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Energy Management in a Manufacturing Industry through Layout Design

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Abstract

Competitive market and effective utilization of available resources are the driving forces towards “Energy Management”. In a manufacturing facility, energy management is often neglected due to some wrong perceptions including high initial investment, low production rates, long payback period (breakeven point), etc. However, these misconceptions are often ignored nowadays by upper management as they realize that energy management is a step towards green manufacturing and sustainability. The benefits of energy management are not only limited to economic savings but also include significant emission reduction. A case study on a small size manufacturing plant illustrates the importance of layout design on energy savings. Systematic layout planning (SLP) and lean tools are employed for designing layout alternatives. The study further compares the energy consumption and waste minimization between the two alternatives. The results show vital improvement in energy savings through layout enhancement.

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Keywords: Energy Management; Layout Enhancement; SLP; Green Manufacturing

1. Introduction

Lean Manufacturing is a philosophy which helps the company to reduce its waste [1]. Lean tools and techniques have been applied worldwide in several industries to increase productivity [2]. It is stated that “lean transcends green” i.e. the firms which have applied lean manufacturing are prone to green transformation [3]. The transformation from traditional to lean production can reduce overall cost, inventory, defects, and lead time significantly along with increasing space utilization up to fifty (50) percent [4]. In this regard, the total savings in energy are also impressive [5]. The relation between lean and green manufacturing has been well explained in article [6]. However, it is also noted that green waste are different from lean waste. Since, the main purpose of lean

manufacturing is to increase productivity i.e. minimizing cost and time. On the other hand, green manufacturing (also known as “environmentally safe”) is precisely concerned with wastes with affect the environment [7, 8].

The most common green waste is energy. The industrial sector consume more than one-third (1/3) of primary energy worldwide [9]. With the increase in energy costs and obligation to Kyoto Protocol, several industries are making efforts to minimize energy consumption without reducing their production [10]. The solution is a dynamic process called Engineering Management (EM) which combines the skills of engineering, management and housekeeping [11]. Energy management is the effective use of energy to maximize profits and enhance competitiveness [12]. In small and medium scale enterprises (SME) energy efficiency is often ignored due to the assumption that energy costs only contribute to a small fraction of the total production cost [13]. The amount of energy saved by productivity improvements often exceeds significantly from the savings obtained by equipment optimization. Since, machine precision comes with technological advancements (which is an expensive investment) thus, for SME energy management is often focused on efficient utilization of secondary resources i.e. utilities, electricity, water, heating, etc. [14]. EM is a cyclic process and is a part of continuous improvement which is applied in various industries. Some recent case studies include [15,16,17]. Although, the approach of EM implementation differs for each industry, yet the benefits are noteworthy in all cases. This case study differs with others in a way that it focuses on layout design and later evaluates the impact of layout on green manufacturing. The results emphasize on both economic and environment effects of a well-designed layout.

Nomenclature

EM	Energy Management
SME	Small and Medium Scale Enterprise
SLP	Systematic Layout Planning

2. Methodology

From energy management (EM) perspective, a production facility is an integrated system which comprise of three partial systems. The systems include production machines, technical building service (TBS provide utility services to facility) and the production shop itself. These three entities are responsible for inter-conversion of energy in a facility as described in Fig. 1. An energy audit (also called energy survey) is a procedure that evaluates the way energy is used in a factory and identifies alternatives for reducing energy costs. The main objectives of the industrial energy audit are to categorize the types and costs of energy use, evaluate alternatives that can substantially reduce energy costs and to establish a plan to employ energy saving projects [19].

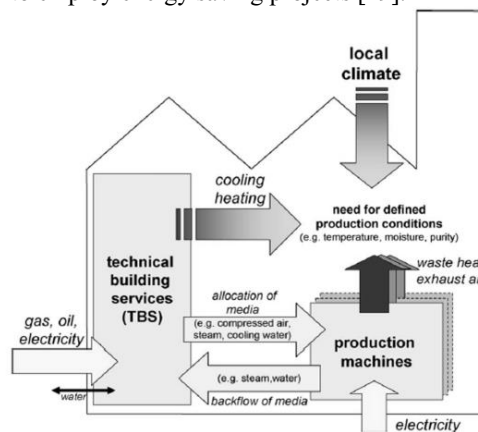


Fig. 1 Energy systems of a production facility [18]

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