Factors to be Considered when Purchasing, Using, Maintaining and Monitoring the Condition of Plant and Equipment for Promoting Sustainable Development

S.M. Ratnaweera

Consultant Management System, CINEC, Millennium Drive, IT Park, Malabe, Sri Lanka

ratnaweera@cinec.edu

Abstract- It has been found that a vast majority of organizations in this country do not have proper guidance about monitoring their plant and equipment in order to enhance productivity. First of all there should be a guide line for the selection and purchase of plant & equipment. There after we should know how to use them correctly, and also how to maintain and monitor their condition periodically. Without introducing such arrangements, most organizations suffer in their business activities and incur heavy losses. Only a few organizations have any clear idea of the factors that have to be taken into consideration when purchasing plant and equipment and other related issues. As we all know the need of the current era is sustainable development which means the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Accordingly, we have to consider the three factors namely the economy, environment and society when we purchase plant and equipment for our organizations.

Keywords- Sustainable development, Selection of plant and equipment, Overall equipment effectiveness.

I. INTRODUCTION

This paper is a result of my long experience as an Engineer, Manager and Consultant, involved in improving the performance of industrial organizations with respect to the quality and productivity. The paper introduces specially the guidelines indicating factors for the selection of plant and equipment for industrial organizations.

The Brundtland Commission in 1987 in “Our Common Future” [1] defined Sustainable development as follows.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

In the present context the concept has evolved and according to Shaker (2015) [2].

The term 'sustainability' should be viewed as humanity's target goal of human-ecosystem equilibrium (homeostasis), while 'sustainable development' refers to the holistic approach and temporal processes that lead us to the end point of sustainability. (p. 305)

Singh et al., 2009 [3] incorporates three main processes contributing to sustainable development.

In terms of sustainability, it must address an integral approach that encompasses suitable measures that reflect economic, environment and social aspects.

The figure below projects this through a Venn diagram.

Fig. 1 Sustainable Development [4]

In Figure 1 above *Social* denotes Respecting individuals, Equal opportunities and Human rights. *Environment* stands for conserving the environment. *Economic* represents consistent economic growth. *Socioeconomic* stands for Sponsorships, employment, Training and Development while *Socio- Environmental* encompasses the criteria Climate Change, Responsibilities for environmental changes, Health and Safety. *Eco-economy* represents Renewable resources and energy efficiency.

II. METHODOLOGY

The following eight factors should be considered when selecting plant and equipment for any industrial organization.

A. *Fitness for the Purpose*

This is the most crucial factor. There is no point in going for equipment of high quality, high efficiency or low cost if the equipment cannot fulfill the desired purpose.

B. *Cost*

The cost of equipment includes several factors as outlined below.

- 1) Purchase Cost – The selling price of the equipment.
- 2) Transportation Cost – The cost incurred to get them down from the place where they are available for sale (CIF value)
- 3) Installation & Commissioning Cost – The expenses incurred to install the equipment in the required location and commence operations.
- 4) Training Cost – The cost incurred to train the operators in order to operate and maintain the equipment.
- 5) Operational Cost – The cost of operation which includes the cost of electricity, fuel or gases which are necessary for its operation.
- 6) Maintenance Cost – Special skills may be necessary to maintain the equipment and also the cost of materials required for maintenance and repairs.
- 7) Disposal Cost – The cost incurred to dispose the salvage item. This has now become a legal requirement. After using the salvage also has to be disposed in an environment friendly manner which has now become a legal requirement

C. *Durability*

This relates to the depreciation of the equipment which means the loss in value due to wear and tear. If the equipment can be used only for a short time, the loss in value due to wear and tear would be very high.

D. *Guarantee and Warranty*

Guarantee means the assured period of fitness for the equipment to function without failing prematurely. If it fails before the guaranteed period due to manufacturing faults, the supplier is bound to compensate the customer for the loss incurred.

Warranty means mandatory maintenances which should be done by the supplier free of charge. However, it is an obligation of the customer to get such services done as recommended by the manufacturers as stated in their service instructions. If an equipment fails for not complying with this requirement the customers will not be compensated for any losses suffered.

E. *Risk of Obsolescence*

This denotes the risk of becoming outdated. Although equipment could be used for several more years, the new equipment that are introduced to the market could be much more productive and could give better quality products or services at a lesser cost. If our competitors use them, they can offer much better products or services at a lesser cost with better quality and efficiency than us and they could become a threat to our business.

F. *Ergonomic Factors (Human Factors)*

As defined by Dohrman Consulting (2014)[5], Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and the profession that applies theory, principles, data and methods to design in order to optimize human wellbeing and overall system performance.

Such factors would enable us to operate and maintain the equipment easily, efficiently and economically which is known as a “user friendly” approach.

G. *Environmental Factors*

According to the Central Environmental Authority (2017) [6], the equipment should be environmental friendly. This means that there should be less emissions such as dust, fumes, gases, smoke, noise, vibration and waste. The cost of energy such as electricity, fuel or gases should also be minimized. After the usage the salvage should be easily disposable without causing any environmental pollution.

Environmental Management System is a set of processes and practices that enable an organization to reduce its environmental hazards and energy cost. This is an important factor that has to be considered in the modern industry.

H. *Occupational Health & Safety Focus*

International labor standards on occupational health & safety specify that all equipment used in the industrial sector should be safe & less hazardous in order to protect the occupational health and safety of employees. Such requirements have to be looked into during the design stages. A systematic approach for managing safety has to be taken into consideration when purchasing equipment.

It is also essential to consider the following two factors when purchasing plant and equipment which are also categorized under safety requirements.

I. No Load Protection

The power supply to the equipment should not turn on without a load which is part of its protection. Any devices connected to it should also satisfy the load requirements.

J. Over Load Protection

Every electrical circuit in the equipment must be protected against overloads.

III. OVERALL EQUIPMENT EFFECTIVENESS (OEE)

Quality rate indicated as OEE measurement is made up of three elements, each one expressed as a percentage and accounting for a different kind of waste in the manufacturing process. The three elements are Availability, Performance & Quality Rate (Paul (2013)[7]; Vorne Industries, 2016 [8].

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality Rate}$$

Fig. 2 – OEE Calculation

- A. **Availability:** Is a measure of the time the plant was actually available for production compared to the manufacturing requirements. Any losses in this area would be due to major breakdowns or extended set up time.

$$\text{Availability} = \frac{(\text{Running Time} - \text{Stoppage Loss Time}) \times 100}{\text{Running Time}}$$

- B. **Performance:** It is the rate that actual units are produced compared to the designed output. Losses in this area would be due to slow speed, minor stoppages or adjustments.

$$\text{Performance} = \frac{\text{Theoretical Cycle Time} \times \text{Processed Amount} \times 100}{\text{Productive Working Time}}$$

$$\text{C. Quality Rate} = \frac{\text{Items Acceptable} \times 100}{\text{Total Output}}$$

If the exact values are not available, the assessed values could be used instead to determine the OEE.

IV. CONCLUSIONS

All industrial organizations should use guidelines by emphasizing the above factors which must be considered when purchasing plant and equipment. They should use manufacturers guidance for the correct use, maintenance and monitoring of plant and equipment.

All related staff should be educated about the use of the above guidelines. Such an approach would be essential to promote sustainability which includes the promotion of economy of the organization and also to comply with the related statutory and regulatory requirements. After purchasing the equipment, they have to be maintained as per the guidance laid down by the manufacturers in their service catalogues and other related literature. Beside that it would be necessary to monitor the condition of the equipment periodically.

By implementing the requirements mentioned in the proposed guidelines, industrial organizations would be able to perform their technical operations efficiently, effectively and economically.

The measure of the Overall Effectiveness of the Equipment (OEE) should be monitored annually and their values should be displayed on the equipment. Such information should be included in the annual fixed asset verification reports and discussed at the management meetings accordingly.

Further the Product Life Cycle (PLC) is the cycle through which every product goes through from introduction to withdrawal or eventual demise. PLC analysis, if done properly, can alert a company as to the health of the product in relation to the market it serves.

Fig. 3 – Product Life Cycle

A product in this instance, can be a physical item or a course in an educational discipline. According to ISO terminology a product is a result of a process. In a production, first a market research has to be conducted to determine the demand. The next stage is designing the product/ course. Then the manufacturing of the physical item or launching the course takes place. Initially there will be a growth which will peak at maturity and then the demand will decrease. Before the demand is completely eliminated the next cycle begins.

Thus when a company orders a physical item or launches a course the life span of the equipment or the demand for the course should be estimated depending on the requirement of the company. If such plans are not made huge losses could be incurred.

REFERENCES

- [1] The Employers' Federation of Ceylon. (2017). Factories Ordinance. <http://www.employers.lk/factories-ordinance-i>
- [1] Brundtland, G. H., World Commission on Environment and Development. *Our Common Future: Report of the World Commission on Environment and Development*. Oxford University, 1987.
- [2] Shaker, R. R. (2015). The spatial distribution of development in Europe and its underlying sustainability correlations. *Applied Geography*, 63, 304-314.
doi.org/10.1016/j.apgeog.2015.07.009
- [3] R. K. Singh, H. R. Murty, S.K. Gupta, A. K. Dikshit. **An overview of sustainability assessment methodologies**, *Ecol. Ind.*, 9 (2) (2009), pp. 189-212
- [4] Venn Diagram- Sustainable Development
<http://muiwo2014g55.blogspot.com/2014/02/venn-diagram-sustainable-development.html>
<https://www.automationworld.com/article/topics/oeef/how-calculate-overall-equipment-effectiveness-practical-guide>
- [5] Dohrman Consulting (2014). What is Ergonomics? [Online]. Available: <http://www.ergonomics.com.au/what-is-ergonomics/>
- [6] Central Environmental Authority (2017). National Environment Act [Online]. Available: <http://www.cea.lk/web/index.php/en/acts-regulations>
- [7] Paul J. Z. (2013). How to Calculate Overall Equipment Effectiveness: A Practical Guide
<https://www.automationworld.com/article/topics/oeef/how-calculate-overall-equipment-effectiveness-practical-guide>
- [8] Vorne Industries (2016). Overall Equipment Effectiveness [Online]. Available: <http://www.oee.com/>