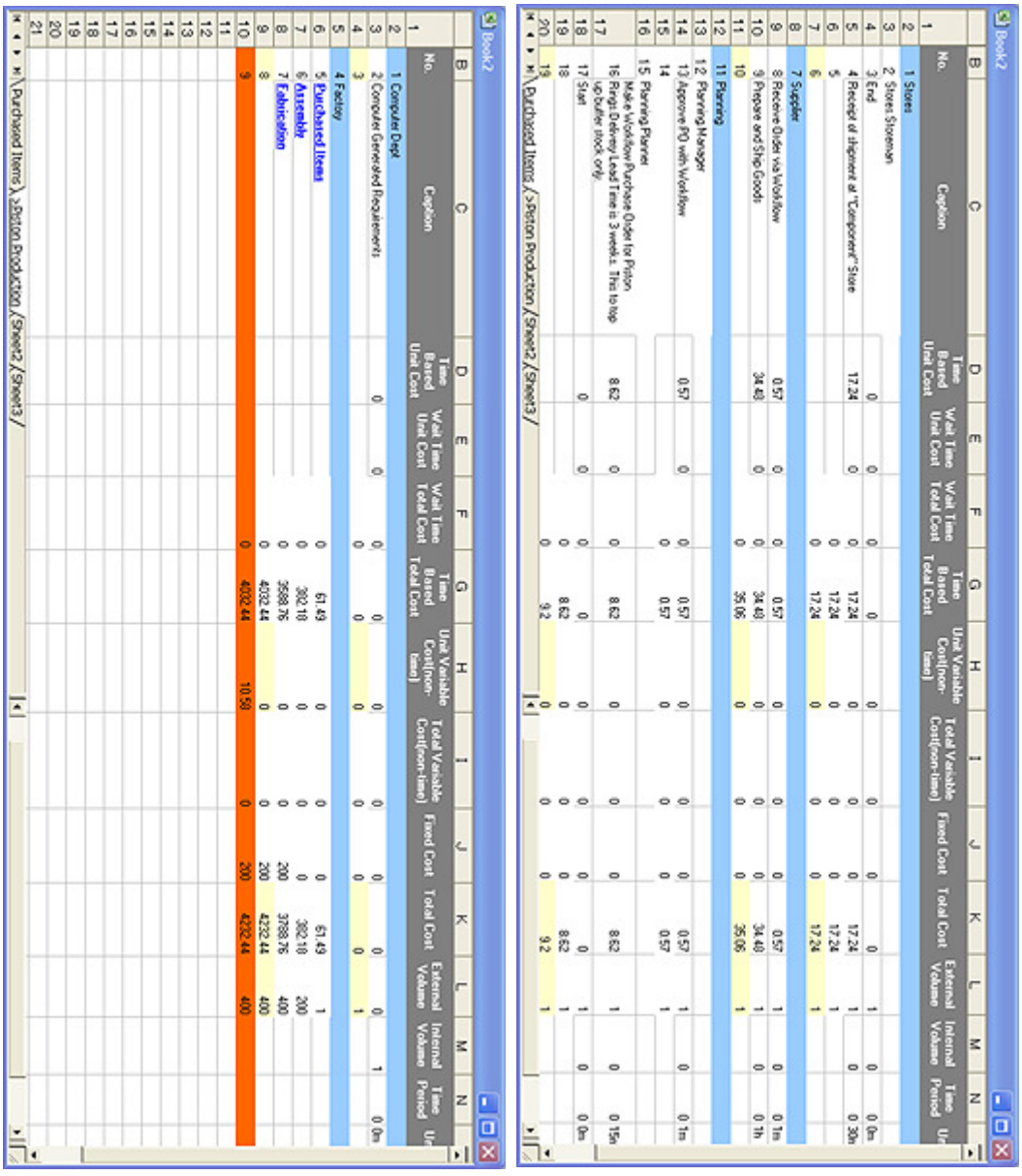
To create a report, double-click on the top level diagram (the one named "**>Piston Production**"). This will open the diagram editor as in the figure above. Then select the **Volumes and Costs** report from the **Analysis** menu.

> ***Note***: If you cannot see the Analysis menu it might be because the Diagram window is not the active window. To make it active just click in the diagram

window (to activate it) and then go back to the **Analysis** menu and choose the **Volumes and Costs** menu.

The format of a report

Figure 16. Each container is displayed in a separate worksheet

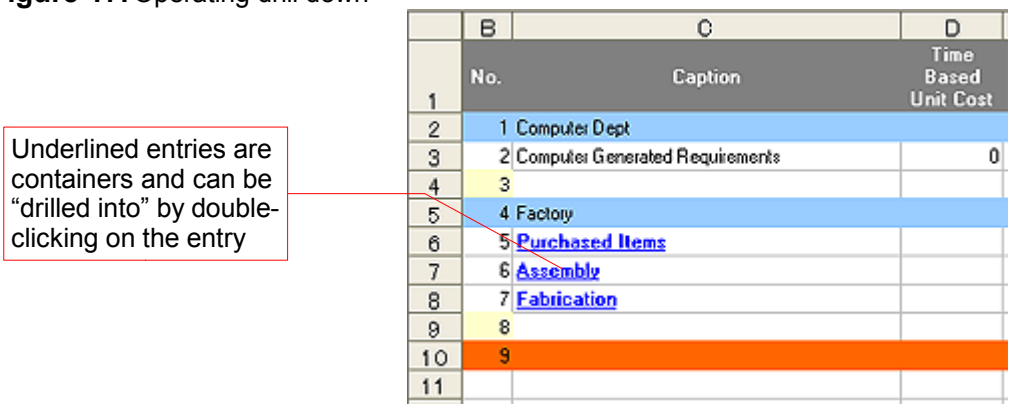


Drilling down

Lines of detail in the "Caption" column that are underlined can be drilled into. To do this double-click on it. After a short delay, the Volumes and Costs analyser will generate a new worksheet. The name of the worksheet is the name of the underlined caption you double-clicked on.

Using this drill-down process you can reach the bottom most level of detail in the process.

Figure 17. Operating drill down

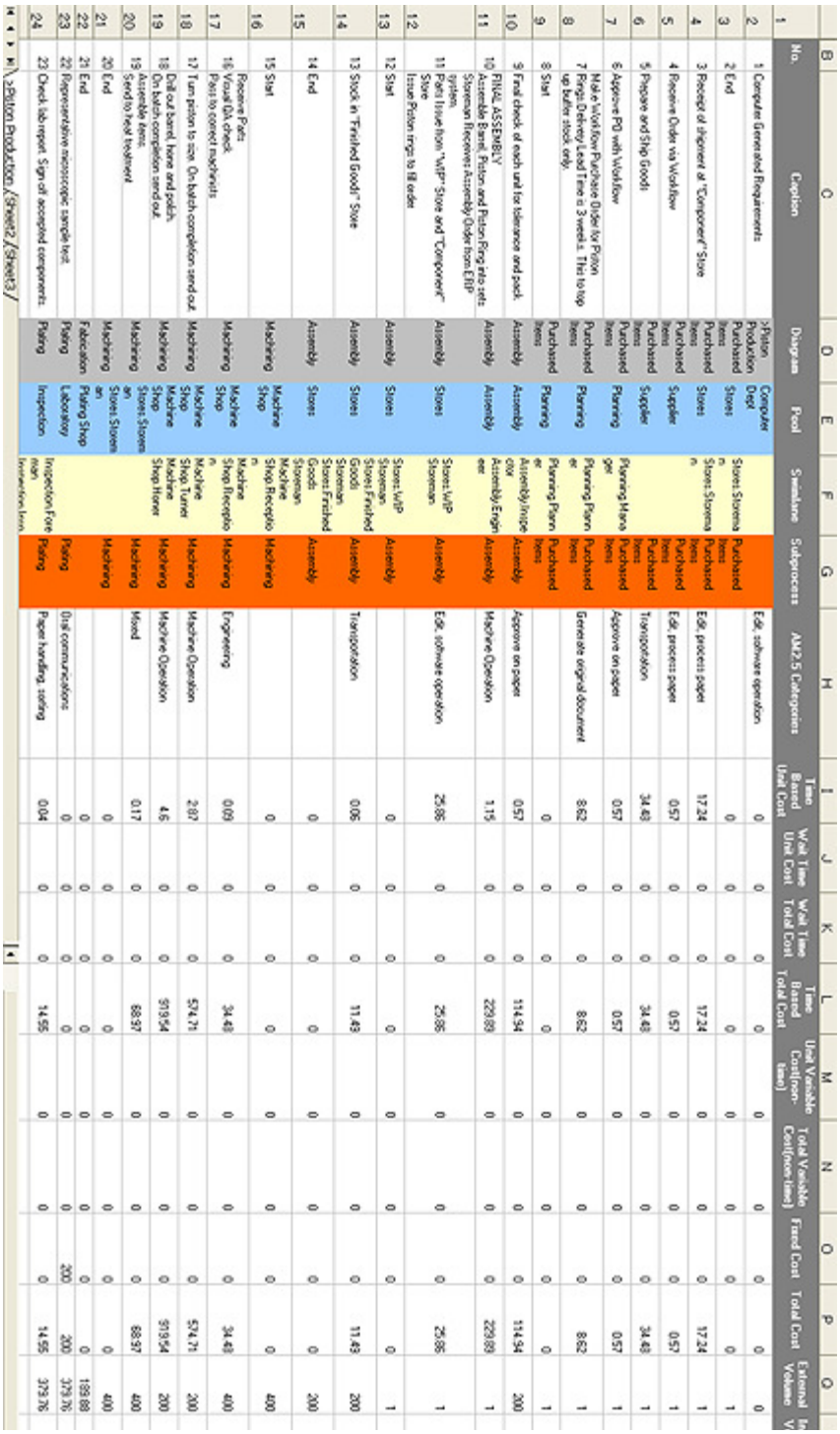


Categories report

The Analysis:Categories menu action provides a way to export a categories matrix directly into Excel.

You must have Excel XP or later installed on your computer in order to do this.

The data is output in a format so that it can be used to create a pivot table in Excel.



No.	Caption	Diagram	Pool	Swimlane	Subprocess	AM2.5 Categories	Time Based Unit Cost	Wait Time Unit Cost	Wait Time Total Cost	Time Based Total Cost	Unit Variable Cost(non-time)	Total Variable Cost(non-time)	Fixed Cost	Total Cost	External Volume
1	Piston Production														
2	1 Computer Generated Requirements	Purchased Items	Computer Dept		Edit software operation		0	0	0	0	0	0	0	0	0
3	2 End	Purchased Items	Stores	Stores:Storema n	Purchased Items		0	0	0	0	0	0	0	0	1
4	3 Receipt of shipment of "Component" Store	Purchased Items	Stores	Stores:Storema n	Purchased Items	Edit process paper	17.24	0	0	17.24	0	0	0	17.24	1
5	4 Receive Order via Workflow	Purchased Items	Supplier		Purchased Items	Edit process paper	0.57	0	0	0.57	0	0	0	0.57	1
6	5 Prepare and Ship Goods	Purchased Items	Supplier		Purchased Items	Transportation	34.48	0	0	34.48	0	0	0	34.48	1
7	6 Approve PO with Workflow	Purchased Items	Planning	Planning Manag er	Purchased Items	Approve on paper	0.57	0	0	0.57	0	0	0	0.57	1
8	Mail in Workflow Purchase Order for Piston	Purchased Items	Planning	Planning Planne r	Purchased Items	Generate original document	8.62	0	0	8.62	0	0	0	8.62	1
9	7 Progs Delivery Lead Time is 3 weeks. Trial to top up buffer stock only.	Purchased Items	Planning	Planning Planne r	Purchased Items		0	0	0	0	0	0	0	0	1
10	8 Start	Assembly	Assembly	Assembly/Inspe ction	Assembly	Approve on paper	0.57	0	0	0.57	0	0	0	0.57	1
11	9 Final check of each unit for tolerance and pack	Assembly	Assembly	Assembly Engin eer	Assembly	Machine Operation	1.15	0	0	22.89	0	0	0	22.89	1
	10 FINAL ASSEMBLY														
	11 Assemble Barrel, Piston and Piston Ring into nets														
	Storeman Receives Assembly Order from ERP system														
12	11 Print Issue from "WIP" Store and "Component" Store	Assembly	Stores	Stores:WIP Storeman	Assembly	Edit software operation	25.86	0	0	25.86	0	0	0	25.86	1
	Issue Piston rings to fill order														
13	12 Start	Assembly	Stores	Stores:WIP Storeman	Assembly		0	0	0	0	0	0	0	0	1
14	13 Stock in "Finished Goods" Store	Assembly	Stores	Stores:Finished Goods Storeman	Assembly	Transportation	0.06	0	0	11.49	0	0	0	11.49	200
15	14 End	Assembly	Stores	Stores:Finished Goods Storeman	Assembly		0	0	0	0	0	0	0	0	200
16	15 Start	Machining	Machine Shop	Machine Shop Receptio n	Machining		0	0	0	0	0	0	0	0	400
17	Receive Parts	Machining	Machine Shop	Machine Shop Receptio n	Machining	Engineering	0.09	0	0	34.48	0	0	0	34.48	400
	16 Visual QA check														
	Post to correct machine/s														
18	17 Turn piston to size. On batch completion send out	Machining	Machine Shop	Machine Shop Turret	Machining	Machine Operation	2.87	0	0	574.71	0	0	0	574.71	200
19	18 Drill out barrel, hone and polish.	Machining	Machine Shop	Machine Shop Honer	Machining	Machine Operation	4.6	0	0	919.54	0	0	0	919.54	200
	On batch completion send out														
20	19 Assemble items	Machining	Stores:Storem an		Machining	Mixed	0.17	0	0	68.97	0	0	0	68.97	400
	Send to heat treatment														
21	20 End	Machining	Stores:Storem an		Machining		0	0	0	0	0	0	0	0	400
22	21 End	Fabrication	Plating Shop		Plating		0	0	0	0	0	0	0	0	189.88
23	22 Representative microscopic sample test	Plating	Laboratory		Plating	Dist communications	0	0	0	0	0	0	200	200	379.76
24	23 Check lab report. Sign off accepted components	Plating	Inspection	Inspection Fore man	Plating	Paper handling, sorting	0.04	0	0	14.95	0	0	0	14.95	379.76

Definitions

Task and Event Properties

Figure 18. Table of Task and Event properties

Property	*Abbreviation*	*Value type*	
Internal Volume	IV	double	Volume that is generated internally
External Volume	EV	double	Volume that is received from upstream or from a container.
Wait Based Unit Cost	WBUC	double	
Wait Time Unit Cost	WTUC	double	
Wait Time Total Cost	WTTC	double	WTTC = Wait time * volume * Wait time Unit cost
Unit Variable Cost Non Timed	UVC	double	UVC = TVC / V
Total Variable Cost Non Timed	TVC	double	VTC = UC * V
Fixed Cost	FC	double	
Total Cost	TC	double	TC = VTC + FC (Variable Total Cost + fixed cost)
Unit Time	UT	Time	Time / Volume
Time	T	Time	Unit time * Volume
Wait Time	TW	Time	
Time Period		Period	Month, Week, Day, Hour, Minute

BPMN metrics instrumentation

The illustration below shows how the components of a process model are instrumented.

Figure 19. Metricated BPMN components