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Partners in Continuous Improvement

Calibration and Measurement Systems Analysis
- A Practical Approach to Implementation -

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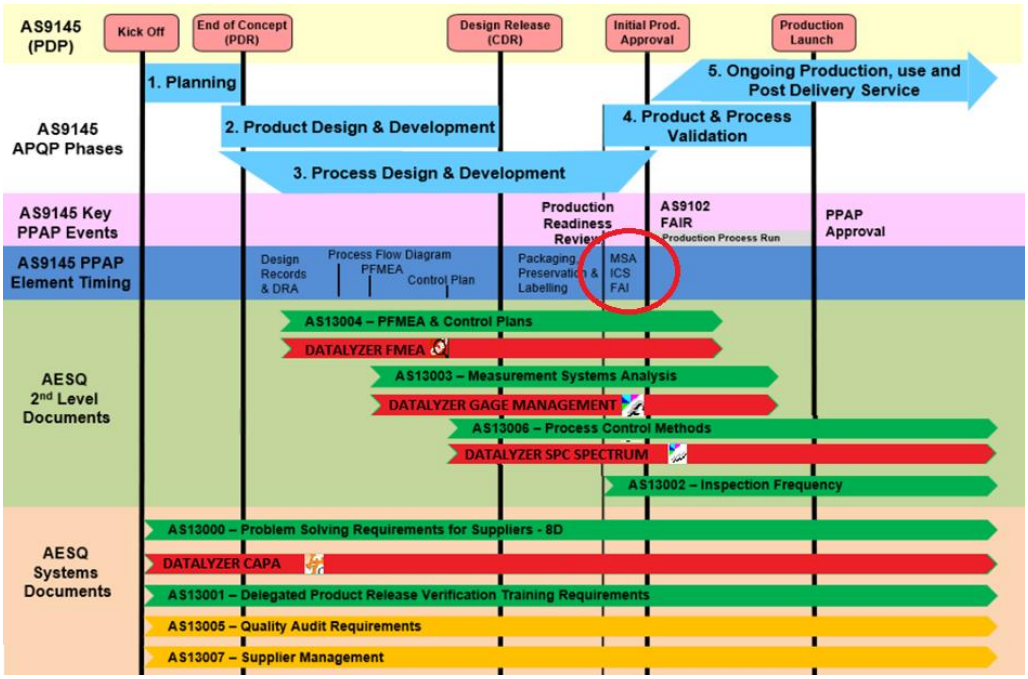
Calibration and Measurement Systems Analysis

INTRODUCTION

The Advanced Product Quality Planning (APQP) process is becoming standard practice in more and more industries. In the graph below you see the steps and requirements shown for the Aerospace industry, but a similar picture can be shown for automotive or other industries.



An important step which is often overlooked is the measurement systems analysis (MSA) step. In principle, it is a very easy and logical step. Skipping this step can result in costly mistakes and loss of time spent on root cause analysis.

We are not saying solving measurement problems is easy, only that checking if your measurements systems are adequate is not so complicated or costly activity to implement.

In this document, DataLyzer will give you some brief introduction in calibration and MSA and provide some guidelines about how you can easily implement calibration and measurement systems analysis.

CALIBRATION

Before we can even start to perform measurements or an MSA study, we need to have a calibrated measurement system. The calibration process has 2 purposes:

1. Make sure the measurement system is adequate to perform future measurements
2. Evaluate if the measurements performed in the past are correct (establish bias).

Calibration costs can be high. If the purpose of calibration would only be to ensure future measurements are ok, then we could also use a new instrument instead of calibrating the existing instrument. Calibration however is needed to give us confidence that past measurements were reliable and statements about the quality of the products shipped were correct.

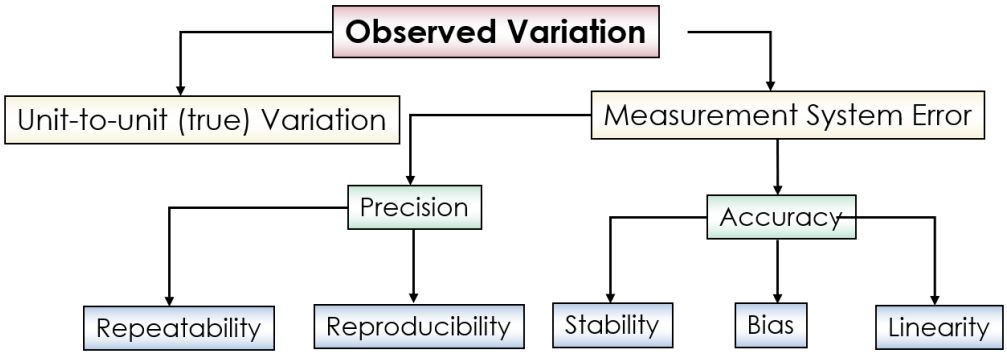
Ideally, calibration information is stored in a database system which is integrated with a quality control or SPC system like DataLyzer. So, whenever a measurement is made, it can be validated if the gage has passed calibration and if a calibration fails, we can immediately see which measurements in the past are suspect.

Although the cost of calibration can be high, the cost of making incorrect statements about quality of products and rejecting good products or shipping bad products is typically much higher.

MEASUREMENT SYSTEMS ANALYSIS

If we use a calibrated gage (acceptable bias) it does not necessarily mean that we will get a correct measurement. If we measure the same product multiple times, we often do not get the same results. This variation is called repeatability and is caused by common causes like difference in the measurement method. Another type of measurement variation is if we ask another person to perform the same measurements or if we use a different gage. This type of variation is called reproducibility. Gage repeatability and reproducibility is also known as GR&R.

In addition to calibration (bias) and GR&R there are 2 more components of measurement variation: linearity and stability.



In addition to common cause variation, we see in measurement systems that we can also have special causes of variation. Some examples of special causes of variation can be:

- Dirt on or in the product or the measurement system
- The measurement system was not correctly zeroed
- A product was not measured at the right position, the right circumstances (e.g., temperature) or the right measurement system. Etc.

The MSA reference manual clearly describes which methods should be used and how they can be used to perform an MSA study.

Why is it so important that we have a correct measurement and we have no special causes of variation?

Let's assume that you are going to the hospital and they are going to take a measurement of specific blood values. Based on the result, conclusions will be made and treatment will be planned. In that case, you would like to be certain measurements are done with calibrated measurement systems and measured variation was kept within required limits.

And even in that case, special causes of variation like measurement mistakes can always happen so therefore every critical measurement is normally repeated at least once to minimize the risk of incorrect measurements.

The importance of a reliable measurement is of course related to the risk of having incorrect measurements and should be considered in the detection rating in the FMEA process.

MSA PROCESS

In the APQP process, it is required to perform an MSA analysis on characteristics. But how do we plan and execute an MSA analysis in practice? We can have hundreds of products, gages and operators performing measurements and we can even have thousands of quality characteristics.

In real life, we take a representative gage in a set of similar gages, a representative product and a representative characteristic. We can start with a type 1 study where we measure 1 product 20 times or more and we show the results in a control chart.

If we want or need to go further, we can then perform a type 2 study.

In that case we take 2 or 3 representative operators, take up to 10 products and measure every product 2 or 3 times. The results indicate if this type gage can be used for these types of characteristics.

In DataLyzer you, can for example link a group of gages to a group of characteristics to establish the relationship. If you analyze the results, you immediately know which MSA study is related to this specific characteristic.

A type 2 study can be time consuming. You need to collect the measurement results, enter 30 measurements and then run the reports and perform the analysis. If this is not automated, it might take you at least 15-20 minutes.

Now let's assume that you are measuring a complex product with 250 characteristics on a CMM. If you need to perform a type 2 study on all characteristics, you will need an automated process otherwise you could easily need a full week to perform all the studies.

If you don't have a fully automated MSA process, you may need to make assumptions based upon experience because it is too time consuming to perform MSA on all characteristics or you perform MSA on the critical characteristics.

TRAINING AND IMPLEMENTATION

To prepare and analyze MSA studies, people require training. A typical training consists of Gage training and MSA training. There are some very effective on-line training modules available. For example, a training program with DataLyzer can consist of:

Gage training 9 hours - 69 US $ per user

This course provides metrology, gage, and GD&T training designed for operators and technicians who use dimensional gages in their jobs to make measurements.

Measurement Systems Analysis training 7 hours - 69 US $ per user

Measurement System Analysis covers techniques for analyzing the variation within a measurement system, determining its suitability for use, and ways to improve measurement systems. The GR&R analysis techniques used in the MSA online training program are in compliance with IATF 16949/AIAG methods.

For further details please download our brochure.

In parallel with the training, you can start performing calibrations and MSA studies using the DataLyzer Gage Management module. This module supports full internal and external calibration and variable MSA studies. It is also integrated with the DataLyzer SPC system. During implementation, DataLyzer can support with training and support engineers analyzing the results.

For details please look at this brochure

Most companies already have calibration in place and so companies can easily configure the calibration themselves in the DataLyzer Gage Management system. If calibration is configured, a typical MSA implementation plan looks like this:

1. Establish products and processes where first MSA implementations will be done
2. Establish responsibilities for preparing studies, executing studies and analyzing studies
3. Establish responsibilities for improving measurement systems in case any of the results are unacceptable
4. Establish reporting - internal and external
5. Train all relevant people
6. Plan the studies
7. Execute the studies and analyze results
8. Evaluate process
9. Plan improvement actions
10. Plan remainder of MSA studies
11. Establish integration requirements with SPC.

Conclusion

MSA is a critical step in an APQP or Zero Defects implementation. Companies struggle to get MSA implemented due to lack of training, resources and priority. DataLyzer offers a very cost-effective complete implementation (including training and support) where you can start fast but can then later completely integrate with FMEA and SPC.

ABOUT DATALYZER

Partners in continuous improvement for 40 years, DataLyzer provides a turnkey solution of training and software systems which includes:

- World-class Quality Management Systems consultancy
- Certificated, eLearning training - APQP, FMEA, Gage Management/MSA, Lean, OEE, Six Sigma and SPC etc.
- An integrated, modular suite of world-class software solutions
- Global installation and training services with continuing support and advice.

Software solutions include, Process Flow, FMEA, Control Plan; Ballooning, real-time SPC and OEE, with Gage Management/MSA, Mould Management, Certificate of Analysis (for reports like FAIR, ISIR and PPAP) and now developing CAPA.

We also provide integrated dashboards, providing advanced real-time/in-process, enterprise and supplier performance monitoring, analytics and reporting capability.

To explore further, please contact your local Account manager or send an email to sales@datalyzer.com