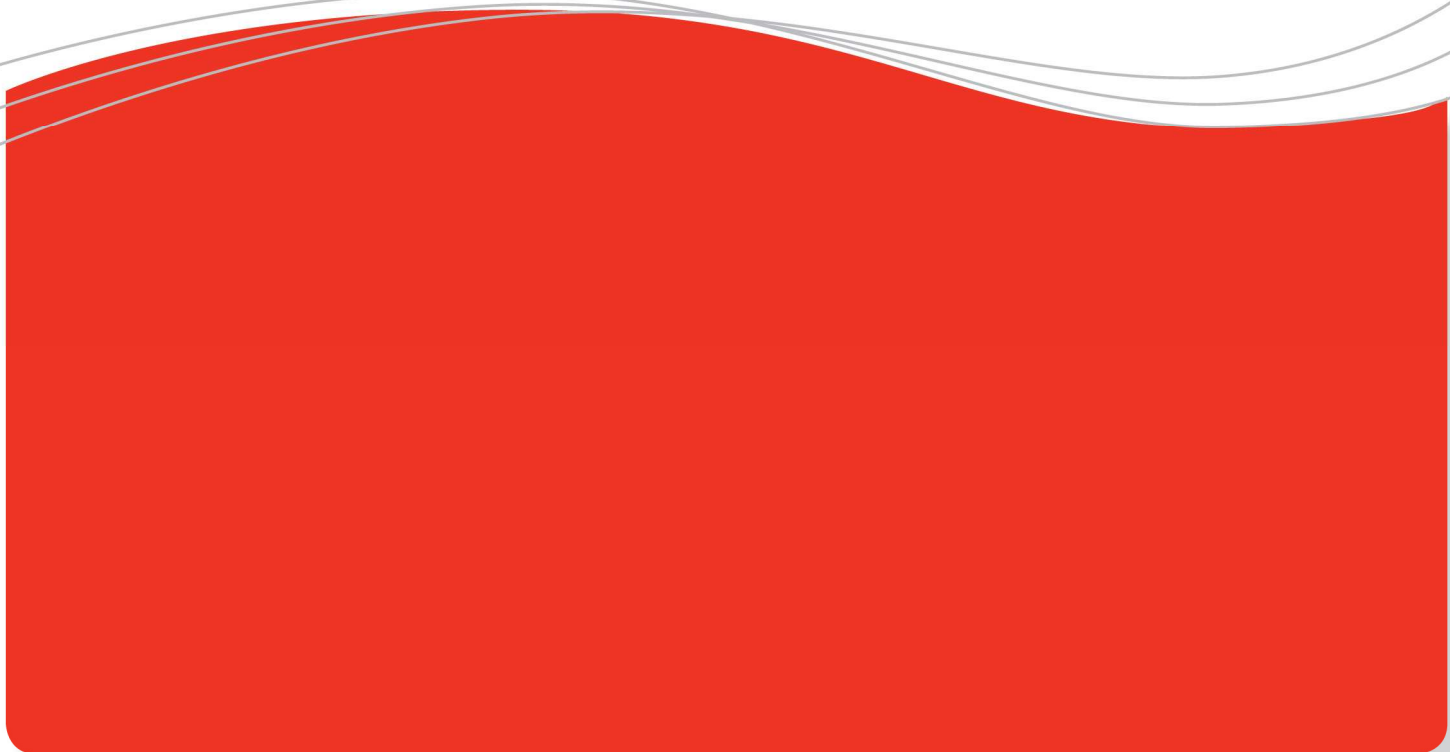




Tracking and tracing in DataLyzer Spectrum



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1. Introduction

SPC is well known for controlling processes. What is less well known is that you can use DataLyzer very well to implement a system for tracking and tracing and for finding causes of variation for example during the measure and analyze phase of a Six Sigma implementation. In this white paper we will explain how tracking and tracing can be implemented and how the data can be analyzed in DataLyzer.

In paragraph 2 the different typologies of tracking and tracing are presented. In paragraph 3 we show some of the general methods of data entry for tracking and tracing. In paragraph 4 we show some of the general tools for analysis and in paragraph 5 we show different types of tracking and tracing in more details.

This white paper is meant to explore some general concepts about tracking and tracing and how they can be implemented in a production environment.

2. Different types of tracking and tracing

Tracking and tracing is very much depending of the type of production situation. Basically there are 4 types of tracking and tracing.

1. Unique serial number for individual products
2. Specific numbers for batches of products like batchnr, ordernr, lotnr
3. Tracking and tracing based on time periods
4. Parallel processes

Ad 1: Examples of production situations where unique serial numbers are used are:

- Production of Solar Modules
- Production of high tech products in Medical Industry

Ad 2: Numbers for tracking are used in most production situations. This can be a batchnumber but for example also an ordernumber. Examples are:

- Batchnumber for mixing dough in a food company
- Batchnumber for a number of cells in a Solar Company
- Ordernumber for a batch of metal products in an automotive company

Ad 3: Tracking and tracing based on date and time means that only time stamps are attached to the measurements. Examples are:

- Process measurements in a chemical process
- Product measurements in a food company
- Temperature and moisture measurements near a production line

Ad 4: Different parallel processes are causing variation. Examples are:

- Multiple cavities in an injection mould
- Multiple spindles for example in battery production



In most production situations there are combinations of the typologies above which make tracking and tracing more complicated. Some examples are:

- Mixing and splitting of batches for example in a PET recycling plant
- Different unique serial numbers are combined in one process step for example multiple modules are combined in one batch in one cycle of the lamination process.
- With a food company batchnumbers are created during mixing and these batches are loaded on a production line and then correlated based on measurements at different points in the process and the throughput time of the production line.
- Batches of material are being used in an injection moulding process with different cavities

3. Data entry for tracking and tracing

There are several features in DataLyzr Spectrum to be used in tracking and tracing.

For the typology under 1 and 2 optional parameters are being used in DataLyzr. Optional parameters can be setup in multiple different ways and there are a lot of different ways to enter the optional parameter values.

Some of the examples are:

- A batchnr is created automatically based on date, time, shift and a sequence number
- Serialnumbers are downloaded from the ERP system and moved through the production process to support full production scheduling
- Batchnumbers are entered by operators during production

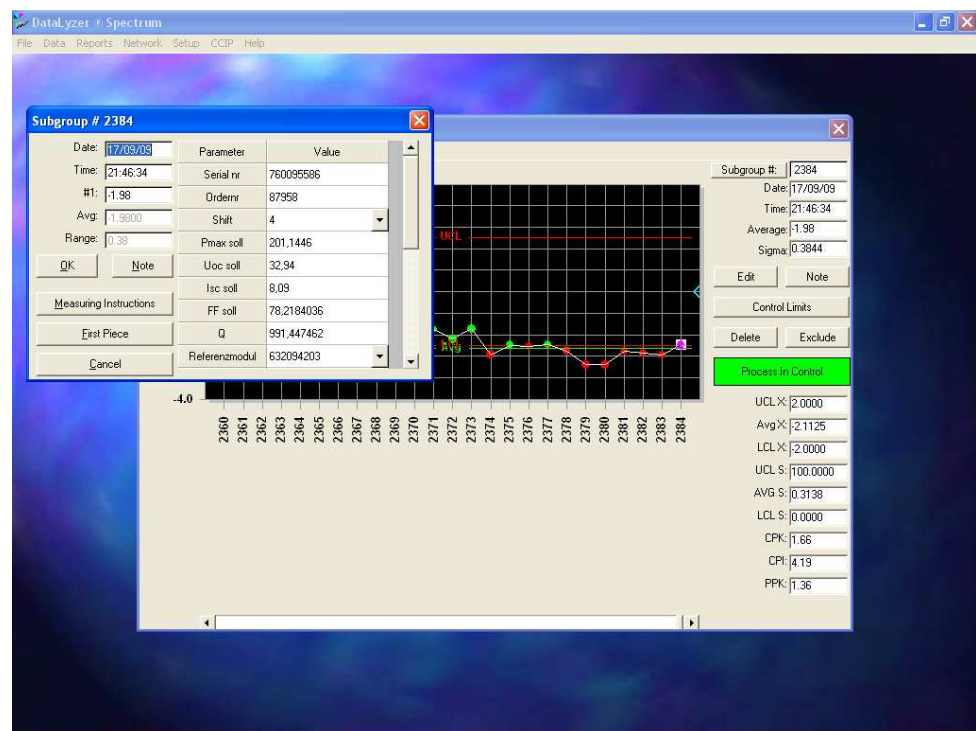


Figure 1: In the example optional parameters are automatically extracted from the ERP system.



In figure 1 you also see that each subgroup in DataLyzr always gets a date and time supporting the third type of tracking and tracing.

There are 2 ways to support the 4th type of tracking and tracing in a SPC system. The first and best method is to create separate control charts for each process. For example in case of an injection moulding process you create a chart for each individual cavity. By comparing the results of the different charts you can analyze if the cavities are a source of variation. Creating separate control charts per parallel process is not always economically feasible. It is not uncommon with injection moulding of performs to have injection moulds with more than 80 cavities. If you check 3 or 4 characteristics this would result in hundreds of control charts per mould. In this case the subgroupsize is often equal to the number of cavities and per cavity one sample is taken.

If this approach is chosen you have to make sure you have proper analysis tools to distinguish the difference between the average and variation with the overall average and variation for the mould.

4. Analysis for tracking and tracing

The DataLyzr software modules offer several possibilities to analyze the data. In this paragraph we show you some examples.

The optional parameters and the date and time play a key role in tracking and tracing. This means that everywhere in DataLyzr you can use a search option to search on any combination of date and time and optional parameters.

This is shown in figure 2.

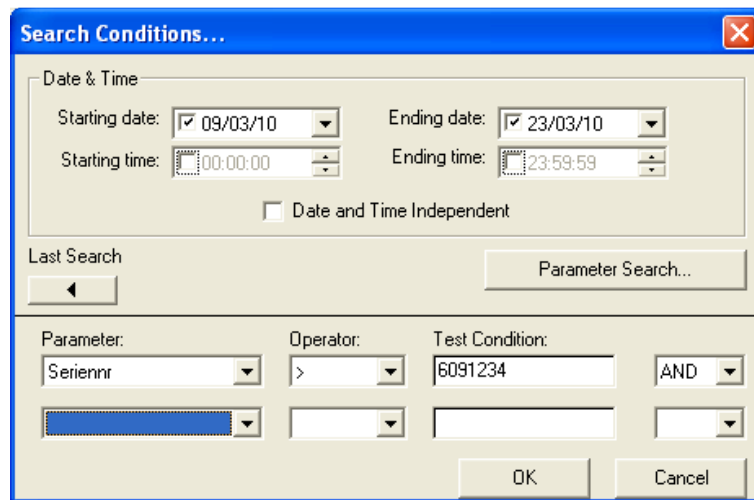


Figure 2: Search options



With the search options you can quickly find the results for a specific batchnumber or for a specific machine setting etc.

Several reports make it possible to compare data sets for example in figure 3 you see a bat chart showing the variation and average of a data set. The data set can be based on optional parameter or as in figure 3 based on different measurements in a subgroup.

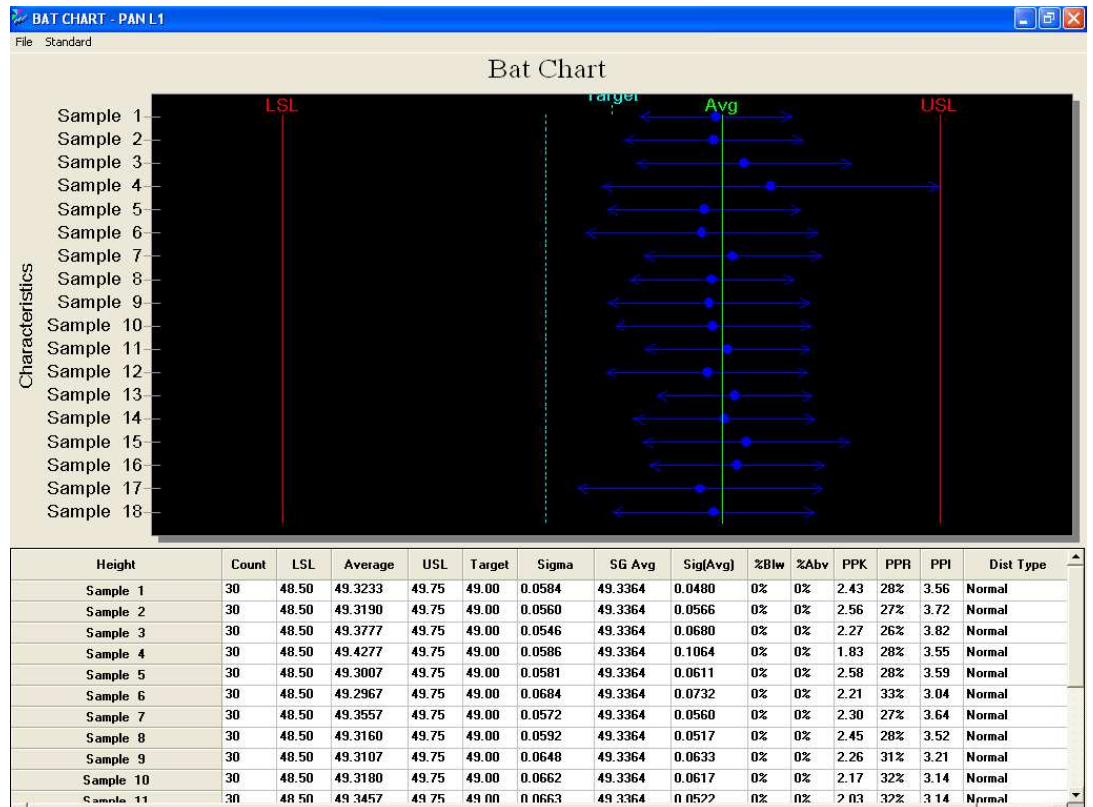


Figure 3: Deviation per cavity from process average

In figure 3 you see the average per cavity for a mould with 18 cavities and the variation per cavity around the subgroup averages.

When you make an analysis for causes of variation you like to include data from different data sources or consecutive process steps and these process steps can be combined based on a specific number or on a date or time. In paragraph 5 we will show how DataLyzer supports the creation of these data sets.

If a data set is opened in DataLyzer you can use the different columns in the data set in a correlation or multi vari analysis.

In figure 4 you see a multi vari analysis based on the factors batchnumber and day of the week. The multi vari supports all types of factors from a data set. This can be optional parameters,



date and time factors but also machine settings or process measurements. This means that you can use the control chart to register the data sets required for analysis to find the causes of variation. During the implementation of Six Sigma companies use DataLyzer to gather the required data to perform the analysis in the Measure, Analyze and Improve phase. Data gathering and analysis is very efficient this way and in addition you can use the SPC techniques to gather additional information which is important for the analysis.

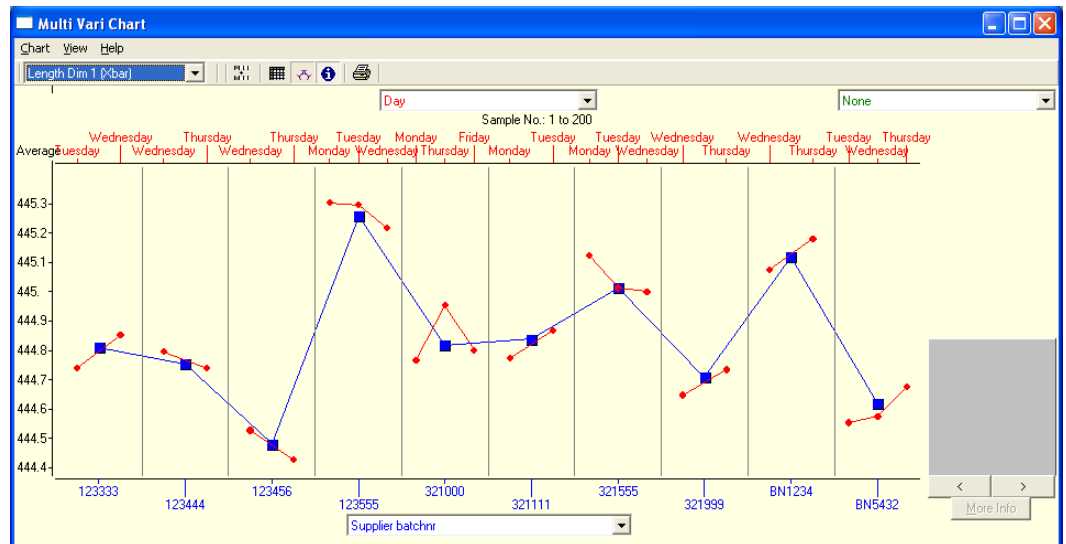


Figure 4: Multi vari analysis with 2 factors (batchnr and day of the week)

To draw conclusions from the multi vari analysis you need to verify if 2 points in as multi vari analysis are statistically different. This can be done instantly by asking for a F and t test for any 2 points in a multi vari analysis. Figure 5 shows the results of such a F and t test.

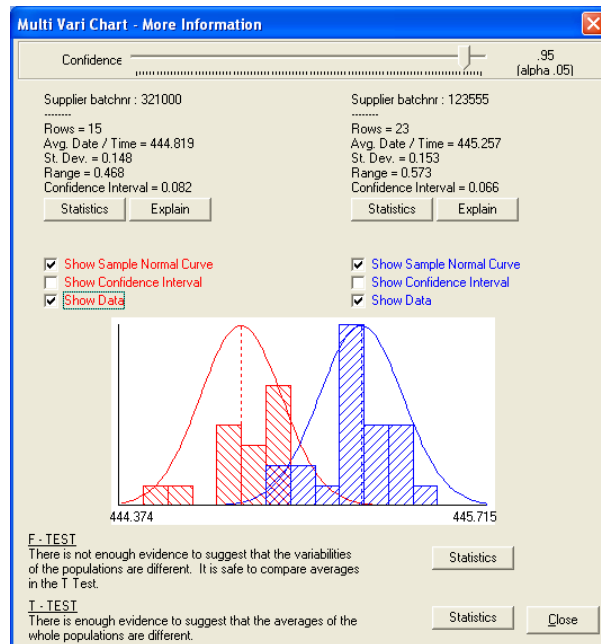


Figure 5: F and t test based on 2 points in the multi vari analysis

5. Specific DataLyzr solutions for tracking and tracing

When you want to create a dataset you need to combine different process steps based on a number (unique number or batchnr) or you have to combine data sets based on time. In DataLyzr Wizard you can combine data from different data sets by combining a unique number in different data sets or by time periods. This data set can be the DataLyzr database but the data can also be taken from external data sources like an ERP system or for example Excel sheets.

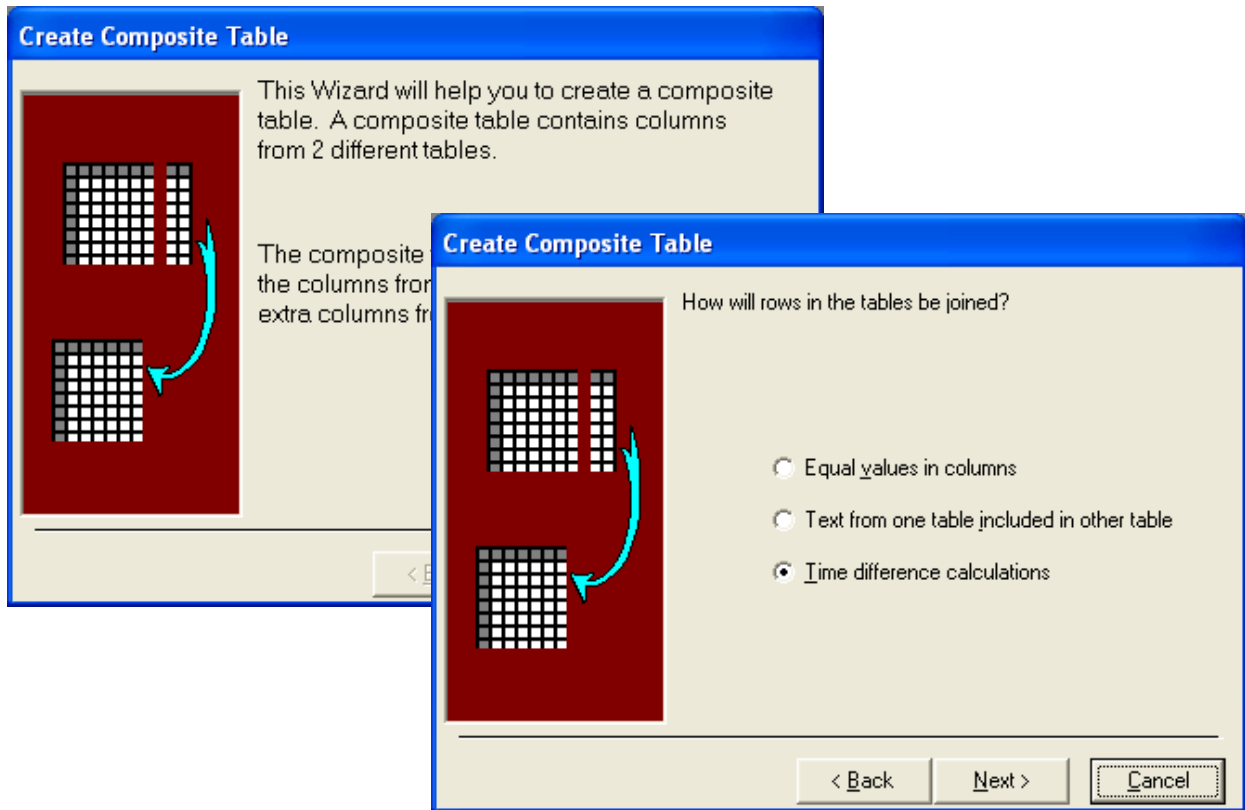


Figure 6: Create a composite table from different data sources

This data set can be created for a one time analysis but it is also possible to store a specific script and open this script on specific times so the tables are composed automatically.

5.1 Unique numbers

Following a unique product

DataLyzer offers several features to support tracking and tracing in case of unique serial numbers.

When a unique product is used in a process you can perform different measurements at a process step. When a product is finished at a process step the product will be transported to the next process step. DataLyzer has a feature to move a serial number from an optional parameter list to the next optional parameter list so operators can only pick serial numbers from the list for products which are available at that process step. At the last process step a serial number can be



removed from the available parameters. This way DataLyzer makes it easy for operators to register serialnumbers if for example barcode is not available or not possible.

Entering additional tracing data

In some production situations it is important to know which material batchnumber or process setting is used for a specific product. If a serialnumber is sequential you have the possibility in DataLyzer to enter the first serialnumber for a new batch and when you enter the serialnumber for the next batch DataLyzer automatically fills the data set with all numbers with that specific batchnr to make it possible to analyze the results based on batchnumber of materials.

It is also to add optional parameter values of different data sets in the same tracing table.

For example in the same tracing table we can store which materialbatchnr is used for a specific serialnr, at what position in the process the specific product is being produced, what process setting was being used during the production of the serial number etc.

Support Bill of Material

When a unique serialnumber is used and the product has subassemblies you can register the subassembly number and the final product number in an optional parameter. This way you can create a full bill of material and trace back which subassemblies were used in a final product.

Joining information of all process steps in separate external data source

When a unique number is registered at each process step an extra function available in DataLyzer I that the table with all information per unique number can be configured in a separate database. A batch program running on predefined intervals can extract all information from the DataLyzer database and export it to an external file or database. The advantage of this solution is that the joined data is instantly available and the performance of the DataLyzer database is not influenced by people extracting reports on an ad hoc basis.

5.2 Batch numbers

Creation of Batch numbers

The creation of batchnumbers is not always easy. For example in a food company it is not logical to give a batch a consecutive number. On a production line the process is more or less continuously where different batches of material are combined.

DataLyzer supports the creation of batch numbers based on a combination of other parameters for example a batchnumber is a combination of date, shift, process step and a consecutive number within a shift.



Throughput or waiting time

If a batchnumber is created also the date and time of the creation are recorded. When this parameter is used again in a next process step it is easy to calculate the time elapsed between the previous process step and the existing process step.

A large food company is for example creating a batchnumber for a dough during the mixing process. When the dough is used at the production line the waiting time is automatically calculated.



5.3 Date and time

Chaining sequences

Data is entered in DataLyzer based on a sequence. All characteristics entered in one sequence are getting the same date and time. This makes it easier to correlate data on different control charts. In most situations you have multiple sequences for example a sequence at startup, a sequence each 4 hours and a sequence each hour.

It is possible to chain sequences to make sure a sequence is automatically started when a previous sequence is finished. The result is that the characteristics entered in the chained sequence get the same date and time which makes tracing based on date and time easier.

5.4. Parallel processes

When you decide to combine parallel processes in one subgroup you can encounter the situation that one of the parallel processes is not running. Examples are a blocked cavity in an injection moulding process or a blocked lane in a process of solar modules. In this case it is important that you can still enter the data and have the analysis possibilities. For this reason DataLyzer offers the possibility to skip a measurement and still allow to continue with data entry.

In this white paper we have discussed some of the available possibilities to use DataLyzer Spectrum not only as a SPC system but also as the information system to establish complete tracking and tracing. For more information or to discuss your situation in detail please contact Marc Schaeffers (info@spc-itk.com) or your local DataLyzer distributor.