ISSUE RESOLUTION CYCLE TIME REDUCTION IN TEST ESCAPE AND MIXING EVENTS USING JIRA

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ABSTRACT

Integrated Circuit (IC) Test Manufacturing consists of highly intricate procedures that involve a series of material movements, including receiving the materials from the assembly sites, incoming inspections, preparations, final testing, Quality Assurance (QA) electrical testing, document checking, and packaging the parts for shipment to customers. These complex processes consist of automated, semi-automated, and manual sub-processes, with the manual steps being susceptible to internal quality issues, such as Test Escape and Mixing, which can occur at any point in the processing stage.

To minimize or eliminate these internal quality issues, continuous improvement programs, such as the Failure Mechanism (FMech) Reduction Advocacy and Zero Mixing Advocacy (ZMA), have been implemented to address root causes and further improve factory quality performance. However, identifying the root cause of a problem and implementing a solution when the problem first occurs pose another challenge. Effective collaboration and alignment among all Test Manufacturing personnel and support groups are essential, as timing is a critical factor in every issue. This paper presents a new approach to issue resolution by promoting collaboration among team members and using the Jira project management tool for efficient issue tracking and Agile methodology support. This new approach automates team dynamics, enhances communication, and encourages knowledge sharing within the team. Furthermore, the customizable dashboards offer insights into various aspects of team performance and issue resolution, such as issue status, cycle time, and a Pareto analysis of root causes. The analysis results of these data can be used as input to other continuous improvement initiatives or tools such as the Failure Mode and Effects Analysis (FMEA) and Total Quality Management (TQM), thus preventing the recurrence of such issues.

1. 0 INTRODUCTION

1.1 Understanding Test Escape and Test Mixing Failure Mechanism

IC testing during Final Test and QA electrical test segregates or sorts tested parts into their appropriate categories (good or reject) and further classifies units into bin numbers such as Bin 1, Bin 2, etc. The goal is to prevent defective or poor-quality parts from finding their way to the customers. There are instances, however, wherein rejects end up being binned or mixed with the good parts.

Test Escape is an event wherein a unit that when tested will be rejected by the testing but was assigned a passing bin result. It is when a tested unit receives a false bin 1 category due to test-related errors that are electrical or mechanical in nature. (ex. Defective Board Component, Stuck Relay, Stuck Unit, Freeze Measurement, Double Drop, Cross-Cabling, Wrong Site Mapping, Wrong Binning Assignment, Broken Binning Signals, etc.).

Test Mixing, on the other hand, are events wherein a unit already categorized as reject or a unit that never got tested still ended up together with the good units. It is when an untested/handler fall-out (HFO) unit and/or a properly categorized reject unit are mixed with good units due to conditions that are mishandling in nature. (ex. Wrong Use of Tube/Carrier, Untested/Reject Tubes placed on Tested Pedestals, HFO placed back on carrier, etc.). Other mixing occurrences involve having a different device or lot ID/date code in a same lot. Refer to the defect model in Fig. 1.

In these cases, it is imperative that the root causes be determined as early as possible so that the process owners can act immediately to prevent more lots from being affected and/or prevent issues from recurring.

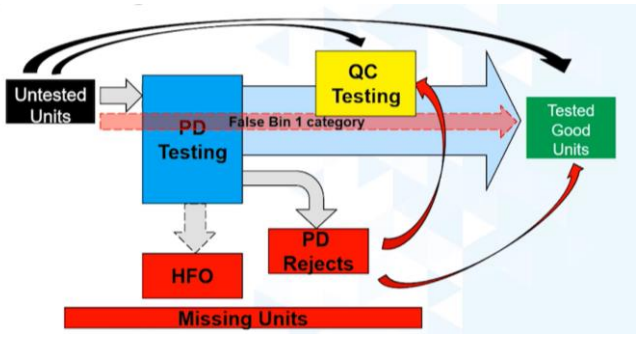


Fig. 1. Defect model

1.2 Issue Investigation Process

Every test escape and mixing issue is being investigated by a cross-functional team composed of members from Process Engineering, Test Product Engineering, Handler Support, Equipment Engineering, Test Manufacturing, and Quality Assurance Engineering. The team reviews all pertinent data such as process maps, test maps, handler logs, count reconciliation reports, and in some cases, operator interview results are included. In the current process, soliciting all these information would entail sending emails to the process owners and sending occasional email follow-ups should they miss providing their data on time. All the back-to-back team discussions happen via email or group chats and all the files reside in the email system as well. Monitoring of issues is in a per team/factory basis wherein the factory QA and Process Engineering representatives manually encode key information about the issues in an excel file. Tracking of root causes is through manual encoding in excel file as well (see Figs. 2 and 3). Measurement of issue resolution cycle time would normally depend on the issuance and approval dates of electronic Quality System (eQS) – internal issue resolution documentation, available upon request for data extraction from the Information Technology (IT) group.

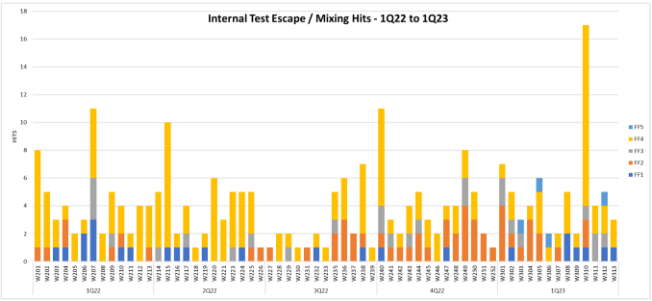


Fig. 2. Manual tracking of test escape and mixing issues using MS Excel

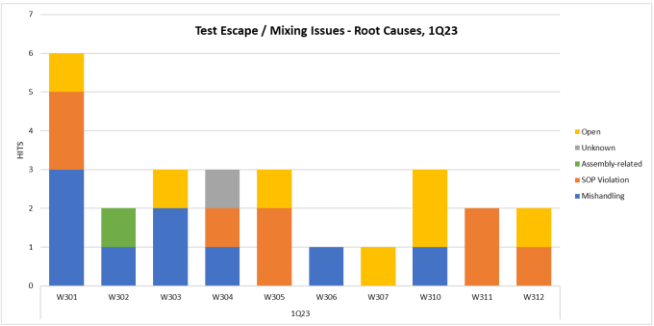


Fig. 3. Manual tracking of root causes using MS Excel

2. 0 REVIEW OF RELATED WORK

An opportunity is seen in terms of improving the investigation process so that issues can be resolved faster and that corrective actions can be immediately deployed. Consequently, the faster the issues are resolved, the sooner those overstaying lots (OSL) and hold lots related to test escape/mixing can be released. The objective of this improved process is to employ the Jira project management tool to automate the tracking of tasks needed for the issue investigation and subsequently, as an enabler to the existing Quality Management System (QMS) platforms such as the eQS, Corrective Action Preventive Action (CAPA), and Material Review Board (MRB). The Jira project will replace email system as the collaboration space and repository of data, as well as eliminate the need for manual encoding of information in MS Excel (Fig. 4).

Fig. 4. High-level issue resolution process flow for test escape and mixing events using Jira as the main collaboration tool

3.0 METHODOLOGY

Jira is a project and issue tracking tool that can be used for bug tracking and agile development[1]. Jira projects can be setup for large projects or by an individual to keep track of their lists of tasks. This is widely used by cross-functional teams and individuals to develop products, track bugs, track shipments, and more due to its flexibility, transparency, and ability to integrate with tools such as Confluence and Bitbucket.

A Jira project was set up and customized to be used for the tracking and monitoring of test escape and mixing issues, for selected focus factories as the pilot project, toward the end of 1Q23. With this Jira project, a systematic approach to test escape and mixing issue investigation was implemented, allowing the team members to organize and allocate tasks and to easily track the progress and manage those tasks.

In the new approach, an automated workflow and task management was utilized, instead of the email- and excel file-based tracking. For every test escape and mixing occurrence, the issue reporters will create a Jira ticket – Production Supervisors for mixing events captured during lot processing and Test Product Engineers for verified untrimmed in-line sampling failures (ILSF), mixing bin, etc.

The investigation process in Jira has four (4) statuses in its workflow, namely Open, Info Request, In Progress, and Closed. Once a ticket is created, it will be automatically assigned to the default QA Engineer based on focus factory assignment. The ticket will then be ***Open*** for review by QA. After the review, QA will transition the ticket status to ***Info Request*** and an auto email notification will be sent to the Manufacturing and the Support Groups for them to provide their data. When all data are complete – Process map from Process Engineering, Test map from Test Product Engineering, Handler logs from Handler Support Group, and Count reconciliation from Test Manufacturing, the ticket status will be automatically transitioned to ***In Progress*** and will be reassigned back to the QA Engineer to facilitate the discussion. QA will own the ticket assignment for the rest of the investigation process up until the issue is ***Closed***. Root cause and corrective action/s are prerequisite to the ticket/issue closure. Refer to Fig. 5.

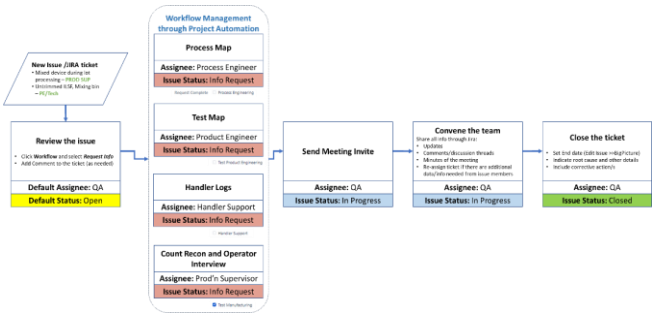


Fig. 5. Detailed issue investigation workflow in Jira

The automatic task assignment and issue status transition were programmed via Jira project automation[2]. Automation rules were written in such a way that the tool provides a sustainable solution to the close collaboration between the teams involved in the issue investigation (see Fig. 6).

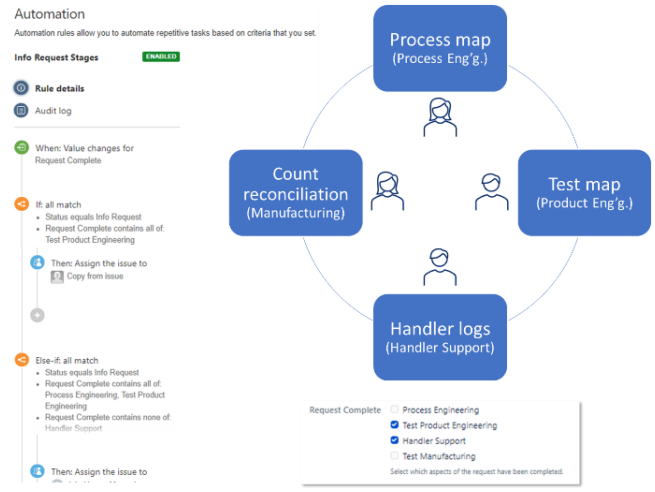


Fig. 6. Task management automation

Auto email reminders are also being sent twice a week (Tuesdays and Fridays) at 9AM to remind the task assignees as well as the team of the remaining open tickets/issues for investigation and tasks for completion. Automating the team dynamics in this way makes the whole process sustainable and needs less supervision.

4.0 RESULTS AND DISCUSSION

4.1 Data Analysis and Files Repository

Test escape and mixing events from 1Q23 were encoded in Jira to jump-start the project. This is to give the target users and stakeholders a good appreciation of the tool. The strategy is to backtrack data from 1Q23 and then to input data in real-time moving forward, as it gets implemented in 2Q23. From the data that was gathered, a dashboard was created, giving the users a good visual of the performance trends per focus factory as well as the details and status of each issue (Fig. 7). The dashboard also contains key information about the issues, i.e., quarter, workweek, focus factory, eQS#, part name, lot ID, start and end dates, etc., that can be filtered for easy analysis of data and to facilitate quick searches. Each issue/ticket in the dashboard is linked to the issue investigation details, giving the users a quick access to the consolidated history and files related to each issue (Fig. 8).

Fig. 7. Screenshot from the Test Escape/Mixing Issues Dashboard

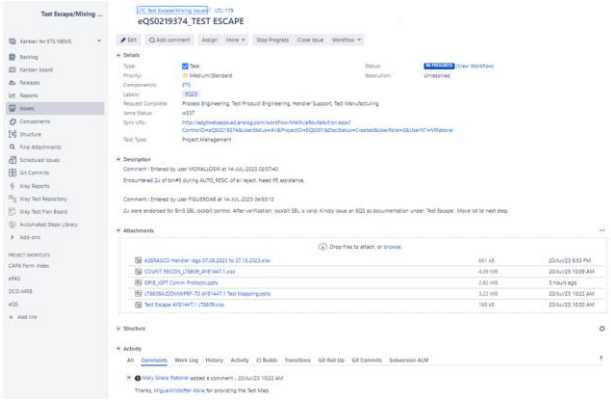


Fig. 8. Issue details and files repository in Jira project

4.2 Tracking of Root Causes and Corrective Actions

With the Jira project in place, tracking of root causes was made straightforward by having a customized dropdown menu of root causes (based on historical data from previous issues). Once the issue investigation is complete, the Jira ticket can be closed by choosing the appropriate root cause from the Resolution dropdown and indicating the corrective action/s details in the Comment box (see Fig. 9). With this simple but important step, the stakeholders were given a visualization of the root causes of the issues as seen from the project dashboard. The status of the corrective actions can also be tracked from the project dashboard (Figs. 10 and 11).

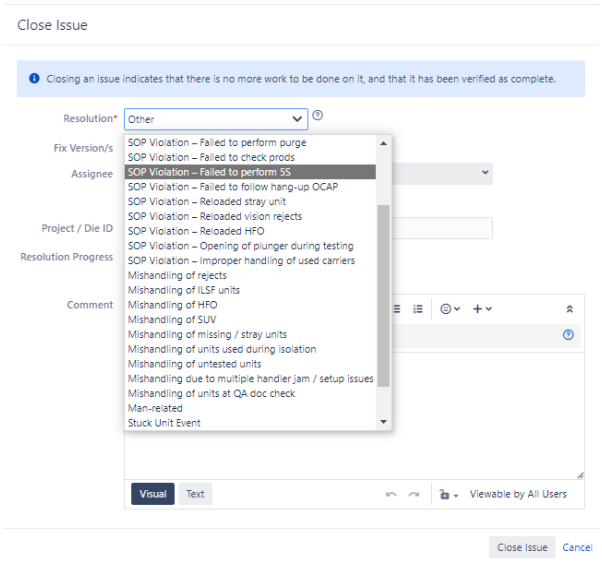
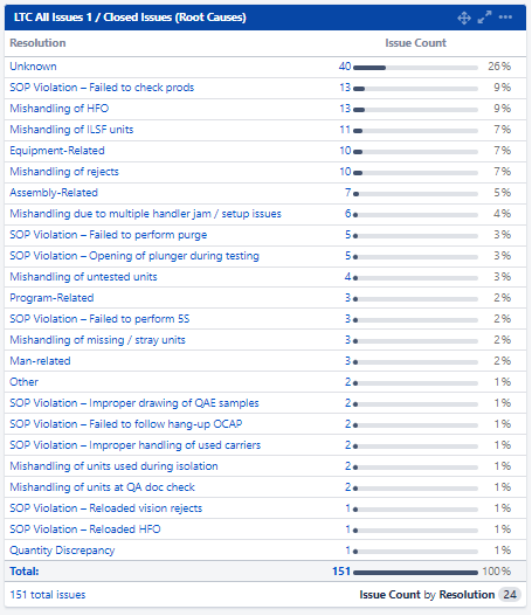


Fig. 9. Screenshot showing the dropdown menu of root causes in Jira



LTC All Issues 1 / Closed Issues (Root Causes)

Resolution	Issue Count	
Unknown	40	26 %
SOP Violation – Failed to check prods	13	9 %
Mishandling of HFO	13	9 %
Mishandling of ILSF units	11	7 %
Equipment-Related	10	7 %
Mishandling of rejects	10	7 %
Assembly-Related	7	5 %
Mishandling due to multiple handler jam / setup issues	6	4 %
SOP Violation – Failed to perform purge	5	3 %
SOP Violation – Opening of plunger during testing	5	3 %
Mishandling of untested units	4	3 %
Program-Related	3	2 %
SOP Violation – Failed to perform 5S	3	2 %
Mishandling of missing / stray units	3	2 %
Man-related	3	2 %
Other	2	1 %
SOP Violation – Improper drawing of QAE samples	2	1 %
SOP Violation – Failed to follow hang-up OCAP	2	1 %
SOP Violation – Improper handling of used carriers	2	1 %
Mishandling of units used during isolation	2	1 %
Mishandling of units at QA doc check	2	1 %
SOP Violation – Reloaded vision rejects	1	1 %
SOP Violation – Reloaded HFO	1	1 %
Quantity Discrepancy	1	1 %
Total:	**151**	100 %

151 total issues — Issue Count by Resolution 24

Fig. 10. Pareto analysis of root causes available from the dashboard

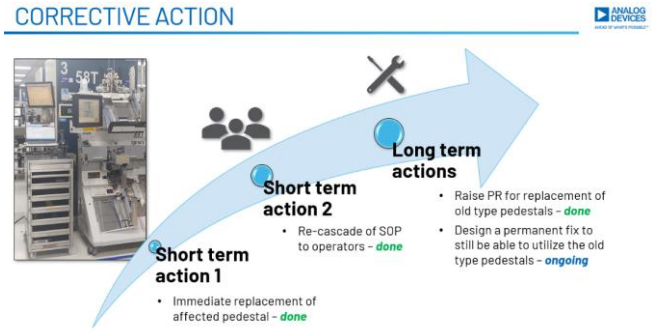


Fig. 11. Screenshot of the corrective action from an issue with *SOP violation – Failed to perform 5S* root cause

Furthermore, by clustering the root causes the team was able to formulate actions to address the *SOP violation* and *Mishandling* issues. Currently, Process Engineering is working with the Training group and Test Manufacturing to continuously monitor the effectiveness of the training program and is pursuing ways in simplifying the operator training module, in addition to the process simplification / lean manufacturing initiatives being worked on by various groups.

4.3 Reducing the Issue Resolution Cycle Time

With the implementation of Jira as tracking tool for test escape and mixing issues, the start and end dates data were used to measure the issue resolution cycle time. Given the purely manual process of task management from the old issue resolution process (aside from the normal prioritization in the production line issue), investigation cycle time reached an average of 84 days, based on Closed issues from 1Q23 data.

Now that the teams and stakeholders are aware of this cycle time data, it opened the opportunity for improvement in the investigation process, to further drive for a shorter cycle time moving forward. Since the full implementation of Jira in w324, a downward trend in issue resolution cycle time was observed, with only 40 days and 16 days in 2Q23 and 3Q23, respectively (see Fig. 12).

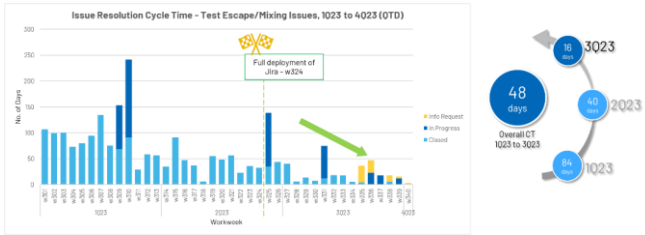


Fig. 12. Issue resolution cycle time, 1Q23 to 4Q23 QTD

Additionally, the pareto of root causes from the Jira dashboard has facilitated the re-investigation of issues with unknown root causes. The history of the issues from the Jira project is indeed a great help for reviewing and tracking even

much older issues and avoiding the hassle of searching for old emails and chats.

5.0 CONCLUSION

Implementing the use of Jira as tracking and monitoring tool for test escape and mixing issues played a significant role in the teams' awareness of the issue resolution performance, thereby opening the opportunity for continuous improvement in cycle time and data retention and analysis.

Since the implementation of Jira project in 2Q23, a significant reduction in the issue resolution cycle time was observed – from 84 days average cycle time of closed issues for 1Q23 down to only 16 days for 3Q23. This reduction in issue resolution cycle time contributes to the decrease in the number of hold lots related to test escape and mixing, translating to additional output and productivity. Moreover, Jira enabled efficient management and containment of issues by organizing and allocating tasks and setting priorities and due dates.

The clustering of root causes from the project dashboard paved the way in formulating actions to address the issues and strengthen the corrective actions, further helping achieve the goal of zero defects and strengthening the quality mindset through process ownership and teamwork.

6.0 RECOMMENDATIONS

The data coming from the Jira project can be exported to MS Excel and can be used as input to Power BI reports should a need for more powerful visualization/dashboard arises.

The use of Jira project can be fanned out for the monitoring of other process-related issues such as visual-mechanical failures and quantity discrepancy, yield monitoring, tracking of Electrical Quality Control (EQC) failures, or any other project management activities that require tracking and collaboration between team members and stakeholders. Teams can create workflows tailored to their specific processes and requirements.

7.0 ACKNOWLEDGMENT

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9.0 ABOUT THE AUTHOR

Mary Grace Raborar holds a bachelor's degree in Electronics and Communications Engineering (BSECE) from University of Santo Tomas. She was a Failure Analysis Technician at Analog Devices Gen. Trias (ADGT) from 2006 to 2012 and Failure Analysis Engineer from 2012 to 2021. Grace is currently a Process Development Engineer at ADGT.