



Comparison of Harbest and Master Harness Methode For Analyzing Defect Wire Harness Product on Toyota Alphard 812888-XXX

Final Project

**By :
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Statement of Authenticity of Final Project

I, the undersigned, declare that the contents of part or all of my Final Project entitled: **“Comparison of Harbest and Master Harness Methode For Analyzing Defect Wire Harness Product on Toyota Alphard 812888-XXX”** is **the result of my own work, completed without using unauthorized materials, and is not the work of other parties that I recognize as my own work.** All references quoted or referred to have been written in full in the bibliography. If it turns out that my statement is not true, I am willing to accept sanctions according to applicable regulations.

Batam, 05 June 2024

A handwritten signature in black ink, appearing to read 'Duwi Ty Prahyoga', with a horizontal line underneath.

DUWI TYA PRAHYOGA

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NIM: 3222101018

Preface

Praise and thanks to God Almighty for His abundant grace so that the author can compile the Final Project. This final project entitled **“Comparison of Harbest and Master Harness Methode For Analyzing Defect Wire Harness Product on Toyota Alphard 812888-XXX”** was prepared to fulfill the requirements in obtaining the degree of Associate Expert in Engineering (AMd.T) majoring in Electrical from Batam State Polytechnic.

This final project would not have been completed without the continuous support and guidance from those the author would like to direct gratitude towards:

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Hopefully the author can repay all the support and assistance that has been given by the parties above and hopefully this final project can be useful for future references and studies.

In writing this final project, the author realizes that there are still many shortcomings that must be corrected and far from perfection. Therefore, the author hopes that the readers can understand it. For your attention, the author would like to thank you.

Batam, 05 June 2024

Author

Comparison of Harbest and Master Harness Methode For Analyzing Defect Wire Harness Product on Toyota Alphard 812888-XXX

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Abstract—PT Sumitomo Wiring System Batam Indonesia was a Japanese company that produced wire harnesses in the automotive world, particularly focusing on quality and quantity issues. Quality problems in customers were the most feared by all parties at PT Sumitomo Wiring System Batam Indonesia. Wire harnesses were a combination of several cables commonly used in vehicles and had a function to deliver electric current and signals to the vehicle. This was very reasonable because if, for example, we bought a wiring harness and it turned out that it was not properly installed with a connector, there was no connection of electric current and the car could not work optimally and could lead to accidents. The wire harness production process did not always run as it should. Problems could arise from machine, human, material, and method factors that could cause defects in the products produced. This study aimed to analyze wire harness defects in one of Toyota's products by visual inspection using the Master Harness and Harness Best Engineering System (HBS) methods. Visual inspection using the Master Harness method was to compare the product with a sample wire harness to ensure that the product or other production results matched the predetermined standards. For the Harness Best Engineering System (HBS) checking method, a wire harness drawing that matched the original size was affixed to the board and then compared with the production wire harness that met the predetermined standards. In this case, Pareto diagrams and fishbone diagrams were used to analyze the resulting data. The results of this study showed a significant decrease in defects from 66 to 30 when using the Master Harness and Harness Best Engineering System (HARBEST) method, which indicated a substantial improvement in the quality of wire harness inspection produced.

Keyword: Wire Harness, Master Harness, Harness Best Engineering System (HBS), Diagram Pareto, Fishbone Diagram, Bar Chart

I. INTRODUCTION

PT. Sumitomo Wiring System Batam Indonesia was a Japanese company located on Jalan Beringin Batamindo Industrial Park No. 08 Batam. PT. Sumitomo manufactured wire harnesses in the automotive world. Wire harness products manufactured at PT. Sumitomo included those for Toyota,

Daihatsu, Mitsubishi, and Suzuki cars [1]. Wiring harnesses served as the intricate network of electrical connections that enabled communication and power distribution among various components within a vehicle. These essential components were responsible for ensuring the proper functioning of a wide array of systems, ranging from engine control and transmission to lighting, entertainment, and safety features. The wire harness was a combination of several cables that were commonly used in vehicles and had the function of delivering electric current and signals in a vehicle [2].

A wire harness is a network of wires that connects various electronic systems in a car, such as the drive system, braking system, security system, and entertainment system. Checking a car's wire harness with the visual inspection method aimed to ensure that each component was properly connected there was no physical damage and the electrical system was operating properly. The wire harness checking process previously used the master method to determine whether the wire harnesses in production were appropriate. However, the use of masters in checking had shortcomings, namely the frequent passing of defects, especially in the dimensions and the fast damage of the master harness was not durable. Also, using the master method took up a lot of space to store the master harness in its box.

The problem formulations in this study were to determine the optimal process for defects generated using Master harness and Harness Best Engineering System (HARBEST) and to analyze defect data generated using visual inspection methods of Master harness and Harness Best Engineering System (HARBEST). Based on the formulation of the problem, the objectives in this study were to determine the optimal process of defects produced by using Master harness and Harness Best Engineering System (HARBEST) analyze the defects produced by comparing two different checking methods. The benefits expected from the implementation of this research were defect analysis data generated in the Wire harness production process using Visual Inspection at PT Sumitomo Wiring System Batam Indonesia, generated data on the causes of defects, and proposed solutions for improvement in the next Wire harness production at PT Sumitomo Wiring System Batam Indonesia.

The limitations in the preparation of this research were that this research only discussed the analysis of defects in Toyota Alphard products using the Visual Inspection Master Harness and Harness Best Engineering System (HARBEST) methods conducted at PT Sumitomo Wiring System Batam Indonesia, and the data analyzed was primary data.

The wire harness is a combination of several cables that are commonly used in vehicles and has the function of delivering electric current and signals in a vehicle [2]. Several companies have produced many wire harnesses and one of them is PT. Sumitomo Wiring System is required for the automotive sector [1]. Wire harness manufacture requires several processes including cutting, stripping, crimping, housing, assembling, checker, tie back, interlock, visual inspection, predeal, and packing. In the wire harness assembly process, the number of wires and components needed varies according to the wire harness to be produced [3].

Below are the types of wire harnesses, one of which is needed in the automotive field, including:

- Main Harness

This main harness functions to connect certain instruments or parts to an automotive electrical circuit such as light switches and speedo meters.



Figure 1. Main Harness [4]

- Door Harness

The door Harness is usually located on the door that connects the harness to other parts such as lowering glass switches, speakers, etc.



Figure 2. Door Harness [5]

- Roof Harness

This harness serves to connect components that are on the roof of the car such as room lighting, rearview mirror controllers, etc.



Figure 3. Roof Harness [6]

- Rear Harness

This harness connects components on the back of the car such as brake lights, directional lights, etc.



Figure 4. Rear Harness [7]

- Front Harness

This harness serves to connect on the front, especially on engine equipment [8].



Figure 5. Front Harness [9]

Various materials needed to make a wiring harness:

- Wire

Its function is as a conductor of electric current.

Wire Type : AV, AVS, AVSS, AVSSX, AVX, AEX, MVVS, APBS, FANS.

Wire size : 0.3; 0.5; 0.85; 1.25; 2; 3; 5; 8; 15; 20; 30; 40; 60; 80; 100.

- Terminal

Its function is as a liaison between circuits by means of terminals mounted on the wire through the process of crimping and jointing.

- Rubber seal

Its function is to protect the entry of water into the terminal, because if the terminal is exposed to water, it will cause corrosion or rust. Rubber seal is made of rubber.

- Sleeve

Its function as a special thermal protector uses sleeves such as: CA 104, CA 103, CB 104, CB 103.

- SH – Tube (Shrink Tube)

Its function is as a terminal protector and its use must be with hot mesia.

Types :

a. SH – Regular tube, with size : D3, D4, D5, D6, D7, D8, D9, D10.

b. SH – Tube W3B2, with size : 3/8", 1/2", 3/4", 2".

c. SH – Tube ES – 2000, with size : ES – 2000 – 1.

- Tape

The purpose of masking tape is to make the circuit fit the image by wrapping, protecting, or both.

- Grommet

Grommet serve the purpose of preventing water from entering the engine compartment and getting into interior areas that are prone to moisture, including the headlight compartment. Grommets can also prevent

engine parts or other body parts that should not come into contact with the harness from touching it.

- **Dummy**
Dummy plugs serve as plug replacements in water-sensitive watertight connections installed on poles or holes where no circuits are installed. Since not all pole connectors are fitted by circuits, dummy plugs are inserted to seal the hole and prevent water ingress.
- **Clip**
On the body or other parts of a car, clip serve as handles. Usually, clips are fastened to joints or safety straps.
- **Connector**
Its function as a circuit house that has been installed terminals function as a connector of electric current from one part to another.
There are 2 types of connectors, namely:
 - a. Waterproof Connector
 - b. Non Waterproof Connector.

II. IMPLEMENTATION METHOD

A. Implementation Stage

The implementation phase of the proposed proposal consists of problem identification, data collection, data compilation, data processing, data analysis, conclusions, and suggestions. A flowchart of the implementation stages can be seen in figure 6.

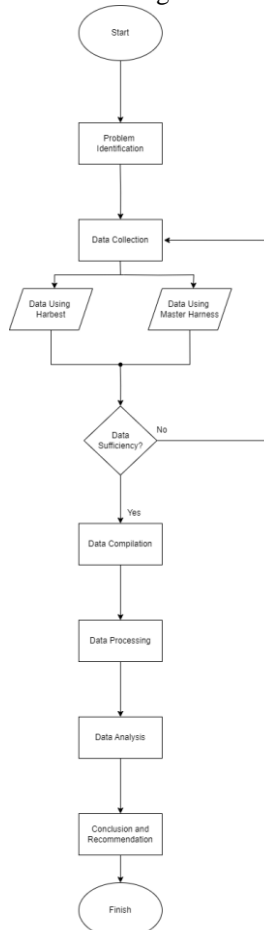


Figure 6. Implementation Stage

The flowchart provided outlines the research flow of the comparison of the Master Harness and Harness Best Engineering System (HARBEST) methods for analyzing defect passes. The steps involved in identifying and overcoming problems by finding defect data first from the results of each method used. Then, it is collected into cohesive data so that it can be processed. In the data processing process, the method used is a pareto chart diagram to find the most defect passes in the wire harness checking process. Next, find out the causes of the most defects using the fish bone diagram method to find out what are the possible causes of the defect. After that, analyze the causes of defects to find solutions to the problems that occur.

B. Master Harness

Master Harness is a wire harness as a standard or benchmark for production products. Master Harness is used as a comparison to ensure that products or other production products meet established standards. All manufactured products are then compared to the master harness mounted on board to ensure that they meet the quality requirements that have been set.



Figure 7. Master Sample W/H

C. Harness Best Engineering System (HARBEST)

Harness Best Engineering System (HARBEST) is a wire harness image that matches the original size, which is 1: 1 scale, then pasted on the board and then compared to the production wire harness.



Figure 8. Harness Best Engineering System (HARBEST)

D. Harness Best Engineering System (HARBEST) Manufacturing

in the process of making Harness Best Engineering System (HARBEST) Toyota Alphard 812888-XXX I started in February. For making Harness Best Engineering System (HARBEST) there are several steps that must be done. The steps of making Harness Best Engineering System (HARBEST) can be seen in figure 9.

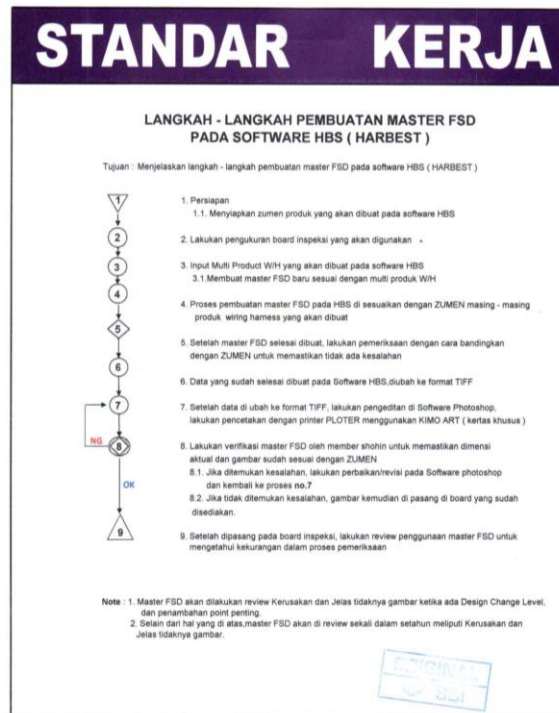


Figure 9. The steps of making Harness Best Engineering System (HARBEST)

After I finished making Harness Best Engineering System (HARBEST) the application of the Harness Best Engineering System (HARBEST) inspection method was carried out in March by the inspector. Before conducting the inspection, the inspectors were given training in using the Harness Best Engineering System (HARBEST) method.

E. Data Collection

Data collection in this final project design was carried out using the observation method and conducting direct

interviews with PT Sumitomo Wiring System employees regarding the types of defects that occurred during the wire harness production process. For direct interviews with employees, the Quality Control department was asked about defect claim data from the SWS Group and the data collected was in the form of primary data.

The following is defect data in January using the master harness checking method that I obtained directly from employees on the line when checking wire harness. Defect data can be seen in the Table 1.

Table 1. Data Defect using Master Harness in January

Line	Line_nm	Inspection Date	Product_no	Prodlbl_no	Defect Name	Defect_dtl
OHTI	09A TOYOTA ALPHARD FLOOR	1/21/2024 17:23	8510K851- B5X20	6EPNGV90D46	Insufficient Length	Short T Distance Con 16 : Ok: 10 , Ng: 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	1/2/2024 0:37	8510K850- B5Y90	6EQ0JV90334	Loose Wire	Wire Abrasion Con 58 , BR, Ct , M38
OHTI	09A TOYOTA ALPHARD FLOOR	1/4/2024 8:19	8510K847- B5X30	6EQYFV90R34	No Taping	No Spot Taping MH
OHTI	09A TOYOTA ALPHARD FLOOR	1/3/2024 8:53	8510K849- B5X30	6EQYFV90R23	No Taping	No Spot Taping MH
OHTI	09A TOYOTA ALPHARD FLOOR	1/21/2024 13:46	8510K851- B5Y80	6EPXEV92603	No Taping	No Taping Joins Con 66

OHTI	09A TOYOTA ALPHARD FLOOR	1/5/2024 10:53	8510K851- B5Y20	6EPQGV91067	Connector Broken	Con 75 Broken
OHTI	09A TOYOTA ALPHARD FLOOR	1/4/2024 18:57	8510K842- B5Y80	6EPXEV91656	Loose Wire	603 W Ct Abrasion Conduit, M31
OHTI	09A TOYOTA ALPHARD FLOOR	1/6/2024 10:06	8510K844- B5X50	6EPRDV90538	Torn Product No. Label	Torn Partmark On M/H Branch Con 46
OHTI	09A TOYOTA ALPHARD FLOOR	1/23/2024 8:53	8510K842- B5Y20	6EPQGV91818	Connector Broken	Con 55 Broken
OHTI	09A TOYOTA ALPHARD FLOOR	1/22/2024 18:43	8510K842- B5Y20	6EPQGV91C47	Insufficient Length	Short-Clip Center-Clip Ok: 98, Ng: 80 Con 76
OHTI	09A TOYOTA ALPHARD FLOOR	1/22/2024 13:55	8510K841- B5270	75SPEV90290	Taping Defect	Broken Pvc Taping M/H
OHTI	09A TOYOTA ALPHARD FLOOR	1/13/2024 5:40	8510K847- B5X20	6EPNGV90L12	Taping Defect	Broken Pvc Taping M/H
OHTI	09A TOYOTA ALPHARD FLOOR	1/11/2024 5:26	8510K846- B5X30	6EQYFV91522	Terminal Deformation	No Optional Con 74
OHTI	09A TOYOTA ALPHARD FLOOR	1/15/2024 4:57	8510K839- B5Y80	6EPXEV91Q14	Incorrect Taping	Terminal Bend Con 96: R , Ct R07
OHTI	09A TOYOTA ALPHARD FLOOR	1/26/2024 7:29	8510K844- B5Y20	6EPQGV91K64	Terminal Deformation	Wrong Optional Con 11 Ok : Merged, Ng : Not Merged
OHTI	09A TOYOTA ALPHARD FLOOR	1/14/2024 10:38	8510K843- B5Y20	6EPQGV91L28	Excessive Length	Con 96 Green No Ct : R09
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	24014W027P- B5Y20	6EPQGV91M90	Wrong Clip	Branch Extension Con 55 Ok: 79, Ng: 102
OHTI	09A TOYOTA ALPHARD FLOOR	1/25/2024 18:28	24014W026P- B5Y40	6EPWFV90S61	Connector Broken	Between Clips For Ok: 178, Ng: 196 +5 -5 MH
OHTI	09A TOYOTA ALPHARD FLOOR	1/26/2024 4:47	24014W022P- B5Y20	6EPQGV91X77	Clamp / Clip Breakage	Con 45 Broken
OHTI	09A TOYOTA ALPHARD FLOOR	1/27/2024 0:49	24014W352P- B5Y20	6EPQGV92285	Excessive Length	Broken Clip (Clmp 12B30KJM)
OHTI	09A TOYOTA ALPHARD FLOOR	1/22/2024 16:51	24014W025P- B5Y20	6EPQGV92285	No Shrink Tube	Abbreviation Con 23 Ok:75, Ng:100 +15 -0
OHTI	09A TOYOTA ALPHARD FLOOR	1/13/2024 12:23	8510K842- B5X20	6EPNGV90D46	Insufficient Length	No HD VTB 18x19.6t50 Slit
OHTI	09A TOYOTA ALPHARD FLOOR	1/31/2024 13:43	8510K851- B5Y20	6EPQGV91C47	Insufficient Length	Short T Distance Con 14 : Ok 10 , Ng 5 +10-0

OHTI	09A TOYOTA ALPHARD FLOOR	1/11/2024 13:30	8510K841- B5X20	6EPNGV90D46	Insufficient Length	Short Clip Center-Clip Ok: 98, Ng: 80 Con 76
OHTI	09A TOYOTA ALPHARD FLOOR	1/22/2024 14:23	24014W027P- B5Y20	6EPQGV91C47	Insufficient Length	Short T Distance Con 11 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	1/22/2024 15:23	24014W021P- B5X20	6EPNGV90D46	Insufficient Length	Short Clip Center-Clip Ok: 98, Ng: 80 Con 76
OHTI	09A TOYOTA ALPHARD FLOOR	1/22/2024 16:18	8510K839- B5Y20	6EPQGV91C47	Insufficient Length	Short T Distance Con 09 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	1/10/2024 22:12	8510K850- B5X20	6EPNGV90D46	Insufficient Length	Short-Clip Center-Clip Ok 98 Ng 80 Con 76
OHTI	09A TOYOTA ALPHARD FLOOR	1/7/2024 21:12	24014W021P- B5Y20	6EPQGV91C47	Insufficient Length	Short T Distance Con 14 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	1/3/2024 18:50	24014W353P- B5X20	6EPNGV90D46	Insufficient Length	Short-Clip Center-Clip Ok 98 Ng 80 Con 76
OHTI	09A TOYOTA ALPHARD FLOOR	1/19/2024 23:07	24014W028P- B5Y20	6EPQGV91C47	Insufficient Length	Short T Distance Con 18 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	1/16/2024 21:33	24014W352P- B5X20	6EPNGV90D46	Insufficient Length	Short-Clip Center-Clip Ok 98 Ng 80 Con 76
OHTI	09A TOYOTA ALPHARD FLOOR	1/21/2024 17:23	24014W022P- B5Y20	6EPQGV91C47	Insufficient Length	Short T Distance Con 15 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	1/2/2024 5:23	24014W021P- B5X20	6EPNGV90D46	Insufficient Length	Short Clip Center-Clip Ok: 98, Ng: 80 Con 76
OHTI	09A TOYOTA ALPHARD FLOOR	1/15/2024 11:38	24014W022P- B5Y20	6EPQGV91L28	Excessive Length	Short T Distance Con 12 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	1/6/2024 8:50	24014W022P- B5Y20	6EPQGV92285	Excessive Length	Extended Branch Con 51: Ok 79, Ng 102
OHTI	09A TOYOTA ALPHARD FLOOR	1/3/2024 2:36	24014W021P- B5Y20	6EPQGV91L28	Excessive Length	Abbreviation Con 22 Ok:75 Ng:100 +15 -0
OHTI	09A TOYOTA ALPHARD FLOOR	1/4/2024 9:23	8510K843- B5Y20	6EPQGV92285	Excessive Length	Branches Extend Con 45 Ok 79 Ng 102
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 11:12	8510K839- B5Y20	6EPQGV91L28	Excessive Length	Abbreviation Con 23 Ok: 75, Ng: 100 +15 -0
OHTI	09A TOYOTA ALPHARD FLOOR	1/4/2024 11:44	8510K846- B5Y20	6EPQGV92285	Excessive Length	Branches Of Con 42: Ok 79, Ng 102
OHTI	09A TOYOTA ALPHARD FLOOR	1/3/2024 10:58	24014W028P- B5Y20	6EPQGV91L28	Excessive Length	Abbreviation Con 23 Ok:75, Ng:100 +15 -0

OHTI	09A TOYOTA ALPHARD FLOOR	1/27/2024 0:54	24014W025P- B5Y20	6EPQGV92285	Excessive Length	Branch Extension Con 55 Ok: 79, Ng: 102
OHTI	09A TOYOTA ALPHARD FLOOR	1/14/2024 7:38	24014W352P- B5Y20	6EPQGV91L28	Excessive Length	Abbreviation Con 05 Ok:75, Ng:100 +15 -0
OHTI	09A TOYOTA ALPHARD FLOOR	1/22/2024 5:21	24014W021P- B5Y20	6EPQGV92285	Excessive Length	Extended Branch Con 30: Ok 79, Ng 102
OHTI	09A TOYOTA ALPHARD FLOOR	1/19/2024 0:43	24014W352P- B5Y20	6EPQGV92285	Excessive Length	Abbreviation Con 17 Ok:75, Ng:100 +15 -0
OHTI	09A TOYOTA ALPHARD FLOOR	1/3/2024 15:45	24014W352P- B5270	75SPEV90290	Taping Defect	Abbreviation Con 22 Ok:75, Ng:100 +15 -0
OHTI	09A TOYOTA ALPHARD FLOOR	1/4/2024 6:22	24014W353P- B5X20	6EPNGV90L12	Taping Defect	Tapping Broken, Con 33
OHTI	09A TOYOTA ALPHARD FLOOR	1/5/2024 17:34	24014W029P- B5270	75SPEV90290	Taping Defect	PVC Broken Taping
OHTI	09A TOYOTA ALPHARD FLOOR	1/6/2024 1:24	24014W024P- B5X20	6EPNGV90L12	Taping Defect	Taping PVC Broken R/B
OHTI	09A TOYOTA ALPHARD FLOOR	1/12/2024 7:32	8510K846- B5X20	6EPNGV90L12	Taping Defect	PVC Taping Breaks In R/B
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K846- B5Y20	6EPQGV91M90	Wrong Clip	Taping Prot Breaks MH
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K847- B5Y20	6EPQGV91M90	Wrong Clip	Bendo Swap Clip and Two-Wing Clip
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K843- B5Y20	6EPQGV91M90	Wrong Clip	Between Clips For Ok 178, Ng 196 +5 -5 MH
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K841- B5Y20	6EPQGV91M90	Wrong Clip	Bendo Swap Clip and Two Wing Clip
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K847- B5Y20	6EPQGV91M90	Wrong Clip	Between Clips for Ok 178, Ng 196 +5 -5 MH
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K841- B5Y20	6EPQGV91M90	Wrong Clip	Bendo Swap Clip and Two-Wing Clip
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K842- B5Y20	6EPQGV91M90	Wrong Clip	Bendo Swap Clip and Two-Wing Clip
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	8510K849- B5Y20	6EPQGV91M90	Wrong Clip	Bendo Swap Clip and Two-Wing Clip
OHTI	09A TOYOTA ALPHARD FLOOR	1/8/2024 5:54	24014W028P- B5Y20	6EPQGV91M90	Wrong Clip	Between Clips Length Ok: 165, Ng: 175 +5 -5 MH

OHTI	09A TOYOTA ALPHARD FLOOR	1/12/2024 7:06	24014W025P- B5Y80	6EPXEV91Q14	Incorrect Taping	Between Clips Length Ok: 154, Ng: 149 +5 -5 MH
OHTI	09A TOYOTA ALPHARD FLOOR	1/7/2024 7:27	24014W024P- B5Y80	6EPXEV91Q14	Incorrect Taping	Wrong Optional Con 56 Ok : Joined, Ng : Not Merged
OHTI	09A TOYOTA ALPHARD FLOOR	1/5/2024 9:36	24014W022P- B5Y80	6EPXEV91Q14	Incorrect Taping	Wrong Optional Con 32 Ok : Merged, Ng : Not Merged
OHTI	09A TOYOTA ALPHARD FLOOR	1/4/2024 4:43	24014W352P- B5Y80	6EPXEV91Q14	Incorrect Taping	Wrong Optional Con 11 Ok : Merged, Ng : Not Merged
OHTI	09A TOYOTA ALPHARD FLOOR	1/11/2024 2:17	24014W022P- B5Y20	6EPQGV91X77	Clamp / Clip Breakage	Wrong Optional Con 56 Ok : Joined, Ng : Not Merged
OHTI	09A TOYOTA ALPHARD FLOOR	1/30/2024 3:42	8510K843- B5Y20	6EPQGV91X77	Clamp / Clip Breakage	Broken Clip (Clmp 12B30KJM)
OHTI	09A TOYOTA ALPHARD FLOOR	1/15/2024 19:11	8510K841- B5Y20	6EPQGV92285	No Shrink Tube	Broken Clip (Clmp 12B30KJM)
Total Defect					66	

The table provided contained a detailed record of visual inspection defect pass results for Toyota Alphard 812888-XXX, specifically focusing on defects identified during the production process. This table served as a comprehensive record of the quality control process for Toyota Alphard 812888-XXX, highlighting recurring issues that needed to be addressed in the manufacturing process. During the month of January, using the Harness master method, the number of defect passes that occurred totaled 66 defects.

III. RESULTS AND DISCUSSION

A. Data Using Master Harness

Usage data using a master harness is a step to find defects or problems during the checking process carried out by the master harness method. Then, the data obtained will be processed using the following quality tools.

- Pareto Chart Analysis

The following is a graph of the defect data in January obtained using the master harness checking method and processed using a Pareto diagram. The diagram can be seen in Figure 10.

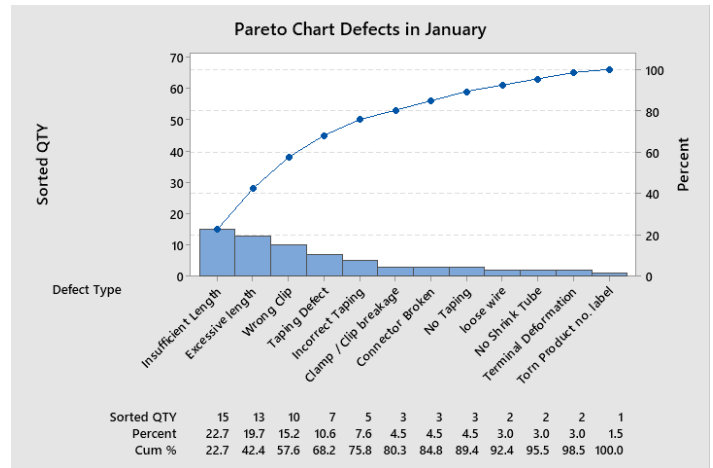


Figure 10. Diagram Pareto Chart

Based on the pareto diagram shown in Figure 9, it shows that the type of defect that often occurs is the Insufficient Length problem with a total of 15 defects or 22.72%. Furthermore, the second frequent type of defect is Excessive Length with a total defect of 13 or 19.69%. Furthermore, the third frequent defect is Wrong Clip with a total defect of 10 or 15.15%. From this value, a percentage of 22.72% of the total 100% number of defects is obtained through the use of the 80/20 Pareto method, where the percentage value that exceeds 20% is the main requirement in finding solutions to reduce defects.

• Fishbone Diagram Analysis

The following is a causal diagram to analyze problems that occurred before on the Pareto chart. The fishbone diagram can be seen in Figure 11.

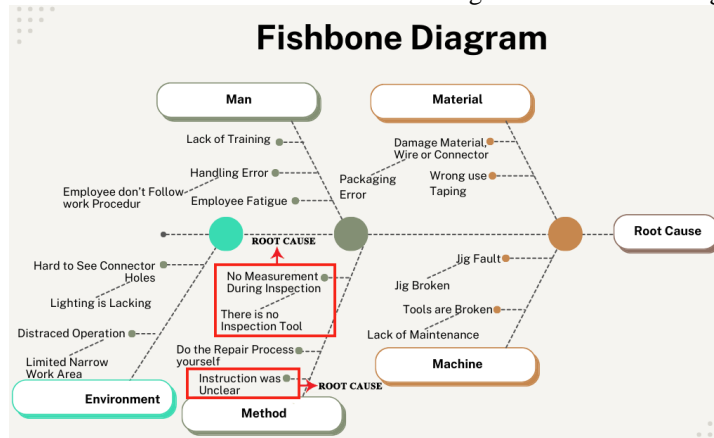


Figure 11. Fishbone Diagram

From the fishbone diagram in Figure 10, it can be seen some of the defect influences that cause the passing of checks and the occurrence of Insufficient Length in wire harnesses.

The following is a table of the root causes analyzed, which can be seen in Table 2.

Table 2. Root Cause

Factors	Hypothesis	Verification	Root Cause?
Man	Lack of Training	Provide retraining	No
	Employee don't Follow work Procedur	Create check items using the check sheet	No
	Handling Error		
	Employee Fatigue	Ensure the health condition of employees before work	No
Material	Packaging Error	Create new packaging standards based on material type and size	No
	Damage Material, Wire or Connector		
	Wrong use Taping	Making tape holders according to type and function	No
Machine	Jig Broken	Inspect jigs, then replace damaged jigs and clean them after use.	No
	Jig Fault		
	Lack of Maintenance	Making a schedule for periodic maintenance	No
	Tools are Broken		
Methode	There is no Inspection Tool	Create a tool that detects defects Insufficient Length	Yes
	No Measurement During Inspection		
	Do the repair process yourself	Briefing and making in the form of prohibitions so as not to make repairs yourself	No
	Instruction was Unclear	Display instructions in the form of a display	Yes
Environment	Lighting is Lacking	Perform light lumination calibration or measurement	No
	Hard to See Connector Holes		
	Limited Narrow Work Area	Make changes to the line design or work area layout	No
	Distracted Operation		

To address this root cause, the proposed corrective action replaces the inspection method with Harness Best Engineering System (HARBEST). The expectation of the Harness Best Engineering System (HARBEST) method helps to detect defects of insufficient length during inspection , Display clear work instructions to reduce errors and Provide retraining on the Harness Best Engineering System (HARBEST) method to employees on proper procedures. Implement stricter quality checks throughout the production process.

By targeting these root causes, the company aims to

significantly reduce the occurrence of defect passes in wire harness inspection. Ongoing monitoring and continuous improvement efforts will be essential to maintain quality improvement over time.

B. Data Using Harness Best Engineering System (HARBEST)

After using the Harness Best Engineering System (HARBEST) checking method for one month, the wire harness defect pass data for Toyota Alphard product 812888-XXX in April was obtained. Defect data can be seen in the Table 3.

Table 3. Data Defect After using HARBEST in April

Line	Line_Nm	Inspection Date	Product_no	Prodlbl_no	Defect Name	Defect_dtl
OHTI	09A TOYOTA ALPHARD FLOOR	4/4/2024 18:57	82141- B5Y80	6EPXEV91656	Loose Wire	Wire Scuffing Con 602 W Ct, M31
OHTI	09A TOYOTA ALPHARD FLOOR	4/22/2024 16:18	82141- B5Y20	6EPQGV91C47	Insufficient Length	Short Clip Center Clip Ok 98, Ng 80 CON 76
OHTI	09A TOYOTA ALPHARD FLOOR	4/10/2024 22:12	82141- B5X20	6EPNGV90D46	Insufficient Length	Short T Distance Con 14 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	4/7/2024 21:12	82141- B5Y20	6EPQGV91C47	Insufficient Length	Short Clip Center: Clip Ok 98, Ng 80 CON 76
OHTI	09A TOYOTA ALPHARD FLOOR	4/3/2024 18:50	82141- B5X20	6EPNGV90D46	Insufficient Length	Short T Distance Con 18 : Ok 10 , Ng 5 +10-0
OHTI	09A TOYOTA ALPHARD FLOOR	4/19/2024 23:07	82141- B5Y20	6EPQGV91C47	Insufficient Length	Short-Clip Center- Clip OK 98 NG 80 CON 76
OHTI	09A TOYOTA ALPHARD FLOOR	4/7/2024 11:56	82141- B5Y20	6EPQGV91067	Connector Broken	Con 75 Broken
OHTI	09A TOYOTA ALPHARD FLOOR	4/8/2024 10:53	82141- B5Y20	6EPQGV91818	Connector Broken	Con 55 Broken
OHTI	09A TOYOTA ALPHARD FLOOR	4/5/2024 15:30	82141- B5Y40	6EPWFV90S61	Connector Broken	Con 45 Broken
OHTI	09A TOYOTA ALPHARD FLOOR	4/8/2024 2:58	82141- B5X30	6EQYFV91522	Terminal Deformation	Terminal Bend Con 96: R , Ct R07
OHTI	09A TOYOTA ALPHARD FLOOR	4/3/2024 6:47	82141- B5Y20	6EPQGV91K64	Terminal Deformation	Con 96 Green No Ct : R09
OHTI	09A TOYOTA ALPHARD FLOOR	4/21/2024 8:59	82141- B5Y20	6EPQGV92285	Excessive Length	Con 22 Extension Ok:75, Ng:100 +15 - 0
OHTI	09A TOYOTA ALPHARD FLOOR	4/20/2024 0:40	82141- B5Y20	6EPQGV91L28	Excessive Length	Branches Extend Con 45 Ok, 79 Ng 102

OHTI	09A TOYOTA ALPHARD FLOOR	4/4/2024 9:23	82141- B5Y20	6EPQGV92285	Excessive Length	Con 23 Extension Ok:75, Ng:100 +15 - 0
OHTI	09A TOYOTA ALPHARD FLOOR	4/1/2024 1:11	82141- B5Y20	6EPQGV91L28	Excessive Length	Branches Of Con 42 Ok 79, Ng 102
OHTI	09A TOYOTA ALPHARD FLOOR	4/4/2024 11:28	82141- B5Y20	6EPQGV92285	Excessive Length	Con 23 Extension 23 Ok:75, Ng:100 +15 -0
OHTI	09A TOYOTA ALPHARD FLOOR	4/4/2024 17:55	82145- B5270	75SPEV90290	Taping Defect	Tapping Broken, Con 33
OHTI	09A TOYOTA ALPHARD FLOOR	4/17/2024 7:25	82141- B5X20	6EPNGV90L12	Taping Defect	PVC Broken Taping
OHTI	09A TOYOTA ALPHARD FLOOR	4/4/2024 19:34	82145- B5270	75SPEV90290	Taping Defect	Taping PVC Broken R/B
OHTI	09A TOYOTA ALPHARD FLOOR	4/12/2024 1:30	82141- B5X20	6EPNGV90L12	Taping Defect	PVC Taping Breaks In R/B
OHTI	09A TOYOTA ALPHARD FLOOR	4/23/2024 4:35	82141- B5Y20	6EPQGV91M90	Wrong Clip	Bendo Swap Clip and Two Wing Clip
OHTI	09A TOYOTA ALPHARD FLOOR	4/5/2024 8:45	82141- B5Y20	6EPQGV91M90	Wrong Clip	Bendo Swap Clip and Two Wing Clip
OHTI	09A TOYOTA ALPHARD FLOOR	4/2/2024 9:20	82141- B5X50	6EPRDV90538	Torn Product No. Label	Torn Partmark On M/H Branch Con 46
OHTI	09A TOYOTA ALPHARD FLOOR	4/2/2024 0:07	82141- B5X50	6EPRDV90538	Torn Product No. Label	Part Number Torn
OHTI	09A TOYOTA ALPHARD FLOOR	4/9/2024 5:06	82141- B5Y80	6EPXEV91Q14	Incorrect Taping	Wrong Optional Con 56 Ok : Joined, Ng : Not Merged
OHTI	09A TOYOTA ALPHARD FLOOR	4/27/2024 8:17	82141- B5Y80	6EPXEV91Q14	Incorrect Taping	Wrong Optional Con 32 Ok : Merged, Ng : Not Merged
OHTI	09A TOYOTA ALPHARD FLOOR	4/25/2024 7:34	82141- B5Y80	6EPXEV91Q14	Incorrect Taping	Wrong Optional Con 11 Ok : Merged, Ng : Not Merged

	09A					
OHTI	TOYOTA ALPHARD FLOOR	4/4/2024 4:50	82141- B5Y80	6EPXEV91Q14	Incorrect Taping	Wrong Optional Con 56 Ok : Joined, Ng : Not Merged
	09A					
OHTI	TOYOTA ALPHARD FLOOR	4/3/2024 16:44	82141- B5Y20	6EPQGV92285	No Shrink Tube	No HD VTB 18x19.6T50 Slit
	09A					
OHTI	TOYOTA ALPHARD FLOOR	4/29/2024 13:19	82141- B5Y20	6EPQGV92285	No Shrink Tube	No HD VTB 18x19.6T50 Slit
Total Defect					30	

The data showed a significant improvement in quality control, as the total number of defects decreased from 66 to 30. A decrease of 36 defects, or about 54.5%, indicated that the Harness Best Engineering System (HARBEST) method had been effectively implemented. Overall, the decrease in defects not only reflected positively on the production process but also demonstrated a commitment to quality and customer satisfaction. Going forward, it was important to maintain this improvement and continue to monitor the defect rate to ensure continuous quality.

The following were the total defects and percent reduction in defects that occurred after using the Harness Best Engineering System (HARBEST) method. The total defect data and percent reduction can be seen in Table 4.

Table 4. Total & percent Defect Data After using HARBEST

Defect Type	Sorted QTY	Percent	Cum
No Taping	0	0.0%	100.00%
loose wire	1	3.3%	100.00%
Insufficient Length	5	16.7%	33.3%
Connector Broken	3	10.0%	70.0%
Terminal Deformation	2	6.7%	90.0%
Excessive length	5	16.7%	16.7%
Taping Defect	4	13.3%	60.0%
Wrong Clip	2	6.7%	76.7%
Torn Product no. label	2	6.7%	96.7%
Incorrect Taping	4	13.3%	46.7%
Clamp / Clip breakage	0	0.0%	100.00%
No Shrink Tube	2	6.7%	83.3%
Total Defect	30		

The data in Table 4. shows that the implementation of Harness Best Engineering System (HARBEST) in April resulted in a significant decrease in defect passes compared to the previous month. The most common defects were related to Insufficient Length with a total of 5 defects (16.7%) and Excessive Length 5 defects (16.7%) and Taping Defect 4 defects (13.3%) of harnesses. This data can be used to identify areas for improvement and optimize the production process to further reduce defects.

C. Comparative Analysis Data

Comparative Analysis Data is in this study comparing defect data collected by the Master Harnes and Harness Best Engineering System (HARBEST) methods. The comparison data can be seen in Figure 12.

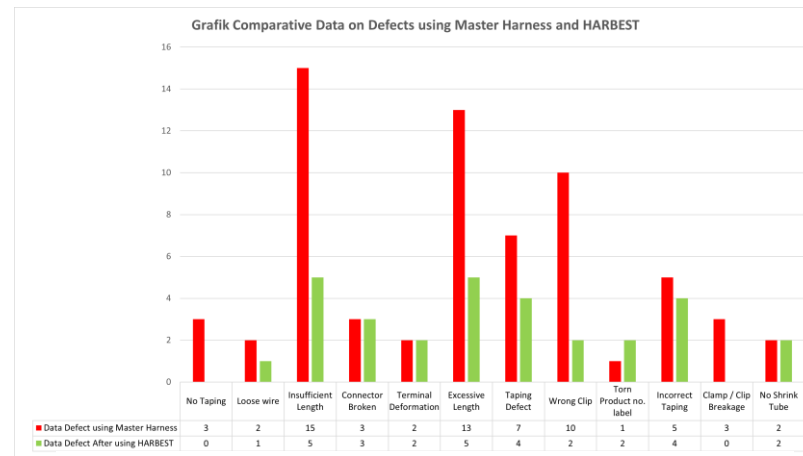


Figure 12. Bar Chart Comparative data on defects using Master Harness and HARBEST

The Comparative Data Analysis Bar Chart provides a comparison between the data collected using the Master Harness method and the data collected using the Harness Best Engineering System (HARBEST) method to compare the passing defect data from both methods. This data helps in identifying the differences and improvements achieved by implementing the Harness Best Engineering System (HARBEST) method.

Defect Reduction, The total number of defects decreased significantly from 66 to 30, indicating a substantial improvement in the quality of wire harness checks produced using the Harness Best Engineering System (HARBEST) checking method. The most common defects, such as Insufficient Length and Excessive Length, still existed but with lower frequency. Elimination of Some Defects such as loose wire that is not taped, torn Product no. label, and non-shrinkable Tube are completely eliminated by using Harness Best Engineering System (HARBEST) checking method. Better Quality Inspection Stricter quality inspection was ensured during the production process when

Attachment

• Drawing Harnes Best Engineering System (HARBEST) Product Wire Harness on Toyota Alphard 812888-XXX

