Introduction to Industrial Engineering

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Abstract: This book was written for undergraduate management students taking the Introduction to Industrial Engineering course. The chapters in this book provide an overview of the profession as well as essential fundamental knowledge that management students may utilize to execute IE approaches in the operation management in the manufacturing and service sectors.

The book contains several features to enhance student learning of IE technique: The opening chapter highlight how it all begin.

Keywords: Operation, engineering, utilize, technique

Introduction to INDUSTRIAL ENGINEERING

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PREFACE

Nowadays, the manufacturing and service sectors are facing strong global competitiveness and rising client demand. All of these difficulties must be met by industries, and industrial engineering plays a critical role in meeting these challenges.

Industrial engineering (IE) is interdisciplinary engineering based on a combination of methodological approaches used to create an integrated or "whole" approach to problem-solving in engineering and management, with the overall objective of increasing productivity.

IE is concerned with the design, enhancement, performance, and assessment of non-segregated systems of people, capital, expertise, information, instrument, energy, materials, and processes. Besides, IE also implements the theory and practice of engineering analysis concept, using psychology in social sciences, physiology, physics, and mathematics in conjunction with engineering principles and methods, to describe, forecast, and judge the outcomes

Its main goal is to develop, improve, and implement integrated systems of people, money, knowledge, information, and equipment so these integrated systems will be more efficient and waste less money, time, raw resources, manpower, and energy while fulfilling the safety standards and regulations.

This book was written for undergraduate management students taking the Introduction to Industrial Engineering course. The chapters in this book provide an overview of the profession as well as essential fundamental knowledge that management students may utilize to execute IE approaches in the operation management in the manufacturing and service sectors.

This book contains several features to enhance student learning of IE technique: The opening chapter highlight how it all began. The Introduction of Industrial Engineering chapter reveals the history and the people who started the IE revolution and how it evolves into an essential requirement for the manufacturing and service sector. In the 2nd chapter, the Standard Operations chapter, the techniques to establishing time standards are outlined. It also highlights the importance of establishing Standard Time for operational activities. Further, in the 3rd chapter, the Process Analysis chapter, the book shares the technique to analyze production processes and measure process efficiency.

The 4th chapter, the Production Planning chapter shares the line balancing technique that intent to reduce idle time and increase efficiency in a production line. Next in the 5th chapter, the Facility Layout chapter will guide the reader on the technique to achieve a smooth flow efficient layout. The 6th chapter, Maintenance Management chapter shows the combination of all technical, administrative, and managerial actions

of industrial plant maintenance that ensure the working process in the industrial plant run smoothly and efficiently, meanwhile also help improving productivity.

The 7th chapter, the Lean Manufacturing chapter shares the production strategy of continuous improvement and wastes elimination without adding money, labor, space, machine, and inventory in an industrial plant. The final chapter, the 8th chapter, Human Factor Engineering chapter shows the science to create the best connection between man and his working environment which includes the environment's ambiance and tools and materials, techniques, and structure, all linked to one's skills, capacity, and limits.

Viewing the above, it can be said that the content of this book underlines the basic foundation of IE technique. The text emphasizes the necessary basic skills for any individual to utilize IE technique in the management of production or service activities. It won't be enough to qualify a person practicing the technique as a full pledge Industrial Engineer however those who apply these IE techniques mentioned in this text should be able to reap the benefits of better efficiency and positive growth in productivity in their organization.

CHAPTER 1

INTRODUCTION TO INDUSTRIAL ENGINEERING

1.0 INTRODUCTION

According to the American Institute of Industrial Engineering (AIIE), industrial engineering is part of the field of engineering concerned with the design, enhancement, performance, and assessment of non-segregated systems of people, capitals, expertise, information, instrument, energy, materials, and processes**.** Besides, industrial engineering also implements the theory and practice of engineering analysis concepts, as well as mathematical, physical, and social sciences, in conjunction with engineering principles and methods, to describe, forecast, and judge the outcomes of the systems. Thus, industrial engineers figure out the most efficient methods to employ fundamental production variables like people, equipment, materials, information, and energy to create a product or offer a service.

Furthermore, industrial engineering is not considered basic engineering, but it is more into interdisciplinary engineering. Industrial engineering is not same as the civil engineering, chemical engineering, and more because it is counted in sciences or disciplines or both. Psychology in social sciences, physiology, physics, and mathematics is the science that includes this engineering. A discipline based on a set of methodological techniques used to achieve an integrated or "whole" approach to problem-solving in engineering and management, with productivity enhancement as the overarching goal.

CHAPTER 2

STANDARD OPERATIONS

2.0 INTRODUCTION

Standard operation is a collection of standards that specify all requirements for a task, operation, or procedure. Each process and technique give detailed instructions for doing a specific task. A standard operating procedure takes the characteristics of a high-level process and augments them with additional information, specific assignments, and processes to meet corporate or industry standards. Regardless of industry, a well-defined standard operation ensures that staffs understand how to conduct routine duties safely, following rules, and consistently, regardless of who completes the activity

Industrial engineers are the key people that initially develop the standard operations. Industrial engineers usually recruit the help of shop-floor supervisors and workers. This is to ensure that corrections to the standards can be made immediately when a change occurs.

The design, development, and installation of integrated systems of manpower, materials, information, equipment, and energy is the core of industrial engineering (IE). Industrial engineers figure out how to utilize the fundamental production components - people, equipment, materials, and energy - in the most efficient way possible for a company. In comparison to engineers in other areas, they are more concerned with people and business organization techniques.

Industrial engineers specify, forecast, and assess the results to be gained from such systems, depending on specialized knowledge and expertise in the mathematical, physical, and social sciences, as well as engineering analysis and design concepts and methodologies.

CHAPTER 3

PROCESS ANALYSIS

3.0 INTRODUCTION

A process is a set of independent tasks that transforms an input into higher-value output material for the organization. Meanwhile, process management is a business process that consists of a sequence of steps that must be completed to carry out certain duties in a firm. A business process can be a collection of related, structured actions or operations that result in the production of a specified service or product that serves a defined aim for a specific customer or customer.

There are three types of business processes. The management process, the operational process, and the supporting process. The management process governs how a system operates. For example, the corporate government. The operational process is the core of the business and generates the major value stream. For example, manufacturing, purchasing, advertising, marketing, and sales. However, the fundamental processes are supported by supporting processes. For example, accounting, recruitment, and call center.

On top of that, specifically for process analysis terms, any aspect of an organization that accepts inputs and converts them into outputs is referred to as a process. For example, McDonald's transforms meat, potatoes, and sauces into packaged food. Cycle time is the average time between the completion of successive units, while utilization is the ratio of the time that a resource is active to the time that it is accessible for use.

Last but not least, we must examine the process to find inefficient tasks, identify potential efficiency improvement tasks, and understand where value can be provided. It is important to analyze the process to improve tasks time by time.

CHAPTER 4

PRODUCTION PLANNING

4.0 INTRODUCTION

Line balance is a useful tool when carrying out a task that involves line adjusting procedures. The purpose of the line adjusting procedure is to make the production line sufficiently adaptable to ingest both external and internal tactlessness. Setting an arranged existence rate until required materials are made within a specific timeframe is part of this technique. Furthermore, fruitful line adjusting necessitates confirmation that the existing portion of each line fragment can be met within a timeframe while utilizing the available production limit. This is a useful tool for accelerating the progression of sequential construction systems and work cells while lowering work requirements and costs.

The harmony between line equilibrium and sequential construction system is marginally extraordinary. Sequential construction system adjusting includes the demonstration of collecting various parts. It includes numerous creation lines while Normal Line Adjusting can just include one creation line. Sequential construction system Adjusting is the issue of appointing activities to workstations along with the mechanical production system so that the task turns into the best from a specific perspective.

Since Henry Passage presented the mechanical production system, the mechanical production system balance has been a significant enhancement issue in the business. The productivity contrast between ideal and problematic tasks can bring about the economy arriving at a huge sum every year. Falsehood adjusting procedures are ordinarily utilized in auto industry mechanical production systems called ALB. An enormous number of little and medium ventures don't utilize the line-adjusting strategy underway lines.

CHAPTER 5

FACILITY LAYOUT

5.0 INTRODUCTION

5.0.1 Layout planning

Layout planning is the decision-making process that involves the physical layout of Economic Activity Centers required by a facility's various functions. The facility layout issue, as stated by researcher Koopmans and Beckmann (2013), is a typical industrial challenge in which the intention is to arrange facilities so that the cost of transferring goods between them is minimised. The primary goals of facility layout planning are to reduce operating expenses, minimise material handling costs, efficiently utilise space, and efficiently utilise labour, by removing bottlenecks, facilitating communication and interaction among employees, between employees and their managers, and between employees and consumers. The facility layout issue, according to Shayan and Chittilappilly (2004), is an optimization problem that seeks to make layouts more effective by taking into consideration numerous interactions between facilities and material handling systems while creating layouts. Evaluation is the most important stage for any problem. It should be carried out very carefully, and the method of evaluation depends upon the type of problem.

There may be more than one approach accessible for a particular problem, such as selecting a layout option using factor evaluation, the possible methods for layout evaluation are listed below:

- Factor analysis, commonly known as the weight factor comparison approach.
- Make a list of the benefits and drawbacks.
- Ranking based on a predetermined factor.
- Compile a list of projected gains and losses.
- Alternatives vs objectives are rated.

CHAPTER 6

MAINTENANCE MANAGEMENT

6.0 INTRODUCTION

Maintenance is defined as the combination of all technical, administrative, and managerial actions during an item's life cycle that aims to maintain it in or restore it to a state in which it performs its intended function. In the same standards, maintenance management refers to the various activities of management that set the maintenance objectives, priorities, strategies, and responsibilities and manage them. This includes planning, controlling, and monitoring maintenance as well as various ways to improve including economical aspects for the organization (Bonde & Fulzele, 2013; Choudhary, 2016). As a key component of maintenance management, the maintenance management policy can be viewed as a basic and integral part. The management organizes, provides resources such as personnel, capital, assets, material and hardware, and others, meanwhile also lead to performing tasks and accomplishing targets. After the plans are created, the management must ensure they are carried out effectively and efficiently. With a clear mission, strategy, and objectives facilitated by corporate culture, organizing starts the process of implementation by clarifying job and working relations such as chain of command, a span of control, a delegation of authority and more (Bradley, 2002; Bonde & Fulzele, 2013). Figure 1 shows the maintenance management flow run in an organization or a plant.

CHAPTER 7

LEAN MANUFACTURING

7.0 INTRODUCTION

To enhance the competitiveness of an enterprise globally, most manufacturers implement lean manufacturing as one of their strategies (Zahraee, 2014). Lean manufacturing can be simply defined as production strategy of continuous improvement and waste elimination without adding money, labor, space, machine, and inventory. It is evolved from the Toyota Production System in Japan. Its origin date from the 1950s, when Toyota start using unusual approaches in its operations to improve quality, reduce inventories, and increase flexibility.

The concept of "Lean" was initially proposed by a Japanese industrial engineer named Taiichi Ohno (1988). It was coined by Krafcik (1988) and then popularized by Womack, Jones, and Roos (1990) in their book entitled "Machine that Change the World". Eventually, its name was evolved to "lean manufacturing". The representative lean manufacturing involve Kaizen, Kanban, and 5S program.

Malaysia Japan Automotive Industries Cooperation (MAJAICO) program was initiated in 2016 to develop and train local automotive industry becomes global competitive player. It facilitated the first lean transformation in Malaysia, (Osman, A. 2020). Besides, research by Edmen Tam and Dr. Christina Chin indicates there are 67% of companies in Malaysia employed and practiced lean manufacturing [8]. Larger and older companies (established over 20 years) are more likely to implement the strategy than the smaller and younger companies (established less than 10 years) because larger companies have a higher understanding of lean. 5S program was identified as most commonly used tools. Furthermore, lean manufacturing has been utilizing in Malaysia manufacturing sub-sectors covers automotive significantly. It also plays role in sectors of electrical and electronics, food and beverages, aerospace composite, iron and steel, wood and wood-based products, machinery and equipment, textiles and apparel, pharmaceutical, and chemicals and petrochemical.

CHAPTER 8

HUMAN FACTORS ENGINEERING

8.0 INTRODUCTION

As a human being, people have values, perceptions, sensations, limitations, and social interactions. Therefore, our body is prone to weariness and exhaustion, backaches, and countless other ailments caused by poor working habits. Human beings are constituted of industrial and service organizations. The human statement nowadays is that usage of the instrument is a distinguishing feature of humans. Even the partial acceptance of this fascinating conjecture shows that a careful assessment of tools, technology, and how they influence our people today and, in the future, must also be included in a complete understanding of ourselves.

8.1 DEFINITION OF HUMAN FACTORS

Human factors engineering is a science to create the best connection between man and his working environment. The term environment includes the environment's ambiance and tools and materials, techniques and structure, all linked to one's skills, capacity, and limits.

Human factors refer to a definitive collection of information. Therefore, human factors referring to environmental, organizational, and employment variables. In other words, human factors concern what people "perform the task and its features," who does the task 'individually and in their ability and where they work 'the organization and its qualities,' all impacted by the broader social concern at the local and national level.

The human factor element can be placed from the "hard" engineering sector to the "soft" organisation's approach along a continuum. The engineering field comprises ergonomics used to treat people as machines with traits, limits, and skills to be analyzed, described, and taken into account while creating or planning work in extreme circumstances.

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