



# **Analyzing Pick Up Errors in The Pick and Place Process on The Yamaha Machine**

## **Final Project**

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# Analyzing Pick Up Errors in The Pick and Place Process on The Yamaha Machine

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**Abstract**—This study analyzes pick-up errors in the pick-and-place process on Yamaha machines used in the manufacturing industry. These errors can impact productivity and product quality, with three main contributing factors identified: dirty or damaged nozzles, issues with the feeder system, and disturbances in the vision system. Preventive solutions were implemented, including maintenance and replacement of nozzles, optimization of feeder parameters, and regular calibration and cleaning of camera lenses. Monitoring results showed that these corrective actions reduced the error rate from 0.105% to 0.089%, demonstrating the effectiveness of the measures taken.

**Keyword:** pick-and-place, Yamaha machine, pick-up error, preventive maintenance, manufacturing industry

## I. INTRODUCTION

In the ever-evolving landscape of manufacturing, the pick-and-place process stands as a linchpin for efficient and precise production. As industries strive for increased automation to enhance productivity and meet growing demands, the intricacies of this process become paramount. The Yamaha machine, renowned for its advanced capabilities in the realm of pick-and-place operations, has become a focal point for research due to its widespread use in modern manufacturing setups[1].

At the core of manufacturing lies the pick-and-place operation, a fundamental step that involves the robotic retrieval and accurate placement of components on a substrate. The success of this process is imperative for the seamless functioning of assembly lines and the production of high-quality goods. Any deviation from precision in pick-up actions can lead to a cascade of errors, affecting not only the immediate task at hand but also the overall efficiency of the manufacturing system[2].

The significance of this research stems from the critical role that pick-and-place operations play in ensuring the quality and reliability of the end product. As industries increasingly rely on automation to meet market demands and maintain competitiveness, the need for error-free processes becomes more pronounced. The Yamaha machine, equipped with cutting-edge technology, has become a cornerstone in addressing these manufacturing challenges. However, like any sophisticated system, it is not immune to pick-up errors,

necessitating a thorough analysis to enhance its performance[3].

## II. METHOD

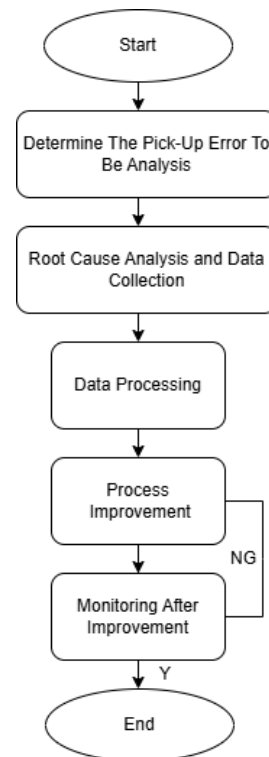


Fig 1. Flowchart Method

In order to analyze pick-up errors, a flow chart is flowcharts are needed to support the workflow to be performed, and help in understanding, designing, and communicating work procedures clearly[4].

In this case, Analysing Pick Up Errors in The Pick and Place Process on The Yamaha Machine, as illustrated in Figure 1. In the first step, Determine the pick-up error to be analysed starts the initial process. Next, Root cause analysis and data collection. After doing Root cause analysis and data collection, data processing is done for the improvement process and monitoring after improvement.

III. RESULT AND DISCUSSION

A. Fishbone Diagram

A fishbone diagram is a structured tool used to identify and analyze the root causes of problems. It visually represents the various factors that affect outcomes, helping institutions improve quality[5]. A cause and effect diagram shows the relationship between the problem at hand and its possible causes and influencing factors consisting of people, materials, machines, methods, and environment. Fishbone diagrams make it simple to identify the root cause of a problem because each factor in the bone has its own root cause[6]. Fishbone diagrams facilitate systematic identification of root causes by categorizing factors such as policies, processes and people. It enhances problem-solving to understand complex issues effectively[7]. According to the preparation stages carried out in making a fishbone diagram are:

1. Prepare and provide a cause-and-effect session
2. Prepare and provide consequence identification.
3. Prepare and provide identification of various categories.
4. Prepare and provide potential causes
5. Preparing and providing a review of each root cause
6. Prepare and provide for reaching agreement on the probable causes[8].

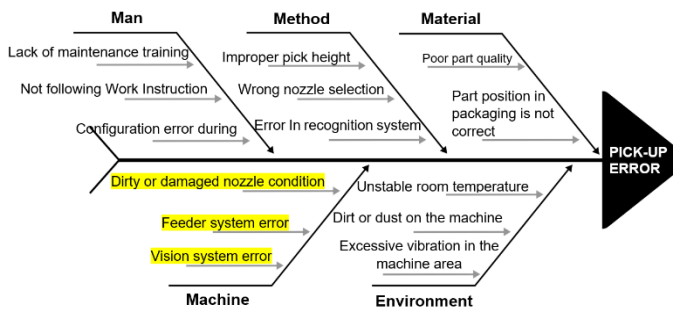


Fig 2. Fishbone Diagram

Table I. Fishbone Table

| No | Factor   | Potential   | Contribut or (Yes/No) |
|----|----------|---|-----------------------|
| 1  | Man      | - Lack of maintenance training<br>- Not following Work Instruction<br>- Configuration error during set up | No<br>No<br>No        |
| 2  | Method   | - Improper pick height<br>- Placement method is not optimized<br>- Error in recognition system            | No<br>No<br>No        |
| 3  | Material | - Poor part quality   | No                    |

|   |             |   |                   |
|---|-------------|---|-------------------|
|   |             | - Part position in packaging is not correct   | No                |
| 4 | Machine     | - Dirty or damaged nozzle condition<br>- Feeder system error<br>- Vision system error                     | Yes<br>Yes<br>Yes |
| 5 | Environment | - Unstable room temperature<br>- Dirt or dust on the machine<br>- Excessive vibration in the machine area | No<br>No<br>No    |

The following is the verification method performed to determine the root cause of the pick-up error.

1. Man
  - Lack of maintenance training : conduct periodic training programs
  - Not following Work Instruction : make SOPs clearer and easier to understand
  - Configuration error during setup : create a detailed setup checklist
2. Method
  - Improper pick height : perform regular calibration
  - Placement method is not optimized : implement continuous improvement
  - Error in recognition system : perform calibration on regular basis
3. Material
  - Poor part quality : conduct stricter incoming material inspections
  - Part position in packaging is not correct : make adjustment to packaging design
4. Machine
  - Dirty or damaged nozzle condition : perform regular preventive maintenance
  - Feeder system error : perform routine preventive maintenance
  - Vision system error : cleaning camera lenses regularly
5. Environment
  - Unstable room temperature : monitoring temperature in real time
  - Dirt or dust on the machine : increase the frequency of cleaning on the machine
  - Excessive vibration in the machine area : repairing the foundation on the machine

Based on the verification results, the author concludes that pick-up errors are caused by three factors, namely machine factors. Dirty or damaged nozzles, damage to the feeder as a component provider and vision errors that cause pick-up errors.

### 1) Data collection

One of the most important things in research is collecting data, data is a collection consisting of facts to provide a broad picture related to a situation. Someone who will make a policy or decision will generally use data as a consideration. Through data one can analyze, describe, or explain a situation[9]. In this case, the authors conducted data collection by taking data on the occurrence of retrieval errors for 10 weeks. Data collection was carried out by taking data on the occurrence of pick-up errors for 10 weeks.

Table II. Data Collection Pick-up Error

| Weekly  | Weekly Usage | Total Error | % Error |
|---------|--------------|-------------|---------|
| Week 1  | 6,779,125    | 8,661       | 0.128%  |
| Week 2  | 10,021,548   | 10,760      | 0.107%  |
| Week 3  | 6,702,008    | 6,045       | 0.090%  |
| Week 4  | 7,348,602    | 6,957       | 0.095%  |
| Week 5  | 4,583,620    | 4,299       | 0.094%  |
| Week 6  | 7,158,550    | 7,873       | 0.110%  |
| Week 7  | 8,594,649    | 8,691       | 0.101%  |
| Week 8  | 8,347,503    | 7,887       | 0.094%  |
| Week 9  | 7,734,468    | 8,861       | 0.115%  |
| Week 10 | 7,873,963    | 9,204       | 0.117%  |
| Average | 7,725,925    | 7,505       | 0.105%  |

Table II is the 10-week collection data of picking errors. Based on the above data in the first week, the pick-up error percentage was high at 0.128%, indicating a significant problem with the feeder, nozzle, and vision system. Then, the pick-up error percentage increased to 0.107% in the second week, indicating the high pick-up error problem had not been resolved. The increasing trend of pick-up error continued in the third week to 0.090% and in the fourth week to 0.095%, indicating the pick-up error problem was getting worse. The pick-up error percentage increased again in the fifth week to 0.094%, indicating that there was no solution to the problem in the previous weeks. The increase in pick-up error percentage continued until the tenth week with an average pick-up error percentage of 0.105%, which indicates that the pick-up error has not been handled properly.

### 2) Identify causes

Pick-up errors are caused by three main factors: nozzle error, feeder error, and vision system error.

Nozzle errors occur when the nozzle in charge of picking up components from the feeder does not function optimally, where

this is caused by dirt or dust attached to the nozzle which results in reduced vacuum power so that components cannot be picked up properly, besides physical damage to the nozzle surface can also interfere with the component picking process.

The second factor relates to the feeder system that functions as a component provider, where inaccurate feeder positioning, damage to the component tape carrier, or interference with the feeding mechanism can result in failure in the component pick-up process.

Lastly, vision system errors arise when the position recognition system is compromised, where improper calibration of the vision system can cause errors in detecting components, while dirty lenses or cameras will degrade the quality of the captured images, affecting the overall performance of the vision system.

The following is a graph of pick-up error data collection for 10 weeks

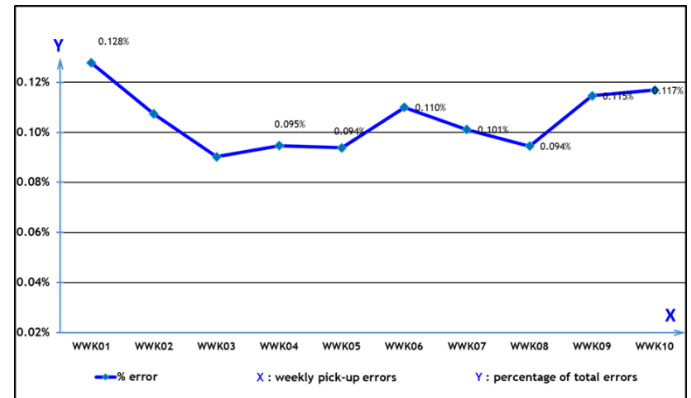


Fig 3. Graph Pick-up Error for 10 Weeks

Figure 3 is a graph of 10 weeks of data collection. Based on the graph. This proves that the percentage of pick-up errors is high.

### 3) Process Improvement

The Improvement process is very important to improve everything, in improving the quality of the product[10]. Once an indication of the cause of the pickup error is found. To prevent the occurrence of pick-up errors, feeder errors, and vision system errors, regular maintenance such as cleaning and replacing worn nozzles, setting optimal feeder parameters, and replacing worn feeder components, as well as regular calibration and cleaning of the camera lens, is required.

### 4) Monitoring After Improvement

After the repair, a monitoring process will be performed to monitor the pick-up error. The monitoring process is carried out for 10 weeks.

Table III. Data Collection Pick-up Error After Improvement

| Weekly  | Weekly Usage | Total Error | % Error |
|---------|--------------|-------------|---------|
| Week 11 | 7,702,992    | 7,242       | 0.094%  |

|         |           |       |        |
|---------|-----------|-------|--------|
| Week 12 | 8,734,414 | 7,000 | 0.080% |
| Week 13 | 8,716,135 | 7,695 | 0.088% |
| Week 14 | 7,354,783 | 6,477 | 0.094% |
| Week 15 | 8,224,729 | 7,754 | 0.094% |
| Week 16 | 7,537,101 | 6,829 | 0.091% |
| Week 17 | 7,441,110 | 6,784 | 0.091% |
| Week 18 | 7,514,318 | 6,761 | 0.090% |
| Week 19 | 7,721,503 | 7,141 | 0.092% |
| Week 20 | 8,427,382 | 7,177 | 0.085% |
| Avarage | 7,937,447 | 7,086 | 0.089% |

Table III is the collection data of picking errors for 10 weeks after improvement. Based on the data above, in week 11, the percentage of errors was still quite high at 0.099%, but the author's improvement efforts began to show results in week 12 with a decrease in the percentage of picking errors to 0.080%. Improvements continued in week 13 where the percentage of errors again dropped to 0.088%. In weeks 14 and 15, the percentage of picking errors remained stable at 0.094%. This shows that the corrective actions taken by the author were effective enough to overcome the pick-up error problem that occurred earlier. The downward trend continued until week 18 where the percentage of pick-up errors decreased to 0.090%, although there was still an increase in pick-up errors. In general, the authors saw a consistent improvement. In weeks 19 and 20, the percentage of pick-up errors reduced to 0.092% and 0.085%. With the authors' improvement efforts, the overall average pick-up error percentage decreased to 0.089%. This shows that the corrective actions taken by the authors were effective enough to improve the quality and consistency of the pick and place process.

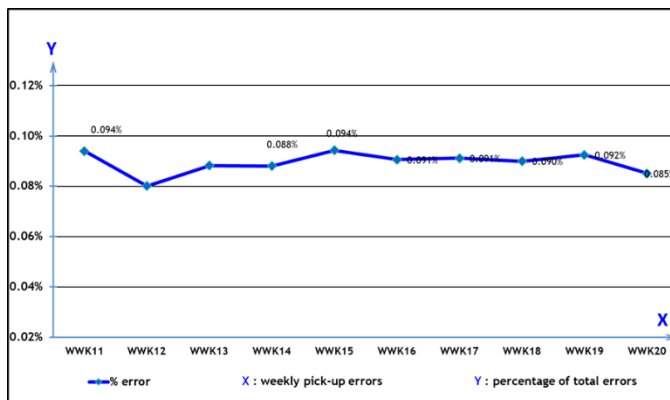


Fig 4. Graph Pick-up Error After Improvement

Based on 10 weeks of monitoring data in graphical form, there was a decrease in picking errors after a series of improvements were implemented that included maintenance of the nozzle, feeder, and vision system. The implementation of corrective measures included cleaning and replacing worn nozzles, optimising feeder parameters, replacing worn feeder components, and regular calibration and cleaning of the camera lens. The results showed a decrease in the percentage error from 0.105% to 0.089%. This proves the effectiveness of the corrective actions that have been implemented.

#### IV. CONCLUSION

The research on Analyzing Pick Up Errors in the Pick and Place Process on Yamaha Machines resulted in two main conclusions. Firstly, it was identified that pick-up errors are caused by three factors: nozzles with damage or dirt, damage to the feeder system that supplies parts, and interference with the vision system that affects the pick-up process. Secondly, a solution to reduce the pick-up error has been successfully implemented through a series of preventive measures, including maintenance and replacement of worn nozzles, optimisation of feeder parameters, replacement of worn feeder components, and routine maintenance in the form of calibration and cleaning of camera lenses. Monitoring results on an operating Yamaha machine showed a significant reduction in the pick-up error rate after the implementation of improvements to all three systems (nozzle, feeder, and vision system).

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