

Moving Towards Cost Saving Optimisation Through Capacitive Test Productive Time Improvement

By Sabri Hasan

Semiconductors are one of the most widely used components in many products. The use of semiconductors has spread by leaps and bounds into broad end-use categories including data processing, communications and customer electronics. In addition to that, it is also vastly used in automotive, military and civil aerospace. The semiconductor industry has been growing virtually nonstop for over 40 years in meeting the global demand that increases year by year. Now, with the concept of Internet of Things (IoT) which is gearing up momentum increases the demand of intelligent computing. This forms a sustainable demand for semiconductors.

In Malaysia, more than 50 MNC companies which are involved in the production of semiconductors contribute to a steady growth of this industry. Infineon Technologies (M) Sdn. Bhd. (Infineon (M)) is one of the largest semiconductor manufacturers in Malaysia with an accumulative investment of more than RM6 billion. Infineon (M) which is located in Melaka experiences an outstanding growth in demands and continue to boost the value chain to produce products with value added semiconductors to their customers.

This organisation which was established in 1973 has fabricated its reputation by manufacturing four types of high quality semiconductor products namely power, discrete, sensors and logic. All these products are supplied to huge entities such as Autoliv, Aisin, Omron, Toshiba, Koito, Continental, Siemen, Denso, Keihin, UAES20 and Toyota Tsusho Electronics Corporation.

Infineon (M) aims to the betterment of life as a whole making life easier and safer through sophisticated technology targeting to achieve more accessible outcomes for everyone. This reputable organisation is ready to boost the quality of lives for its customers through providing a more reliable modern technology. Thus, these goals inspire its 8,200 employees to challenge the status and open up new horizons to succeed.



Innovative Creative Circle (ICC) In Developing Teamwork

Participation by employees is extremely crucial in meeting high standards of customer needs. Infineon (M) upholds to this philosophy which is notably believed to reduce the number of complaints and reject rate in the operations of daily production. It also believes and is well aware of the fact that this can only be accomplished through a structural teamwork activity known through Innovative Creative Circle (ICC). This initiative is strongly believed to be able to bring all employees towards the same path of

excellence. ICC is a problem solving initiative which is conducted by a small group of employees who usually come from the same work background. These employees voluntarily meet on a regular basis to carry out activities involving ICC to specifically identify, investigate, analyse and solve work related issues. They use ICC tools and methodologies in overcoming issues concerning work and its process, productivity, man power as well as quality.

It is a fact that commitment from the management is a crucial element for a successful ICC implementation. The management usually provides a structured guideline using ICC and subsequently ensures the readiness of the employees in executing this project. In addition to this, the Human Resource Department plays a major role in furnishing the employees with the right ICC tools through on job training and mentor-mentee approaches. With such implementation, Infineon (M) has established 400 ICC groups since it was introduced in 1996.

Towards Better Performance Through Problem Identification

In quest to excellence, Infineon (M) uses ICC to resolve specific production problems that hinders them from achieving the targeted Key Performance Indicators (KPIs). Most importantly, the company is committed to improve cost and delivery by constantly improving work processes and eliminating waste, human and corporate resources. With this in mind, an ICC team known as Measurement Team was formed in 2013 with ten members from the Logic Operation Department. The team consisted a combination of senior and junior members that was expected to accelerate the learning curve of ICC tools for problem solving in Infineon (M).

In 2014, the team had identified that the capacitive testing productive time was at underperformance as compared to the targeted KPIs set by the management. At that time, the productive time rate

was only at 55.9 percent with a schedule downtime of 25.8 percent. Based on the output generation achievement, it came to surface that the machine only produced 336,000 pieces of output per week. In addition to that, the mechanical reject rate recorded an unstable performance of 0.28 percent which led to 99.5 percent of actual test yield.

This had portrayed an undesired image to the Logic Operation Department when delays actually occurred in the next few processes that involved the production line. Subsequently, Measurement Team knew that they had to resolve this issue as soon as they could using ICC tools and techniques. For a start, the team had set up several realistic targets which covered improvement in productive time rate by 70 percent. This increased output generation and test yield by 450,000 pieces per week and 99.7 percent respectively.

The problem arose during the capacitive testing process that is usually conducted for the purpose of detecting package structural defect such as 'near short' between adjacent wires and inner leads. However, these were not detectable in



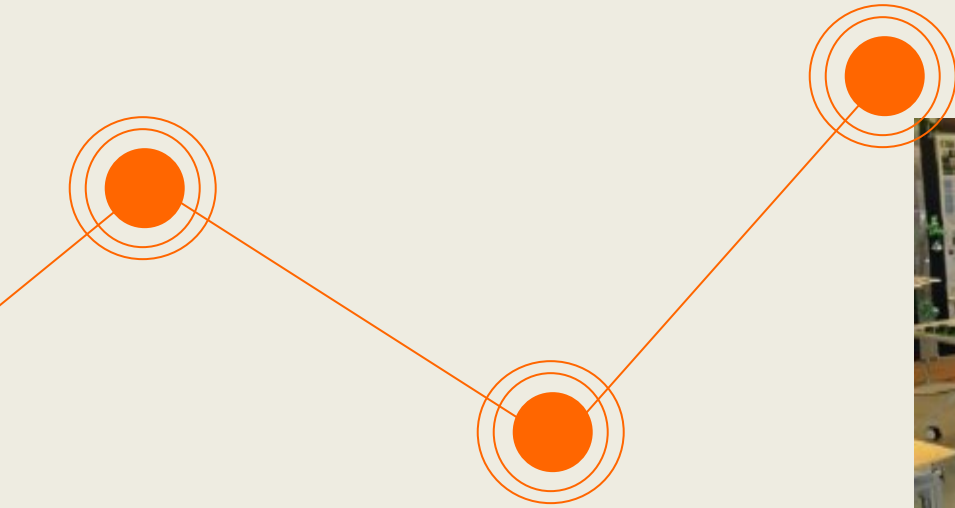
conventional x-ray screening and Automated Test Equipment (ATE) testing. It was also discovered that high set-up time was needed in which contributed to a lower productive time rate for this process. Following these series of discoveries, the team used Ishikawa Fishbone and Tree diagrams to obtain the potential root causes of the problem.

As a result, eight causes were identified but they had only decided to concentrate on three crucial causes. The causes were namely, the long duration needed for the process of transferring trays which relatively resulted in low output and low machine utilisation rate. Then, was the double cylinder in the capacitive test machine which also led to a long duration for set-up time. This consequently contributed to test contact failure due to high in stoppages. Finally, the unfit carrier was also identified in performing test contact failure which contributed to a high bend lead. The team knew that this was the most crucial stage of ICC where there was an urge to come together looking out for solutions to overcome all the barriers. The team was given the space where all members worked together in investigating the issues at production line which hinders them to perform better.

Generating Ideas For Improvement

Brainstorming sessions were regularly held to generate ideas in solving the root causes. In addition to this, the combination of senior and junior members in ICC team also accelerated the process of generating ideas which brought elements of creativity and innovation into the proposed solutions. The Why-why analysis and Tree diagram were utilised in each proposed solution that guided the team in optimising results. The team had tested and monitored the performance of each solution within six months before the solutions were fully accepted and endorsed by the management. This allowed the team to make necessary modifications within the testing period in achieving the best outcome. Their aim was to improve production time and increase output generation and test yield. The table below shows the actions taken to overcome the root causes.

Root Cause	Proposed Solution	Action Taken
Long duration in the process of transferring trays	To modify tray holder design to improve machine Units per Hour (UPH)	1. Double tray holder concept was designed and applied into the capacitive test machine
Double cylinder which played a role in test contact failure due to high in stoppages	To reduce the instability of the cylinder motion to push the test match plate and contact pusher	2. The double cylinder is changed to single compact cylinder (RDQB025) which led to zero risk of test contact failure with even up-down motion position
The unfit carrier was identified to perform test contact failure which resulted high in bend lead	To modify insert carrier which will shorten length design of tolerance and gap in the carrier	3. Tighten tolerance and gap carrier design by 0.02mm to avoid package offset during placement of the package



INNOVATION IN MAKING INFINEON BETTER

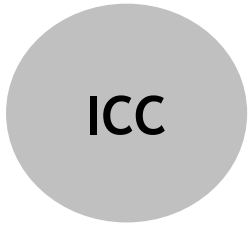
55.9%
Capacitive testing
productive time

25.8%
Schedule downtime

336,000
Pieces of output per week

0.28%
Mechanical reject

99.5%
Test yield



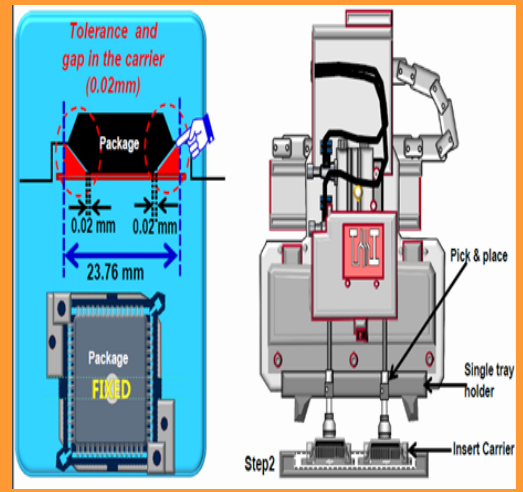
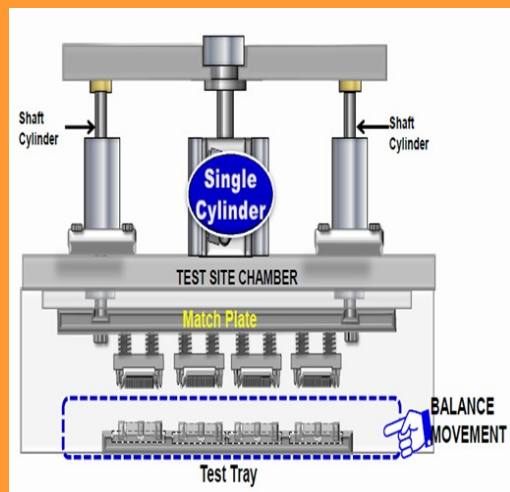
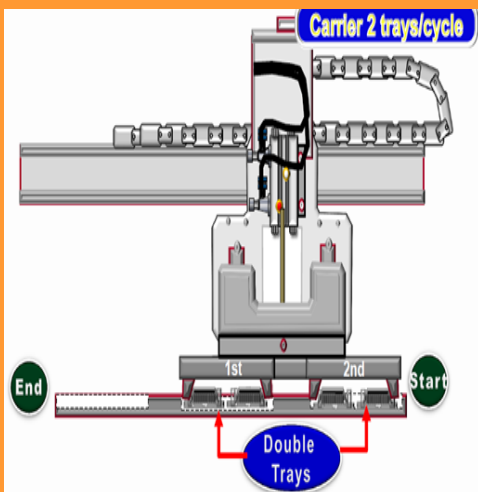
Unable to achieve the targeted KPIs set by management

improved all KPIs and managed to save cost
RM960,059 annually

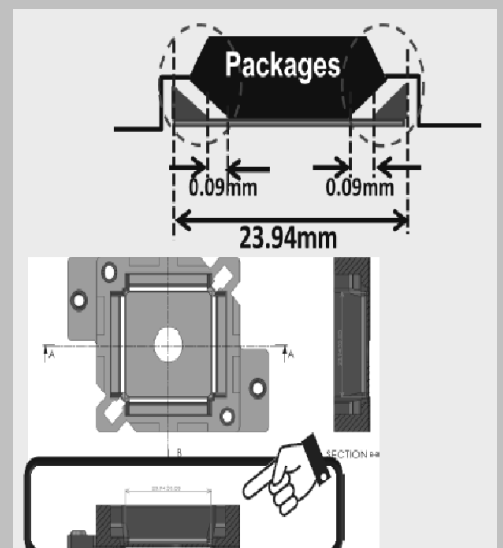
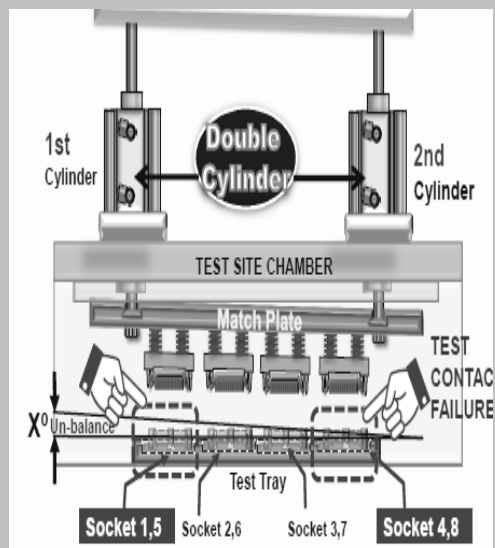
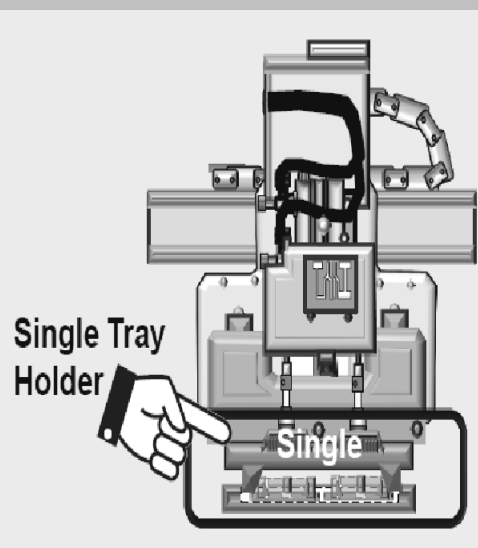
Solution 1
Double tray holder

Solution 2
Single compact cylinder

Solution 3
Tighten tolerance and gap carrier design by 0.02mm



BEFORE ICC PROJECT



Through these improvements, the team managed to achieve all the targeted outcomes which brought to a significant increase in productivity. The team is making a breakthrough in the production line as it has delivered an output on time, which would reduce the customer complaints. The improvements which only cost RM114,967 were also cascaded and deployed to all related processes in Infineon Technologies Asia Pacific, Singapore. This has also led to a potential expansion of improvement at Infineon Technologies Batam, Indonesia and Infineon Technologies Wuxi, China. Now, Infineon (M) is able to operate efficiently as time wastages in the capacitive testing process and test contact failures were eliminated through the implementation of ICC project by its own employees.

Analysis Of ICC Project In Infineon (M)


The initiatives through ICC brought tremendous benefits in overcoming the issue of productive time rate during the capacitive testing process. The modification of single tray holder, double cylinder and unfit carrier have resulted an increase in productive time rate from 55.9 percent to 78.2 percent, amounting to a 39 percent improvement in productive time. The team is able to surpass the targeted value of 70 percent. The test yield also has increased to 99.89 percent as compared to 99.7 percent before the ICC project. Not only that, this improvement has also increased the total output production. Previously, it was recorded that the total output was 336,000 pieces, and has simultaneously increased to 459,000 pieces per week.

There was also a reduction in schedule downtime breakdown from 25.8 percent to only 8 percent. The unscheduled downtime performance has surpassed the

department target of 5 percent to 1.5 percent after the implementation of ICC. A significant improvement can also be seen through a reduction in bent lead reject from 0.28 percent to zero percent. The retest time also has reduced to 12.5 percent as compared to 13.8 percent before the project. Due to these achievements, customer complaints have significantly reduced from 10 to 2 cases.

Most importantly, the Segment Planning Department is proud to announce that the cost saving of this ICC initiative is RM960,059 annually. This is contributed through the in-house modification by RM84,210 and RM236,889 of cost saving in new test system. While the major cost saving for this project is generated through an increase in output generation and productive time improvement which amounts to RM638,960. Thus, ICC project is able to shape Infineon (M) to be more competitive in gaining a high cost saving every year with the impact of increase in capacitive test productive time rate.

COMPARISON BEFORE AND AFTER ICC IMPLEMENTATION

Productive time rate: Before : 55.9% After : 78.2%	 <p>Total cost saving: RM960,059</p> <ul style="list-style-type: none"> • Modification parts: RM84,210 • New test system: RM236,889 • Output generation and productive time improvement: RM638,960 	Schedule downtime breakdown: Before : 25.8% After : 8%
Test yield: Before : 99.7% After : 99.89%		Bend lead reject: Before : 0.28% After : 0%
Total output produce per week Before : 336,000 pieces After : 459,000 pieces		Retest time: Before : 13.8% After : 12.5%
Unscheduled downtime Before : 4.7% After : 1.5%		No. of customer complaints: Before : 10 cases After : 2 cases