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Standard Work Documents(SWD) Development and Implementation of New Production Line(M4A) at Continental Automotive pvt. Ltd.

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Abstract - *Standard routines are part of the daily work in a lean organization and are the basis for continuous improvement in production. The main goals of standard work are: Standardize all work activities, controlling the process, quick identification of process deviation & design. In this work, it is aimed to standardize the working process in the M4A production line, develop the check sheet from 7QC tools to obtain the continuous improvement and zero defect products as output, implement the 5S in the M4A line to maintain the quality of working conditions in the production line, identify and implement the Poka-Yoke to eliminate product defects by preventing, correcting or drawing attention to human errors as they occur,& prepare the virtual workstation. Data such as standard work instruction, check sheet, Poka-yoke has been collected and analysed from existing MR2 line in the company. For the first work station in M4A product line, it has been tried to keep up the ergonomics between machine, operator and raw material. Many discussions were made to sort the bins and worker position in handling the raw materials. After discussing with the supervisor of the line, we wrote the Standard Work Instruction (SWI) for the first work station. After approved from production and quality departments, the same was implemented to rest of the 13 work stations of the M4A product line. The software Filmora, version 8.0.78 is used to create the virtual workstation as it is user friendly which helps in making videos, audios and many more.*

Key words: **7QC, Poka-yoke, check sheet , M4A, Standard Work Instruction (SWI) , Filmora**

1. INTRODUCTION

1.0 M4A Product

A M4A product is a mechanical and electronic module which isa part of the engine management system. It is designed to control engines with displacements from 50cc to 350cc (higher displacements compliance to be assessed between customer and continental (company)) for single cylinders. An automotive class electronic control (ECU) unit with a 26 pin connector used to extend the inputs/outputs of the M4A.

M4A module consists of the following parts

a) A mechanical throttle body.
b) Throttle position sensor (TPS) to monitor the opening and closing of a throttle plate.
c) An air intake temperature sensor (ITS).
d) A manifold pressure sensor (MAP).
e) An idle actuator.
f) A 3 axis accelerometer (Tilt switch).

Figure 1.1 M4A Module

Functions of M4A Module

The M4A addresses the following function:

a) Engine control through processing input data from sensors into output data to actuators.
b) Airflow control through a mechanical actuation (by the driver) and automated control (by ECU and an actuator).

1.1 Standard Work, Purpose and Goal

Standard Work

Detailed definition of the most efficient method to produce a product (or perform a service) at a balanced flow to achieve a desired output rate. It breaks down the work into elements, which are sequenced, organized and repeatedly followed.

Each step in the process should be defined and must be performed repeatedly in the same manner. Any variations in the process will most likely increase cycle time and cause quality issues. It typically describes how a process should consistently be executed and documents current 'best practices.' It provides a baseline from which a better approach can be developed, allowing continuous improvement methods to leverage learning.

Purpose

a) Standard routines are part of the daily work of all the employees and leaders in a lean organization
b) Standard routines are the basis for Continuous Improvement
c) Standard routines for employees are called Standard Work

Goal

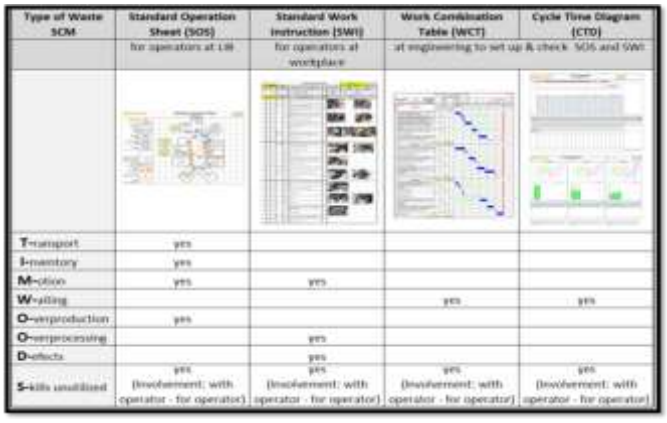
a) Standardize all work activities
b) Controlling any form of variation in the process
c) Quick identification of process deviation
d) Design the basis for Kaizen in Quality, Safety, Flexibility, Time, Cost and Ergonomics

1.2 Standard Work documents for Production

The following work documents have to be prepared for any component production for better performance which is shown in table 1.1.

a) Standard operation sheet
b) Standard work instruction
c) Work Combination Table
d) Cycle Time Diagram

Table: 1.1 Standard Work Document (SWD) Process



Standard Operation Sheet

Content of Standard Operation Sheet (SOS) is an arrangement of equipment and the process chain per operator, aligned in numbering with the steps from Standard Work Instruction (SWI). Areas for buffers and material stocks have to be included. In addition, either in the layout or in an extra list incoming and outgoing materials including the empty goods that has to be replenished more often than one time per shift, has to be shown with the replenishment volume and frequency for logistics. Process and operation steps with safety, ergonomic and quality aspects have to be highlighted. Ergonomic symbol must be used in the control plan for the operator to have knowledge about the Ergonomic risk in the process.

Standard Work Instruction

Work instruction includes the specific ergonomic principals, safety and quality rules for the work stations. Operation steps are defined in such details (right hand-left hand) so that the standard of a work can be assured. Pictures on the right side give additional information for elementary steps. In case operation steps needs a longer description (for visual inspection with a lot of pictures or for starting the process in the morning) the operations steps must be simple descriptions with a basic hint for further details in an attached additional document. Only for tasks that are allocated to the operations as part of work. By this we can keep focus on the documents of the cycle.

Table: 1.2 SWI Process

Work Combination Table:

From this table one can observe the combination of manual work time, machine processing time and walk time for different operations in production line.

Cycle time diagram:

The Cycle Time diagram can be used for measuring the average cycle time of each tasks.

1.3 Poka-yoke

Poka-yoke is a Japanese term that means "mistake-proofing". Poka-yoke can be implemented at any step of a manufacturing process where something can go wrong or an error can be made. For example, a fixture that holds pieces for processing might be modified to only allow pieces to be held in the correct orientation.

A methodical approach to build up poka-yoke countermeasures has been proposed by the Applied Problem Solving methodology, which consists of a three-step analysis of the risks to be managed:

a) Identification of the need
b) Identification of possible mistakes
c) Management of mistakes before satisfying the need

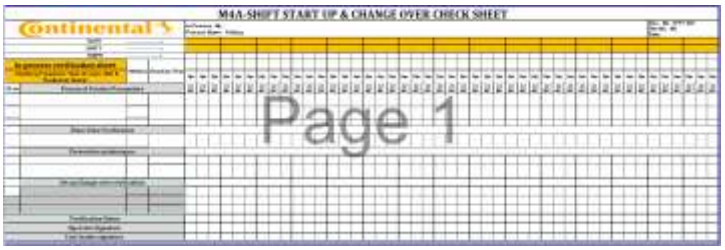
This approach can be used to emphasize the technical aspect of finding effective solutions during brainstorming sessions.

1.4 Check Sheet

The check sheet is a form (Document) used to collect data in real time at the location where the data is generated.

The defining characteristic of a check sheet is that data are recorded by making marks ("checks") on it. A typical check sheet is divided into regions, and marks made in different regions have different significance. Data are read by observing the location and number of marks on the sheet.

Table: 1.3 Start-up & Change overCheck Sheet



1.5 Virtual Workstation

The virtual workstation is the modern day solution to the display of the standard work instructions (SWI), Poka-yoke, and check sheet in the specific workstation. According to the industry norms the SWI has to be put up in each workstation, virtual workstation being a soft copy the whole SWI, poka-yoke, and check sheet can be displayed on computer monitor in the specific workstation.

1.6 5S

5S is a system for organizing spaces so work can be performed efficiently, effectively, and safely. This system focuses on putting everything where it belongs and keeping the workplace clean, which makes it easier for people to do their jobs without wasting of time or risking injury.

2. LITERATURE SURVEY

Puvanasam A.P et Al. [1]defined eight steps for developing standardized work. They are:Establishing the improvement teams, Determination of the cycle time, Determination of the work sequence, Determination of the standard quantity of work in progress, Preparation of a standard workflow diagram, Preparation of a standard operation sheet and Continuous improvement of standard operations. In their work, the performance measures of the process were optimized which are necessary to structure and standardize any tangible process.

Gabriel Vidor et Al. [2] introduced a framework for assessing Poka-Yoke devices (PD), encompassing both those designed for quality control (referred to as quality PD) and those designed to control hazards to health and safety at work (referred to as safety PD). The framework assesses the processes of the design, operation and maintenance of PD, rather than the outcomes of these processes.

Cristina et Al. [3] aimed to study the relationship between 5S evolution and productivity in a local company from Mores County, Romania, which operates in automotive industry for over 10 years, and it is part of an Austrian group. The objective of this paper was to demonstrate that 5S method is very important and have a positive correlation to overall performance of production results.

G. Anand and RambabuKodali[4] presented a case study of a medium-sized valve manufacturer in which the decision of implementing LM is made by analyzing the capabilities, practices, tools and techniques of alternative manufacturing systems apart from understanding its effect on the decision areas of the operations department.

3. PROBLEM DEFINITION AND OBJECTIVES

3.0 Problem Definition

Development and implementation of Standard Work Instruction as it is the most powerful Lean tool that forms a base line for Kaizen. Identifying and implementing Poka-yoke to prevent, correct or draw attention to operators. Check sheet is a kind of Poka- yoke to ensure smooth production. Development of check sheet by identifying process parameters and ensuring operators to these process parameters before start of the shift.

3.1 Problem Objectives

a) Standardizing the working process in theM4A production line by implementing the Standard Work Instructions (SWI) to ensure that processes are consistent, timely and repeatable.
b) Development of check sheet from 7QC tools to obtain the continuous improvement and zero defect products as output.
c) Implementation of the 5S in the M4A line to maintain the quality of working conditions in the production line.
d) Identification and implementation of Poka-Yoke to eliminate product defects by preventing, correcting or drawing attention to human errors as they occur.
e) Preparing the virtual workstation to display in each workstation for faster and efficient understanding of the process to the worker and also to overcome the failures on his own.

4. METHODOLOGY

Methodology is the systematic theoretical analysis of the method to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge and it is depicted in flow chart.

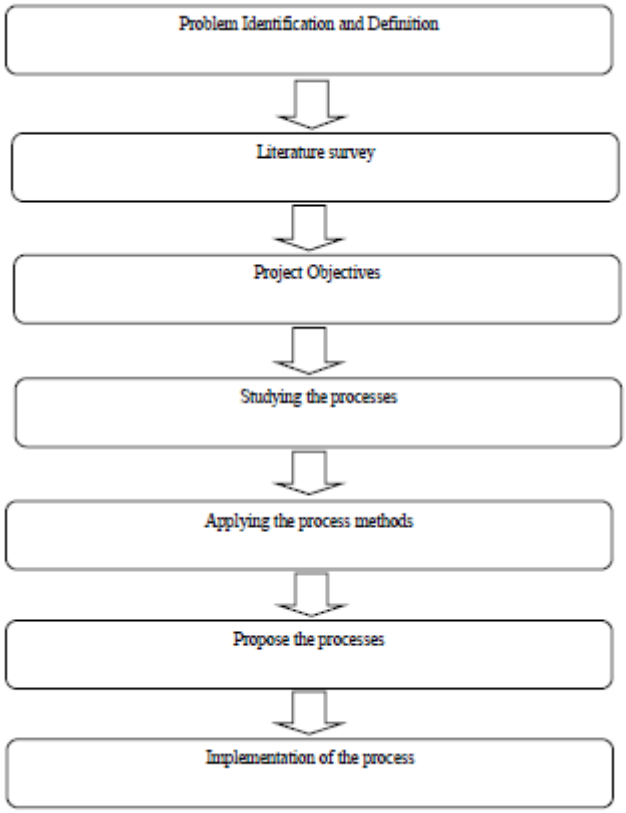


Figure 4.1 Methodology

5. DEVELOPMENT of STANDARD WORK INSTRUCTION

5.0 Data Collection

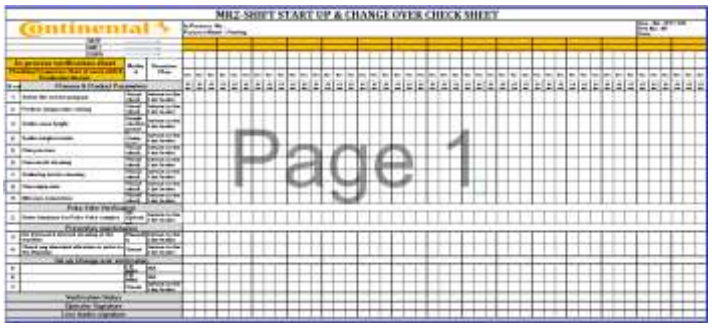
To develop standard work instructions to the new line, one has to refer the pre-existing procedure in any line which has satisfactory results. MR2 is an existing line in the company. The data is collected from that line i.e., MR2 where the study has been done on the Standard Work Instruction, check sheet & poka-yoke.

Table 5.1 Data Collection

Table 5.2 Data Collection on Standard work Instruction

Table 5.3 Poka yoke

Table 5.4 Shift Start-up & Change Over Check Sheet



5.1 Data Analysis

From MR2 Product line the collected data like Standard Work Instruction, check sheet, poka-yoke is carefully examined to develop M4A line. It has been discussed with the operators of the MR2 Product Lineabout the utilization of the Standard Work Instruction (SWI), Poka-yoke and 5S in that line. We observed whether the operator is doing the work according to the SWI and enquired them regarding any inconvenience during the working according to the SWI. The feedback was taken from the operator that they did not express any inconvenience in the work as per Standard Work Instructions (SWI).

5.2 Procedure Development The data which was collected and analysed is used to implement the same in the M4A product line. For the first work station in M4A product line, we tried to keep up the Ergonomics between Machine, Operator and raw material. Many discussions were made to sort the bins and worker position in handling the raw materials. After discussing with the supervisor of the line, we wrote the Standard Work Instruction (SWI) for the first work station. Once approved from production and quality manager departments the same was implemented to rest of the 13 work stations of the M4A product line.

5.3 Standard Work Instruction

A Standard Work Instruction is a step by step instructions arranged by an organization to help worker carryout routine operations. Standard Work Instruction are the instructions designed to ensure that processes are consistent, less time consumable, repeatable and highly efficient. Standard Work Instruction aims to achieve quality output, efficiency, uniformity of performance while reducing failure which is given clearly in table 5.5. During the development of standard work instructions, tools, safety, ergonomics, health, quality, visual check, manual check, process, symbol and general activities have been considered.

Table 5.5 Standard work instruction- PCBA Heater

5.4 Poka-Yoke

It says about mistake proofing and helps to avoid mistakes. In this, wrong position of components, missing of components, model mix-up, incorrect software, wrong orientation, process skip, wrong part, wrong process parameter, improper tool setup etc. have to examined at most care. The developed Poka yoke of M4A line is shown in table. 5.6.

Table 5.6 Poka yoke of M4A Line

5.5 Check Sheet

1. Check sheet gives the complete set of data at that location. Process parameters such as temperature, pressure, time, speed have been collected repeatedly since they affect the manufacturing procedure indirectly. The details given in table 5.7.

Table 5.7 Check sheet of M4A Line

5.6 Procedures of creating virtual workstations

Creation of Virtual workstation plays an important role in realising the actual work station. The procedure to be followed in creating workstation involves:

a) Creation of the SWI, poka-yoke, and check sheet as usual with help of traditional procedure.
b) Approval of the above documents.
c) Teaching and practicing the SWI, poka-yoke, and check sheet in the workstation.
d) Capturing the videos of the processes in the workstation with pictures of specific task, with the help of SWI, poka-yoke, and check sheet earlier created.
e) Arranging and sorting the videos accordingly.
f) Creating the complete video and photo with subtitles.
g) Adding the audio to the AV effects.
h) Rendering the video.

The software used to create virtual workstation isFilmora, version 8.0.7.8 as it is user friendly which helps in making videos effectively. This software helpedto include videos, photos, pictures, audios, transitions, titles, subtitles and many more.

6. CONCLUSIONS

The overall aim of the work was to setup the M4A line in a standard way for the smooth functioning of the same. For smooth functioning of the line, Standard Work Documents, Poka-Yoke, Check sheets and 5S methods were implemented and the line is ready for the production with clear cut instructions in each workstations. A daily training was given to the workers in the line to eliminate any doubts in the preliminary level itself.

A whole new concept of virtual workstation was introduced in the company for the first time so as to provide maximum clarity for every worker in each workstation. The virtual workstation will help the worker to overcome any difficulties that they face in the real workstation. The software Filmora, version 8.0.7.8 is very effective as it helped lot to create audio, video and photos.

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