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DESIGN AND ANALYSIS OF METALLIC KANBAN CLIP AT TOYOTA KIRLOSKAR MOTORS

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Abstract: **A well-defined and Systematic methodology is essential for to eliminate the problem for recoding the punched frame number data at chassis assembly area, which in turn has considerable influence on the correct confirmation of punched frame number data. Metallic kanban clip us the type of jig used for clipping the E-kanban Card to the frame as after completion of the frame umber punching for Innova Vehicle in frame number punching area at Toyota Kirloskar Motors. The equipment is used for the clipping purpose and jig will go under several processes like spot welding, Robot welding and PTED(ED-Coating) with the E-kanban card. In this paper the Pokayoke design and development is done in the Kaizen area at Toyota Kirloskar Motors to eliminate the loosing of punched frame number data for Innova Vehicle.**

Keywords: **Poka-yoke, Spot Welding, Robot Welding, Kaizen, PTED area .E-kanban card.**

1. INTRODUCTION

Work plays a central role in the majority of adult lives at many socioeconomic levels. It maintains income and contributes to individual identity and social status. There is emerging evidence that continued participation in a work role has therapeutic benefits. From the point of view of employment, the term "extra movement" refers to that process which takes a lot of time to obtain and maintain a suitable job and to progress within that job are remarkably lower than the general processes due to some abnormality in working area.

The main objective of the project is to investigate and to eliminate the errors occurring in Toyota Manufacturing Plant and analyzing the problems as per TKM Work standards by doing Kaizen activities at TKM. There is the prime importance for the paper topics, which involves Design and Optimization Metallic Kanban card clipping system for to confirm the punched frame number. The purpose of this paper is to study the Frame Punching, Frame Welding, frame painting and Quality Inspection of vehicle Processes in a semi-automated automobile Manufacturing Plant(TOYOTA KIRLOSKAR MOTORS) and optimize the process by eliminating the problems in punched frame number confirmation at assembly area

In the old Fame Welding area, the INNOVA vehicle Frame number punching process will takes place, where the number punched frames are moved to for welding process, further it moves for the ED-Coating process too at PTED area and finally the ED-Coated Frames are sent to the assembly unit. There the frame number is scribed on scribing paper and graphite pencil, then that paper is attached to the frame itself, after that the paper stick to the vehicle Check Sheet. The major problem occurring at assembly area, if any mistake with the Team Member while scribing the frame number or poor print on the scribing paper leads to major problem for the confirmation of the frame number of the vehicle and again leads to problem for the customer while registering the vehicle at govt. sectors like RTO offices.

2. LITERATURE SURVEY

2.1 Poka-Yoke

The Poka-Yoke (a Japanese word that means mistake-proofing) technique was first developed in 1961 by Shigeo Shingo. Poka-Yoke uses devices on process equipment to prevent the human or machine errors that result in defects, or to inexpensively inspect each item produced to determine whether it is acceptable or defective. Poka-Yoke-designed manufacturing devices are one of the bases of Shingo's zero quality control concepts, which means that the defect rate in a production system is zero. Poka-Yoke design can dramatically decrease the risk of producing defectives products (Shingo, 1986). The Poka-Yoke philosophy also aims to make work easier and prevent errors caused by monotony or other process-related causes.

In many productive environments, there is a tendency to equate speed with productivity. Traditional engineering processes are designed to increase the efficiency of an operation by enabling people and machines to work faster, and processes are usually complicated to achieve greater speed; yet it is these complications which cause many of the errors people and equipment make, resulting in more defective products.

By contrast, the Poka-Yoke philosophy aims to increase productivity by simplifying processes, making them more efficient, reducing the number of errors that need to be corrected, and increasing the overall efficiency of the system. Poka-Yoke can be used wherever errors can occur and can be applied to any type of processes and helps workers to be "right first time", enhancing the quality of the product and the overall output of the process. Poka-Yoke supports efforts to eliminate waste caused by: over production, inventory, waiting, transportation, motion, over processing, quality defects, reprioritization and also waste caused by people's skills. Most importantly, Poka-Yoke was developed with the aim of making work easier for workers without disabilities, and as such demonstrate the value of often simple adaptations tailored to the job at hand.

It is often assumed that adaptations to support the diversity of situations faced by disabled workers present a huge challenge for designers. In fact, the extra intellectual effort needed to overcome disability often results in a better final design for both the disabled and non-disabled users. In this paper, we argue that Journal of Industrial Engineering and Management - http://dx.doi.org/10.3926/jiem.2011.v4n3.p436-452 - 442.

Poka-Yoke represents a suite of simple and relatively inexpensive ways of improving access to work and the productivity and performance of disabled and non-disabled workers, and a powerful tool for implementing Universal Design in the workplace. [7]. Universal design of workplaces through the use of Poka-Yokes: Case study and implications

Cristobel Miralles.

2.2. Design Ideas of an Electronic Kanban System

Based on the theory and description of the electronic kanban system, some principles or ideas concerning an electronic kanban system design can be presented. First, the electronic kanban should follow the principle of the traditional card based kanban system. These principles have been developed and tested over a long period of time by world-leading manufacturing companies. These principles include, for example, smoothed and leveled production, mixed model sequencing, stable material flow, operations tight synchronization (takt-time calculations), and pull signals generated by the status of inventory or production system. Second, the electronic kanban system should support the continuing improvement that is considered by many authors as one of the most powerful features of the kanban system. The traditional kanban system is used to lower down inventories and minimize production batches until hidden problems are revealed. After the problems are corrected, the inventories and batch sizes are reduced to reveal new problems. This improvement approach should be included in the kanban system to obtain most of the advantages of the pull production system.

An electronic kanban system should also support the operations improvement by collecting and reporting data about manufacturing operations and material movement and storage. Third, the system should be user-friendly and the user system interface should be well designed. The kanban system function is dependent on the users following the principles of the system. The kanban system reliability and ability to manage the production are directly related to the operator reporting the transactions and possible problems in a standardized way. Therefore user involvement in the planning process is important in developing ICT-systems that are applicable in the manufacturing environment. Despite all the possibilities that information technology gives, the system should be as simple as possible from the operator point of view. Production batch status or transactions reporting should be automated wherever possible. Fourth, the system can be used to solve problems related to the card based kanban system. The production mix change management, process visibility, system speed and reliability improvement are major issues in justifying investment in the electronic kanban system. These functions or needs should be taken into account while planning the software controlling an electronic kanban system. Fifth, the electronic kanban system will help to overcome manufacturing process shortcomings like machine breakdowns, quality problems or material flow problems. However, the system should in the first place support the operations improvement instead of making it easier to live with the problems. [5]. Phillips Marksberry (2010), "The Modern Theory of the Toyota Production System", CRC Press, Taylor & Francis Group.

3. EXPERIMENTATION & METHODOLOGY

3.1 Concept Selection

Concept selection is the process of evaluating concept with respect to customer needs and other criteria, comparing the relative strengths and weakness of the concepts, and selecting one or more concepts for further investigation or development.

- We use some method, implicit or explicit, for selecting concepts, Decision techniques employed for selecting concepts range from intuitive approaches to structured methods.
- Successful design is facilitated by structured concept selection. We recommend a process called ***Concept Screening Matrix***.
- Concept screening uses a reference concept to evaluate concept variant against selection criteria and it uses a coarse comparison system to narrow the range of concepts under consideration.
- Concept selection is applied not only during concept development but throughout the subsequent design and development process.
- Concept selection uses matrix as the basis of six-step selection process. The six steps are:
  1. Prepare the concepts.
  2. Rate the concepts.
  3. Select one or more concepts.

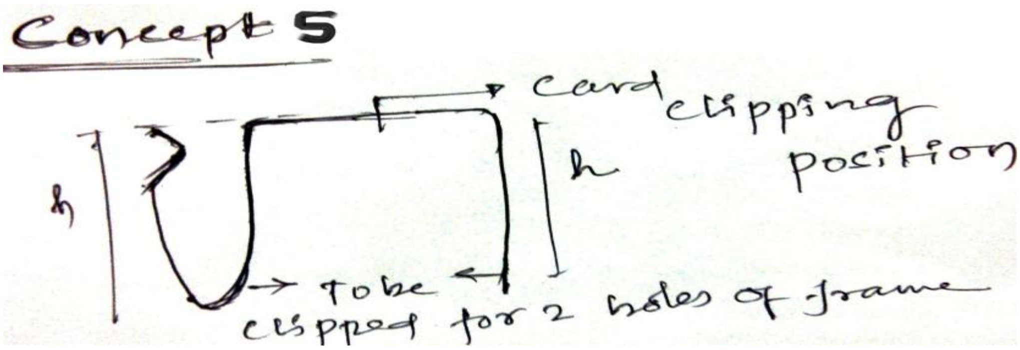


Fig 1: Concept selection

3.2 2-D and 3-D Full Model

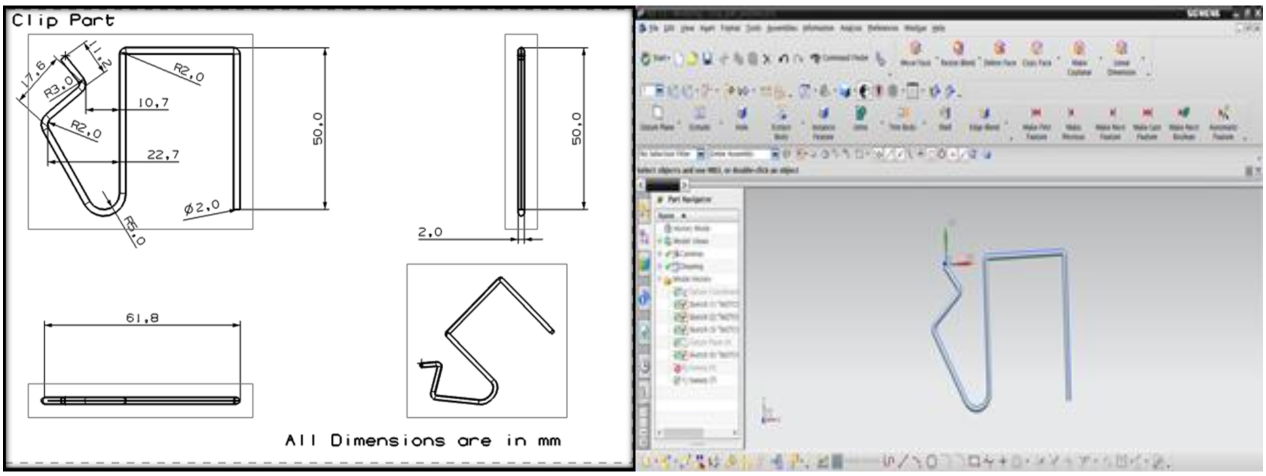
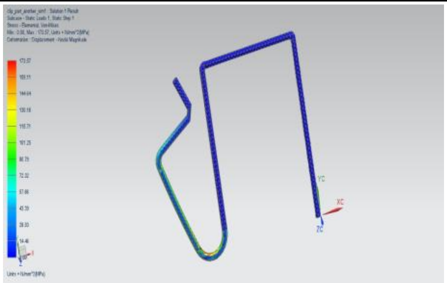
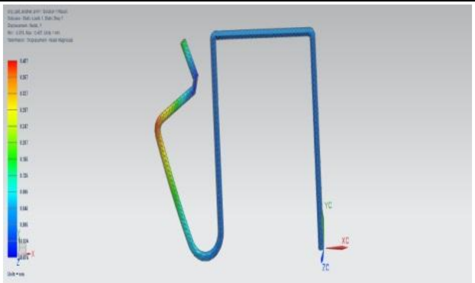


Fig 2: 2D and 3D Models

3.3 Part Analysis Condition

VON-MISES Stress	Displacement
Clip: Load= 5N	
	
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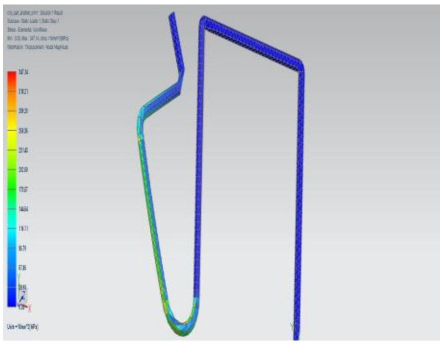
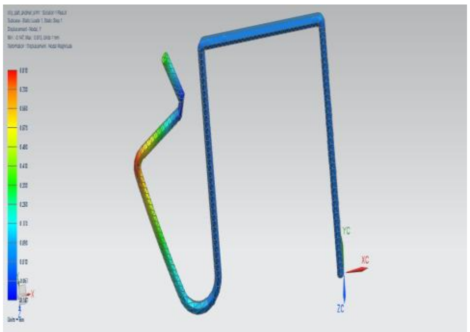
	

Fig 3: Analysis Conditions of Clip

Results Sheet

Table1: Analysis result table

Components	Load		Max stress (Mpa or N/mm^2)	Deformation (mm)	
	N	Kg		Min	Max
Kanban Clip	5	0.5	173.57	-0.074	0.407
	10	1	347.14	-0.147	0.813

All above figures will show the structural analysis of Metallic Kanban clip. From the NX-NASTRON results we can see the different loading condition and with respect to that change in maximum stress and displacement conditions as by varying the loading conditions from above table.

For Pneumatic Pedal Pusher

Clip Part: Min load = 5-9N
Max load = 10N and above

4. IMPLEMENTATION RESULTS AND PROCESS FLOW

The metal clip for to hold E-Kanban card is implemented at Plant #1, starts from weld old frame area to Assembly Chassis line, for to confirm the frame numbers punched data for Innova Vehicles. It is noted that during implementation some changes are made in the process as the member should clip the kanban card with prepared jig (clip) as by after finishing the frame numb punching process and also member should confirm the position and presence of kanban card at each and every process like Frame spot welding, Frame robot welding, Frame painting area and Chassis assembly area. [6]. Karl. T. Ulrich & Steven Eppinger "Product design and Development".

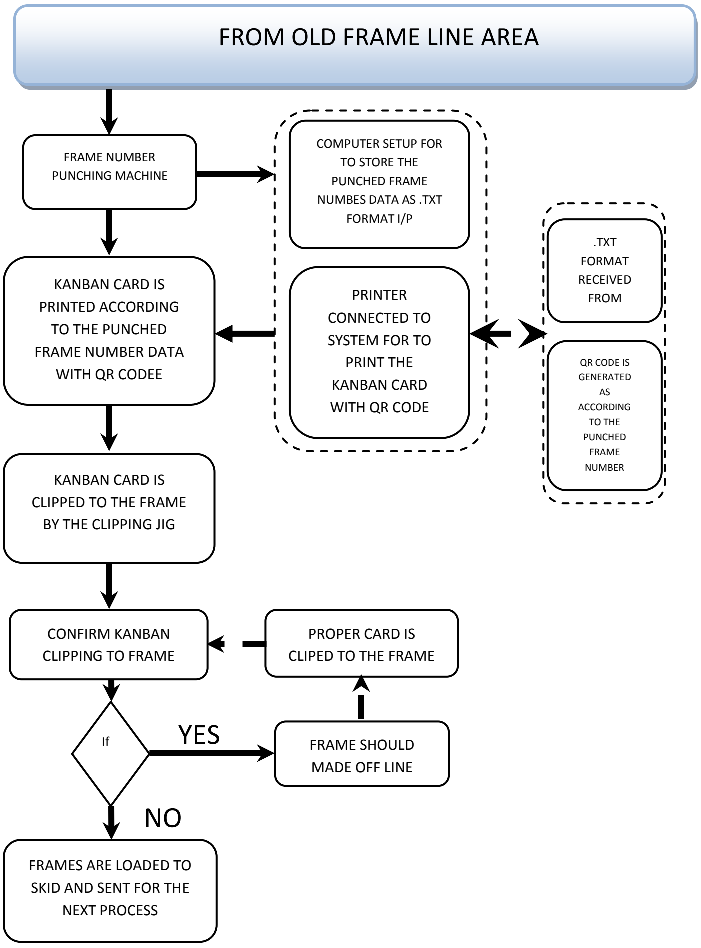
Results:

The kanban clip is having length of 50 mm, width 55 mm and weighs 20-30gm is fabricated by considering all essential data as required.

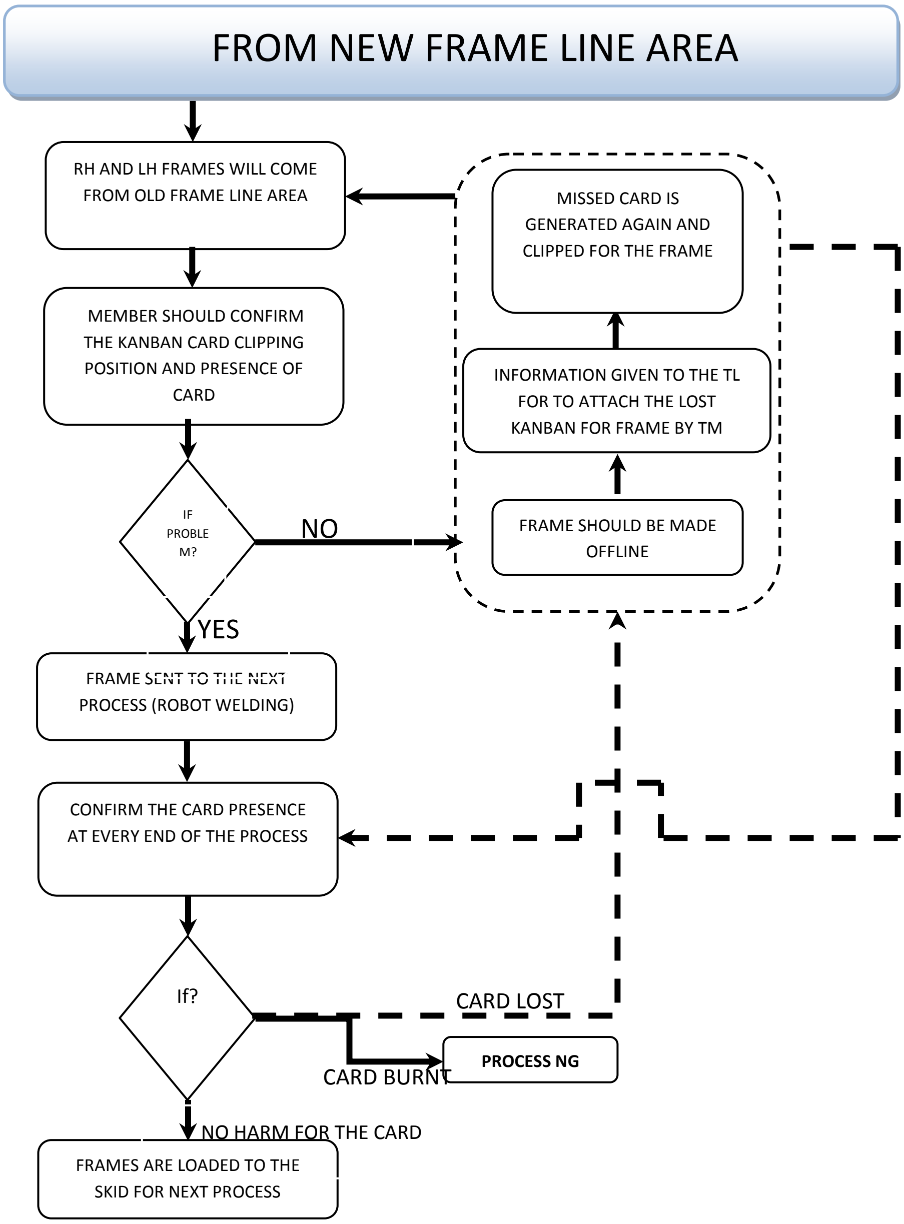
Figure shows Kanban Clip with the E-Kanban Card and and the process flow.

Fig 4: Process flow of Kanban Card

Process Flow:



Flow chart 1: Process flow From Old Frame Welding area



Flow Chart 1: Process Flow from New Frame Welding Area

5. CONCLUSION

Metallic kanban card clip provides a best design for clipping the E-Kanban card for the frame of Innova Vehicle. The design is made as per TKM standards and also do not disturb any process in flow of kanban card, mainly at Robot Welding area and ED-Coating process area for the Innova frame.

After conducting number of trails the position and design of clip has been approved and implemented successfully in the Frame welding and ED-coating area at Toyota Kirloskar Motors plant.

Clipping of E-kanban card helps to store the punched frame number data and provides details about the frame number data of Innova Vehicle.

5.1. Future Scope

1. Design of clip can be enhanced for better performance.
2. Giving a card locking system for the clip can make zero process errors.

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