A REVIEW STUDY ON GREEN ENGINEERING AND PRACTICE OF ANALYTICAL NETWORK PROCESS (ANP) DECISION

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***Abstract*: Today, growing industrialization generates enormous environmental pressures, and numerous environmental issues emerge everyday as a result of this industrialization. With a worldwide knowledge of environmental danger and commercial pressure to maximize benefits, production has to be developed and Green Manufacturing or Environmental Manufacturing (ECM) is the only answer to these issues. Environmental production is being adopted by multinational and local companies worldwide. Green production has grown rapidly over recent decades, yet changes because of green production will not occur suddenly, but over time. It is a question of continual improvement and the industries alone must not make the adjustments; government must also play a major part in establishing the appropriate atmosphere that supports environmental production. Green Production Savings time and money. Green manufacturing allows us to manufacture more goods in the same environment than green ones.**

***Keywords*: Green Engineering, Network Process, Green Manufacturing**

I. INTRODUCTION

Manufacturing plays a highly important function in a company, in particular to enhance competitiveness and performance. With fast technological advancements, consumer demands and globalization, production continues to adapt and evolve. The automotive industry launched mass production methods at the beginning of the century that changed manufacturing processes. Over the years, there has been a need for flexible and mass customization methods without sacrificing productivity or quality to fulfill individualized client requirements. Fig. 1.1 below illustrates this shift in the philosophy of production throughout time.

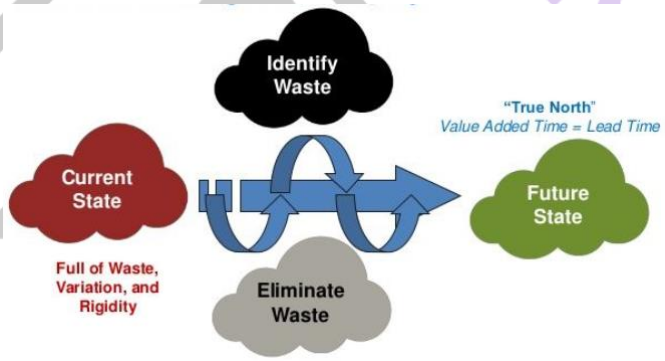

Fig. 1.1 Change in Manufacturing Philosophies

Because of recent price volatility and widespread recognition there a pressing environmentally friendly generating utilizing fossil fuel. emphasis production and green production is not new. green production itself. The idea has been around for a number of decades but manufacturers have never gotten a lot of attention save for attending seminars and rating surveys properly. But recent trends indicate that, with an increased emphasis on climate change, there is a shift of attitude and thus good action is finally coming. From Fig. 1.2 below you may understand the fundamental idea of environmentally aware manufacturing or green manufacturing and its effect on production. Both the effect on the environment and production are linked to environmental-conscious production.

Fig. 1.2 Concept of Setting Conscious Process

Environmentally Conscious Manufacturing (Green manufacturing)

Production that is environmentally aware is known by a variety of different names, including clean, green, ecologically sound, environmentally responsible, and sustainable manufacturing, to mention a few. Regardless of the many abbreviations, the basic goal remains the same: the development and delivery of products that minimize negative environmental effects throughout the manufacturing, use, and disposal phases of their lives. different production, they have a level of importance. In the words of Melnyk and Smith, this system integrates product and process design considerations into manufacturing processes, production schedules, and control considerations in such a way that environmental waste flow is identified, quantified, evaluated, and managed in order to reduce and minimize environmental impacts while simultaneously maximizing resource efficiency.

Fig. 1.3 Meaning of Environment Conscious Manufacturing

The meaning of the word may also be understood by the self-explaining figure 1.3. However, the basic principles of green production are quite straightforward and relate to limiting the use of resources and the effect of a product on the environment. From conception to end of life, this philosophy covers all the components of its life cycle. With green manufacturing there are enormous possibilities. Although the market size of green manufacturing is difficult to quantify, industry analysts think it would be extremely important in the next decade. As governments, businesses and consumers understand the significance of greening the obstacles to investment in these technologies, they are anticipated to decrease quickly.

II. LITERATURE REVIEW

Francis (2009) In his research, the environmentally aware implementation of quality functions is assessed as a novel approach to green manufacturing. In his research, environmental metrics are utilized as assessment criteria for technical needs for the implementation of environmentally aware quality functions before any design ideas are created. This leads to the creation of an ecologically beneficial product.

Zhou (2011) Proposed assessment of green production methods based on simulation analysis. He utilizes simulation to detect the complex process flux and decision-making logic involved and connects simulation with a search method to enhance solutions. The design of the simulation model underlined a strong structure that effectively reflects the process flow and decision logic of common GSD improvement applications. The simulation included a process/activity cost structure to reflect important compensation provided by various costs drivers throughout the GSD process. Experiments to test and confirm the suggested ideas were conceived

and executed via simulation. A study of response surface methods (RSM) was performed which revealed the potential of established research in the search for optimum solutions under relaxed circumstances.

Xiuyan (2009) Uses TOPSIS methodology to evaluate green productions comprehensively. A synthetic assessment approach for rating green productions, based on TOPSIS algorithms, was presented in his research to detect the greenness of products. This thorough assessment technique is also utilized at three other US power facilities. With this approach, power plants may be classified according to their green characteristics. With the rise of industrialization, environmental concerns become major challenges for influencing sustainable human development. As a result, more and more businesses have begun to consider green in the manufacturing process.

Xiaozhen (2009) Green production logistics relates to manufacturing companies. The Green production logistics integrates green manufacturing ideas and techniques to the production logistics system. To integrate process control theory, logistics simulation technology and information technology, green manufacturing logistics can reduce environmental damage and improve the energy utilization rate of the production logistics system. His article introduces the meaning and issue area of green production logistics. The green features of the logistics of manufacturing are analyzed. We next examine methods of implementing green production logistics and present their design that includes technical base, data support and green workshop layer implementation. At conclusion, this architecture's application mode is examined on the basis of PDM, which provides the theoretical foundation for implementing the green production logistics in manufacturing workshops in China.

Zhongling & Xiwen (2010) The green manufacturing and recycling economic technique applied in the gold mining company in China. The operation of a gold mine company is a complex system engineering/productive flows, the theory of the recycling economy is applied in the production of gold minerals, aims at fundamental prevention and efforts to reduce or reduce the impact of gold mineral production processes improve the environmental quality, solves environmental issues of China's gold mining, achieves the necessary results In order to accomplish the goals of helping the country and the people and benefiting future generations, the unification of economic benefits, social benefits and environmental benefits of companies has been achieved.

Liang (2012) In his study, he claimed that both the quality of human life and health have been severely affected and endangered by global warming, climate change, environmental degradation and environment pollution. For every company and industry, it is thus extremely essential that 6 R principles be completely implemented including research, reduction, reuse, recycling, rescue and revival and that the warming conditions be improved. In order to regulate green management principles 6R, reduction, reuse, recycling, rescue and recovery includes regeneration, refreshment or recovery for administrative and administrative bodies. Cloud computing is considered to be the most promising IT solution (IT). It not only lowers paper usage but also improves the IT level. Based on these benefits, cloud computing has gathered energy saving and high efficiency in green management industries from the growing IT sector.

Zanakis, Solomonb & Dublishc (1998) In their simulation experiment the performance of 8 methods will be investigated: ELECTRE, TOPSIS, Multiplicative Exponential Weighting (MEW), simple additive weighting (SAW) and 4 versions of AHP (original versus geometrical scale and right prospector vs. average transformation solution) and the following results can be observed: The following technique performance order were generated by a similar ranking reversal experiment: SAW and MEW (best), followed by TOPSIS, AHP and ELECTRE. It should be noted that the version of ELECTRE utilized has been tailored to the typical MADM issue and has thus not taken use of the method's ability to handle ordinary or imprecise information problems.

Xianlin, Hua & Jiajia (2009) The assessment of Green Manufacturing Enterprises is based on MADM and five first level assessment aims and twenty-four second level appraisal goals, which form a complete evaluation system, integrating subjectivity and objectivity with economic efficiency and social efficiency concurrently. First 5 subsystems are thoroughly assessed using the main analytical technique of the components; next the weights of each subsystem are decided using the analysis hierarchy process. This approach completely expresses objective information in the evaluation process, embraces the expertise of policy makers and makes a thorough, objective and correct assessment of green manufacturing companies.

Zhonghua & Zhaowei (2006) Assess green manufacturing (GM) features and overall quality management (TQM). In many areas, the connection between green manufacturing and total quality management is addressed and the integration of GM and TQM is demonstrated through strategic, tactical and operational elements.

Rusinko (2007) Investigate the relationships between certain eco-sustainable manufacturing techniques and specific competitive outcomes in a sector that is environmentally significant yet underappreciated. Due in part to the constraints of earlier studies, his study on the impact of the environment on the outcomes of the organisation is ambiguous in its conclusions. Some of these issues are also addressed in a poll conducted by the whole commercial carpet industry in the United States; 84 percent of those who responded reflect the market as a whole. According to his findings, environmentally friendly manufacturing techniques more the long run. In instance, different types of environmentally friendly manufacturing techniques (such as pollution prevention and product management) are associated with a variety of competitive outcomes (e.g., manufacturing cost, product quality). These specific findings are helpful in fulfilling the environmental and competitive expectations of engineering and operational management, as well as in addressing the needs of customers.

Field & Sroufe (2002) The research examines the consequences for the structure of the supply chain and the supplier's relationships of recycled vs virgin materials and also the wider impacts of the operational strategy. They examine the on-board carton sector,

where vertical integration is widespread, and non-integrated companies are both clients and rivals of integrated enterprises. These numerous connections between suppliers/clients/competent provide an excellent setting for observing changes in the supply chain using recycled materials. The benefit of changes in the supply chain and supplier relationships mainly extends to unintegrated companies, so it expects that recycled material inputs will be dominated by non-integrated businesses and that the non-integrated to integrated firm's ratio will increase with decreasing capital costs over time.

Yinsheng, Guang, Xueyi & Ryoichi (2003) The method by which LCA (Life Cycle Assessment) products are evaluated for their greenness is shown, and this is one of the most difficult issues in PLCA (Products Life Cycle Analysis). A non-uniform strategy for assessing the greenness of goods, based on the DEA model, is presented in this article, after a thorough analysis of the shortcomings of existing comprehensive techniques for evaluating green items is conducted. This process not only assesses the greenness of certain goods in comparison to a technical reference product developed using product information, but it also demonstrates how to quantitatively improve the greenness of goods by employing the DEA efficient DMU frontier project theory and DEA efficient DMU frontier project theory (Decision Making Unit). Finally, they provide a numerical example of the greenness assessment of coolers to show how the established method may be used and where it can be found in the literature.

Zhu A. (2007) Research on green degree design, develops the green degree measurement technique, promotes the principles and the viable green degree approach, creates the deployable green degree model, designs the green degree process. This may assist companies clarify the emphasis of the green level and select the best program. How to deploy green goods to produce products that not only satisfy green demands, but also the cost constraint is a significant issue for companies. With the adoption of green manufacturing, the recovery economy has developed and new industrialization has become an important production trend.

Zhang & Min (2009) The "Green" has become a global issue, with governments worldwide making environmental rules and regulations for businesses more stringent. Green supply chain implementation is one of the emblems of harmonious society and thus the study of green supply chain companies includes theory and practice. Their research relies on the green supply chain construction model of car companies based on the GSCOR model, which outlines the fourth element of the Green Automotive Supply Chain's unique functioning of four key components: green procurement, green industry, green supply and green recycling.

Gary & Paul (2009) perform an inquiry to establish if manufacturers recognized by the Shingo Prize have reached the greener state due to their dedication to Lean production and compare their findings with the information provided by Melnyk, which is the green of more than 1100 manufacture facilities. The businesses that Shingo recognizes have substantially greater greenness than the manufacturers that Melnyk has examined. This shows that Lean enterprises embrace Green goals and transcend Green production as a natural extension of their culture of continual waste reduction, fundamental to the world-class Lean programmer.

Zhang (2010) Produce research on the development and use of Green Manufacturing Enterprise Information Resources. According to him, the resources of information promote green production. Compared with conventional manufacture, green manufacturing stresses the simultaneous and complete consideration of resource and environmental issues throughout the lifetime. The construction of its information system is thus more complex and difficult. His investigation proposed a solution to technical problems such as information collection and acquisition, database storage, auxiliary decision making and the exchange of all kinds of information via an analysis of the connotations between green manufacturing and its operational nature.

Baoju & Jian (2011) manufacture virtual green manufacturing model. With the fast growth of IT and value diversification, the trend towards production automation is evolving, with globalization, virtualization and green virtual green manufacturing technology being only a kind of sophisticated pattern of production created under this trend. In green manufacture, the connotation of virtual green production is presented with virtual production (VM) and the current status of virtual green production at home and abroad is examined and its use in manufacture is evaluated.

Jihong & Junguang (2009) This paper describes the cleaner manufacturing concept as well as ISO14000, as well as the contrasts and similarities between the two. When it comes to mechanical activities, the selection of green manufacturing equipment is a practical way of reducing resource consumption and the negative impact on the environment. A process face of characteristics is used to choose the best machine tool from among the ever-growing number of available choices on the market, according to the criteria used. With the use of a technique known as the, it possible construct a selection model that may be used to selections.

Anastas and Zimmerman (2007) also served to reduce the effect on the environment; they were also addressed later in this book. For each kind of organization, these tools are extremely helpful to adopt green manufacturing and make it simple to comprehend environmentally-friendly or sustainable production.

Carmen, Sofia & Stefan (2011) Present an analytic hierarchy process as the possible decision-making technique for assessing the adoption of management systems for WEEE (Waste Electrical and Electronic Equipment). The model presented is based on the study of policy, economic, social, technological and environmental problems that may influence effective WEEE management systems implementation. The suggested model may assist WEEE managers to better understand the critical elements in the deployment of WEEE management systems.

Rao, Bleicher, Kalyankar & Dorn (2011) Choose the finest environmentally aware manufacturing (ECM) alternative program that constitutes a significant manufacturing environment issue. They propose a combination method that combines the values of the characteristics and their relative significance to give a more accurate assessment of the alternatives. The method also enables the

decision maker to assign the relative values to the characteristics systematically. The fuzzy logic is utilized to convert qualitative qualities into quantitative attributes. An example is provided in your study to demonstrate the method.

Similarly, **Tan et al (2002)** They claimed that green manufacturing integrates manufacturing problems with the ultimate goal of reducing adverse environmental impacts and resource consumption throughout the product life cycle, which includes the design, synthetics and manufacturing processes as well as packaging materials, transportation, and manufacturing use of the products.

Panyaluck is a Filipino word that means "**lucky" (2004)** According to the results of a study of 108 electronics manufacturers, the materials, processes, packaging, work environment, and waste systems all had a direct impact on the adoption of green management methods in the manufacturing environment.

PVA is a multi-attribute decision model developed by **Sangwan (2006)** that contains 61 indicators to support green manufacturing systems. This model is known as the PVA (GMS). The adoption of green manufacturing systems not only allows for the preservation of a competitive advantage, but it also results in much larger competitive advantages over traditional manufacturing systems. According to the findings of this study.

Zhou et al. (2008) created an evaluation index system, an assessment procedure, and an assessment technique that could be used to evaluate a green product development project. Into the evaluation index system were integrated six characteristics: technical indicators for the environment, natural resources, energy, economic indicators for the economy, and social indicators for the society. The ANP technique is used to complete the majority of the job (Thomas. L. Saaty, 2005). AHP is one of the most frequently used techniques for managing multi-criteria problem decision-making, and it is one of the most widely used methods in the world. When AHP is used to make decisions, a number of assumptions are made, such as the independence of the components on the higher level, the independence of the elements on the level, and the structure of the hierarchy of the decision problem, to name a few examples (Saaty 1994, Saaty & Zoffer 2011). The assumption of independence between the different decision-making variables is, however, a significant disadvantage of the AHP approach. The analytical network process (ANP), on the other hand, quantifies the interdependence of choice criteria and allows for a more systematic study of those features. Furthermore, the interaction of choice characteristics at the same level, as well as feedback between two different levels, are important issues that should be considered throughout the decision-making process and investigated further. Because of this, the AHP method does not perform well when such choice problems are addressed (Saaty, 1996). Saaty developed and improved ANP as a complete and supplemental AHP method, which was then enhanced further. In contrast to AHP, ANP provides a more generic decision-making model without making any additional assumptions about the independence of the components at higher levels from the lower parts, as well as the independence of the elements within a given level of abstraction. Despite all of these features, applications of ANP in a decision-making situation are not very common at this time. However, in recent years, there has been a rise in the use of ANP in multi-criteria decision-making problems (Jharkhariaa & Shankar, 2007).

The ANP method may be used to generate choices that cannot be structured in a hierarchical manner and that do not contain assumptions that are both internally and externally independent of one another. Since its conception, the ANP method has been used in a variety of areas. It also makes it possible to include all of the essential elements (physical or intangible, objective or subjective, and so on) that contribute to making the best decision (Saaty, 2005). In today's world, the ANP is the most comprehensive framework for evaluating social, political, and commercial decisions available to policymakers. One element of the ANP models is a control hierarchy or network of objectives and criteria that regulate interactions in the research system; the other part is a subnet of influences among issue components and clusters, one for each control criterion (Saaty, 2008).

Gencer and Gurpinar (2006) The use has been shown. developed systematically assessed the relationships between supplier chain characteristics and ANP.

Sauer et al. (2004) Ecological Performance of Electrical Consumer Products shown.

Kone and Buke (2007) It was demonstrated may utilized in Turkey assessment power production.

Karpak and Topcu (2010) the framework for network prioritization of success criteria enterprises.

Ahmed M. Deif university of Regina Green production has been considered as a rival production method, according to him, green production saves time, money and energy

III. CONCLUSION AND FUTURE WORK

This study has created an estimation model and evaluation of factors on the basis of extensive workable techniques, integrating commentaries by areas, followed by a computation of weights by ANP for the assessment of factors. Finally, the model is utilized to identify effective ECM factors in any organizational structure. The environmental issues are growing every day and environmentally aware production is the greatest way to solve these concerns. But the environment and market are dynamic and change from time to time, so that the best solution/alternative is to utilize fresh methods. Investigators, academics, scientists and industrialists already operate in this area, but there is still some gap and a lot of effort has to be done to eliminate this gap.

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