CHAPTER 1

INTRODUCTION

1.1. Problem Background

Stability in process to create quality control of product to reach the product specification or nonconformity prevention has been influenced by man and machine aspects. Both aspects are important on nonconformity prevention and quality control reach on process. On the other hand those aspects have their own complex aspect on there problems. Based on those, problem analysis and problem solving based on quality control analysis and ergonomics aspect being need to developed.

Based on those need and reason, nonconformity analysis on study case of Boom ZX-30 excavator product component been develop. On this case study, Quality control aspect analysis on nonconformity and human factor need to develop. Quality control aspect will bring the assessment of nonconformity cause problem identification. It will focus on process stability analysis to reach specification on result (in order to prevent nonconformity cause). On the other hand human aspect will bring human working analysis assessment that based on human capability and limitation. This analysis will discuss effect of working load and human body limitation to human disorder and injured.

Finally in the complexity of those aspect, the analysis need to compare and differentiate among those

variable that influenced in order to have solution on existing of nonconformity problem.

1.2. Problem Statements

How are the relationship among Quality control and Ergonomics, especially on high body work load, energy expenditure, human limitation, human disorder and injured, through stability of machinery process to prevent nonconformity ?

1.3. Objectives

a. Analysing quality control aspect and human aspect on nonconformity problem.
b. Analysing human posture based on human capability and limitation in conducting the work especially on body working load and body limitation that may effected to human disorder and injured.
c. Evaluating the relationship and potential causes of Quality control and Ergonomic that influenced on existing nonconformity problem.

1.4. Limitations

a. Quality control and Ergonomic analysis is only conducted in machinery process from hole making process 40 mm diameter of product of Boom ZX-30 Excavator component.
b. Quality control analysis focused on the potential cause of nonconformity problems with Pareto, out of control data, and quality control pattern analysis. The out of control data and pattern analysis formed by $\bar{X}$ (mean) chart and R (range) chart and

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collaborated with Cause Effect diagram on evaluation of the problems. Data-Processing of Quality control on $\bar{X}$ (mean) chart and R (range) chart are use the WinQS software.

c. Ergonomics analysis focused on working load analysis using biomechanics and energy expenditure analysis.

d. The operator working posture analysis using Mannequin Pro 7 software in each marking position, then analysed with the Biomechanics graph.

e. The human posture analysis on biomechanics only discussed on human posture alternative on each of marking position (human posture element analysis on machining process activities, this definition will used on the next discussion) with highest work force load that considering on Jig Boom Zx-30 dimension limitation.

f. The Sequential of marking position on this study have been based on the actual operator (Mr.Sutrisno) method of work on Jig Boom ZX-30 product. The method of work had been developed under experience, knowledge, technique of operator that improved the quality control and nonconformity on product.

g. The Anthropometry data that used are length, width, and depth of upper arm, lower arm, hand, thigh, lower leg, foot, head, neck, chest, abdomen, and the others are weight and height. All of those are use the default anthropometry population of South Chinese.

h. Biomechanics as human work load measurement conducted part of body that will be: neck, head, right and left shoulder, right and left arm elbow,

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back, right and left hip, right and left wrist, right and left knee, and also right and left ankle.

i. Physiology analysis in human injured and disorder are discuss on cause and effect of human injuries based on working load and movement range limitation of human body segment, energy expenditure, fatigue. Those analyses will based on the medical historical data of operator's injured.

j. Other factor of work that involve on machining process, like machine heat, noise and vibration or all environments aspect that may effected are not discussed in this study.

k. Other factor of work that influenced on human work and physiology such as temperature of working environment, vibration, noise, and human motivational are not being discuss.

1.5. Research Methodology

1.5.1. Object Of The Research

Object of this research is Boom ZX-30 product on machining process of 40 mm of diameter with Jig support equipment facility at PT. Hitachi Construction Machinery Indonesia.

1.5.2. Research Preparation

On this step it will be defining problem formulation, purpose and aim of research and problem boundaries.

1.5.3. Collect The Data

Data collection will be concerned out through:

a. Interviewing method.

That is done by generate question to operator related to topics, such as ergonomic aspect. It related to work load and injury of operator at the time of doing production process and Quality control aspect problems.

b. Observation method.

That been done on the observation at the object such as measuring length and wide of machine, operator's human posture when done the process, sketch the picture of facility location , and also at aspect of Quality control dimension that is like dimension of research object and also problems that influencing it.

c. Literature Study

Literature Study is done by searching from book reference and also journal of theory that support.

1.5.4. Data Calculation and Analysis

In this data processing phase is step data processing step at aspect of Quality control and aspect of Ergonomic.

A. Quality Control Analysis

That is development phase analyse at quality control aspect where focused to product quality control character analysed and there with the problems influencing on it. This step will be consist of:

a. Pre analysis of product in its quality control aspect in purpose to give the description on the product quality control that covering:

- Quality control physical aspect of product.
- Quality control on dimensional aspect criteria of product.
- Other quality control criteria of product that may consider(ex. Welding, rejected product)

b. Potential nonconformity analysis.

c. Pre analysis on production process and production facilities support that will be consist of:

- Production process of product.
- Process capabilities and support observation on technology aspect and other (such as human factor, time, method, and cost) and will be analyzed with statistical method.

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d. Quality control data calculation and interpretation with statistical process control method on R chart and Mean chart with support of WinQS software. This step will consist of:

- Statistical process control result ($\bar{X}$ (mean) chart and R (range).
- Controlled and Out of controlled Qualification and data pattern analysis.
- Cause analysis of out of controlled process.
- Evaluation on out of controlled data that may cause by Special Cause and Common Cause on SPC graph.

e. Setting the assumption in order to making simple the analysis based on capabilities and limitation on each factors that influencing on stability result of production process quality control.

f. Searching and analysing potential variable that influence on the problems with cause – effect Ishikawa diagram.

g. Determining potential cause of problems by the evaluating on Ishikawa diagram and Statistical Process Control graph related to the set of assumption (which have been determined consider on ability and limitation at aspect of production process on d point).

h. Making quality control conclusion then will be discussed with Ergonomic analysis.

B. Ergonomic Analysis

The following are steps in ergonomic analyses:

a. Identifying problems that related to human being limitation (operator) on activities. Problem identified natural condition of operator work method on process of machinery and quality control handling influenced by Jig limitation on dimension. Evaluation of operator's health condition will involved on the process.

b. Developing 2D and 3D modelling on dimension of jig, machine and product and also other physical dimension by using AutoCAD 2004.

c. Analyse work method and position marking of operator movement. Step in this stage are as follows:
   - Analyse the actual operator's work method on the sequential of machining process observation.
   - Making sequential marking position and observation on machining time activities and their details.

d. Analysing the alternative of operator body posture that formed when doing production process and its interaction to machine and jig. Then setting the load and element of activities assumption of human posture on each marking position. This step of assumption setting consists of:
   - Setting the element of activities (transition position marking, activities code, on each marking position.
   - Setting the load assumption on human posture based on simulation of load (on tire tube pressure).

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e. Then analyse the work load on body posture with the analysis of Biomechanics graph using the Mannequin Pro 7 software. This step is develop the Biomechanical graph based on Operational Process Chart, and machining time cumulative.

f. Analysing the work load aspect using Biomechanics graph and consider on physiology aspect of human limitation.

g. Analysing the injury that had been caused by over work load and human physiology limitation related to the injury.

h. Calculating and then analysing the Energy Expenditure of work load and bring the assessment based on human energy expenditure limitation.

i. Evaluating the human physiology limitation by human posture analysis related to over flexion (that is condition of human body segment movement that over of movement range limitation, this definition will use on next discussion) and resting time.

C. Collaboration Analysis Step.

Phase of correlation analysis of characteristic result of Ergonomic and Quality control that is correlation analysis among fact that had been identified by Biomechanical graph and Data plot result chart, and Energy expenditure graph.

1.6. Final Thesis Outlines

CHAPTER 1   INTRODUCTION

Introduction are consist of problem background, problem definition, purpose of the research limitation of the research, research methodology, and final thesis outlines.

CHAPTER 2   STATE OF THE ART

This chapter is consist of the previous research that mentioned on each and related to this research.

CHAPTER 3   BASIC OF THEORY

This chapter is consist of theoritical based literature that provide basic of research problem solving.

CHAPTER 4   COMPANY AND DATA PROFILE.

This chapter are consist of sort company that research took place and product description.

CHAPTER 5   DATA ANALYSIS AND DISCUSSION

This chapter is consist description of data analysis and research result.

CHAPTER 6   CONCLUSION AND SUGGESTION

This chapter is consist of conclusion of discussion and suggestion of problems that had been identified.

1.7. Research Methodology Flow Chart

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                    ┌─────────┐
                    │  Start  │
                    └─────────┘
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        ┌────────────────────────────────────┐
        │     Quality control Pre analysis    │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │      Potential non conforming       │
        │              analysis               │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │     Pre analysis on production      │
        │      process and production         │
        │        facilities support           │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │    Quality data calculation with    │
        │     statistical process control     │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │   SPC data Interpretation & Cause   │
        │     analysis of out of controlled   │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │        Setting the assumption       │
        └────────────────────────────────────┘
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        ┌────────────────────────────────────┐
        │    Determining potential cause of   │
        │     problems by cause - effect      │
        │        diagram SPC result           │
        │           interpretation            │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │  Quality control evaluation and     │
        │              result                 │
        └────────────────────────────────────┘
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        ┌────────────────────────────────────┐
        │    Identifying Ergonomic problems   │
        └────────────────────────────────────┘
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        ┌────────────────────────────────────┐
        │   Developing 2D and 3D modelling    │
        │          on jig facilities          │
        └────────────────────────────────────┘
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        ┌────────────────────────────────────┐
        │     Analyse  work method and        │
        │          position marking           │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │   Setting the alternative and       │
        │  assumption of operator body        │
        │ posture on load and element of      │
        │             activities              │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │   Biomechanic analysis using the    │
        │     Mannequin Pro 7 software        │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │  Biomechanic graph development &    │
        │   Analysis, and so physiology       │
        │             analysis                │
        └────────────────────────────────────┘
                         │
        ┌────────────────────────────────────┐
        │    Energy Expenditure analysis      │
        └────────────────────────────────────┘
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        ┌────────────────────────────────────┐
        │             Continued               │
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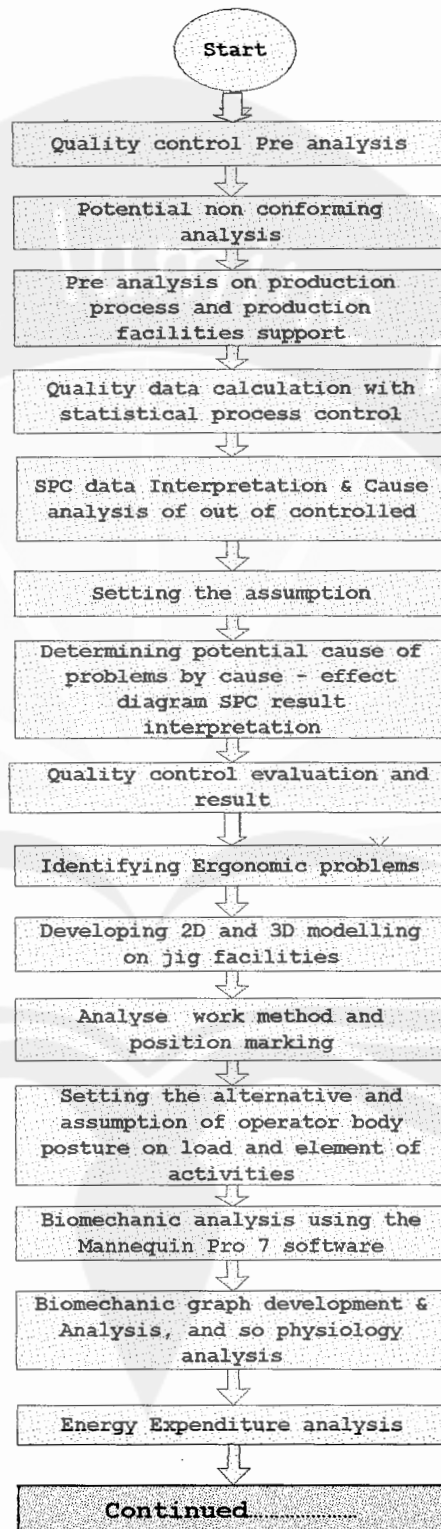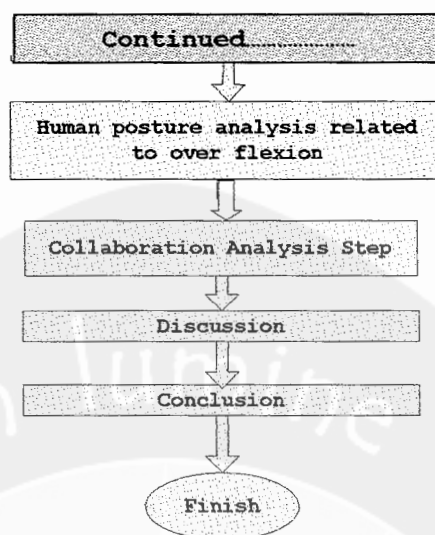
Figure 1.1. Research Methodology Flow Chart

Figure 1.1. Research Methodology Flow Chart (Continued)