Promoting Sustainable Practices in Industrial Set-Ups: An Action Research on Capacity Building of Managers towards Green Factories

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ABSTRACT

Manufacturing operations of industries have resulted in impact on resources, besides creating impacts on human health and wellbeing. This indicates towards a rampant need for the development and adoption of green building rating systems in manufacturing sector which will help in steering growth towards sustainable industrialization. This in turn can be accelerated by generating awareness amongst stakeholders of manufacturing sector to voluntarily adopt green practices for their factory buildings. Thus in this context, Indian Green Building Council (IGBC) has developed green factory rating system which can help address issues like energy efficiency, conservation of natural, betterment of working conditions and enhanced productivity. The paper discusses the green factory rating system, its benefits and intervention programme to promote green industrialization. The intervention was targeted towards empowering the stakeholders to make potential improvements in the working conditions in their existing non-green factory buildings.

Keywords: Green Factory Rating System; Managers; Industrial sector; Indoor Environment Quality technologies; training programme

1. INTRODUCTION

Sustainable Development stands for meeting the needs of present generations without jeopardizing the ability of futures generations to meet their own needs [1]. While buildings and development provide countless benefits to society, they also have significant environmental and health impacts. With rapid industrialization and urbanization in India, construction activities have increased manifold and their impact on environment is being felt. In addition, society has become more aware of the negative effects of indoor environment on buildings [2,3]. Industrial buildings construction and operation have extensive direct and indirect impacts on the environment. They use

resources such as energy, water and raw materials, generate waste (occupant, construction and demolition) and emit potentially harmful atmospheric emissions [4]. The introduction of green building guidelines to establish uniform standards for the application of sustainable practices and their acceptance has been a recent trend in the developing countries [5]. The green building movement in the India has encouraged the creation of green building rating systems. IGBC was instituted in 2001 and LEED-India was introduced in 2007. LEED –India was developed by adapting LEED –USA to meet Indian conditions [6]

In India, Current GHG emissions from industry – including electricity – are estimated to be about 750 million tons CO2e. There is an opportunity to reduce emissions from industry by about 680 million tons of carbon dioxide equivalent (CO2e) per year by 2030. But most of these opportunities are expensive [7]. Also, occupational morbidity amongst industrial slums in India is seen to be very high. Occupational injuries and deaths in industries due to hazardous machinery, toxic chemicals, high rise construction, unprotected machinery, poisoning and burns form manufacture of chemicals, etc. have increased in both organized and unorganized sectors [8]. Thus in light of these facts it becomes imperative to take initiatives to make a positive shift towards sustainable industrialization. IGBC green factory building rating system is a voluntary and consensus based programme. Green concepts and techniques in the industry can help address national issues like energy efficiency, conservation of natural resources, handling of consumer waste, water efficiency and reduction in fossil fuel use in commuting [9].

The paper focuses on conducting an intervention through awareness program, which was targeted to motivate stakeholders towards potential improvements in the working conditions in existing non-green factory buildings. This paper can be of immense utility for pioneer organizations promoting sustainability where in such interventions can be used to undertaken to generate awareness and promote the noble cause of sustainable development.

2. OBJECTIVES
- To understand the concept of green factories and it benefits
- To study the knowledge and attitude of stakeholders vis a vis green factories
- To develop and conduct a need based training program regarding Indoor environmental quality and occupational health in factories
- To study post training change in knowledge and attitude regarding green factories

3. METHODOLOGY
The paper discusses the green factory rating system, its benefits and intervention programme to promote green industrialization. The intervention was targeted towards empowering the stakeholders to make potential improvements in the working conditions in their existing non-green

factory buildings. A need based training programme was developed to generate awareness amongst managers of non-green factories regarding green factories with special reference to IEQ credits. For intervention non-green factories located in Capital and National Capital Region were selected randomly. The sample selected from these factories comprised of all top and middle level manager who were deputed by the organization for training. Top managers were selected, as they are the chief catalysts for implementation of strategic decisions in an organization. Middle managers apart from playing an important role in organizational decision making also look over the operations in the factories and serve as a link between workmen and top management.

4. RESULTS AND DISCUSSION

A. Training Programme

Intervention was a training programme, which consisted of awareness raising training modules, which was assisted with comprehensive tools. The training programme developed is discussed with respect to its content and delivery.

A 1. Content

To meet both the aims and objectives, and the differing levels of knowledge and expertise of the target audience, three modules have been formulated which each having 3 sessions as indicated by Figure 1

A. 2 Delivery - The training program was framed into 3 elements as indicated by Figure 2
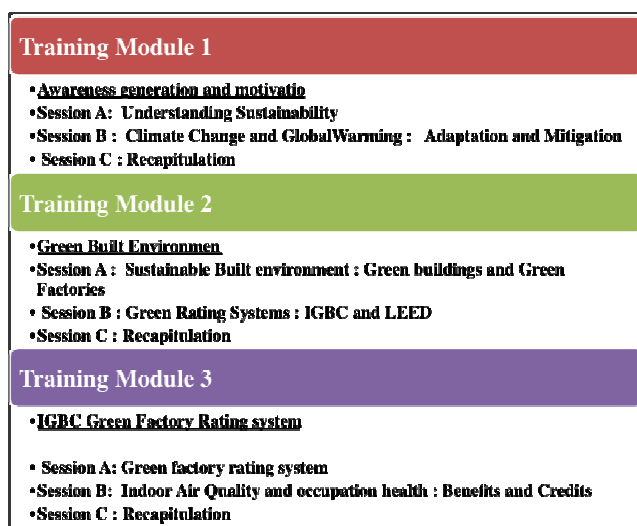

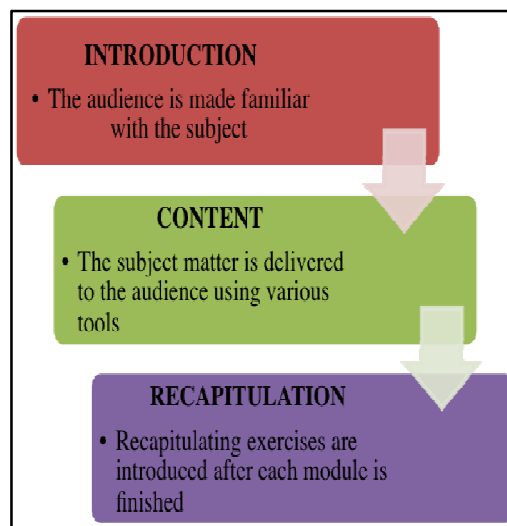**Figure 1: Content of training programme**   **Figure 2: Delivery of training programme**

B. Intervention

The respondents were assessed for their knowledge and perception before and after training various issues: Sustainable development and global warming, green built environment, green rating systems, green factory concept and IEQ

It was observed that respondents had fairly good idea of the term sustainable development but they not could not relate it to other options like green building movement, 4R's use of low cost materials. Respondents had fairly good idea of the issue of global warming as in pre-test, three fourth (75%) could identify its correct meaning. However, in post-test nearly all (90%) respondents chose the right option. Participants showed keen interest in understanding the role of manufacturing sector in global warming so that they can take suitable actions for mitigation and adaptation. In pre-test, it was observed 65% of responses were received for green buildings being associated with specialized high cost construction.

Also, even though the respondents belonged to large manufacturing corporations, surprisingly 15% responses were received relating green buildings with a building, which is green in color. However, these misconceptions were dealt in the training program, they were made aware of the fact that green buildings are high-performance building providing economic, human and community benefits as well as reduced environmental impacts.

In post-test respondents were able to comprehend the same as majority of responses (85%) were obtained for option 4 (Protecting occupants health and improving employee productivity). Also, respondents could recognize the resource efficiency of green buildings since 70% responses were attained for option 3 (Efficiently using energy, water, and other resources) and 40% responses were received for waste materials for construction.

In pretest respondents could not comprehend the green factory concept. To bring about a change in knowledge many examples were cited from operational green factories, wherein a special emphasis was laid on IEQ credits employed. Participants were made familiar with IGBC green factory framework, which caters both to existing and new factories.

Ensuring proper IEQ is one of the most pertinent component of the rating system, in pretest only 20% responses were received for this option whereas in post-test percentage responses increased to 95% as indicated by Table 1. Also, percentage of respondents that could identify green rating systems increased from 10% in pre-test to 100% in post-test.

Total percentage is greater than 100 as more than one response was obtained

Table 1: Distribution of sample with regard the knowledge about features of green factory rating system

Features of green factory rating system	Pre-Test (percentage)	Post-Test (percentage)
Site Selection and Planning	0	35
Water Conservation	25	50
Energy Conservation	45	80
Material Conservation	15	60
Indoor Environment Quality	20	95
Innovation & Design Process	15	50

A shift in the average scores from low to high indicated a perceptual change towards sustainable development and climate change. Pre-training respondents were seen to oblivious to the seriousness of climate change as they perceived it to be exaggerated. Post-test training their perception changed and they showed interest in knowing the contribution of manufacturing sector in climate change. They also showed a positive perception post-training

Figure 3: Distribution of the sample indicating perceived challenges towards adoption green factory guidelines

towards sustainable development as they were interested in knowing how they can access workshops, seminar relating to these issues.

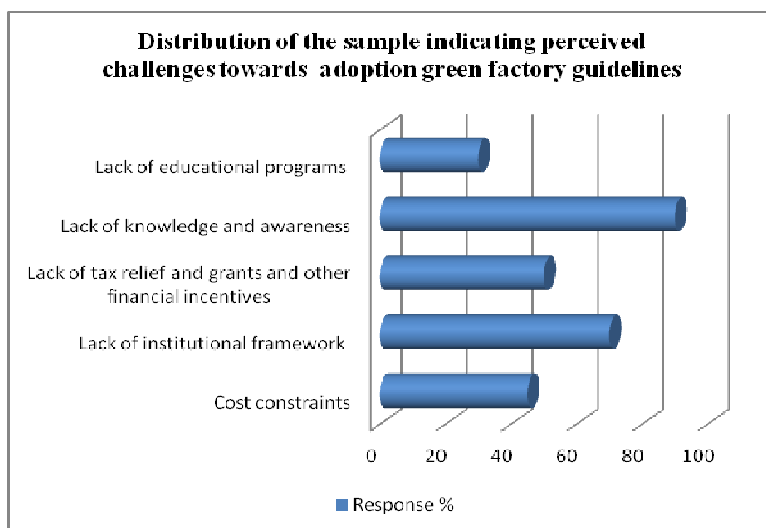The knowledge towards IEQ technologies was seen to be quite low amongst respondents in pre-test. Respondents also were oblivious to the technologies like airflow and Air Changes per Hour (ACH) less than one fourth responded correctly. They were made aware of the adverse health effects of maintaining of not maintaining an optimum airflow and Air Changes Hour in a factory set up. In post-test 85% responded correctly for both. Respondents also lacked knowledge

regarding the VOCs and break out spaces. They were acquainted with these two concepts and their importance by drawing examples from existing green factory set up where implantation of these credits has led to reduced incidence of sickness and greater satisfaction amongst workers.

Respondents were asked to identify what they perceived to be major barrier towards adoption of green factory guidelines. Figure 3 Indicates towards a need of strong movement to build awareness towards green factories amongst stakeholders as maximum percentage of responses (90%) indicated towards the lack of knowledge and awareness as being the major barrier towards adoption of green factories. Hence this training module can be of immense utility for pioneer organization promoting sustainability where in such interventions and training strategies can be undertaken to generate awareness and promote the noble cause of sustainable development through adoption of green building practices.

Table 2: Distribution of the sample indicating the pre and post scores

Test Scores		Pre-test (Percentage)	Post-test (Percentage)
Very low	Below 40	30	0
Low	40-60	45	0
Average	61-80	20)	15
High	81-100	5	25
Very high	101-120	0	60

Based on the responses obtained in knowledge, scoring was done. Categories were created and scores were arranged under these categories to determine the number of respondents scoring high or low in pre-test and post-test. Table 2 indicates a considerable amount of difference between the pre-test and the post-test scores of managers. The paired t-test was calculated for knowledge scores. The means of pre-test and post-test were found to be statistically significantly different. Thus, it was inferred that overall training did have an impact on knowledge level and perception of managers.

5. CONCLUSION

The need of sustainable development is picking up pace, with one of the major concerns being to provide healthy environment for citizens to live and work. Rapid industrialization has led to massive pollution significant greenhouse gas emissions and degradation of the natural environment, which has resulted in an impact on resources, human health and wellbeing. This indicates towards a rampant need for the development and adoption of green building rating systems in Industrial sector which will help in steering growth towards sustainable industrialization. To address this, IGBC has developed a new rating system for green factories and industrial structures.

The paper brings out the concept of green rating factories and its benefits. It focuses on a need based intervention programme, which was developed to promote green industrialization. The training program gave holistic overview towards green movement particularly green factory rating system eliciting in-depth information regarding with special reference to IEQ credits and the benefits accrued through its implementation. IEQ and occupational health in factory building directly impacts the human health and productivity of occupants. The training program was fruitful in bringing about a knowledge and perception change towards green factory rating system. Such interventions can be taken up at a wider scale to motivate stakeholders to address the health concerns and productivity of workers along with other environmental concerns through adoption of green factory guidelines. Training programmes can be used as a catalyst in accelerating this adoption. To achieve the goal of sustainable industrialization globally, it is imperative that such rating systems for industrial buildings are developed and implemented by other leading rating systems like LEED (US), BREEAM (UK), CASBEE (Japan), Gold Star (Australia) and so forth. Future generations can be also empowered towards the goal of green industrialization by incorporating the knowledge regarding the same in school curriculum. This is in the view of the fact that future generations will take on the role of the industrialist, entrepreneur or the workforce in any organization. Hence, the knowledge of green industrialization would help them in addressing sustainable development in more responsible manner.

REFERENCES

[1]   UNDP: Sustainable Energy, 2012. Retrieved from:
        http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/sustainable-energy.html

[2]   TERI: Sustainable Building- Design Manual, Vol. 1 and 2. The Energy and Resource Institute (TERI), New Delhi, India, 2004

[3]   Reis, R., Bilec, M. M., and Needy, K. L.: The Economic Benefits of Green Buildings- A Comprehensive Case Study. *The Engineering Economist*,2006, 51: 259-295

[4]   Whole Buildings Design Guide Sustainable Committee. 2010. *Sustainable*, Retrieved, April 14, 2013, from http://www.wbdg.org/

[5]   Pothbore, V., Syal, M., Korkmaz, S: Adoption of Green Building Guidelines in Developed Countries Based on U.S.and India Experiences. *Journal of Green Building*, Spring 2009, Vol. 4(2), 158-174

[6]   USGBC, (2008). Greening the codes, Retrieved, April 14, 2013, from: www.usgbc.org/

[7]   McKinsey & Company: *Environmental and Energy Sustainability: An Approach for India*, 2009, Mumbai, India

[8]   Young, P., Byrne, G. and Cotterell, M: Manufacturing and the environment. *The International Journal of Advanced Manufacturing Technology*, 2005, 17(3), 488-493

[9]   IGBC: *Green factory rating system*, CI , IGBC, 2009