



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**MANUFACTURING COMPLEXITY CHARACTERIZATION:  
CASE STUDY AT MICRO-NANO PRECISION SDN. BHD**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) with Honours.

By

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FACULTY OF MANUFACTURING ENGINEERING

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## **APPROVAL**

This Bachelor's report submitted to the senate of UTeM and has been accepted as fulfillment of the requirement for the Degree of Bachelor of Manufacturing Engineering (Manufacturing Management) with honours. The member of the supervisory committee is as follow:

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## **ABSTRACT**

Complexity has turned out to be a great challenge in the manufacturing industry through the application of documentation, process flow, standardization and manufacturing activity. This study aims to identify the type of manufacturing complexity, to characterize how the industry manages and simplifies complexity and to make recommendation for industry to improve productivity via well-managed manufacturing complexity. Micro-Nano Precision Sdn. Bhd (MNPSB) is chosen for the case study. Survey and interviews were conducted and the respondents were the management team of MNPSB. Analysis was done to explore the data in detail and the data was interpreted in Microsoft Excel 2007 to categorize manufacturing complexities into three categories consist of most complex manufacturing activity, moderate complex manufacturing activity and least complex manufacturing activity. Each category of manufacturing complexity has different factors that contribute to the problem in manufacturing activities. Most complex has problem regarding with project planning due to lack of machine capacity and production rate to support customer demand. Thus, lead to high work in progress between processes. Moderate complex occurs due to high reject rate in quality control and inspection because of pressure of meeting dateline in a very short duration. Standard of procedure skip also leads to high rejection rate. Based on the case study, least complex was found in outsourcing. This is due to no problem was found regarding manufacturing complexity. Processes involved such as purchasing process flow went smoothly and documentation in supplier assessment was organized.

## **ABSTRAK**

Pembuatan rumit pada masa kini menjadi salah satu masalah terutamanya kepada industri pembuatan melalui kertas kerja, peralihan proses, penetapan kerja dan aktiviti pembuatan. Tujuan kajian ini dilakukan adalah untuk mengenal pasti jenis pembuatan rumit, untuk mengenal pasti bagaimana syarikat menguruskan pengeluaran kompleks dan memberi cadangan bagaimana sepatutnya industri menguruskan pembuatan rumit untuk meningkatkan produktiviti. Micro-Nano Precision Sdn. Bhd (MNPSB) telah dipilih sebagai lokasi untuk melakukan kajian ini. Kajian dan temuduga dijalankan kepada pihak pengurusan sebagai responden. Analisa dilakukan untuk meneroka data dan data ditafsir dalam Excel 2007 untuk mengasingkan pengeluaran rumit kepada tiga bahagian iaitu pengeluaran aktiviti yang paling rumit, pengeluaran aktiviti yang sederhana rumit dan pengeluaran aktiviti yang kurang rumit. Setiap kategori pengeluaran kompleks mempunyai faktor yang berbeza dalam menyumbang masalah dalam aktiviti pengeluaran. Perancangan projek ialah paling rumit manakala pengawalan kualiti ialah sederhana rumit dan pembekal luar ialah kurang rumit. Perancangan projek adalah paling rumit kerana kapasiti mesin dan kadar pengeluaran tidak dapat menampung permintaan pelanggan. Operator pengawalan kualiti yang tidak mengikut prosedur kerja dan masa untuk memeriksa produk yang menyumbang kepada pengeluaran rumit dalam pengawalan kualiti. Pembekal luar paling kurang rumit kerana perjalanan aktiviti di dalamnya lancar serta mempunyai kertas kerja yang sistematik.

## **DEDICATION**

*For my beloved parents:*

Mr. Ahdenan@Adnan Bin Esa

Madam Nora Binti Hj. Ibrahim

*For my PSM supervisor*

Dr. Wan Hasrulnizam B. Wan Mahmood

*For my project advisor*

Dr. Bong Cheng Siong

*And my treasured friends*

UTeM's students



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*Bismillahirrahmanirrahim...*

In the name of Allah S.W.T, the creator of all creations, all praised to Him, the most Merciful and Most Blessing, Alhamdulillah I had completed this study successfully.

A thousand of gratitude to Dr. Wan Hasrulnizam B. Wan Mahmood, my respectable supervisor for his advice and motivation for me to completed this study. Not also to forget Micro-Nano Precision Sdn. Bhd General Manager, Dr. Bong Cheng Siong for helping me with this project by allowing me to take the company data. Without the data, the report will not be as detail as shown in this report.

An acknowledgement with great respect to my beloved family and without their prayers, willingness and moral support this study would be difficult to complete. Last but not least, I would like to acknowledge all the Project Sarjana Muda Committee for their handwork in order to ensure the successful of this task.

*Muhammad Aidil Bin Adnan*

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## LIST OF ABBREVIATIONS

C/A	-	Clear Anodize
CLM	-	Council Logistic Management
CNC	-	Computer Numerical Control
EDM	-	Electrical Discharge Machining
EN	-	Electroless Nickel
GD&T	-	Geometrical Diameter and Tolerance
GM	-	General Motor
HOD	-	Head of Department
HR	-	Human Resources
MNPSB	-	Micro-Nano Precision Sdn. Bhd
MNPPG	-	Micro-Nano Precision Penang Sdn. Bhd
NCR	-	Non Conformance Report
OEM	-	Original Equipment Manufacturer
PG	-	Profile Grinding
PIC	-	Person in Charge
QC	-	Quality Control
RA	-	Roughness of a Surface
SOP	-	Standard of Procedure
SCM	-	Supply Chain Management
TQM	-	Total Quality Management
WIP	-	Work in Progress

# **CHAPTER 1**

## **INTRODUCTION**

This chapter provides the background, objectives, scope and importance of the study. Besides, it briefs information about manufacturing complexity in Micro-Nano Precision Sdn. Bhd.

### **1.1 Background of Study**

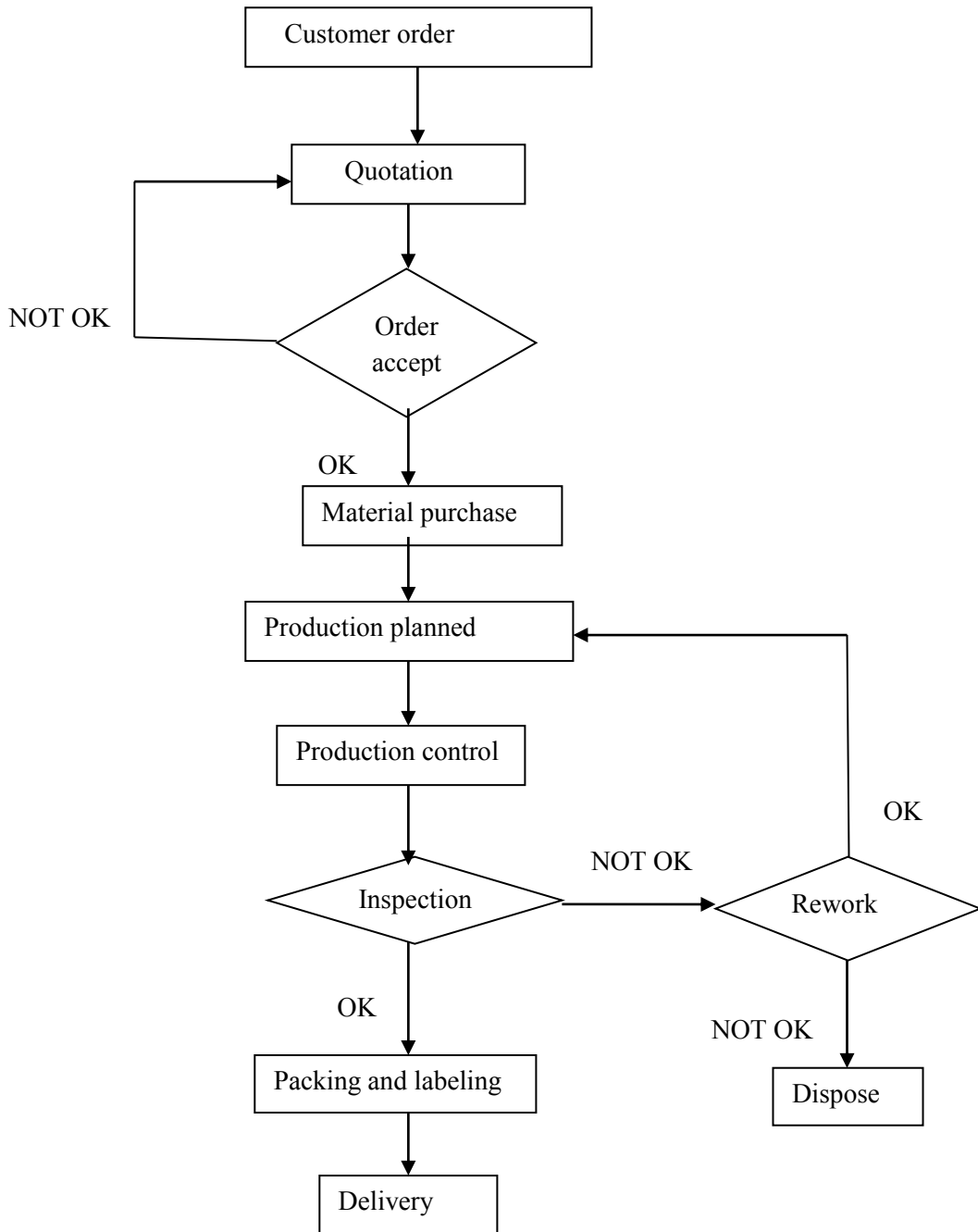
At present, manufacturing complexity is become multifaceted and has converted a new great challenge for industry. Manufacturing complexity occurred in every area of manufacturing activities such as manufacturing system design, total quality management, supply chain management, inventory management, project management, human resources and job design spreading across the organization silently without noticed and can be triggered as the malfunction of an manufacturing element. The mapping of interdependence between and among those elements, and measuring the metrics of the elements and their interrelationships, if elements are missing or defective, not properly interfacing or misaligned, or not performing correctly, then it is considered manufacturing complexity occurred.

The understanding about manufacturing complexity is essential to control the non-linear behavioursystem of production system to create a competitive, predictive and productivity manufacturing system. Behaviour of the system and issues are unpredictable such as behavior of machine and human can increase manufacturing complexity that comes with complicated issues in manufacturing activities. Unpredictable behavior of manufacturing system can cause lack of information and variety in aspects of manufacturing process, system and operation. Thus more

opportunities and information for the product, system or process will behave in unpredictable manners while the systems operate, managing, designing and anticipating resulting consequences facing difficulty because of manufacturing complexity. Research needed for implementation of translating manufacturing complexity into competitive advantages.

## **1.2 Problem Statement**

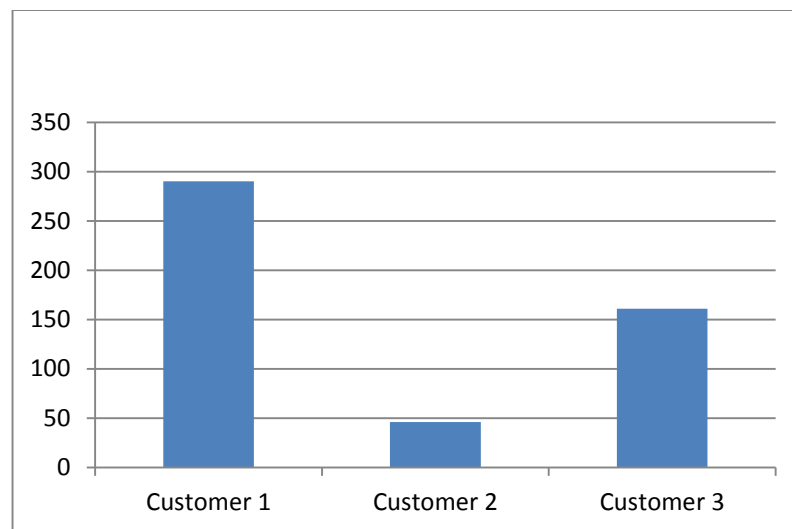
Micro-Nano Precision Sdn. Bhd (MNPSB) is a tool fabrication company and an original equipment manufacturer which fabricate product designed by customer. Fabricated tools in the company such as trim and form, molding, cavity bar, precision punches and tools, degate tools, die inserts, die sets, core and cavity injection mold for plastic industry, jig and fixtures, automotive parts and machining part. The company fabricate many types of tool consist of variety of design and each types of tools was made through different process. The flow of production indicated in Figure 1.1 starts with customer order and receiving of product drawing through e-mail. Price quotation of product is determined concerned of the process involved, material sourcing and delivery requirement. Order decision making based by machine capacity and the capability of the company to produce the product. Material purchasing implemented as the order accepted and product start to fabricate by determined process. In production has internal inspection after each process to control the quality of product while in progress. Person in charge has to monitor the product for the product need to complete on time and in good quality. The completion of product need to go through QC department for final checking and the rejected part need to rework or dispose based on the quality of product. The good quality product is packing and labeling and send for the delivery.



**Figure 1.1:** General Production Flow

Pre observation has determined MNPSB has problem in fabricating product on time. The production took more time as expected to fabricate a product as shown in Figure 1.2. Figure 1.2 show drawing quantity of the product that late on due date based by three main customers from June 2014 until August 2014 and these three customer give more profit to company. Total late outputs for customer 1 are 290 drawings, for

customers 2 are 46 drawings and for customers 3 are 161 drawings. Each drawing has different quantity of tools and product for each customer are different in design and made by different process which in conventional machine or automatic machine. The machine such as wire cut machine, grinding, CNC grinding, profile grinding, EDM machine, CNC milling, CNC turning and conventional turning are the machines involved in fabricated the tools.



**Figure 1.2:** Drawing Quantity of Late Product Produced from June until August for Three Main Customers

The problem found because of capacity planning in MNPSB and the reason due to lacking in determine the changeability of capacity levels by when and how much and deal with key work centre and all individual resources. The problem lead to the failure in forecast product families and individual product (Ceryan and Koren, 2009). It is critical for MNPSB to plan capacity requirement planning and determining when and by how much the capacity levels should change such as in circumstance of when customer demand more than machine capacity.

Managers and person in charge cannot organize sequence of processes appropriately because three main customers given more priority than other customers contribute to time waste also for other customers. The rework of rejected product is put on hold in order to process a much urgent products ordered by the main customers contribute to

the increasing of pending work in progress product but the product from main customer still late on due date. Process operators skip the product inspection in work in progress because many inspection tools lost inside the machine department and can increase the rework rate and consistently increasing the time waste for production indirectly. This problem is strictly need serious attention to solve the waiting waste on meeting the production dateline.

MNPSB have high product reject as shown in Table 1.1. Table 1.1 shows total reject for the process involved in production for three main customers from June 2014 until August 2014. Rejected product can be found before the process, while in process, after process and after QC inspection. There are two kind of inspection in MNPSB which are internal process inspection and QC inspection. Each process has different rate of producing reject and the reject consume of machine problem or human error operating the machine. Program reject occurs when programmer wrote inaccurate program in the automatic machine lead to the defect on the product. Assembly reject happened when the installation between tools parts is unmatched and will scratch the product. Total reject of 182 pieces in three month is high for MNPSB because the company is a precision company which takes quality seriously.

**Table 1.1:** Total Reject from June until August for Three Main Customers

<b>Process</b>	<b>Total Rejects</b>
<b>Wire cut</b>	61
<b>Small grinding</b>	15
<b>Big grinding</b>	9
<b>CNC grinding</b>	7
<b>Profile grinding</b>	4
<b>EDM</b>	8
<b>CNC turning</b>	45
<b>Conventional turning</b>	14
<b>CNC milling</b>	12
<b>Program</b>	4
<b>Assembly</b>	3
<b>Total</b>	<b>182</b>

Problem detected in MNPSB is quality control and inspection because inspection is failed conform to requirements, fitness of purpose, degree of preference, measure of requirement of promises and degree of excellence and controlling all this things to meet specification and standard because QC staff skip the standard of operation in checking the product. This was due to chasing the due date while the quantity of product is too many and the tools for checking are difficult to find because of missing inspection tools in QC. The inspection tool is not positioned in appropriate place make the checking work difficult. QC staff also use sampling plan for checking but it is forbidden to use sampling plan because the MNPSB is a precision company which require the checking for all tools without skipping any of it. The purpose of quality control and inspection is to check and control the quality of product for use or purpose at the most economical level in aspect of design, manufacture and assembly to ensure procedures and controls at various stages is effective (Mohammed *et al.* 2013). The problem needs serious study to determine the solution for high reject in MNPSB such as make the QC staff follow the SOP of checking without affecting the time of the production because the total of reject related to the dateline of the production. More rejected product need a lot of rework which means more time wasted on the production which leads to the failure of the company on chasing the due date of the product.

### **1.3 Objective**

- i. To identify the types of manufacturing complexity.
- ii. To characterize the industrial approach in managing manufacturing complexity in Micro-Nano Precision Sdn. Bhd.
- iii. To make recommendation for industry to improve productivity via well-managed manufacturing complexity.

### **1.4 Scope**

This study is conducted in Micro-Nano Precision Sdn. Bhd (MNPSB). It focuses more on study of manufacturing complexity in the aspect of quality; manufacturing system design, inventory management; supply chain and project management. Figure 1.3 shows the general view for scope of the study. For data collection, observation, interview, and questionnaire are used. The duration of this study is almost one year which started on July 2014 and ended on April 2015. The person involved in this study are HR executive, general manager, QC senior engineer, supply chain manager, senior technical manager, production manager, QC HOD and machining HOD. The result can be used as a reference for complexity study. The result may not applicable for other industry which have different business operation.