UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

LEAN ADOPTION FOR EFFECTIVE MACHINE'S MAINTENANCE PERFORMANCE

TAN WEE KIEN

Master of Manufacturing Engineering
(Manufacturing System Engineering)

2016

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

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

NON-DISCLOSURE RESTRICTED USE AGREEMENT
("Agreement")

by and between

Tan Wee Kien
with home address at BB-272, Jalan Merpati 1, Taman Melaka Baru, Batu Berendam, 75350, Melaka, Malaysia.
- hereinafter referred to as "**Recipient**"

and

Infineon Technologies (Malaysia) Sdn. Bhd. (56645-D)
with office at Free Zone, Batu Berendam, 75350 Melaka, Malaysia
- hereinafter referred to as "**Infineon**"

- both may hereinafter be referred to as "**Party**" or "**Parties**"

Effective Date: 1st March 2014

Expiration Date: 28th February 2016

Survival Period: 5 years

WHEREAS, Infineon intends to engage in collaboration with the Recipient concerning the Master Project on "***Lean Adoption for Efficient Machine's Maintenance Performance***" by Tan Wee Kien (880518-04-5261) as a **Master in Manufacturing Engineering (System)** Degree project ("Purpose");

WHEREAS, in the course of such discussions and other activities (which may include line visits, presentations as well as the supply of services), it is anticipated that Infineon will disclose to the Recipient certain Confidential Information (as defined below) for the Purpose as set forth above;

NOW THEREFORE, the Parties agree as follows:

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   In addition, each Party further agrees to keep the existence of this Agreement confidential and not to use the same of the name of the other Party or its Affiliates as part of any disclosure or in marketing or publicity materials without the prior written consent of the other Party.

3. **Restrictions**. All Confidential Information delivered pursuant to this Agreement shall
   a. be used by the Recipient solely for the Purpose as set out in this Agreement, unless otherwise expressly agreed to in writing by Infineon; and
   b. not be distributed, disclosed, or disseminated in any way of form by the Recipient to anyone except its own or its Affiliates' university, who have a strictly academic need to know and who are bound to confidentiality by their agreements or otherwise not less stringent than under the obligations of this Agreement and the Recipient shall indemnify Infineon for all damages and costs arising from any unauthorized use or disclosure by the Affiliates; and
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   e. is approved for release by written agreement of Infineon; or
   f. is required to be disclosed to comply with any mandatory laws, judicial or governmental order or decree, provided that prior written notice be given to the Discloser as far as practicable.

 Recipient's initials:

5. **Refusal**. Either Party shall have the right to refuse to accept any information under this Agreement prior to any disclosure and nothing herein shall obligate either Party to disclose any particular information.

6. **No License**. No license or right to use under any patent or patentable right, copyright, trademark or other proprietary right is granted or conveyed by its Agreement. The disclosure of Confidential Information and materials shall not result in any obligation to grant the Recipient any rights therein.

7. **No Remuneration, Warranty or Liability**. The Parties are not entitled to any remuneration for disclosure of any information under this Agreement. No warranties or any kind are given and no liability of any kind shall be assumed with respect to such information or any use thereof, not shall Infineon indemnify the Recipient against or be liable for any third party claims with respect to such information or any use thereof.

8. **Termination**. This Agreement has an Effective Date and an Expiration Date as specified above. Prior to the Expiration Date, the Agreement may be terminated with respect to further disclosures upon thirty (30) days prior notice in writing. The obligations accruing prior to termination as set forth herein, shall, however, survive termination or expiration of this Agreement for the term of the Survival Period as specified above.

9. **Injunctive Relief**. In the event of a breach of this Agreement, the Recipient agrees that damages may not be an adequate remedy and instead an order for injunction or other forms of equitable or specific relief may be sought for as a court of competent jurisdiction sees fit to grant.

10. **Ownership, Return**. All Confidential Information provided by Infineon pursuant to this Agreement, shall remain the property of Infineon, and along with all copies, analysis or abstracts thereof, shall upon respective request of Infineon either be returned to Infineon or be destroyed by the Recipient or be purged from the records of any data storage system of the Recipient after termination of this Agreement. Such request shall be notified in writing by Infineon to the Recipient within ninety (90) days after termination of this Agreement. In case of destruction, the Recipient shall confirm in writing of such destruction to Infineon.

11. **No assignment**. This Agreement may not be assigned by either Party without the prior written consent of the other Party.

12. **Written form**. The provisions of this Agreement may not be modified, amended, nor waived, except by a written instrument duly executed by the Parties hereto. The requirement of written form itself can only be waived by mutual written agreement.

13. **No Contract**. This Agreement governs confidentiality and restricted use of Confidential Information between the Parties and shall not constitute an offer or acceptance or any form of agreement between the Parties for the supply of goods and/or services to Infineon, the terms to which shall be separately agreed in writing between Parties.

14. **Dispute Resolution**. All disputes arising out of or in connection with this Agreement, including any question regarding its existence, validity or termination, shall be settled finally

by binding arbitration under the Rules of the Kuala Lumpur Arbitration Centre ("Rules") by three arbitrators in accordance with the said Rules. Arbitration shall take place in Malaysia where its procedural law shall apply where the Rules are silent. The language to be used in the arbitration proceeding shall be English.

15. **Governing Law.** This Agreement shall be subject to the substantive law in force in Malaysia without reference to its conflicts of law provisions.

IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representatives on the dates specified below.

Tan Wee Kien

Signature: .....

Date: 13/5/15

NRIC number: 880518-04-5261

Infineon Technologies (Malaysia) Sdn. Bhd. (56645-D)

Signature: .....

Name : Low Sau Khiong

Title: Senior Manager

Date: 13/05/2015

NRIC number: 580226-04-5185

Company stamp:

Infineon Technologies (Malaysia) Sdn Bhd (56645-D)
Batu Berendam Free Trade Zone
75350 Melaka
Malaysia

Witnessed by: .....

Name: CHONG MIN FAH

Title: STAFF ENGINEER

Date: 13/5/2015

NRIC number: 750929-04-5579

Witnessed by: .....

Name : Nor Azman bin Jaafar

Title : Senior Program Manager

Date: 20/5/15

NRIC number: 660806-05-5371

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SESI PENGAJIAN: **2015/16 Semester 1**

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Disahkan oleh:

(_____)

(_____)

Alamat Tetap:

NO. BB272, Jln Merpati 1,

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FAKULTI KEJURUTERAAN PEMBUATAN

Tel : +606 331 6019 | Faks : +606 331 6431/6411

Rujukan Kami (Our Ref) :
Rujukan Tuan (Your Ref) :

28 Feb 2016

Pustakawan
Perpustakaan UTeM
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya,
76100 Durian Tunggal,
Melaka.

Tuan/Puan,

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Sukacita dimaklumkan bahawa Laporan Projek Sarjana yang tersebut di atas bertajuk ***"LEAN ADOPTION FOR EFFECTIVE MACHINE'S MAINTENANCE PERFORMANCE"*** mohon dikelaskan sebagai *SULIT / TERHAD untuk tempoh LIMA (5) tahun dari tarikh surat ini.

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Sekian dimaklumkan. Terima kasih.

Yang benar,

PROF. MADYA DR. MOHD RIZAL BIN SALLEH
Dekan
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka

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DECLARATION

I declare that this thesis entitled "Lean Adoption for Effective Machine's Maintenance Performance" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : TAN WEE KIEN

Date : 20/3/2016

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Manufacturing Engineering (Manufacturing System Engineering).

Signature : .....

Supervisor Name : DR. RIZAL

Date : 18.3.2016

ABSTRACT

In the manufacturing, every industry will involve in ramp up. This will indirectly encourage the company to purchase more machines to meet the increasing demand proportionately. However, as more machines and utilities are purchased, the working area needs to be expanded accordingly as well. During such steep ramp up, most of the plans and strategies may not be fulfilled thoroughly. Therefore, with increase of machines and utilities, the maintenance system requires makeover in order to cope with the ramp up too. The 5S will deteriorate together with the planned activities which are applicable previously, but may not be applicable now. Lean manufacturing system in maintenance bay is one of the project plans to improve the current situation to cope with the steep ramp up. The tools, re-layout, 5S, Total Productive Maintenance (TPM), Single Minute Exchange Die (SMED) are all taken into consideration in this project to help ensure that the manufacturing is one step ahead towards the next level of maintenance, the predictive maintenance. The intention for this system has always been to cope with the ramp up as well as minimize the equipment downs frequency by making use of proper tools, 5S, TPM concept and SMED concept. The end in mind of this project is to meet the vision of lean manufacturing in maintenance by eliminating common wastes faced by such industry.

ABSTRAK

Dalam sektor perkilangan, setiap industri akan terlibat dalam ramp up yang ketara. Ini secara tidak langsung akan menggalakkan syarikat untuk membeli lebih banyak mesin untuk memenuhi permintaan yang semakin meningkat secara berkadar. Walau bagaimanapun, semasa banyak mesin dan utiliti yang telah dibeli, kawasan kerja perlu diperluaskan dengan sewajarnya juga. Sepanjang ramp up yang ketara ini, kebanyakan rancangan dan strategi tidak boleh dipenuhi dengan sempurna. Oleh itu, dengan peningkatan mesin dan utiliti, sistem penyelenggaraan memerlukan makeover untuk menghadapi situasi ramp up tersebut. 5S akan merosot bersama-sama dengan aktiviti-aktiviti yang dirancang yang terpakai sebelum ini, tetapi mungkin tidak sesuai untuk dipakai kini. Sistem pembuatan Lean dalam Maintenance Bay adalah salah satu pelan projek untuk memperbaiki keadaan semasa untuk menghadapi ramp up tersebut. Alat, semula susun atur, 5S, Total Productive Maintenance (TPM), Single Minute Exchange Die (SMED), semuanya diambil kira dalam projek ini untuk membantu memastikan bahawa pembuatan adalah satu langkah ke hadapan ke arah peringkat seterusnya penyelenggaraan. Niat untuk sistem ini adalah sentiasa untuk menghadapi ramp up serta untuk mengurangkan kekerapan surut peralatan dengan menggunakan alat-alat yang betul, 5S, konsep TPM dan konsep SMED. Pencapaian utama projek ini adalah untuk memenuhi wawasan pembuatan lean dalam penyelenggaraan dengan menghapuskan pembaziran yang biasa dihadapi oleh industri tersebut.

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Particularly, I would also like to express my deepest gratitude to End of Line Manager Mr. Chong Min Fah, my direct superior from Infineon Technologies of M2, Miss. Heng Soo Ann, the passionate Molding Engineer that shares the common vision with me, Mr. Chandramohgan a/l Palamandy and Mr. Nasri Bin Kassim, the technicians from M2 Molding for their assistance and efforts in all the hands on works.

Special thanks to all my peers, my mother, beloved father and siblings for their moral support in completing this thesis. Thanks also to all my Masters Lecturers that provided all the insight in terms of knowledge and valuable lessons that is applicable directly and indirectly to this thesis. Lastly, thank you to everyone who had been to the crucial parts of realization of this project.

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A2	-	Plating Process
AHP	-	Analytical Hierarchy Process
AV	-	Availability
CBM	-	Conditional Based Maintenance
CI	-	Consistency Index
CM	-	Corrective Maintenance
CR	-	Consistency Ratio
DC	-	Design Concepts
DMAIC	-	Define, Measure, Analyse, Improve, Control
DOE	-	Design of Experiments
DP	-	Distance from Parts
ESH	-	Ergonomics, Safety, Health
FMEA	-	Failure Mode Effect Analysis
IS	-	Inventory Size
JIPM	-	Japan Institute of Plant Maintenance
JIT	-	Just-In-Time
M	-	Motion
M2	-	Module 2
MCDM	-	Multiple Criteria Decision-Making Techniques
MEC	-	Microelectronics Center
MMO	-	Man-Machine Optimization
MP	-	Machine Performance

MTBA	-	Mean Time Between Assists
NV	-	New Vector
NVA	-	Non Value Added
OCAP	-	Out of Control Action Plans
OEE	-	Overall Equipment Efficiency
OJTI	-	On Job Training Instructions
OVA	-	Operation Value Added
PC	-	Personal Computer
PM	-	Preventive Maintenance
POM	-	Power Melaka
PQCDMS	-	Productivity, Quality, Cost, Delivery, Morale, Safety
PR	-	Productivity
PSI	-	Preference Selection Index
PV	-	Priority Vector
QCDMS	-	Quality, Cost, Delivery, Morale, Safety
QM	-	Quality Maintenance
QRA	-	Quick Response Actions
RI	-	Random Index
RTR	-	Reel to Reel
S	-	Safety
SAP	-	System Applications Products
SD	-	Scheduled Downtime
SMART	-	Specific, Measurable, Achievable, Realistic, Timely
SMED	-	Single Minute Exchange Die
STS	-	Strips to Strips
TFM	-	Total Fab Manufacturing

TIMWOOD	-	Transport, Inventory, Motion, Waiting, Over-process, Over-production, Defects
TOPSIS	-	Technique for Order Preference by Similarity to Ideal Solution
TPM	-	Total Productive Maintenance
TPS	-	Toyota Production System
TQM	-	Total Quality Management
TWI	-	Training Within Industries
T&E	-	Training and Education
UD	-	Unscheduled Downtime
VA	-	Value Added
VSM	-	Value Stream Mapping
WIP	-	Work In Progress
4M	-	Man, Method, Machine, Material
5S	-	Seiri, Seiton, Seiso, Seiketsu, Shitsuke
λmax	-	Maximum Eigenvalue

CHAPTER 1

INTRODUCTION

1.1 Background

In this topic, the company that will be the subject is Infineon Technologies and the area of focus is on molding process in Module 2 (M2) DPAK Strip to Strip (STS). Infineon Technologies is a manufacturing company in semiconductor industry which manufactures chips encapsulated in units form usually to be installed for electrical and electronic appliances. This manufacturing involves processes such as chips in wafer form (wafer sawing), die bond, wire bond, A2 plating, molding, plating, trim and form, vision check, and testing. Each process plays an important role in terms of machine performance as well as its productivity. This is important especially when millions of such units are produced in a short period of time.

This study focuses on the Lean Adoption for Efficient Machine's Maintenance Performance for molding process. There are many types of wastes that can be observed from the maintenance side if they are not managed and identified properly. Several numbers of wastes when they are combined together may cost the company millions or billions of dollars of losses.

While productivity increases, number of wastes such as defects may be inevitable. Therefore, it becomes essential to look at the contribution from the maintenance side to not only on the machines performance, but also on its effectiveness, efficiency, and wastes reductions.

Many companies faced millions of dollars losses yearly due to improper planning and the unnecessary expenses on wastes such as transportation, inventory, motion, waiting, over-processing, overproductions, and defects. Infineon Technologies is no stranger to such wastes. As semiconductor industry becomes more competitive; process and manufacturing improvements, as well as wastes reductions are essential where adopting the Lean concept is one of the important keys to increase the profit margin of the company by reducing unnecessary costs.

With the current ramp up, more machines are purchased and tools management need to be further improved and must take into account the number of machines involved. This requires proper planning on production line and also on the maintenance room. The maintenance room is the heart of the production lines as the activities carried out will support the machines performance and the production. Therefore, it is important to understand the situation that the current production lines and maintenance are facing.

With the current ramp up also, comes proper planning. This planning will take into consideration the transportation and motion where the time taken to transport tools for maintenance to machines cannot be taken lightly. This will also help to reduce the waiting time which is a non-value added activity. Therefore, the proper tools kit to perform Preventive Maintenance (PM), weekly or daily maintenance, calibrations, and other maintenance must be effective and meaningful. Besides transportation, inventory to store