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Guidelines for Improving Productivity, Inventory, Turnover Rate, and Level of Defects in Manufacturing Industry

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Abstract

This study used snowball sampling from 40 manufacturing companies in Thailand. The majority of the said companies, 20, were in plastic industry, followed by electric and electronic industry, garment and textile industry, food and beverage industry, automotive industry, and construction industry, with the number of companies accounting for 10, 4, 3, 2, and 1 respectively. The results showed that 13 companies were large, 13 companies were medium, and 14 companies were small. In addition, 19 plastic companies were original equipment manufacturers while the only other one produced its own brand. Meanwhile, 9 electric/electronic companies produced their own brands and were original equipment manufacturers but the only one in this field produced only its own brand. All of garment and textile, automotive, and construction companies were original equipment manufacturer companies. Employees who operated machines had performance at 80-90%. In contrast, other departments which were not concerning with machine, such as finishing, assembling and packing, did not have their performance measured. Plastic companies operated 7 days with 24 hours, especially injection machine department, with 2 or 3 shifts while other industries worked 6 days with 8-11 hours per day. Defect rate was controlled by customer at 2-3%. Raw material inventory was 7-30 days. Work in process inventory was 1-3 days. Meanwhile, finished goods inventory was 1-30 days. Turnover rate was 5-10%. The company should measure the performance in all departments to know strengths and weaknesses; and then create a project to improve productivity with suppliers, employees, and customers involvement such as 5S, QCC, Kaizen, TPM, TQM, ISO, SPC, and lean manufacturing system. The company should create work instructions in Thai, Burmese, Cambodian or Laos to reduce communication issues. Since small but frequent orders were not worthwhile to set up manufacture frequently, the companies determined to produce high volume at one time, leading to high level of inventory. Thus, the company should focus more on forecast and negotiation to avoid dead stock. The company should understand its employees to maintain current employees and at the same time create attractive welfare to attract prospect employees. Company qualified for quality, cost, and delivery will survive in fierce competition. According to the establishment of AEC, there are opportunities to create its own brand, and relocate to border areas of AEC customers.

Keywords: Employee performance, Machine efficiency, Inventory, Turnover, Defects, Manufacturing ındustry.
JEL Classification Codes: M1 (Business Administration)

Contribution of Study
This study is one of very few studies which have investigated the current situations, opportunities, and obstacles in manufacturing industry, and to create a model for improving the efficiency while reducing the levels of inventory, turnover, and defect.

1. Introduction

Currently, globalization makes communication free and borderless. In addition, as a result of an establishment of AEC (ASEAN Economic Community) in 2015, there has been a fierce competition in both domestic and international markets. Therefore, manufacturing companies need to seek strategies designed to increase productivity, reduce costs, improve quality, and reduce delivery lead time to customers, all of which require the cooperation of all parties from suppliers, subcontractors, employees, and management teams. The majority of manufacturers have selected continuous improvement programs as their main strategic initiatives to improve quality, customer service levels, and overall total value to their customers.

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Labor productivity is critical to the competition. In addition, it can also increase sustainable revenue. Companies with higher costs will have lower competitiveness which leads to loss, and they finally have to withdraw from the business. Thailand labor productivity has increased by 2% per year which is very low when compared with other countries such as Vietnam and China with 4% and 10% of increase, respectively (Tansakul and Sutthiwatanaruputh, 2014). The unit labor costs of Thailand increased by 3% while those of Indonesia fell by 12% (Tansakul and Sutthiwatanaruputh, 2014). According to both low level of productivity and high level of unit labor costs, the competitiveness of Thailand is reduced.

Inventory is one of the most expensive assets of many companies, representing as much as 50% of total invested capital. Managers have long recognized that good inventory management is crucial. In addition, a company can reduce costs by reducing inventory. On the other hand, production may stop and customers may become dissatisfied when an item is out of stock (Heizer and Render, 2014).

To sum up, according to a low level in production, a high level of labor unit costs, and high level of inventory, employers need to create the improving program to improve productivity while reducing inventory, turnover rate, and defects, which will enhance company's competitive advantage.

2. Literature Review

2.1. Performance

Performance analysis is a process used to evaluate the cost efficiency, reliability, and timeliness of corporate management and design. The purpose of performance analysis is to identify areas of improvement in company's activities as well as to aid strategic decision making. This study is mainly concerned with performance, especially operational performance.

Operational performance is related to organization's internal operation such as productivity, quality of product, and customer satisfaction (Feng *et al.*, 2007). It is typically assessed along with the dimension of percent returns (Frohlich and Westbrook, 2001; Rosenzweig *et al.*, 2003; Poirier and Quinn, 2004) percent defects (Frohlich and Westbrook, 2001; Rosenzweig *et al.*, 2003) delivery speed (Buzzell and Ortmeyer, 1995; Frohlich and Westbrook, 2001; Chen and Paulraj, 2004) production costs (Frohlich and Westbrook, 2001; Rosenzweig *et al.*, 2003; Chen and Paulraj, 2004; Poirier and Quinn, 2004) production lead time (Buzzell and Ortmeyer, 1995; Frohlich and Westbrook, 2001; Rosenzweig *et al.*, 2003) inventory turns (Frohlich and Westbrook, 2001; Zhu and Kraemer, 2002; Ranganathan *et al.*, 2004) and flexibility (Rosenzweig *et al.*, 2003; Chen and Paulraj, 2004).

2.2. Productivity and Firm Performance

Productivity is the ratio of outputs (goods and services) divided by the inputs (resources, such as labor and capital). The manager's responsibility is to enhance the productivity because improving productivity means improving efficiency (Heizer and Render, 2014).

Based on the microeconomic theory, the efficiency of production or economic performance is divided into two categories, i.e. technical performance and efficiency of resource allocation. Technical performance refers to a possible maximum output from the processing of minimal inputs. Meanwhile, the efficiency of resource allocation means a maximum of producing in which the manufacturers are satisfied with the matching of resources and objectives. In other words, the efficiency of resource allocation can be explained as the yield derived from using the lowest cost.

Conventionally, a firm performance has been observed and measured in accounting words (Conant *et al.*, 1990; Jennings and Samuel, 1994). However, the literature concerning with measurement of business performance (Lynch and Cross, 1991; Kaplan and Norton, 1992) proposed that managers prefer to locate relatively less importance on traditional financial performance's measures, e.g. return on investment or net profits. It is consistent with Barros and Santos (2006) who proposed that firm performance be an outcome from the ability to use resources and CEO care for overall result of both finance and non-finance performance. In general, the word performance results in the leading position of measurements such as profit, cost and market share Laitinen (2002). Sink and Tuttle (1989) asserted that performance should not be dealt barely as a financial perspective. In addition, Li and Olorunniwo (2008) suggested that performance can be evaluated by non-financial performance such as efficiency, growth, and profit.

The firm performance serves as a major link among the strategies, implementation and evaluation operations (Emmanuel *et al.*, 1990; Haktanir and Harris, 2005). This is corresponding to Melia and Robinson (2010) who proposed that evaluating the firm performance is related to the strategy of the organization. Therefore, organizations need to set clear goals and rules to improve efficiency and move towards the achievement of the goals. In addition, many organizations believe that the performance evaluation can be conducted based on the implementation of any strategies. The reported performance will take place at all levels of the organization similar to financial report (Neely *et al.*, 2002).

Organizations, especially in the private sectors, must cope with tough competition and the need to survive and grow. While the external business environment comprises competitive forces, internal competency relies on limited resources. Recently, business executives and researchers have focused on investigating the relationship between competitive priorities and firm performance. Operational measures which are usually used as firm performance measures include productivity, quality, cost, timeliness, and accuracy (White *et al.*, 1999; Ahmad and Schroeder, 2003; Hallgren, 2007; Kathuria *et al.*, 2010).

2.3. Inventory

Managers around the globe have long recognized that good inventory management is crucial. The objective of inventory management is to strike a balance between inventory investment and customer service. Inventory can serve several functions that add flexibility to firm's operations. There are four functions of inventory, i.e. separating various parts of the production process, decoupling the company from fluctuations in demand and providing a stock of goods that will provide a selection for customers, taking advantage of quantity discounts, and hedging against inflation and upwards price changes (Heizer and Render, 2014).

To accommodate the functions of inventory, companies maintain four types of the following inventories. First, it is raw material inventory which has been purchased but not processed. The second type is work in process (WIP) inventory which refers to the components of raw materials that have undergone some change but are not completed. Third, maintenance-repair-operating (MROs) inventory is often a function of maintenance schedules, repair schedules, and other schedules. Finally, it is finished goods inventory which is the completed products awaiting for shipment or future customer demands (Heizer and Render, 2014).

The number of works in process from overproduction affected the manufacturing process and production cost. Traditional concept focused on the overproduction or pre-production for a long time in order to get the lowest cost per unit regardless of thinking whether there will be a lot of work in process or not. The problems of overproduction include the loss of time and labor in unnecessary production, storage space, costs of moving, waste not being resolved immediately, sunk costs, and hidden production problems.

2.4. Turnover Rate

Turnover refers to the amount of movement of employees in and out of an organization, normally presented in terms of the turnover rate (Chruden and Sherman, 1972). Meanwhile, Mobley (1982) defined the meaning of employee turnover as the discontinuance of membership in an organization by the person who received monetary compensation from the organization. In addition, Tanke (2001) has defined turnover as the movement of employees out of the organization. All of the aforementioned turnover definitions by different scholars helped the researcher in concluding that the movements of employees, who received monetary compensation from the organization, by rotating around the labor market, between organizations, jobs and careers, are normally present in terms of the turnover rate.

2.5. Level of Defects

Product defects refer to anything that makes the product unsafe while using (Robinson, 2009) which may occur from many reasons. The first defect is a result of poorly designed or tested products, not enough or too little. The product does not function as it was designed. The second flaw is a result of production that is not correct, such as the wrong use of materials. Consequently, the production does not meet product specifications. The last one is incomplete guidelines on the practice, and inappropriate or incorrect warnings of the dangers.

Defect rate refers to the ratio between the number of product defects, errors or defects which are harmful to total output. In some cases, it may be calculated as a percentage of the waste. If the waste is very small, the defect rate will be calculated on the amount of parts per million pieces (PPM). Meanwhile, as the service cannot be taken apart, it will count the number of defect per million opportunities (DPMO).

2.6. Manufacturing Industry

Manufacturing industry refers to those industries involved in the manufacturing and processing of items and indulge in either creation of new commodities or in value addition. The manufacturing industry accounts for a significant share of the industrial sector in developed countries. The final products can either serve as a finished good for sale to customers or as intermediate goods for use in the production process.

The manufacturing industry is important to Thailand's economy due to highest GDP in 2013. The majority of manufacturing industry consist of electric and electronics, chemicals, petroleum and petrochemicals, iron, automotive and automotive parts, plastic, shoes and leather, food and beverage, wood and furniture, tire and rubber, paper and publication, textile and garment, and cement (Office of the National Economic and Social Development

Board, 2013). Regarding the above concept, thus, the sample population consisted of executives and managers working for manufacturing industry in Thailand.

3. Research Methodology

3.1. Samples and Procedures

The design of this study is a qualitative approach which was done by using in depth interview by means of snowball sampling from 40 participants working as managing directors, executives, production and sale managers from 40 companies. The data collection was made from April to June, 2015. The data analysis was done by means of content analysis by 3 professionals working for industrial management and industrial engineer.

4. Results

The majority of the said companies, 20, were in plastic industry, followed by electric and electronic industry, garment and textile industry, food and beverage industry, automotive industry, and construction industry, with the number of companies accounting for 10, 4, 3, 2, and 1 respectively. The results showed that 13 companies were large, 13 companies were medium, and 14 companies were small. The company with the age over 15 years accounted for 24 companies, followed by those with the age of 11-15 years, 6-10 years, and less than 5 years, which accounted for 7, 5, and 4 companies respectively. In addition, 19 plastic companies were original equipment manufacturers while the only other one produced its own brand. Meanwhile, 9 electric/electronic companies produced their own brand and were original equipment manufacturers but only one produced only its own brand. All of garment and textile, automotive, and construction were original equipment manufacturer companies. There were 21 companies that employed both Thai and foreign workers, such as Burmese, Cambodian, and Laos labors. Plastic companies, especially injection machine department, operated 7 days with 24 hours, with 2 or 3 shifts, while other industries worked 6 days with 8-11 hours per day.

4.1. Productivity

Considering medium and large companies, employees who operated machines had their performance at 80-90% based on the measurement by using cycle or takt time received from customers, or set standard time by using time and motion study. In contrast, the performance of other departments, such as finishing, assembling and packing, which were not concerning with machine, were not measured. Most of them were ISO 9001 qualified, guaranteeing the productivity control for all processes by using work instructions. On the other hand, small companies operating in fierce competition with small number of employees did not have enough resources to set and control performance measurement system; therefore, most of their performance was measured by using their owner or supervisor's experiences.

4.2. Inventory

Regarding plastic industry, raw material inventory was a small amount due to the plastic resin prices, which had been changing frequently depending on market prices. Purchasing in bulk raw materials resulted in a risk of loss from the price difference. Moreover, the plastic resin had to be ordered from suppliers which were determined by customers, and the work in process was between 1-3 days. Most companies would assign employees, who controlled the injection molding machine, to finish pieces during the injection molding machine was running. Therefore, the WIP was small volume. Meanwhile, finished goods inventory was 3-30 days. Customers would give the annual forecasting but they would split orders into small ones on a weekly basis. Small but frequent order was not worthwhile to set up manufacture frequently; therefore, the companies determined to produce high volume at once, leading to high level of inventory.

Meanwhile, raw material inventory for electric and electronic industry was very high because the companies needed to import raw materials from Germany, America, and Japan, the process of which took a long time for transportation. Therefore, they selected to purchase in bulk raw materials, in order to avoid the shortage of materials. The raw material inventory was accounted for 30 days by average. There were many processes and more skilled workers were still required, which was the main problem for this industry. Therefore, the work in process inventory was high, about 7-15 days by average. Lastly, finished goods inventory was very small, between 0-3 days as customers wanted the products immediately or behind schedule.

Considering garment and textile industry, raw material inventory was very high due to imported fabric and leather from foreign countries, such as America and Japan. In addition, companies needed to purchase materials from the suppliers, which were determined by customers. Therefore, suppliers had high level of bargaining power to ask maximum purchased volume, leading to high level of raw material inventory, accounted for 30 days by average. According to the incomplete performance measurement system, mixed between using standard time and supervisor experiences, the work in process was about 4-7 days.

The finished goods inventory was 3 days by average due to the fixed 1-2 shipments per week.

Meanwhile, raw material and work in process inventory for food and beverage was very low since it needed to be produced before being rotten, leading to 0-2 days inventory. In contrast, finished goods inventory was very high at 30 days by average due to the processing and containing into can or bottle and due to the seasonal demand.

Considering automotive industry, companies controlled all inventories by using Toyota Production System (TPS), Kamban, just in time (JIT), and lean manufacturing system; therefore, all inventories were 2-3 days by average.

4.3. Level of Defects

Defect rate for all industry was controlled by customer at 2-3% using 3 stations of quality control points, i.e. incoming point, in-process point, and outgoing point. The majority problems occurred from human mistakes, e.g not following the work instruction, low skill, misunderstanding, and the employment of foreign workers who might not understand and dedicate to work.

4.4. Turnover Rate

Turnover rate was 5-10%, which was acceptable. Most of the turnover rate occurred in operation or daily-wage employees while the turnover rate from staff or salary employees were very low. Most companies were located in an area with many factories; thus, employees had an opportunity to compare the compensation, welfare, and benefits offered in the companies nearby. Consequently, the staff turnover rate is relatively high, almost the same for all companies.

5. Discussions and Conclusions

The company should use time and motion study to set standard time, which is needed to measure performance in all departments. In addition, the companies need to calculate the actual capacity which will result in accurate resource planning, such as number of workers, materials, machines, capacity, and working hours. Moreover, employees will sense equality. It is also advisable to create a project to improve productivity with suppliers, employees, and customers involvement such as 5S, QCC, Kaizen, TPM, TQM, ISO, SPC, and lean manufacturing system. The company should create work instructions in Thai, Burmese, Cambodian or Laos to reduce communication issues. Small but frequent order is not worthwhile to set up manufacture frequently; therefore, the companies always determine to produce high volume at once which will lead to high level of inventory. Thus, the company should focus more on forecasting and negotiation to avoid dead stock. The company should also understand their employees to maintain current employees and create attractive welfare to attract prospect employees too. Companies qualified in terms of quality, cost, and delivery will survive in fierce competition. According to the establishment of AEC, there are opportunities to create their own brands, and relocate to border area or AEC countries in order to get new customers.

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List of Companies

Bk Plastic Product Co. Ltd.
Super Production Co. Ltd.
Act Ishihara (Thailand) Co. Ltd.
Ukkarit Rungrueng (2000) Co. Ltd
Vithit Factory Group Co., Ltd.
ASEFA Public Co. Ltd.
Fischer Tech (Thailand) Co., Ltd.
Millennium Polymer Co., Ltd.
TTC Air Conditioning Co. Ltd.
Bitwise (Thailand) Co.Ltd.
Roi Et Flour Co., Ltd.
Broad Advance Co., Ltd.
Thongkrua Engineering Co. Ltd.
Pholvas Packaging Co., Ltd.
Starfish Co., Ltd.
A.K.P. Technology Co., Ltd.
Heil Trailer Asia Limited
Intertool Technologies Co. Ltd.
Energy World Corporation Co., Ltd
Seagate Technology (Thailand) Co., Ltd.Engineer Plastic Products Co., Ltd
Hana Semiconductor (Ayutthaya) Co., Ltd.
Smartrac Technology Co., Ltd.
Thai Evolution Industry Co., Ltd.
P.E.I. Plastic Co., Ltd.
C.E.S. Systems Co., Ltd.
Lak Chai Ka Sura Co., Ltd.
Thai Trafo Manufacturing Co., Ltd.
Siam Brothers Co., Ltd.
Kanarug Garment Co., Ltd
M And N Manufacturing Co., Ltd
Ukkarit Rungrueng Co. Ltd
Focus Plastic Industry Co., Ltd
P.V. E. Engineering Ltd., Part
S.D.K. Group Co., Ltd
Ornament Textile Co., Ltd.
Chokthawee Plastic Co., Ltd
AT Design Station Co., Ltd.
CRV Packaging Co., Ltd.
Hi-Q Plas Co., Ltd