CHAPTER I INTRODUCTION

I.1 Research Background

In the current era of globalization, all companies want to provide the best service to all customers. It aims to satisfy its customers. Increased services insists companies to improve performance, both in terms of cost and time. Time performance can be seen from the time of production or total makespan produced to complete a order. Long production time will cause delays in meeting the existing demand. This will disappoint consumers.

XYZ is a company which focus in the field of maintenance services for turbine engines in aircraft and industrial. Products which are produced by PT XYZ is a service which are inspection, modification, repair and overhaul for aircraft turbine engines. Aircraft turbine engines is one of the main components of the aircraft were used as propulsion. Each aircraft at least use a single turbine engine as propulsion and the others uses two turbine engines. Increasing the number of aircraft used will certainly be marked by an increase the amount of use of a turbine engine, the increased demand for turbine engine repair services to ensure readiness in aircraft turbine engines, and flight safety assurance. The increased demand for repair services for aircraft turbine engines, the PT XYZ demand to give products and services of good quality, competitive price in the market and are always trying to ship the order to the customer on time.

Based on Figure I.1, explained that the overhaul process start from the holding of the meeting of the customer and the PT XYZ until inspection, until the final disposition results, namely the examination results after going through stages of disassembly and cleaning engine, so the kind of treatment should be carried out by PT. NTP, which is made in the form of a document that has been agreed by the production manager to do to the next stage.

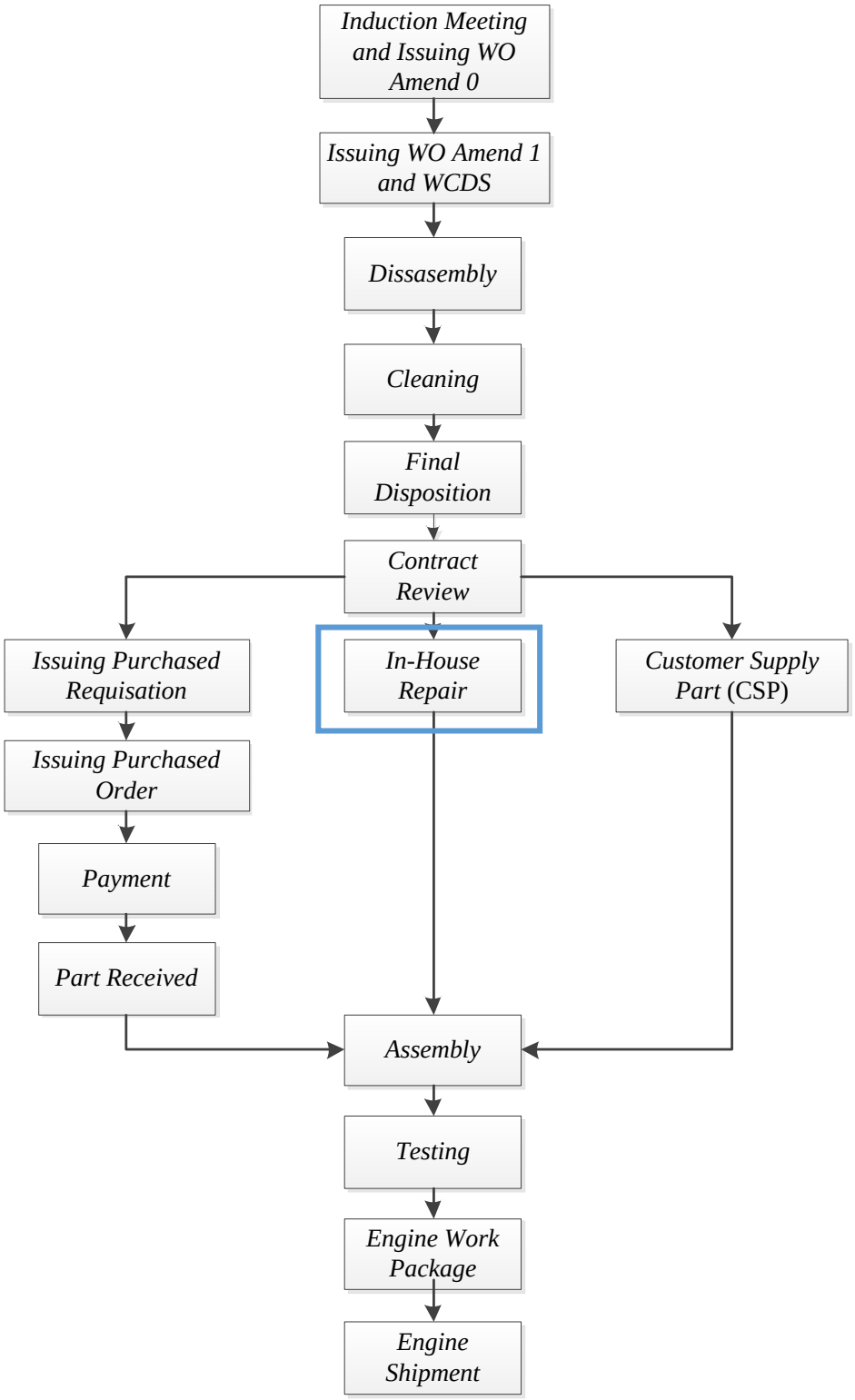

Figure I.1 Overhaul Process

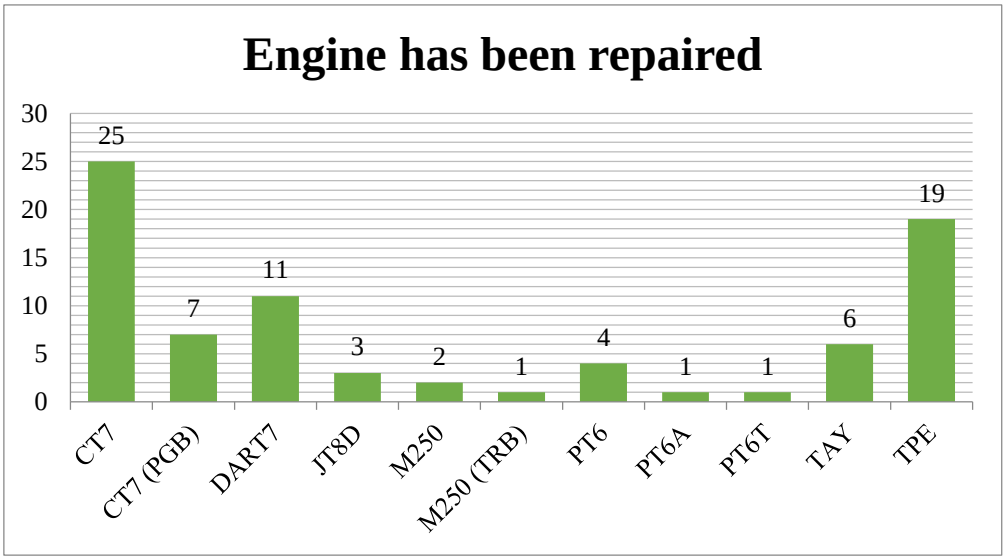

Figure I.2 The amount of engine which is arrived at PT XYZ on February 2014 until June 2015 (Source: PT XYZ, 2014)

PT XYZ services capable for many engines which are CT7, CT7 (PGB), DART7, JT8D, M250, M250 (TRB), PT6, PT6A, PT6T, TAY, and TPE. Figure I.2 depicts that an engine type CT7 is an engine which frequently repaired or maintained in PT XYZ. After going through the overhaul stages, there was the gap between the TAT MPS (Turn Around Time) which has been planned with TAT ACT (Turn Around Time). TAT MPS is lead time that has been scheduled by the companies to accomplish the whole process of service and TAT ACT is real or actual lead time that has been used to accomplish the whole process of service.

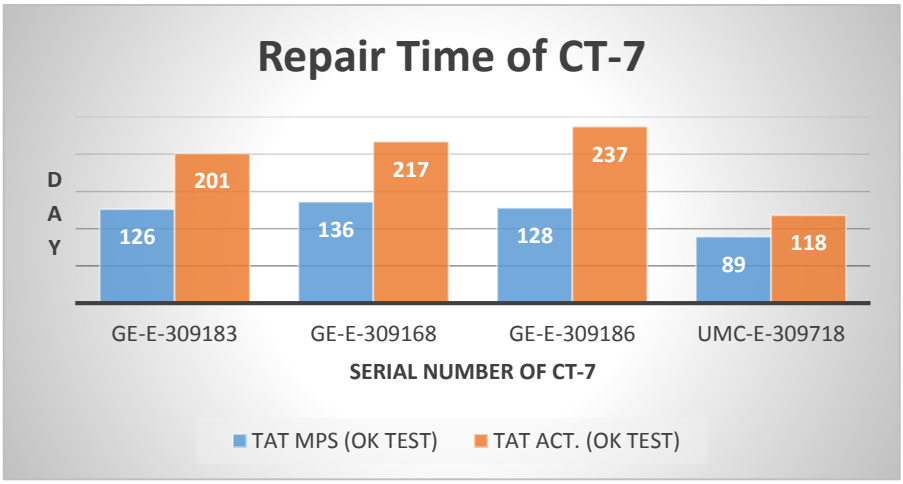

Figure I.3 Gap between TAT MPS and TAT ACT in repair process for engine CT7 on March until May 2014 at PT XYZ
(Source: PT XYZ, 2014)

Based on Figure I.3, depicts that of all four CT7 engine serial number can not meet the repair processing time predetermined by the production manager and the customer, resulting in a relatively large gap which causes delay delivery order to the customer. So there is the problem in repair process of CT7 engine at PT XYZ. Many lateness and many demand in CT7 engine become the reason taking the CT7 as the object of this research. Repair process in PT XYZ conducted depending on the type of engine so there is the problem in CT7 operator team when do the repair process to the engine. Significant amounts of lateness and demand can give the high probability of lateness and delay of delivery order engine to the customer. So it can increase the cost and bring the company to penalty.

CT7 engine consists of several module which are propeller gearbox, hot section module, accessory section module, cold section module, and power turbine module. Each module consists of many part. In this research, the object will be focused in cold section module because there are many parts that have high probability to be repaired in PT XYZ compare with other modules. If there are parts will be repaired in another modules except cold section module in PT XYZ, they will be done in some method with the cold section method.

Table I.1 Root Causes Contribution at Aero Production Engine CT7 in 2014 PT XYZ (Source: PT XYZ, 2014)

AERO PRODUCTION REVIEW		
ROOT CAUSES CONTRIBUTION		**%**
Material	17	**68%**
Operation	10	**40%**
CSP	1	**4%**
Business	4	**16%**
Quality (RTS Engine)	1	**4%**
TOTAL ENGINE	25	1.32

Delays in delivery order to the customer can be caused by several root of the problem. Table I.1 shows percentage contribution of the root causes based classification has been done by PT XYZ. There are some root causes which are Material, Operation, CSP, Business, and Quality (RTS Engine). The first root causes is material which has been solved in another research. The second root

causes is operation which will be discussed in this research. The elements involved in operation problems which are operator, machine repair, material, part, component, and engine as the object to be handled. In the process of handling the engine, failure risk and errors may exist because of a series of processes of maintenance or repair engine consists of streak activities like material procurement, stock, processing time, labor, risks that occur in one activity can inhibit the next activity so that in the end deadlines for maintenance or repair of engine that has been approved by the customer can not be met. Late submission of the results of maintenance or repair of the engine to the customer not only be detrimental to the company in terms of cost, but also in terms of the company's reputation.

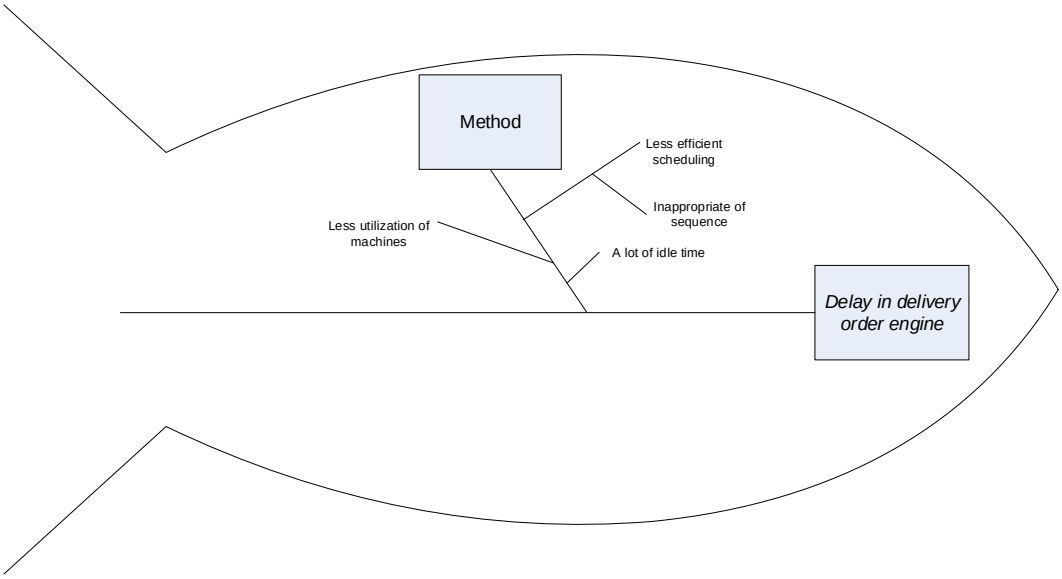

Figure I.4 Fishbone Diagram for problems of late submission of the results of maintenance or repair engine pada PT XYZ

Root cause of operation has the relation with the method which process repair conducted. Method which is used to do the repair influence the lead time or the makespan like Figure I. 4 showed the causes of delay in delivery order engine. This research will focus on the scheduling engine or workcenter in-house repair. In this section there are several machines or workcenter namely repairable, accumulation, GE-CT7, balance, lathe machine, CNC lathe machine, inspection (300 S), FPI, Visual Inspection, inspection (400 P), blades and vanes and bench repair, metal and plasma spray, inspection (700 E), chemical cleaning, mechanical cleaning, and inspection (800 H) which is not scheduled at all. All sequence job or task that is

done in First Come First Serve (FCFS) rule which is the one job should be accomplished first before go to the next job. This rule can give long makespan to accomplish all job and will bring to delay in delivery engine.

Table I.2 CT 7 Capacity of CT7 (October – Desember : 480 work hours)

No	Area / Process	Estimation Hour of Given Work Load					Available Man Hour	Deviation
		Repair			Total	Work Hours		
		Std	AMP	Qty				
1	Rec. Inspection/Preliminary Insp.	8	0,13	8	8	480	60	No
2	Engine Evaluation/Shop Preparation	16	0,14	8	18	480	69	No
3	Induction Meeting / Open Wipe #	8	0,14	8	9	480	69	No
4	Issue TMWO	24	1,14	8	219	480	549	No
5	Disassembly	16	1,24	8	158	480	593	No
6	Dirty Inspection	8	0,63	8	40	480	300	No
7	C & A Cleaning,inspect,assy, test	51,8	1,00	8	414	480	480	No
8	Cleaning	16	0,44	8	57	480	213	No
9	NDT	8	0,63	8	40	480	300	No
10	Central Inspection	40	0,53	8	171	480	257	No
11	Dispo	8	0,25	8	16	480	122	No
12	TMWO Repair	16	1,50	8	192	480	720	No
13	Repair	3	2,56	8	61	480	1.227	No
14	Sub Assy & Final Assembly	62,33	1,24	8	616	480	593	3,88%
15	Engine Test	24	0,67	8	128	480	320	No
16	Preparation for Shipment	24	0,11	8	21	480	53	No
17	Engine Shipment	8	0,11	8	7	480	53	No

In compiling a scheduling, thing that should be concerned is the capacity of an existing machine or workcenter. Capacity will determine whether scheduling can be implemented with the available capacity to the capacity is required. Table I.2 shows that the capacity of CT7 engine for 8 parts repaired. In this research total parts will be repaired is 8 parts. Available man hours is calculated from AMP is multiplied by work hours (480 hours). At In-House repair, workcenter meets the needed capacity. Eights parts need 61 man hours and the capacity available is 1227 man hours. There is no deviation for the requirement capacity. It can be concluded that the scheduling process of repair at the in-house repair can be done for the cold section modules.

Based on the problems of delay and lack of scheduling on the part at in-house repair, it is needed a method to determine the exact scheduling workload and the order of each machine or workcenter with makespan minimization criteria. Selection criteria of scheduling to minimize makespan, it because makespan is the total time for completion of works ranging from the first sequence which is done on a first machine or first work center until last work on the last machine or last work center (Ginting, 2009). Makespan calculation means has calculated processing time, flow time, and idle time. After finishing work with makespan that has been minimized by scheduling, PT XYZ can reduce the number of lateness or delay of delivery order of the engine and the operator can do other work or allocated to other department that need.

I.2 Problem Statements

The problem statements of this research are:

1. How to determine the sequence of processes in the repair process of CT7 engine at in-house repair department at PT XYZ to minimize makespan?
2. How to schedule the machine that appropriate in repair process of CT7 engine at in-house repair department at PT XYZ?

I.3 Research Objectives

Based on the problem statements, the research objectives of this research are:

1. Determining the sequence of processes in the repair process of CT7 engine at in-house repair department at PT XYZ.
2. Scheduling the machine that appropriate in repair process of CT7 engine at the in-house repair department at PT XYZ.

I.4 Research Boundaries

1. CT7 engine repair process is sequential.
2. Module engine is cold section modules.
3. Using Matlab software in the process of iteration.
4. The processing time of each machine deterministic (not using the element of probability).

5. Data to be processed is the historical data from 2014 and includes machine types, job number, type of job, and the job order.
6. The amount of each type machine is one and each machine can only execute one operation at a time.
7. All machines are available at time t=0 s.
8. All jobs are released at time t=0 s.
9. Transportation or repositioning time and layout are ignored.

I.5 Research Benefits

The objective of this research are:

1. As recommendations to help reduce the total makespan on CT7 engine overhaul process at PT XYZ.
2. It can help improve the performance time of the repair of CT7 engine at in-house repair department at PT XYZ.
3. As a recommendation to reduce the delay in the repair process in CT7 engine at in-house repair at PT XYZ.
4. This research can be used as material for further research information which is related to this study.

I.6 Writing Systematics

This Research is described in systematics of writings, as follows

Chapter I Introduction

This chapter contains the description of the background issues that become as basic research at PT XYZ, problem statements, research objectives, research boundaries, research benefits, and writing systematic. This chapter describes the general research conducted at PT XYZ for the overhaul process of CT7 engine.

Chapter II Literature Review

This chapter contains the literature that related to the problems studied and the results of studies that have been done in the past. The literature on this chapter will become a theoretical basis that will be used in this research in solving the problems.

Chapter III Research Method

In this chapter, it is described steps to conduct research starts from research object, the type of data used, data collection techniques, data processing steps as well as problem-solving framework which systematically arranged that will be a guide in solving the problem in this research. This chapter contains research methods, conceptual model and problem solving systematic.

Chapter IV Collecting and Data Processing

In this chapter describes the collecting and data processing which is used in the study. The data collection is divided into two, namely data obtained from the company and the data processed in accordance with the data needed to perform data processing for the study.

Chapter V Experimental Results and Analysis

In this chapter contains the analysis of this research, there is the analysis of the machine or work center scheduling (job shop) using a genetic algorithm.

Chapter VI Conclusions and Suggestions

This chapter contains the conclusions of the study and suggestions for PT XYZ and further research.