اونيۏرسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

IMPROVING OEE DATA QUALITY BY AUTOMATED DATA COLLECTION THROUGH IDENTIFYING PRODUCTIVITY POTENTIALS

K.Vasanthan a/l Karuppiah

Master in Manufacturing Engineering (Manufacturing System Engineering)

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IMPROVING OEE DATA QUALITY BY AUTOMATED DATA COLLECTION THROUGH IDENTIFYING PRODUCTIVITY POTENTIALS

K.VASANTHAN A/L KARUPPIAH

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

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2017

DECLARATION

I declare that this thesis entitled "Improving OEE data quality by automated data collection through identifying productivity potentials" 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 : K. Vasanthan

Date : 24/03/17

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Manufacturing Engineering (System Engineering).

Signature : ....

Supervisor Name : ...ASSOC. PROF. IR. DR. PUVANASVARAN A/L A. PERUMAL
Faculty Of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal, Melaka

Date : 17/4/2017

DEDICATION

I dedicate this hard work of mine to my beloved – wife Vijaya and Sons Puvenraj, Saranraj and Deepanraj and my Sai family. Their continuous enouragement, motivation, inspiration and support had let me towards completion of this project.

ABSTRACT

Most semiconductor organizations take after the SEMI standard rules to gauge equipment availability and utilization by means of Overall Equipment Effectiveness (OEE). Be that as it may, a few issues should be vanquished to get improve data accuracy of OEE. For instance, the time interims of OEE losses are basic to the improvement studies, however it is difficult to gather reliable and precise information. Hence, people will find the obscure contrasts between the manual recorded losses from their operational system and OEE losses from SEMI standard definition once people execute OEE. Besides, how to acquire the every stoppages of machine in real time to determine equipment stability issued to be conquered.

This project is to develop an IT integrate framework to record the equipment process state for the bottleneck process "wire bonder" in the semiconductor assembly industry. Semiconductor equipment interface protocol for equipment to host communication (SECS/GEM) and Manufacturing Execution System (MES) into an Automated Data Collection framework for gathering valuable information. The information quality is further assurance by the real time detection of equipment status from the automate data collection framework. The application of the automate data collection framework is get rid of the unknown OEE losses. This will resolves the accuracy and timeliness issue associated with manual gathering OEE information.

ABSTRAK

Kebanyakan industry semikonduktor mengamalkan peraturan SEMI standard untuk mengukur avalability dan utilization melalui Keberkesanan Peralatan Keseluruhan (OEE). Jadi kerana ia boleh, beberapa isu perlu dikalahkan untuk mendapatkan meningkatkan ketepatan data OEE. Sebagai contoh, interim masa kerugian OEE adalah asas kepada kajian penambahbaikan, tetapi ia adalah sukar untuk mengumpul maklumat yang boleh dipercayai dan tepat. Oleh itu, orang akan mencari perbezaan-perbezaan kabur antara manual mencatatkan kerugian daripada sistem operasi dan kerugian OEE dari SEMI definisi biasa sekali orang melaksanakan OEE. Selain itu, bagaimana untuk memperoleh setiap pemberhentian mesin dalam masa nyata untuk menentukan kestabilan mesin adalah satu lagi isu untuk dapat ditawan.

Kajian ini akan membangunkan IT berintegarsi sistem untuk merekod selang masa OEE kerugian bagi peralatan cerutan " Wire Bonder" dalam industri pemasangan semikonduktor. Mengintegrasikan sistem komunikasi dan sistem pelaksanaan pembuatan (MES) ke dalam satu sistem Pengumpulan Data secara automatik(ADC) untuk mengumpul data yang berguna. Kualiti data adalah tambahan guaranty oleh pengesanan masa nyata status peralatan daripada sistem komunikasi. Penggunaan sistem ADC adalah menghapuskan kerugian OEE tidak diketahui. Ini akan menyelesaikan masalah itu tepat dan menepati masa yang dikaitkan dengan tradisi data OEE mengumpul yang manual.

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CHAPTER 1

INTRODUCTION

1.1 Background

Overall Equipment Effectiveness (OEE) is a measure that quantifies how well is a manufacturing unit performed. It is comparing what the equipment produced to what the equipment could have potentially produced. Enhancing OEE is a critical factor in the manufacturing industries because of contracting net revenue, consolidation and wild rivalry have driven the desideratum diminish the expense.

OEE is a quantifiable data which have high potential to unleash hidden capacity (Muchiri and Pintelon, 2008). OEE accounts the losses in term of availability, performance and quality. The losses of the production system are recorded from one of the sources such as real time manufacturing data. it is collected by using Manufacturing Execution System (MES), similar resources which track and store the real time production data and from the manual files that record the production details and maintained by the production team. By eliminating the losses from the production system, the unplanned downtime of the machines is reducing, thus increasing the OEE.

OEE is a well-known measure for a production line. It must be utilized to quantify the execution of the individual machines (Muchiri and Pintelon, 2008). OEE was initially presented by Nakajima in year 1988. Many studies have contended about the utilization OEE throughout the years. With the development of OEE, distinctive changes were done to OEE to fit to more extensive viewpoint as assumed vital for the organizations.

The intensity of the manufacturing facilities is not just relying on upon the utilization of the equipment but additionally relies on operator productivity (Chien et al., 2013). The human element which is operator is the most vital and a basic element that impact to the machine profitability (Dvořák et al., 2008). The interference issues (i.e. permitting one operator to work or repair a few machines) result in machine idleness and at the same time reduce the performance of the production system. This interference time is the potential time lost in the total planned production time.

To remain competitiveness, most of the manufacturing companies should take steps to increase the productivity and establish more preponderant operational stability. Manufacturing companies should manage the engenderment networks efficiently and this includes the key challenge of increasing the efficiency of the shop floor operations. There are many variables which affect the performance of the system. The throughput of the production system is affected by the capacity of the machines in the system

Depending on the nature of the production system, some machines are disrupting the flow of products across the production system and affecting the overall throughput. Another important component of the production system that will impact directly to the improvement of the overall production performance is the maintenance. According to Mishra (2012), if the maintenance is not performed in the right way, then it may lead to over maintenance or under maintenance which might increase the cost and reduce the productivity. Therefore, the cost effective and right maintenance performed at right time will boost the productivity of the production system by reducing the total breakdown time and by reducing the frequency of breakdowns.

The companies have grown remarkably in sophistication bristling with MES systems which monitor the machine activity almost every instant of the time. This results to the accumulation of the machine data. Figure 1.1 shows the average data rows collected per year from a machine in the shop floor of a semiconductor manufacturing company. If 500,000 data rows are collected per machine and the production line has ten machines, then the amount of data collected for the production system is 5 million data rows per year which is a huge amount of data.

Tapping the valuable information from these vast troves of data which otherwise would go unused could help manufacturer to gain valuable insights and this leads to profitable operation. The analytical information extracted from the huge data collected can help to identify the bottlenecks and the selection of the maintenance strategies. The analytics could be conducted on myriad of ways over the large data which could identify the correlations and hidden patterns, thus support the fact-based decision making process in the production environment. Therefore, manufacturers must take the advantage of this real time data collected by MES to tackle their biggest challenges and the most important objectives.

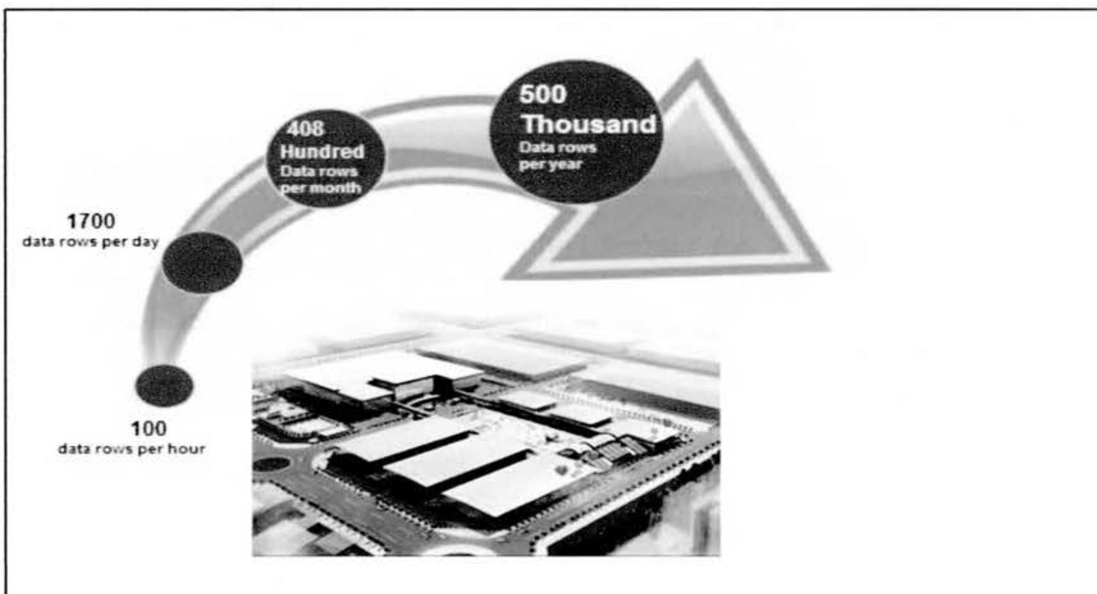

Figure 1.1: Average data rows of data collected per machine (Mukund, 2015)

1.2 Equipment and Materials International (SEMI) Standards

The SEMI standards facilitate real-time data assortment from the production equipment. Apart from OEE as an efficient dimension tool in the manufacturing environment, the SEMI standards offer a method to observe the efficiency of equipment on the production floor. TPM, together with SEMI specifications, furnish meaningful know-how about the productiveness, utilisation, equipment reliability, equipment availability and equipment maintainability of manufacturing operations. SEMI developed a few requirements and SEMI E10 is common in conjunction with OEE, particularly measure the efficiency of the equipment. This has created an increase acceptance and higher interest to explore the application with the aid of the electronic manufacturing industries.

The performance effectivity measures how effectively the equipment is utilised and the effectiveness of quality product produced throughout the manufacturing process. To establish this link, the SEMI Equipment Communication Standard (SECS) and Generic Equipment Model (GEM) were situated. It is outlined as a set of communication interface protocol between a host computer and the production equipment. SECS/GEM standard is a two-way communication between host and equipment on the production floor through the factory local area network (LAN). The factory provides the host approach and the equipment manufacturer provides the equipment SECS/GEM standard messaging. Through this system, the SECS/GEM standard provides reliable and accurate real-time information from the production equipment.

SEMI E10 establishes six basic apparatus states and aggregations of those states as proven in Figure 1.2 and Figure 1.3. Additional visibility and better decision of equipment operation is also carried out by means of creating user defined sub-states that map to the six general states. This allows for customers to customize their SEMI E10 application to unique operating situations and equipment efficiency ambitions whilst preserving compliance with the SEMI E10 main state definitions and RAM/Utilization metrics.

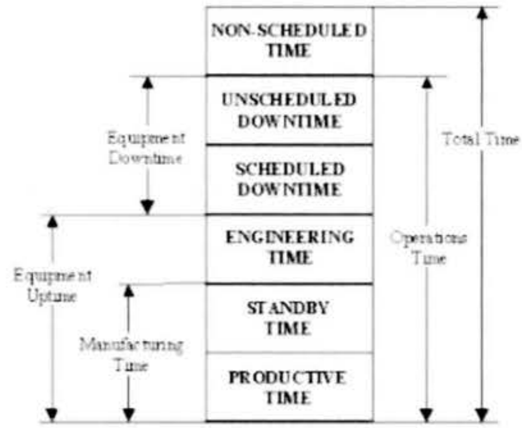

Figure 1.2: SEMI E10 basic state stack chart. (Thomas, 2016)

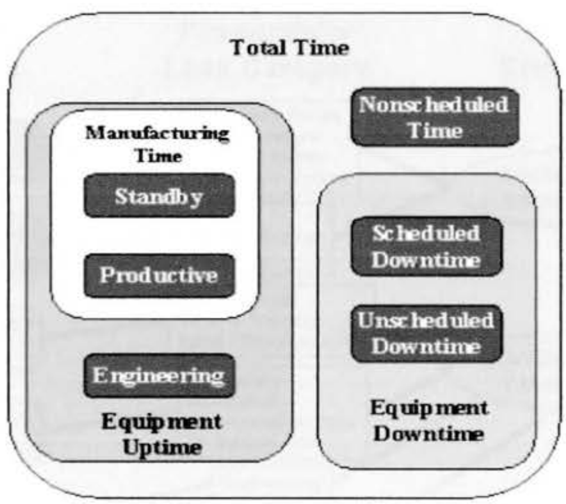

Figure 1.3: SEMI E10 basic state (Thomas, 2016)

SEMI E10 presents the baseline equipment performance information utilized for ability analysis and constraint administration, as well as baseline data for a suite of higher level performance metrics together with the cost of ownership defined in SEMI E35 (SEMI, 2004), Overall Equipment Effectiveness (OEE) outlined in SEMI E79 (SEMI, 2016) and factory level productiveness defined in SEMI E124 (SEMI, 2007) as proven in Figure 1.4.

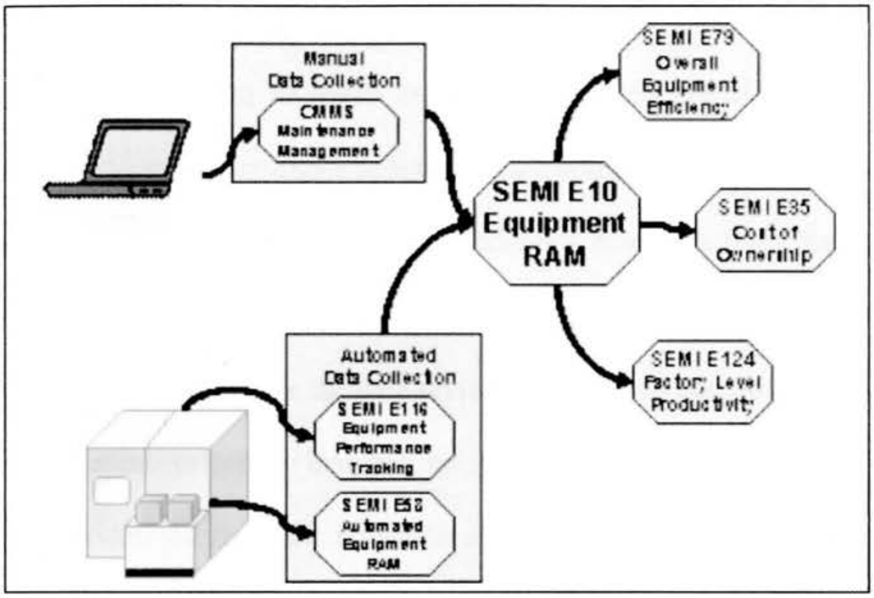

Figure 1.4: The suite of performance and productivity metrics (Thomas, 2016)

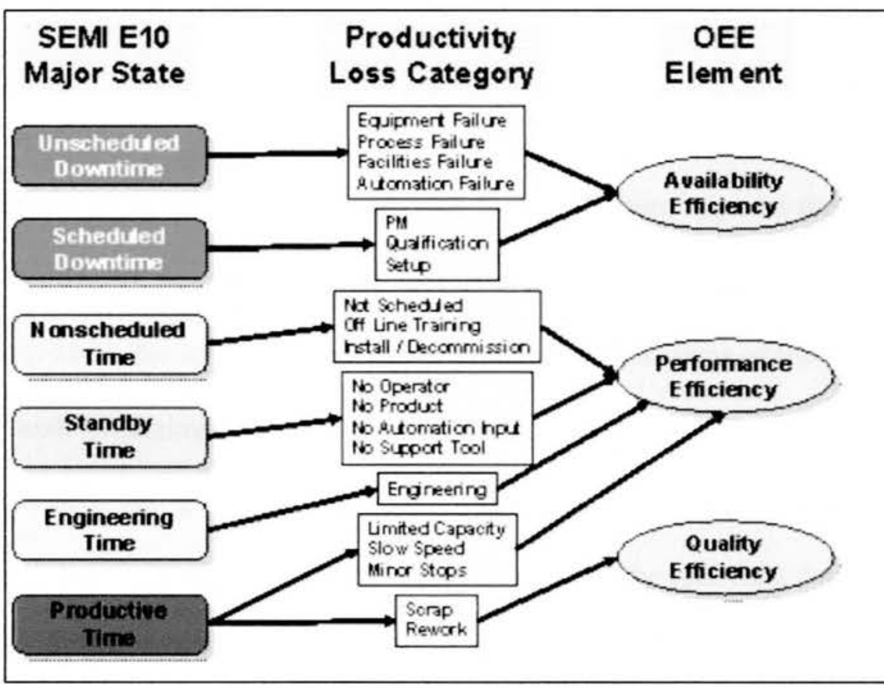

Figure 1.5: SEMI E10 state to SEMI E79 OEE mapping (Thomas, 2016)

SEMI E10 is particularly tightly linked with SEMI E79, providing critical equipment time-in-state information used in equipment productivity (OEE) metrics. Figure 1.5 shows the mapping between SEMI E10 and SEMI E79 which allows continuous improvement team to determine productiveness growth possibilities and monitor the success of improvement efforts using usual equipment state monitoring data collection.

1.3 Significance of the Study

This study is intended to make an advancement of knowledge to beef up the productivity in Infineon Technologies semiconductor company by real time data amassed from the shop floor. The algorithms for the bottleneck detection from the real-time data might be used as an alternative to simulation of production system which needs much more capabilities and time and by utilize the data driven analysis will take lesser time to simulate. Additionally, different priceless insights on the key performance symptoms of the production system derived from the real-time analysis will function on base for decision making to improve the production performance and for this reason a data driven decision making process in manufacturing industries is made.

1.4 Purpose

The purpose of the study is to establish the ways where improve the productivity of the production line by way of controlling and managing the system constraints. The system constraints could be due to the bottlenecks or common breakdowns of the machine. Before controlling and managing the system constraints, identifying the system constraints is important. By addressing and managing the system constraints, the overall availability of the production line is increased. To aid this, evaluation of the real-time data is done for an assembly line in Infineon Technologies semiconductor manufacturing company.

1.5 Problem Statement

Currently, Infineon Technology semiconductor company has several different groups responsible for collecting various types of data on the status of the manufacturing system. The types of data range from equipment performance, process data, product testing to material usage of the whole manufacturing system. The information collected is an important part of maintaining the productivity, process performance and product quality. The information collected is used in various types of management systems such as quality management system, process management system, production management system and the equipment performance monitoring system. These systems are integral parts of the improvement project selection and development of the process in manufacturing and directly support Infineon Technology semiconductor company to stay in competitive market and save millions of dollars in manufacturing losses.

In Infineon Technology semiconductor company, data collection processes are a combination of manual and automated methods. These processes are time consuming and labour intensive, and they present numerous quality, cost and delivery concerns. Since several groups are responsible for collecting the data, several trips over the same maintenance section are required to collect the necessary equipment information. Overall Equipment Effectiveness (OEE) keeps to gain acceptance as an effective method to measure equipment performance. Capturing and recording accurate equipment information is crucial for producing reliable OEE report. It is for a commonplace opinion that productivity improvement is in recent times the most important task for company to be able to stay aggressive in the global market.

A well-known way of measuring the effectiveness is the OEE index. it is first evolved by way of the Japan Institute for Plant Maintenance (JIPM) and it is widely used in the manufacturing industries. Moreover, it is the backbone of the methodology for exceptional improvement such as Total Quality Management (TQM) and Lean manufacturing.

Every semiconductor manufacturer needs to reduce machine downtime, with limited resources accessible to devote to downtime reduction. However, the foremost vital method in any downtime reduction program is due to the accuracy of the data, where the resources will do the best with quality of data. The primary step in any downtime reduction program should be measurement, as a result of cannot fix what you do not measure. (Keegan, 2014). The most economical and reliable technique of downtime measurement is through the automatic equipment data assortment.

Infineon Technology semiconductor company is dealing with many challenges in the industry. The traditional maintenance is considered as passive and non-productive to the current manufacturing or production process. The benefit from these studies have often been constrained for the reason of unreliable or inflexible equipment (Krishnamoorthy, 2014).

Problem is further clarified with a series of questions such as what is the specific object of nonconformity, what is wrong with the object, where is the object when nonconformity was noticed first, where is the nonconformity located on the object, how many objects have the same nonconformity and what is the pattern of occurrences. In this case, the problem is OEE data collector does not gathers the actual performance of machine due to manual logging. The huge gap between with actual machine state vs recorded machine state. Figure 1.6 shows the data comparison between the actual performance and recorded data of a machine.