



Faculty of Manufacturing Engineering

**AUTOMATION OF THE MANUAL TASK AT STRIP TEST
PROCESS IN SEMICONDUCTOR MANUFACTURING**

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Teoh Woei Sheng

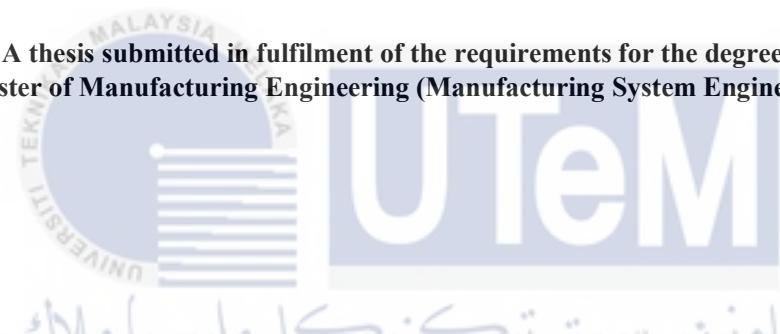
Master of Manufacturing Engineering (Manufacturing System Engineering)

2021

**AUTOMATION OF THE MANUAL TASK AT STRIP TEST PROCESS IN
SEMICONDUCTOR MANUFACTURING**

TEOH WOEI SHENG

A thesis submitted in fulfilment of the requirements for the degree of
Master of Manufacturing Engineering (Manufacturing System Engineering)



Faculty of Manufacturing Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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TAJUK: AUTOMATION OF THE MANUAL TASK AT STRIP TEST PROCESS
IN SEMICONDUCTOR MANUFACTURING

SESI PENGAJIAN: 2020/21 SEMESTER 2

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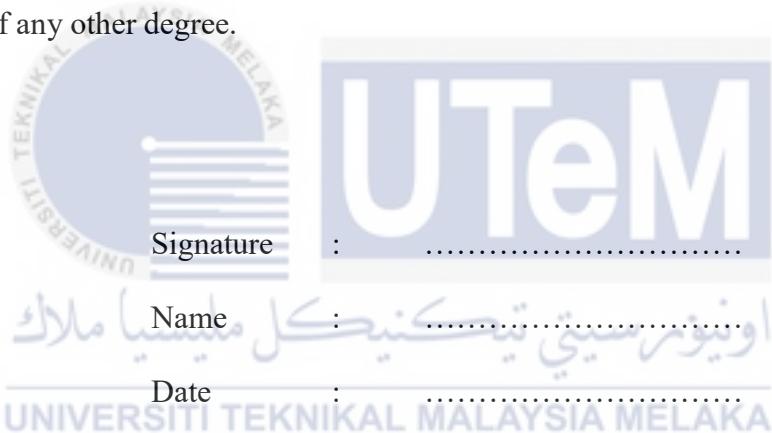
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DEDICATION

To my beloved wife (Agnes Khoo), mother (Judy Saw) and father (Teoh KC).



ABSTRACT

Strip testing is a semiconductor manufacturing process that performing electrical test while the device still in the lead frame strip. The device in the strip have to go through lead cut process for electrical isolation of the leads therefore we are able to perform individual devices test without affected/influence by other devices on the same strip. Strip test is a parallel testing of multiple units at the same time, increase throughput and reduce cycle time. Automation will replace the operator repetitive job and at the same time fully integrated with the manufacturing execution system. During change of lot, operator require to perform a series of system to physical validation and also many steps of system tracking in process before the lot started. Recipe are manually downloaded by the operator. Test program require manual triggering after the test order loaded into the tester. After processed, processed lot require operator attention in order to have the operator manually perform tracking out process then only manually moving out the lot to the next operation/process. By having all these manual key in, manual selection, manual loading, it consumed so much of productivity time and nevertheless by having human intervention it will increase the possibility of the quality issue. The objectives for the research are to investigate the current task at the strip test process. To develop an automation strategy at the trip test process. To validate the developed automation strategy. I will perform a detail study on current work mehtod, transaction and hardware then identify potential improvement area. Development and hardware upgrade to be carried out after identified the improvement area. By having automation functionality, we are expecting the gain of productivity and quality. Reduce the operator repetitive job and optimize the process can well be achieved by succeeding this research. Direct loading and unloading automation is the future of manufacturing without any human interaction, and this research is hoped to have a significant contribution and readiness for next level of automation.

ABSTRAK

Uji jalur adalah proses pembuatan semikonduktor yang melakukan ujian elektrik semasa peranti masih dalam jalur bingkai plumbum. Peranti di jalur harus melalui proses pemotongan plumbum untuk pengasingan elektrik dari plumbum oleh itu kami dapat melakukan ujian peranti individu tanpa dipengaruhi / dipengaruhi oleh peranti lain pada jalur yang sama. Uji jalur adalah ujian selari bagi beberapa unit pada masa yang sama, meningkatkan throughput dan mengurangkan masa kitaran. Automasi akan menggantikan tugas berulang operator dan pada masa yang sama sepenuhnya disatukan dengan sistem pelaksanaan pembuatan. Semasa pertukaran lot, pengendali perlu melakukan serangkaian pengesahan sistem ke fizikal dan juga banyak langkah pengesahan sistem dalam proses sebelum lot dimulakan. Resipi dimuat turun secara manual oleh pengendali. Program ujian memerlukan pemicu manual setelah pesanan ujian dimasukkan ke dalam penguji. Setelah diproses, lot yang diproses memerlukan perhatian pengendali agar pengendali melakukan proses pengesahan secara manual, kemudian hanya memindahkan lot secara manual ke operasi / proses berikutnya. Dengan memasukkan semua kunci manual ini, pemilihan manual, pemuatan manual, ia menghabiskan banyak waktu produktivitas dan walaupun dengan campur tangan manusia, hal itu akan meningkatkan kemungkinan masalah kualiti. Objektif penyelidikan adalah untuk menyiasat tugas semasa proses ujian jalur. Untuk mengembangkan strategi automasi semasa proses ujian perjalanan. Untuk mengesahkan strategi automasi yang dikembangkan. Saya akan melakukan kajian terperinci mengenai metod kerja, urus niaga dan perkakasan semasa dan kemudian mengenal pasti kawasan peningkatan yang berpotensi. Pembangunan dan peningkatan perkakasan akan dilakukan setelah mengenal pasti kawasan penambahbaikan. Dengan mempunyai fungsi automasi, kami mengharapkan peningkatan produktiviti dan kualiti. Kurangkan tugas pengulangan operator dan optimumkan proses yang dapat dicapai dengan menjayakan penyelidikan ini. Automasi pemuatan dan pemunggahan langsung adalah masa depan pembuatan tanpa interaksi manusia, dan penyelidikan ini diharapkan dapat memberikan sumbangan dan kesediaan yang signifikan untuk tahap automasi seterusnya.

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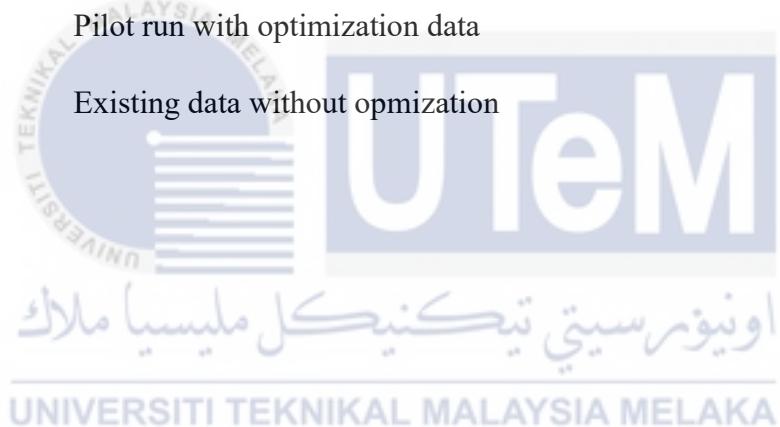
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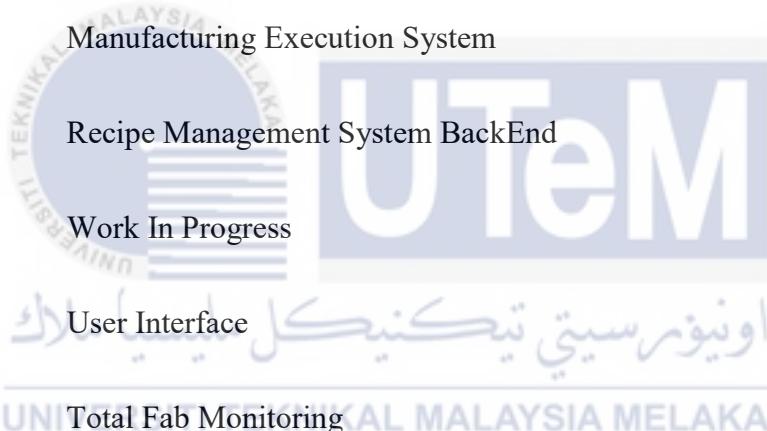
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LIST OF ABBREVIATIONS

EAF	-	Equipment Automation Framework
ESD	-	Electro Static Discharge
FA	-	Factory Automation
MES	-	Manufacturing Execution System
RMS BE	-	Recipe Management System BackEnd
WIP	-	Work In Progress
UI	-	User Interface
TFM	-	Total Fab Monitoring



CHAPTER 1

INTRODUCTION

1.1 Background

Strip testing is a semiconductor manufacturing process that performing electrical test while the device still in the lead frame strip. Strip is as shown in Figure 1.1.

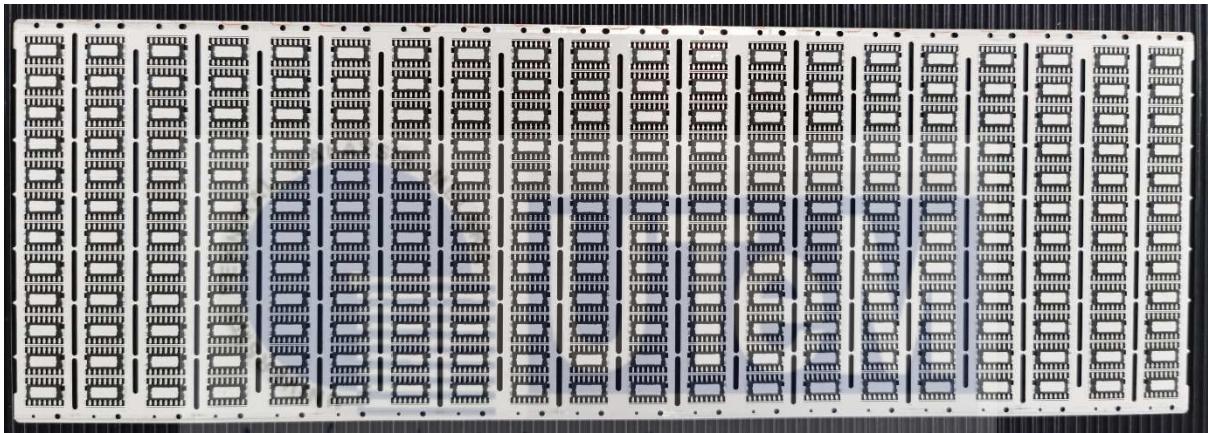


Figure 1.1: Strip (Infineon, 2020)

The device in the strip have to go through lead cut process for electrical isolation of the leads therefore we are able to perform individual devices test without affected/influence by other devices on the same strip. Strip test is a parallel testing of multiple units at the same time, increase throughput and reduce cycle time. Singulation of the device only happen after the testing process that is the other way compare to standard singulation process. Strip test addressed the issues of handling very small packages as the test if after singulation is hard to handle but when it is in a strip form then it is easy to handle. Singulated is shown in Figure 1.2.



Figure 1.2: Singulated device (Infineon, 2020)

Handling issue are also referring to bent leads, package cracks, missing units, ESD damage and jammed units. Strip testing is also facilitates lot tracking, all devices in secured location and can be precisely registered and identified by software, in the same way that die are tracked on a wafer map during wafer probing (EESemi, 2006). Strip test process shown in Figure 1.3.



Figure 1.3: Strip Test Process (Infineon, 2020)

This research will study on the how automation will improve the productivity and quality to the strip testing process. At the same time, we will address the industry problem as currently at semiconductor industry backend manufacturing is facing a problem on the automation limitation. Before we transform into Smart Factory or Industry 4.0 we have to ensure our system

and machine is ready and towards that direction. As of the concept of Automation is the pre-requisite for the Automated Material Handling System to have direct load and unloading to the machine.

Automation will replace the operator repetitive job and at the same time fully integrated with the manufacturing execution system.

For this research, it will contribute to the semiconductor industry by optimizing the process that lead to generate more throughput by having the same amount of machine.

1.2 Problem Statement

Strip test is also known as matrix test that is a testing process that perform testing in lead frame form instead of singulated form. Strip test technology are developed to reduce the cost of test at the same time reduce the time of the testing process (Beng, 2012) (STATS ChipPAC, 2018). In other words, with the same amount of time for singulated unit test, we are able to process more lots.

Despite their advantages, current strip testing is not a fully optimize solution. During change of lot, operator require performing a series of system to physical validation and many steps of system tracking in process before the lot started as shown in Figure 1.4.

› Current change lot flow

Handler State	Operation	Operation	Idle	Idle	Idle	Idle	Idle	Operation	Operation
Current Lot	Testing	Testing	Track-Out	Remove from handler					
Next Lot				Track-in	Place into handler	Soaking		Testing	Testing

← ~6-7 mins equipment idle time →

Figure 1.4: Current Change lot flow (Infineon, 2019)

The operator is require to manually download recipe management system as shown in Figure 1.5.

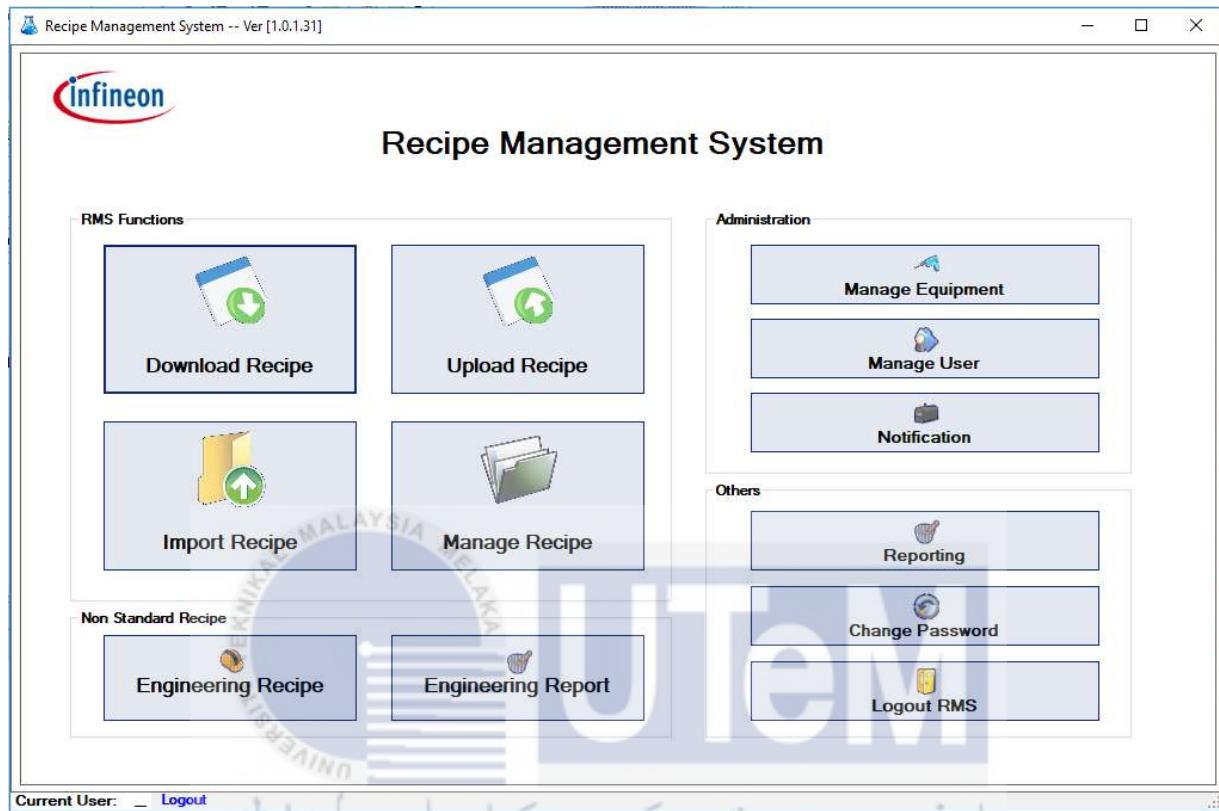


Figure 1.5: Recipe Management System (RMS) (Infineon, 2020)

Test program require manual triggering after the test order loaded into the tester as shown in Figure 1.6.

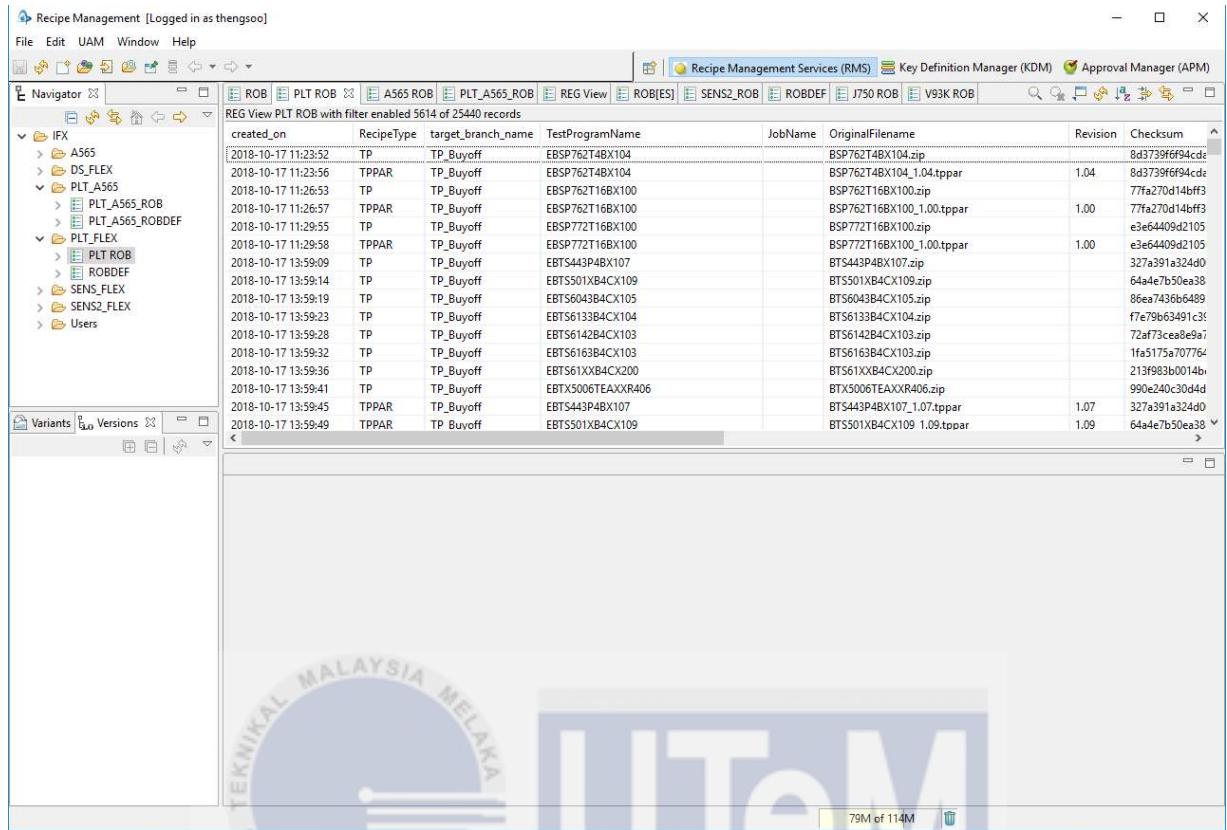


Figure 1.6: Test Program Management (Infineon, 2020)

After processed, processed lot require operator attention in order to have the operator manually perform tracking out process then only manually moving out the lot to the next operation/process. By having all these manual key in, manual selection, manual loading, it consumed so much of productivity time and nevertheless by having human intervention it will increase the potential risk of the quality issue. Figure 1.7 below shows the current process flow

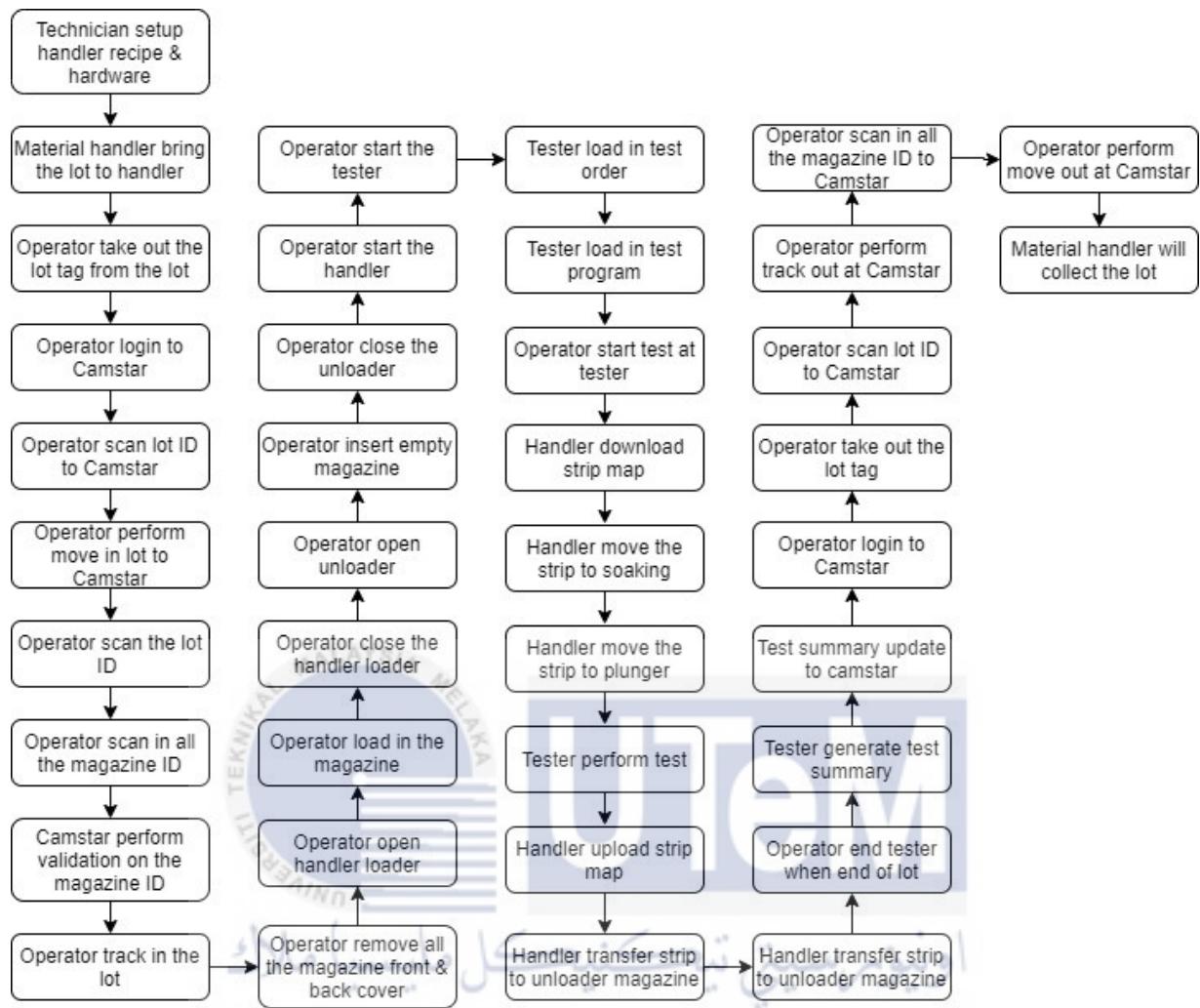


Figure 1.7: Strip test process flow

Based on current data, it shows that we have spent 2 minutes to perform change lot as shown in Figure 1.8. Only during change lot time the operator require to perform a series of task before we can run the machine as stated in the Figure 1.4.