

Spotfire Statistica®

Product Traceability

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User Groups and Connections

Administrators can use Statistica Enterprise Manager for creating, configuring, and managing web forms.

Users/Grou	ps and Folders	s (System Viev	v)		
Create users/groups or sync to	Database Co Save in <i>System</i>	nnections Data Configu	urations		
domain Create folder structure	View and user permission granted	Save in <i>System</i> <i>View</i> and user permission	Analysis Con Save in System	Report	
	Where is the data located?	granted Retrieve data from Database Connection	View and user permission granted Analyze data from Data Configuration	Save in <i>System</i> <i>View</i> and user permission granted Build report	
				based on Analysis Configuration	

- Characteristics: Numeric fields for a web form (example, pH)
- Labels: Text or date data for a web form (example, Lot Number)
- Data Entry Setups: Web form configuration that groups Characteristics and Labels to collect data
- Data Entry Setup Sequences: Group and order of Data Entry Setup

When a user creates a Data Entry Setup they typically create a Data Configuration and Analysis Configuration too. The configuration uses the Data Entry Setup as a data source.

Data Entry Server

The data entry task where user can use the web form managed by the Statistica Enterprise Manager application, is performed by using Internet Explorer (IE), Chrome, Safari or Firefox.

The compatibility view settings must be used with IE10 and IE11. Users can open a browser and visit a URL such as http://[servername]/dataentry.

If the data is already within a database or a spreadsheet, there is an option for importing historical data rather than manually entering the data.

Statistica

Analytic consumers can log in to Statistica[®] to execute Product Traceability Process Data Explorer or Process Tree Viewer.

The users might also run a workspace by using product traceability's data alignment for a process. Or the user might import historical data by using a Data Entry Setup in addition to manually entering data.

Product Traceability Configuration

You can use product traceability to specify the relationships between multiple stages of a process when the data for that process is recorded using a Data Entry Setup or Data Entry Server.

Each step in the process is represented by a System View folder within the Statistica Enterprise Manager application.

Data Entry Setups are designed to participate in the product traceability relationships. Data can be manually entered or imported using a Data Entry Setup. The relevant characteristics and labels are assigned product traceability roles, which indicate how they help describe the relationships between stages in the process. Here is a brief summary:

- 1. Each step in the process is represented by a System View folder. Each folder has a **Use as unit operation** option, which can be selected. This indicates that the folder represents a stage in a process that is tracked by the Product Traceability logic.
- 2. Each folder contains one or more Data Entry Setup objects. Each Data Entry Setup has a **Participate in product traceability** option, which is selected. This indicates that the Data Entry Setup contains data that can be tracked by the product traceability logic.
- 3. The relationships between adjacent stages of the process are defined by Labels in the Data Entry Setups. The Labels are assigned Product Traceability roles, such as Batch ID, Previous Batch ID. The contents of the Batch ID and Previous Batch ID Labels indicates the order of the various Data Entry Setups in the process.
- 4. The Characteristics are assigned Product Traceability roles indicating whether a given Characteristic is a measurement that can be tracked by the Product Traceability logic, and which method must be used to summarize or Aggregate that Characteristic's data. For example, Characteristic data can be aggregated by Mean, Median, Minimum, Maximum.

After the relationships between process steps have been defined and the data has been entered into the Data Entry Setups, the process across multiple stages can be summarized either graphically or by data aggregation. The Process Tree Viewer displays a graphical summary of the relationships between process stages. The Process Data Explorer displays aggregations of the data for each process stage and across all process stages.

System View

Each System View folder has a **Use as unit operation** option. Selecting this option indicates that the folder represents a stage in a process to be tracked by the Product Traceability features. There is also an option to select a custom icon to represent a stage of the process in the Process Tree Viewer display.



Data Entry Setups

Each Data Entry Setup has a **Participate in product traceability** option. Selecting this option indicates that the data in this Data Entry Setup is tracked by the Product Traceability features. There is also an option to associate the Data Entry Setup with a particular Unit Operation. A Unit Operation is a System View folder that represents a process stage for Product Traceability. A Data Entry Setup has default Unit Operation with the System View folder in which the Data Entry Setup resides.



Labels

Labels define a Data Entry Setup relationship with adjacent stages in the process.

The contents of the Batch ID and Previous Batch ID Labels indicate the order of the various Data Entry Setups in the process.

A Batch ID uniquely identifies the current batch in the process. The Previous Batch ID indicates the batch ID that precedes the current batch in the process. This defines where the current batch fits into the overall process.



Characteristics

If a Characteristic is given the Measurement role in Product Traceability, that characteristic's data can be aggregated by the Process Data Viewer. The Aggregation Type specifies the method of aggregation.

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Roles and Aggregation Types

Role options and their explanations:

Roles	Explanations
None	No role in Product Traceability
Measurement	Never relevant for Labels
Amount/Weight	Used when calculating weighted aggregation in Process Data Explorer
Batch ID	Uniquely identifies current batch

Roles	Explanations
Previous Batch ID	Indicates the batch ID that precedes the current batch in the process
Reference Batch ID	Used to associate batches from two or more Data Entry Setups together as part of a single batch. Each batch must have a unique batch ID that is entered into a Batch ID Label. Data from other Data Entry Setups can be included as part of that same batch by having the contents of a Reference Batch ID Label match the contents of the Batch ID Label in another Data Entry Setup.
Annotation	Can be used to enter explanatory details
Start Time and Stop Time	These are used when the Process Data Explorer restricts the batches to be aggregated by start and stop times. This is a common use case with PI data which is defined in terms of start and stop times.

The section on the Process Data Explorer demonstrates the working of Aggregation Types. Notice that some Aggregation Types are disabled for Labels. Since Label data is nonnumeric, numeric calculations like Mean and Standard Deviation do not make sense. But it can be possible to calculate the Mode (most common), First, or Last Label.

Process Tree Viewer

Open Statistica application, on the **Enterprise** tab, click the **Process Tree Viewer** option to open the Process Tree Viewer dialog.

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Enterprise	Data	Product Traceability
		Enterprise Analysis/Report
For Help, press F1		CAP NUM REC

The **Process Tree Viewer** dialog displays the ordered relationships between batches. The arrows indicate which batches feed into which subsequent batches.



Process Data Explorer

Open Statistica application, on the **Enterprise** tab, click the **Process Data Explorer** option to open the Process Data Explorer dialog.

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It calculates and displays aggregated values of the Characteristics in a specified batch.

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StepA.EntryFormA StepB.EntryFormB StepC.EntryFormC Batch Relationships		1 primary_ batch_id	2 EntryFormA. UnitsA_Mean	3 EntryFormA. BatchCurrent	4 EntryFormB. UnitsB_Mean	5 EntryFormB .BatchPrevi ous	6 EntryFormB .Weight	7 EntryForm BatchCurre
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The aggregation can optionally be weighted bases on the contents of Labels with the Product Traceability role of Amount/Weight.

Detailed Example

Now that we have a general feel for what Product Traceability does, let's look at a detailed example. We are using the Statistica Enterprise Product Traceability features implement a Web Data Entry scenario that is organized as shown in this flow chart:



- The orange squares are batches.
- The contributions (or weighting) from upstream batches are in the green dotted squares.

Folders - Unit Operations

In the context of Product Traceability, the System View folders that contain the relevant Data Entry Setups are known as Unit Operations.

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We designate them as such by selecting the **Use as unit operation** checkbox.

This example has three unit operation folders: StepA, StepB, and StepC. Each folder corresponds to a stage in a hypothetical process.

Only folders that are unit operations are accessible in the Process Data Explorer or Process Tree Viewer.

Labels - Batch IDs, Previous Batch IDs, Amounts/Weights

Each Label must have a Product Traceability role specified.

This example has three labels:



- **BatchCurrent** is a batch label with Product Traceability role Batch ID. That means this field uniquely identifies a given batch.
- **BatchPrevious** is a piece label with Product Traceability role Previous Batch ID. So this field indicates which batches from the previous stage feed into a given batch. A piece label allows multiple values (pieces), which is needed when there are multiple batches from the previous stage feeding into a batch.
- **Weight** is also a piece label, with Product Traceability role Amount/Weight. Each entry of BatchPrevious has a corresponding entry in Weight, indicating how to weight the contributions from each batch in the previous stage.

Characteristics - Measurements

Each Characteristic must also have a Product Traceability role.

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This example has three Characteristics and three Data Entry Setups.

There is a separate folder for each Data Entry Setup, and each Characteristic resides in the same folder as the Data Entry Setup that contains it. For example, The Data Entry Setup EntryFormA contains the Characteristic UnitsA, and both reside in the **StepA** folder.

The three Characteristics are:

- UnitsA contains the measurements recorded for batches in the first process stage recorded using EntryFormA. Its Product Traceability role is Measurement. The name UnitsA was chosen to be deliberately vague. In practice, the name of a Characteristic would reflect the type of data being recorded, for example temperature, viscosity, pH, and so on.
- **UnitsB** contains the measurements recorded for batches in the second process stage recorded using **EntryFormB**.
- **UnitsC** contains the measurements recorded for batches in the third process stage recorded using **EntryFormC**.

Data Entry Setups to Define Layout of Web Data Entry Form

Data Entry Setup objects define which Labels and Characteristics must be included in a given batch.

They also define the organization of those Labels and Characteristics in the web data entry form where the users enter the data.

To include the data entered into a Data Entry Setup, the Product Traceability option **Participate in product traceability** must be selected.



Specific Example Batches

Consider batch B1 shown in the flow chart of our data entry scenario:



Data for batch B1 is entered using Data Entry Setup EntryFormB, which is laid out as follows:



The details of batch B1 in the second stage of the process are the current batch ID (B1) and the units observed in that batch (8). That information is entered in the Label and Characteristic outlined in blue in the preceding image.

The pertinent details of batches A1 and A2, which are the batches from the previous stage that feed into batch B1, are batch IDs of those previous batches (A1, A2) and the respective contributions/weightings from each of those previous batches (2, 6). That information is entered in the Labels outlined in green in the preceding image.

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Addeellings at 1/23/2015 1 stream Samples Piece 1 2 A2 rrent Sample Piece 1 B1	BatchPrevious Weight 2 6 BatchCurrent UnitsB

Now let's take a closer look at A1, A2, and B2.

The **BatchPrevious** label's product traceability role is **Previous Batch ID**. The Weight label's product traceability role is **Amount/Weight**. They are both piece labels to allow entering contributions from multiple batches in the previous stage.

The **BatchCurrent** label's product traceability role is **Batch ID**. The UnitsB characteristic's product traceability role is **Measurement**.

After the product traceability relationships among batches has been established and the data for the batches has been entered by web data entry, we can then take advantage of that information to better understand how the process operates. The tools for organizing and retrieving that information are the **Process Tree Viewer** and the **Process Data Explorer**.

Visualizing Relationships Using Process Tree Viewer

The Process Tree Viewer is used to visualize the relationships between process stages and batches.

Procedure

- 1. Open Statistica, select the **Enterprise** tab, and click **Process Tree Viewer** option to open the Process Tree Viewer dialog.
- 2. You can pick only one Unit Operation (process stage) at a time. Then you can optionally select a subset of data to include in the view.
- 3. You can specify the subset either by Batch ID or by data range. For this example we have selected batch C1.

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4. To display the process tree view, click **Run**.

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Bi Bi C1 C1 C1 C1 C1 C1 C1 C1 C1 C1			Unit Operation	StepC
Start Time 1/23/2015 10:17:39 AM Stop Time 1/23/2015 10:17:39 AM B1 B2 C1 C1			Batch ID	C1
B1 B1 C1 C1 C1 C1 C1 C1 C1 C1 C1 C1 C1 C1 C1			Start Time	1/23/2015 10:17:39 AM
			Stop Time	1/23/2015 10:17:39 AM
	B1			

The relationships among all batches that affect the batch C1 are seen.

5. To change the focus of the tree view, double-click some other batch, for example B1.



6. You can see the relationships among just the batches that affect or are affected by batch B1.

Summarizing Relationships Using Process Data Explorer

The Process Data Explorer is used to numerically summarize the relationships between process stages and batches. This is done by aggregating the measurements from batches in previous batches that affect a given batch.

Procedure

1. Open Statistica, select the **Enterprise** tab, click **Process Tree Viewer** to open the Process Tree Viewer dialog.

- 2. You can pick only one Unit Operation (process stage) at a time.
- 3. Optionally, select a subset of data to include in the view.
- 4. Specify the subset either by Batch ID or by data range. For this example, select batch C1.

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Enterprise	Data	Product Traceability
Product Traceability	Select Batches By Batch ID: C1 By Date Range: From: Select a date 15 To: Select a date 15	Image: Solution of the soluti

5. To see the next group of options, click **Run**.



6. All unit operations (process stages) are included, and the Standard aggregation method is used. To display the results, click **Run**.

Workbook1* - Aggregated I	Data												×
Workbook1*		Aggregated Data Merge: Multiple cases=Fill with MD, Unmatched Cases=Fill with MD Data Sources: SteoA EntryFormA. SteoB EntryFormB. SteoC EntryFormC										-	
		1 primary_ batch_id	2 EntryFormA. UnitsA_Mean	3 EntryFormA. BatchCurrent	4 EntryFormB. UnitsB_Mean	5 EntryFormB. BatchPrevio us	6 EntryFormB .Weight	7 EntryFormB .BatchCurre nt	8 EntryFormC .UnitsC_Mea n	9 EntryFormC .BatchPrevio us	10 EntryFormC .Weight	11 EntryFormC .BatchCurre nt	
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Result

We selected batch C1 at the start of running the Process Data Explorer. So the results seen are the aggregation of all batches that contribute to batch C1. For more information, see the flow chart. All batches in the first unit operation (A1, A2, and A3) contribute to batch C1. Because aggregation type was set to Mean in the Product Traceability Role section of the Characteristic UnitC, we calculate the mean of those three batches: (6+9+8)/3 = 7.667. That is the left-most value outlined in red.

Both batches in the second unit operation (B1, B2) contribute to batch C1. The mean of the measurements of those batches is (8+6)/2 = 7. That is the middle value outlined in red.

The weighted aggregation method is a little more complex:



It uses the amounts entered in the **Weight** label to weight the contributions of the upstream batches. The calculation details are described in Appendix C.

Appendix A - Process Tree Viewer Options

The **Batch** button at the top displays a dialog. You can select one or more batches from one unit operation.



In the left pane, only one unit operation can be selected. Then, in the right pane, you can specify batches by Batch ID or by date range.

To specify batches by Batch ID, select the **By Batch ID** radio button and click **Find Batches**. You can see the Find Batches dialog. Click **Find** to list all batch IDs within the specified unit operation and date range. Then highlight one or more batch IDs and click **OK**.

A Find B	atches: StepC		? ×
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Select Bat	tches		
C1			
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This returns you to the Product Traceability dialog, placing the selected batch IDs in the textbox at the upper-right.

Product Traceability	? <mark>- × -</mark>
 InstallationName Traceability StepA StepB StepC 	Select Batches By Batch ID: C1 By Date Range: From: 1/22/2015 12:00 AM To: 1/23/2015 12:00 AM Run

Now, you can click **Run** to display the tree diagram with all batches that affect, or are affected by, the specified batch.



Double-click another batch, example B2. This redraws the tree diagram to focus on that other batch.



The buttons at the top of the tree viewer dialog can be used in the following ways:

- **Batch:** displays the batch selection dialog.
- **Open:** selects a *.ptv file containing a previously saved tree view display.
- **Save:** saves the tree view display as a *.ptv file.
- **Print:** prints the tree view display.
- **Copy:** copies the tree view display to the clipboard.
- Explore: displays the Process Data Explorer options.
- **Output:** puts the tree view display into a Statistica report document, and puts the summary batch information into a spreadsheet.

Appendix B - Process Data Explorer Options

You can display the Product Traceability dialog for selecting a unit operation and one or more batches within that unit operation.

Roduct Traceability	? 💌
 InstallationName Traceability StepA StepB StepC 	Select Batches By Batch ID: B2 By Date Range: From: Select a date 15 To: Select a date 15 Run

After selecting batches, click **Run**, Process Data Explorer dialog is displayed where you can select the aggregation method, the data to include in the calculations, and whether to include the raw data.



The buttons at the upper-right of the Process Data Explorer dialog can be used as follows:

Button	Description
Deploy Analysis Configuration	Creates a Statistica Enterprise SVB (Statistica Visual Basic) analysis configuration that generates the Process Data Explorer results.
Deploy Data Configuration	Creates a Statistica Enterprise SVB data configuration that generates the data aggregation summary.
Load from Enterprise	Populates the options in theProcess Data Explorer dialog with the options from SVB data configuration or SVB analysis configuration that was created by deploying Process Data Explorer results.
Back	Takes you back to the Product Traceability dialog, where you can select a different unit operation and batches.
Run on Server	Runs the data aggregation on the Statistica Enterprise server and then displays the results on the local Statistica workstation.
Run	Runs the data aggregation on the local Statistica workstation and displays the results.

Appendix C - Weighted Aggregation Calculation

Calculating weighted fractional contribution between two lots.

$$\begin{split} X_{A \to B} &= \frac{\text{Lot B from Lot A}}{\text{Total on Lot B}} \\ \text{Where A is the donating lot and B is the receiving lot.} \\ \text{Example: Lot A1, gives 2g to Lot B1, with a total load of 8 g. Lot B1 gives 4g to Lot C1, with a total load of 10 g.} \\ X_{A1 \to B1} &= \frac{2g}{8g} = 0.25; \quad X_{B1 \to C1} = \frac{4g}{10g} = 0.40 \end{split}$$

Calculating weighted aggregation for transfer across all steps for one unique path.

$$\mathbf{X}_{\mathbf{A} \rightarrow i \rightarrow i+1 \dots \rightarrow \mathbf{C}} = \prod_{\mathbf{A}}^{\mathbf{C} \cdot \mathbf{I}} \mathbf{X}_{i \rightarrow i+1}$$

Where **A** is the Upstream Lot, **C** is the Downstream Lot and *i* is the variable number of Midstream Lots involved in the unique path of transfer across Lot **A** and Lot **C**. (**Note:** If there are no midstream lots, then the overall path's weighted fractional contribution is equal to the originally calculated weighted fractional contribution between **A** and **C**).

Example: $X_{A1 \rightarrow B1 \rightarrow C1} = X_{A1 \rightarrow B1} \times X_{B1 \rightarrow C1} = 0.25 \times 0.40 = 0.10$

Calculation for total weighted fractional contribution for each upstream lot that contributes to the downstream lot of interest:

 $X_{A \to C} = \sum X_{A \to j \to C}$ Where **A** is the Upstream Lot, **C** is the Downstream Lot and *j* represents the number of unique paths of transfer between Lot **A** and Lot **C**. Example: Lot A1 also contributes to Lot C1 through Lot B2, $X_{A1 \to B2 \to C1} = 0.40$ $X_{A1 \to C1} = X_{A1 \to B1 \to C1} + X_{A1 \to B2 \to C1} = 0.10 + 0.40 = 0.50$

Weighted fractional contributions can then be used to find the weighted average values of an Upstream Lot variable.

Weighted average of a variable calculation:

$$AvgVar = \sum_{i=1}^{k} (X_{Ai \to C} * Var_{Ai})$$

where Var is the value of some variable from Upstream Lot Ai.

Upstream Lots A2 and A3 contribute to Downstream Lot C1, such that $X_{A2 \rightarrow C1} = 0.30$ and $X_{A3 \rightarrow C1} = 0.20$.

Upstream Lots A1 has a variable value of 6, upstream Lots A2 has a variable value of 9, and upstream Lots A3 has a variable value of 8. Therefore, the weighted average of the variable value for Downstream Lot C1 is calculated as follows:

$$(X_{A1 \rightarrow C1})^*6 + (X_{A2 \rightarrow C1})^*9 + (X_{A3 \rightarrow C1})^*8 = (0.50)^*6 + (0.30)^*9 + (0.20)^*8 = 7.3$$

Example fractional contribution table:

					Overall Path's
	Fractional		Fractional		Fractional
Upstream	Contribution	Midstream	Contribution	Downstream	Contribution
Lots	$(X_{A \rightarrow B})$	Lots	$(X_{B \rightarrow C})$	Lot	$(X_{A \rightarrow B \rightarrow C})$
A1	0.25	B1	0.4	C1	0.10
A2	0.75	B1	0.4	C1	0.30
A3	0.33	B2	0.6	C1	0.20
A1	0.67	B2	0.6	C1	0.40

Example upstream lot's total fractional contribution table:

	Upstream Lot's
	Total Fractional
Upstream	Contribution
Lots	$(X_{A \rightarrow B})$
A1	0.50
A2	0.30
A3	0.20

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