

To Assess Implementation of Green Lean Techneque(GLT) in Mining Industrty

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Abstract : Today day by day technology advancement carry out everywhere, also this advancement is shown in many industries as well as organisations. The study is significant for researchers working in the field of Green lean development and other similar systems as the study will provide an exhaustive review of literature and trace the origin and evolution of green lean (GL) practices, environmentally conscious manufacturing, sustainable manufacturing, sustainable production, environmentally responsible manufacturing, clean manufacturing, and cleaner production. The primary work also shows the perceived benefits of combination of factors that influence the adoption and implementation of Green lean practices. The result shows that benefits of various combinations of factors influenced the adoption and implementation of Green lean practices.

IndexTerms – Green Lean (GL), sustainable manufacturing, LeanManufacturing

I. INTRODUCTION

The term “green” manufacturing can be looked at in two ways: the manufacturing of “green” products, particularly those used in renewable energy systems and clean technology equipment of all kinds, and the “greening” of manufacturing reducing pollution and waste by minimizing natural resource use, recycling and reusing what was considered waste, and reducing emissions. In this thesis, the emphasis is given on second definition of green manufacturing *i.e.* reducing resource use, waste, and pollution, along with recycling and reusing what was formerly looked at as waste, yields benefits not only in terms of an improved bottom line, but in terms of employee motivation, morale, and public relations. Lean management is an integrated system that helps an organization to sustain in this competitive industrial scenario [14]. In the recent years, Lean Manufacturing (LM) is gaining considerable importance and popularity as an approach that can achieve considerable performance improvement in the industry [15]. Though the lean concept itself was not a single point invention but the outcome of a dynamic learning process that adapted practices emanating from the automotive and textile sectors in response to environmental uncertainties in Japan the term “lean” was coined by Krafcik [16] who introduced the term “lean” to describe a production system that uses less resources of everything compared to mass production.

1.1 Significance of the study

The factors affecting green manufacturing studied and data collected are expected to help decision makers in government to develop policies and prioritize them to mitigate green manufacturing barriers from Indian perspective. The ranking and the hierarchy of the factors affecting green manufacturing will provide these decision makers with the required understanding to prioritize policies in a sequential manner based on the rank and hierarchy of the factors. The analysis of this data will be helpful to the top management in industry to develop and prioritize their business strategies for smooth implementation of green manufacturing. The inter-relationship among various factors and their driver-driven relationship is expected to help the managers/executives to develop an effective plan to mitigate the root causes for enhancing green manufacturing. The comparison of drivers will help the Indian mining industry to learn and develop the future environmental policies.

The study is significant for researchers working in the field of green manufacturing and other similar systems as the study will provide an exhaustive review of literature and trace the origin and evolution of green manufacturing, environmentally conscious manufacturing, sustainable manufacturing, sustainable production, environmentally benign manufacturing, environmentally responsible manufacturing, clean manufacturing, and cleaner production. Thus, this study will suggest an action plan to help green manufacturing implementation in India.

1.2 Objectives of paper

1. To assess scope of green lean technique in industrial aspect.
2. To determine the extent to which the operating marble mines in Rajsamand have adopted and implemented Green lean practices and their perceived benefits.

2. LITERATURE REVIEW

The first GS citation for the term “Green Manufacturing” comes from Lewis in the article “The games children play - even Verminous Skumm is made of recycled material” published in 17 EPA Journal in 1991. The article educates the children about the environmental issues in manufacturing while they play games. The first article with “Green Manufacturing” in the title of the article is found in year 1995 by Dickinson et al. entitled “Green product manufacturing” published in AT&T technical journal. The GM is the application of sustainable science to the manufacturing industry. The term GM was coined to reflect the new manufacturing paradigm that employs various green strategies and techniques to become more eco-efficient. This strategy includes creating products/systems that consume less material and energy, substituting input materials, reducing unwanted outputs, and converting outputs to inputs (recycling) (Deif, 2011). [4]

Deif (2011) opined that sustainability is a concept and GM is a methodology to the design and engineering activities involved in product development and/or system operation to minimize environmental impact [5]. Green manufacturing is a

concept of production which connects the design of products and processes that reduces waste, eliminates costly end-of-the-pipe treatments, provides safer products and reduces use of energy and resources (Burchart-Korol, 2011)[4]. The fundamentals of GM are related to minimizing the use of resources and the environmental impact of a product. Successful implementation of GM requires going beyond small standalone initiatives and adopting an integrated three-step framework: (i) planning for green as a core part of business strategy, (ii) executing green initiatives across the supply chain by shifting towards green energy, green products and green processes, and (iii) communicating and promoting green initiatives and their benefits to all stakeholders.

The GM is an on going process of continually improving manufacturing techniques with an ultimate goal of sustainability and it is a process with sustainability as the ultimate albeit distant goal considering three areas of knowledge - specificity of sustainability, triple bottom line, and technology wedge which refers to action affecting the use of technology, materials and energy eventually leading to sustainability (Guerry and Boots, 2012)[13]. Balan (2008) opined that in addition to faster and cheaper, several other factors such as materials used in manufacturing; generation of waste, effluents and their treatment (or possible elimination); life of the product; and finally treatment of the product after its useful life are also important considerations in manufacturing a product or evaluating an existing process line.[2]

Green manufacturing deals with maintaining sustainability of environmental, economical and social objectives in the manufacturing domain and attempts to establish a solid foundation for all the three pillars to achieve sustainability in business operations. It is a method to develop technologies to transform materials without emission of greenhouse gases, use of non-renewable or toxic materials or generation of waste (Allwood, 2009).[1]

The GM is a modern manufacturing strategy integrating all the issues of manufacturing with goal of reducing and minimizing environmental impact and resource consumption during a product life cycle; which includes design, synthesis, processing, packaging, transportation, and the use of products in continuous or discrete manufacturing industries. Liu, Zhang, Cheng, 1999).[8]

Green has moved from being perceived as a "necessary evil" to being seen as "good business". The companies take their problem solving approach to the next level and develop innovative techniques towards effective solutions, which result in cost savings from reduced work handling, effluent control, process automation, etc. All these efforts are applications of green manufacturing. This manufacturing concept is not just restricted to addressing the social and environmental impact of a pollution-centric process. The main objectives of GM include pollution prevention, waste reduction, materials and energy consumption reduction, political traction, brand enhancement, regulatory compliance, talent retention, consumer retention and attraction, cost savings, etc. (Deif, 2011[9]; Sangwan, 2006[10], 2011; Bhattacharya[11], Jain, Choudhary 2011)[3].

The goals of green manufacturing are frequently achieved through product and process design. Green manufacturing encompasses all factors associated with environmental concerns in manufacturing by continuously integrating eco-friendly industrial processes and products. Green manufacturing can mitigate air, water and land pollution, reduce waste at the source and minimise health risks to humans and other species (Hui, Chan, Pun 2001).[7]

For products, green manufacturing attempts to minimise environmental impacts throughout the product life cycle. For processes, green manufacturing strives to conserve materials and energy, eliminate toxic substances and reduce waste produced. Green manufacturing is an advanced manufacturing system which aims to improve process efficiency and minimise environmental impact and resource consumption during manufacturing (Sivapirakasam, Mathew, Surianarayanan, 2011). GM is a manufacturing method that minimizes waste and pollution and is a subset of sustainable manufacturing.[12]

The research on green manufacturing can be divided into two groups: first, the work that deals with the overall concept of green manufacturing (Sangwan, 2006)[9] and second, the work that provides various analytical tools and models to realize green manufacturing at different levels (Deif, 2011)[5].

3. RESEARCH METHODOLOGY

This heading outlines the methodology employed to study the implementation of green lean practices in marble mining industries in Tehsil-Amet of Rajsamand district. The following segments are covered under this heading: type of sampling, number of samples, type of data, statistical test to be used.

3.1 Research Design

3.1.1 Type of Sampling: Convenience sampling.

Convenience sampling is being used as mine is not the place where anyone can go. It is technical project and person related to mining or person given consent/permission by the owner of the mine can enter the running mine with all safety measures taken. Known mining persons were contacted and the respective mine has been visited.

3.1.2 Number of Samples: 20 opencast marble mines

The number of marble mines having area between 1 to 5 Hectare areas is taken as sample near Tehsil Amet and Jhanjhar. The sample size is 20 with respect to the type of sampling chosen *i.e.* convenience sampling.

3.1.3 Type of Data Collection: Primary Data.

Data were collected through structured questionnaire of 20 questions (attached as Annexure A) related to green lean practices in those mining areas *i.e.* how much waste generated in the form of slurry is recycled or used in some other products, how much water is being used for cutting the marble blocks and how much of it is recycled, how much money has been spent on implementation of green lean manufacturing practices in the mining area, etc.

3.1.4 Statistical Test: Likert Scale, Descriptive statistics and Paired sample t-test.

3.1.4.1 Likert Scale:

Likert (1932) developed the principle of measuring attitudes by asking people to respond to a series of statements

about a topic, in terms of the extent to which they agree with them, and so tapping into the cognitive and affective components of attitudes.

Likert Scaling is a unidimensional scaling method. A Likert-type scale assumes that the strength/intensity of experience is linear, *i.e.* on a continuum from strongly agree to strongly disagree, and makes the assumption that attitudes can be measured. Respondents may be offered a choice of five to seven or even nine pre-coded responses with the neutral point being neither agree nor disagree.

To measure the extent to which these practices were adopted or will be adopted in future, a

5-Likert scale will be used where: 1 represents Not Adopted, 2-Thinking of Adoption, 3- Adopted but not implemented, 4-Currently implementing, and 5-Successfully implemented.

To identify the extent of perceived benefits of the adoption and implementation of green manufacturing practices, another 5 scale Likert Scale will be used where: 1 represents not significant, 2-little significant, 3-neutral, 4-relatively significant, and 5-significant.

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study, Data and Sources of Data, study’s variables and analytical framework. The details are as follows;

4. FINDINGS AND ANALYSIS

This section of thesis shows the findings and analysis of 20 marble mines.

4.1 To determine the extent to which the operating marble mines in Rajsamand district have adopted and implemented green lean practices

Questionnaire & Analysis:

- (a) Is the energy efficient mining machinery used for production and transport purpose has been adopted?

Table 4.1: Number of mines having adopted energy efficient mining machinery used for production and transport purpose

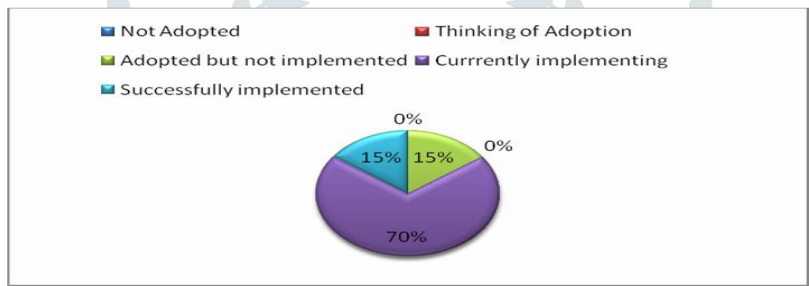


Fig 4.1: Pie chart showing Number of mines having adopted energy efficient mining machinery used for production and transport purpose

Interpretation:

According to the pie chart shown above, out of 20 mines 70% of the mines are currently implementing energy efficient mining machinery and very few *i.e.* 3 mines out of studied sample size have implemented the running of energy efficient mining machineries few years back. And remaining 3 mines are still thinking of adoption.

- (b) How much money is spent on environment initiatives and has this money being used for adoption of green lean practices?

Table 4.2: Number of mines spending money on environment initiatives for green manufacturing implementation

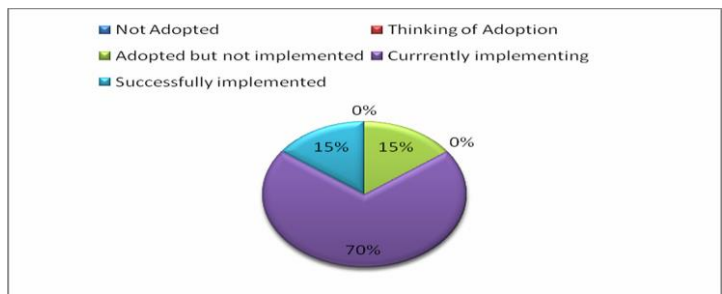


Fig 4.2: Pie Chart showing number of mines spending money on environment initiatives for green manufacturing implementation

Interpretation:

As per the Pie chart, almost 70 percent of the firms are currently implementing the green lean practices and 15

percent firms are thinking to be on the same way while rest have successfully implemented. Some of the Environmental initiative which was kept in mind by the Mines owners were Treating of Mine site water that is recycling it for Marble cutting. And Use of marble waste for manufacturing of soapstone

(c) Has the firm done environment risk analysis before and after adoption of green lean practices?

Table 4.3: Number of mines having done environment risk analysis before and after adoption of green manufacturing

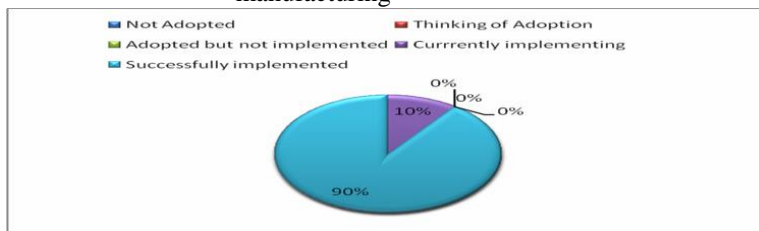


Fig 4.3: Pie chart showing number of mines having done environment risk analysis before and after adoption of green manufacturing



Interpretation:

Environmental risk analysis is necessary for each and every mines working. Thus According to the Pie chart almost 90 percent of the firms have successfully done with the environment risk analysis before and after adoption of green manufacturing and rest are in process *i.e.* currently implementing.

(d) Has the firm has environment management system or plan?

Table 4.4: Number of mines implementing environment management system or plan

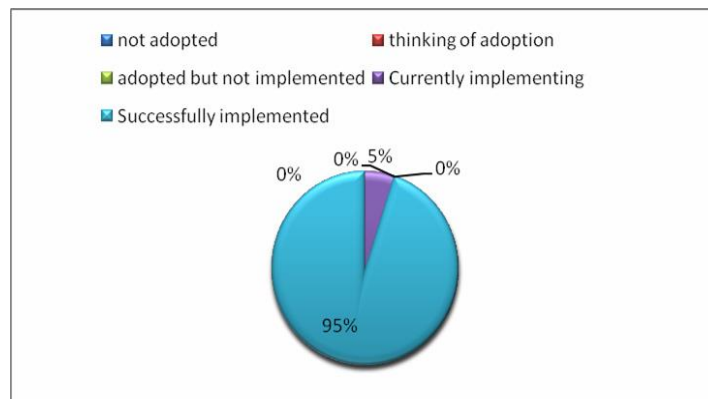


Fig 4.4: Pie chart showing number of mines implementing environment management system or plan

Interpretation:

State Government is providing with the lease for the Mining sites. Thus the mining firms who are not following the Guidelines set by the Government will have their lease cancelled. From the Pie, it can be seen that 95 perfect firms are having Environment Management system or plan, while only one firm hasn't implemented environment management plan.

(e)Is there a commitment of green le anpractices from all levels of employees in the firm?

Table 4.5: Number of mines having positive thinking of employees in implementing green manufacturing

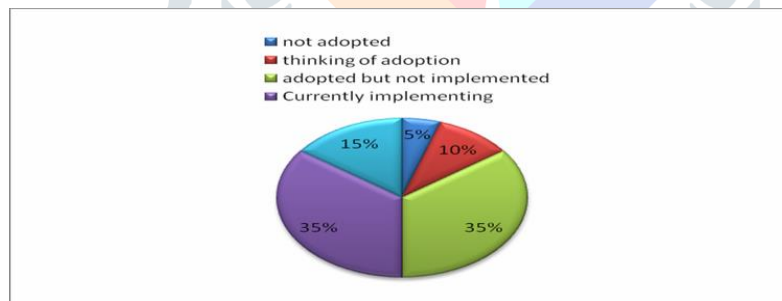


Fig 4.5: Pie chart showing number of mines having positive thinking of employees in implementing green manufacturing

Interpretation:

Most of the Employees are in favour of adopting the Green Manufacturing Practices as Labour Force in mining sites is quite high and GM helps in Hazard Free Zone. As per the chart, Only 15 per cent of the employees are having a commitment of green manufacturing , rest 35 per cent are currently implementing and the same have adopted but not implemented.

(f) Participation from the employees for adoption of green lean practices?

Table 4.6: Number of mines having participation employees in implementing green lean practices

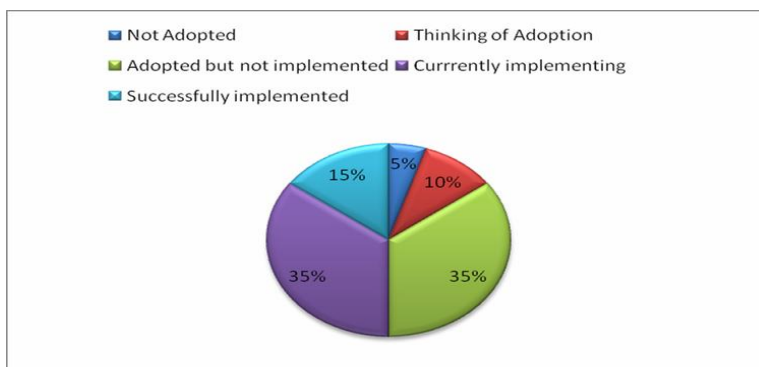


Fig 4.6: Pie chart showing number of mines having participation of employees in implementing green manufacturing

Interpretation:

As per the chart, only 15 percent of the employees are have participated in green lean practices, rest 35 percent are currently implementing and the same have adopted but not implemented

(g) Have there been product development and innovation practices?

Interpretation:

According to the pie chart, only 45 Percent of firms are developing products and are in innovative practices, and 25 percent have adopted but not implemented. Further 15 percent have successfully implemented and same are thinking of adoption. Marble waste is used in manufacture of soapstone. Bigger mine are also manufacturing synthetic marbles and chippings.

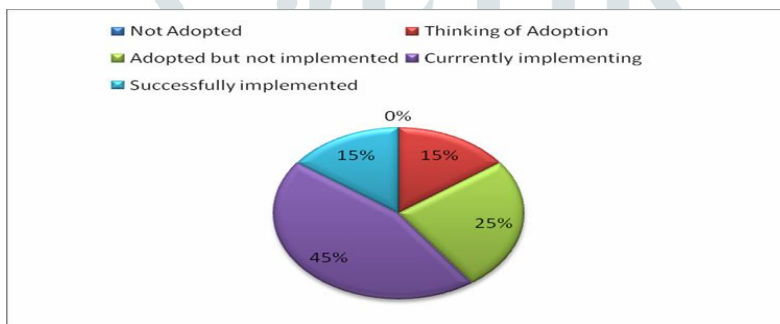


Fig 4.7: Pie chart showing number of mines having adopted innovative practices

(h) Consumption of waste internally and creating a market for waste products?

Table 4.8: Number of mines utilizing waste from mining

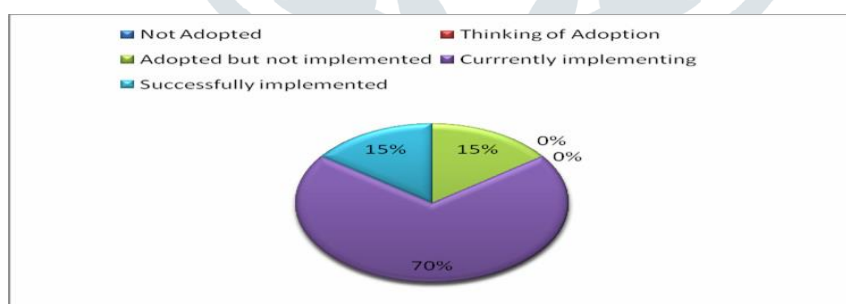


Fig 4.8: Pie chart showing number of mines utilizing waste from mining

Interpretation:As per the Pie chart, 70 Percent of the firms are currently implementing the practice of waste management internally and creating the market for the waste products and 15 percent have successfully implemented. 15 percent have not yet implemented.

5. CONCLUSION:

The primary work shows that via different questionnaires, the extent to which the operating marble mines in Rajsamand district have adopted and implemented green lean practices, has been determined through percentage on 5 point Likert Scale mentioned. Such as, how many of the mine owners are using energy efficient mining machinery for production and transport purpose and the result shows that 28 out of 40 sampled mines (70%) are currently implementing energy efficient mining machinery and 6 out of 40 samples mines (15%) are still thinking of adoption. In this way all the data have been converted into understandable and conclusive percentage form.

The primary work also shows the perceived benefits of combination of factors that influence the adoption and implementation of Green Manufacturing practices on 5 point Likert Scale mentioned. Various questions have been asked from the mine owners regarding waste reduction, scrap rate, capacity utilization, pollution, etc. and the answers were obtained on Likert Scale. The results shows that approx. 60% of the mine owners think that the perceived benefits of various combinations of factors influenced the adoption and implementation of Green lean practices.

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