ELECTRONIC MEASUREMENT SYSTEM ANALYSIS

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ABSTRACT

"Amplify a Sustainable Future", is one of Ampleon's taglines which focus on the theme connected to the United Nations Sustainable Development Goals – Greenhouse Gas Reduction and Diversity and Inclusion (D&I).

Sustainable manufacturing is the creation of manufactured products through economically-sound processes that reduce negative environmental impacts while preserving energy and natural resources.

Diversity and Inclusion at Ampleon enhances creativity and innovation. When employees with different cultural backgrounds and levels of expertise collaborate, it can help improve innovation and creativity.

Sustainable and D&I activities are one of the priorities at Ampleon which gives big impact on environmental sustainability and cost savings activities at Ampleon Philippines.

In connection to AI Horizons: Uniting Creativity and Technology for Tomorrow's Innovation and with association for the sustainability and D&I activity of Ampleon, an efficiency improvement project is conceptualized. This will bring customer satisfaction and will encourage even more employees at Ampleon to create innovative projects.

To support this efficiency improvement project at Ampleon, an electronic / automated system is initiated to integrate all required MSA documentation in the system. This system will also help fulfill a requirement for our customers.

1.0 INTRODUCTION

Measurement System Analysis is a statistical tool used to assess data quality. This tool can be used to determine measurements' accuracy and identify sources of error. Measurement System Analysis can assess data quality from various sources, including surveys, experiments, and observational studies.

In manufacturing, can be used to assess the suitability of a Measurement System for use in quality control.

Ampleon's competitive emphasis to attain a sustainable future a team was formed to initiate improvement for measurement system analysis. Designed for the semiconductor environment, the factory uses manual transactions in handling MSA activities, to monitor and gather MSA data for different processes. This project will help ensure that MSA results per process will be monitored via IoT.

Current monitoring uses manual counting of data and manual creation of graphs in Excel. MSA review and approval is routed using printed reports. Final reports are generated by means of excel and power point presentation.

1.1 MSA Activity Plan

The MSA Activity Plan refers to the schedule of activities of all measurement tools used in the production line. Schedule may depend on the calibration period of gauges for variable MSA or once per year whichever is more frequent and the recertification period of operators, inspectors, and other users for attribute MSA. Repeat studies will be required if any significant changes occur to equipment location and/or process.



Fig. 1 MSA Activity Plan is part of worksheet of the MSA Basic Variable Template. It consists of the different schedules per processes that need to undergo MSA activities.

1.2.MSA BASIC VARIABLE TEMPLATE

The MSA Basic Variable Template is an excel file which consists of five worksheets, MS Evaluation Report, Repeatability and Reproducibility (ANOVA Method) Datasheet, Repeatability and Reproducibility (X-Bar & R Method), Bias and Linearity Datasheet. Variable data in a MSA study for a given characteristic comprises collecting data on stability, bias, linearity, and gage repeatability and reproducibility (GR&R); this is based on statistical hypothesis and disposition criteria and deciding acceptability of the measurement system.

1.2.1 MS EVALUATION REPORT

The MS Evaluation Report is one of the worksheets included in the Basic Variable Template. It comprises of the gage, BFG / Product Line, Date of MSA, Process Owner, Team Members, Calibration Details which includes the Calibration ID, Calibration Date and Due Date. The MS Evaluation Reports also includes the summary of description of Measurement System Analysis, wherein the types of MS used and the MSA methods used for the Variable MSA report. Critical Parameters and specification limits are also included.



Fig. 2. MS Evaluation Report is part of worksheet of the MSA Basic Variable Template. It consists of

1.2.2 Gage Repeatability and Reproducibility Datasheet

The Gage Repeatability and Reproducibility is a measurement systems analysis technique that uses an analysis of variance (ANOVA) random effects model to assess a measurement system. Three appraisers are needed to complete the study.



Fig. 3. Gage Repeatability and Reproducibility (ANOVA) datasheet

1.2.3 GR&R Datasheet (Xbar&R Method)

The Xbar&R method is an alternate method for conducting a GRR analysis. This method is used when a lower sample size is preferred for the number of trials per part per operator. A set of mathematical equations are defined to estimate %R&R, making this method easy for calculations.

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Fig. 4. GR& R Datasheet (Xbar&R Method)

1.2.4 Bias Datasheet

The Bias, also referred to as Accuracy, is a measure of the distance between the average value of the measurements and the "True" or "Actual" value of the sample or part.



Fig. 5. Bias Study Datasheet

1.2.5 Linearity Study Datasheet

The Linearity Study is a measure of how the size of the part affects the bias of a measurement system. It is the difference in the observed bias values through the expected range of measurement.



Fig. 6. Linearity Study Datasheet

1.3 Attribute Gage MSA Template

An attribute gage study is a study that examines the bias and repeatability of an attribute measurement system. For example, you may have an automatic inspection gage that performs a 100% end of line inspection. It is important that this gage is accurate and repeatable.



Fig. 7. Attribute Gage Study Template

1.4 Attribute MSA Golden Sample Reference Sheet

The Attribute MSA Golden Sample Reference Sheet is used to identify all the identified golden samples used in a particular MSA study. Corresponding processes have different sample numbers and their respective reference value.



Fig. 8. Attribute MSA Golden Sample Reference Sheet Template

1.5 Variable MSA Golden Sample Reference Sheet

The Variable MSA Golden Sample Reference Sheet is used to identify all the identified golden samples used in a particular MSA study. Corresponding processes have different sample numbers and their respective reference value.



VARIABLE MSA GOLDEN SAMPLES REFERENCE SHEET (Xbar & R, Anova

Fig. 9. Variable MSA Golden Sample Reference Sheet Template

2. 0 REVIEW OF RELATED WORK

Measurement System Analysis (MSA) is used to determine the sustainability of a measurement system for use. It is fundamental to have a well-functioning measurement system so that the data collected is accurate and precise. There are many factors to consider when conducting a measurement system analysis.

Designed for the semiconductor environment, the factory uses manual transactions in handling MSA activities, to monitor and gather MSA data for different processes.

The factory uses other applications that help minimize the use of manual transactions.

Measurement Systems Analysis (MSA) is a tool for analyzing the variation present in each type of inspection, measurement, and test equipment. It is the system used to assess the quality of the measurement system. In other words, it allows us to ensure that the variation in our measurement is minimal compared to the variation in our process.

The main objective of Measurement Systems Analysis is to gauge the measuring system's validity and minimize the leading process variation due to the measurement system.

It gauges the quality of the measurement system or instrument.

Organizations normally consider measurement data in making decisions regarding the process or business. Hence data should be accurate.

Data accuracy is one of the fundamental requirements in the DMAIC process. It helps to evaluate the effect of the measurement system on the collected data. If the measurement system data is inaccurate, we will decide based on incorrect data.

3.0 METHODOLOGY

3.1 Materials used in Electronic Measurement System Analysis.

- MSA Activity Plan
- MSA Basic Variable Template
- MSA Attribute Gage Study Template
- Variable MSA Golden Sample Reference Sheet
- Attribute MSA Golden Sample Reference Sheet

3.1.1 Procedure: Performing Measurement System Analysis using Manual Transaction

Conducts Measurement System Analysis study on the processes indicated in the MSA Activity Plan. MSA Study includes a team of three appraisers. Appraisers or users of the respective equipment that undergoes the MSA study.



Fig. 9 Measurement System Analysis Study

3.1.2. Generates MSA Reports

Generation of MSA Reports are prepared by the MSA Leader of each department. MSA reports are represented by different excel datasheets templates that generate the result of a specific MSA study.



Fig. 10 MSA Reports Excel Templates

3.1.3 Prints MSA Report for Approval

Completed MSA reports are printed by the MSA leader.



Fig. 11 Printing of MSA reports

3.1.4 Submits MSA Report for Approval

The completed MSA reports are printed and manually routed to corresponding approvers. MSA Approvers include the Process Superior and MSA Coordinator.



Fig. 12 Manual Approval of MSA reports

3.1.4 Consolidation of MSA Report

The completed MSA reports in excel format are consolidated. The reports are saved in a common drive or folder.

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Fig. 13 Shared drive or common folder for MSA reports

3.2 Change Request Notice Board

Change request notice forms are sent to our international headquarters. This form is a requirement needed for all improvement projects with respect to application changes. The change will lead to improvements, changes in workflow, or configuration. This change can be scheduled. A workaround is available.

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Fig. 14 Change Request Forms

3.2.3 Process Workflow for E-MSA

E-MSA Process workflow was designed to clearly view the different project requirements and procedures.



Fig. 17 Process Workflow Example

3.2.1 Presentation to MSA Team and programmers

A series of meetings were conducted during the conceptualization of the improvement project. MSA teams collaborated and brainstormed all the important details of the project prior to the presentation in the Change Control Board meeting.

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Fig. 15 Screenshot of actual MSA team meeting

3.2.2 Presentation to Change Control Board

Presentation to the Change Control Board was scheduled. After the meeting it was decided if the project will proceed to the next phase of the process.

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Fig. 16 Screenshot of actual Change Control Board Presentation

4.0 RESULTS AND DISCUSSION

4.1 Electronic Measurement System Analysis

E-MSA or Electronic Measurement System Analysis is an automated system designed for the semiconductor industry. E-MSA was created through INTREXX application. MSA automation will be of big help in our processes. Paperless transactions can be achieved.

4.1.1 E-MSA User Access View

E-MSA User Access is viewed once the link is accessed.



Fig. 18 E-MSA User Access View

4.1.2 E-MSA Icon

E-MSA Icon is represented by an image solely for MSA application. Once selected it will go directly to the home page of the system.



Fig. 19 E-MSA Icon

4.1.2 E-MSA Home Page

E-MSA Home Page is represented by an image solely for MSA application. Once selected it will go directly to the home page of the system.



4.1.3 E-MSA Approval Window

E-MSA Approval window is viewed after a successful uploading of MSA reports in the system. MSA Approvers are selected according to its corresponding process. MSA approvers are automatically managed in a hierarchical approach. The MSA approvers can either approve or disapprove an MSA report. If MSA report is approved, it will be transferred to the next level approver which is the MSA Coordinator. After approval the MSA reports will be transferred to the "Completed" table of MSA reports in the system.

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Fig. 21 E-MSA Approval Window

4.1.4 E-MSA Reports Summary

E-MSA Reports summary are saved in the system. Approved MSA reports are automatically transferred in the "Completed" table of MSA reports in the system.

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Fig. 22 E-MSA Reports Summary

5.0 CONCLUSION

Electronic Measurement System Analysis or E-MSA is an inhouse automated system created in INTREXX application. From MSA manual transactions to an improved and efficient system that is functional. E-MSA provides the end users with paperless transactions. It allows the user to do online transactions of all measured data in MSA. MSA reports are routed, validated, and approved in the system. E-mail notifications are automatically prompted to all respective users with access to the system. Easy monitoring and tracking of all MSA reports pending and completed activities are monitored in the system. Digital archiving of MSA reports is also included in the new system. E-MSA is an auditready system that satisfies our customer requirement with the IT enabled MSA system that is audit ready.

6.0 RECOMMENDATIONS

As a recommendation, the team implements the use of the new application for Measurement System Analysis. Usage and deployment to all MSA team as the new way of working in Measurement System Analysis study. Creation of general procedure and work instruction of the new system for Measurement System Analysis.

7.0 ACKNOWLEDGMENT

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9.0 ABOUT THE AUTHORS



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10.0 APPENDIX

Appendix 1 MSA Report Templates

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Appendix 2 Change Request Form



Appendix 3: E-MSA Application

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