Research Article

Journal of
Environmental
Nanotechnology

Validation for Environmental Management System in an Educational Institution (ISO 14001)

R. Malathy[1*], K. Kavinmathi[1], G. L. Mukesh[1]
[1]Department of Civil Engineering, Sona College of Technology, Salem, TN, India
Received: 02.02.2020 Accepted: 04.03.2021 Published: 30-03-2020
*muthusamysujatha7@gmail.com

ABSTRACT

ISO 14001 Environmental Management System standard was developed by an internationally selected standards committee to help all types of organizations develop plans to minimize their brunt on the environmental aspects; especially, to minimize air pollution. ISO: 14001:2015 helps an organization to achieve the planned outcomes of its environmental management system, which provide value for the environment and the organization. The main aim of this paper is to identify whether ISO 14001 certificate is needed for an educational institution and to identify the environmental issues and finding the significant improvement in the organizational performance due to the certification. An Environmental Management System (EMS) is a part of an organization's overall management system. It is a systematic approach dealing with environmental aspects of an organization. It is a structural framework to manage, evaluate and improve the environmental performance in a verifiable way. As a part of the EMS, the university implemented a 'Plan–Do–Check–Act' (PDCA) cycle for controlling and continuously (constantly) improving its environmental performance.

Keywords: Environmental Management System; Organization; Improved Environmental Performance.

1. INTRODUCTION

ISO 14001 is an Environmental Management System and a standard which prescribes that a company shall establish an environmental policy that identify all the potential environmental effects arising out of its operations and implement procedures designed to minimize these effects within the bounds of what can reasonably be achieved at an acceptable economic cost.

As it is critical to execute the natural administration strategy ISO 14001 likewise propose that there must be a devotion to investigate the arrangement activity and non-stop refinement in its achievement in diminishing ecological damage. ISO norms give arrangements and accomplish advantages to practically all segments of movement, including agribusiness, development, mechanical building, producing, dissemination, transport, clinical gadgets and data.

ISO 14001 standards initiate a "Plan-Do-Check-Act" (PDCA) cycle in the area of environmental management.

A management system consists of pronouncement and methodology through which decisions are made and day-to-day activities (of an organization) are directed. Any large organization will have a number of management systems to deal with different conditions of its operations. A system to deal with the environmental effects of an organization can be thought of as an Environmental Management System (EMS).

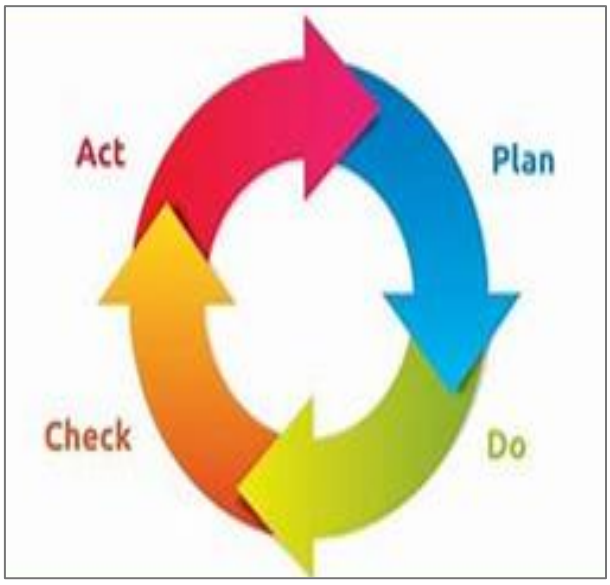


Fig. 1: Plan-Do-Check-Act

The ISO defines an environmental management system as "a part of an organization's management system used to enlarge and implement its environmental policy and manage its environmental form".

Organization identifies those conditions of its business that have a compelling impact on the environment, to set objectives and targets to minimize these impacts; and to develop programmes to achieve targets and to implement other operational control

measures to ensure conformity with the stated environmental policy.

It also takes steps to enroll staff in its environmental practices. Staff whose activities had the potential to consequently impact on the environment, received specific training, and all staff are encouraged to participate in its e-learning module which covers perception of environmental issues and discern ability, what the university is doing to manage its environmental impact, the basics of its environmental management system and environmental management and good method in the workplace.

In this paper, Sona College of Technology, Salem, Tamandu, India, has been taken for consideration and the environment management system adopted were discussed in detail and suggestions were given for improvement.

2. CASE STUDIES

According to a case study in Certification at Bayer Pharmaceuticals in Berkeley, California, for being certified as an ISO 14001 company, it is examined on the standard guidelines. This study employs a case study technique to conduct an analysis of the company's certification process in order to lead to an insight of the factors that interfered. EMS improves the environmental performance of an organization are:

1. Auditor bias/ knowledge of environmental policy and science and

2. Motivating factors within the company for Achieving certification.

The goal of this process is to change the mind set of employees so that environmental activities were not premeditated external to their basic job duties, nor the responsibility only; and to create a cyclic EMS that extends ahead of compliance to continuous improvement, using the potential offered by the ISO 14001 standard to its fullest extent.

According to Pooja Arora and Smite Chaudhry (2010), ISO 14001 emboldens and channels the creativity of all members of the organization, making them active agents of change promoting environmental protection, resource conservation and enriched efficiency. In industrial sector the highest numbers of certificates were in the electrical and optical equipment sectors followed by the chemical and fibre sectors. As it is critical to execute the natural administration strategy ISO 14001 likewise propose that there must be a devotion to investigation the arrangement activity and to non-stop refinement in its achievement in diminishing ecological damage. ISO norms give arrangements and accomplish advantages to practically all segments of movement, including agribusiness, development, mechanical building, producing, dissemination, transport, clinical gadgets and data. It acts as an ideal catalyst to speed up the environmental performance of substantial that do not have an EMS or have not advanced over their existing EMS. The standard can achieve the results with ineffective enforcement and regulation rather it is a system that can yield solid benefits with serious responsibility and efforts from organization.

According to a case study by author Mangala Joshi (2001), Indian textile industry has started take up source reduction and waste treatment as approaches to specific environmental problems. The regulatory pressures from Government through Pollution Control Boards (PCB) to defer with discharge limits for water effluents and air emissions are still the major driving factor towards industries. Environmental Management System (EMS) is a cost-effective way for companies to manage their environmental responsibilities. ISO 14000 series of standards provides model for organizations to control their prompt and long-term environmental impacts. It is predictable that more and more textile units in the organized sector in India would opt for ISO 14001 certification in near future, owing to the ever-growing environmental consciousness.

According to Padma *et al.* (2008), the purpose of the case study is to identify the critical factors (CFs) of ISO 14000; to determine if ISO 14000 certification results in reformed organizational performance; and to analyze the levels of and changes in these CFs and levels of and changes in the Indicators of Organizational Performance (IOPs) in relation to firm quirk considered in the present study. The data collected have been analyzed by using statistical techniques. In the course of time, these firms appear to understand the EMS and energetically implement it in order to realize long-term benefits. ISO 14000 certification is becoming an essential requirement in the industries worldwide in order to adopt sound environmental practices. With the increasing impact on environment and stricter waste treatment and disposal guidelines, Indian chemical and pharmaceutical companies have shown greater adherence to environmental management practices.

According to Gavaskar *et al.* (2017), the case study is based on ISO 14001 and compares the validation with other certified industries. In view of the above, response has been collected to have further advancement through developed model which was prepared based on the factorization of various input and output variables which is linked to the clauses of ISO 14001. The developed model has represented almost all the clauses of ISO 14001 considering main content of the all the requirements. Response was collected from the industries where input and output variables were sent earlier and also those involved in the exertion of the system.

Evidences arrived out of case study have suggested that the model questionnaire improves the environmental performance of an organization and bringing potency in the system.

Mohammed Matovu (2000), stated that implementation ISO 14001 process and its significance for regional environmental management. The region of Central Japan (known as Chubu in Japanese, which literally means centre) was chosen for this case study. The investigation centers around chosen issues, for example: (1) the patterns and goal of private firms in the usage of an ISO 14001- based ecological administration framework (EMS); (2) the hindrances during framework usage; (3) the role of the system in intensifying environmental performance within the certified organization and (4) the relation between the major stakeholders, local citizens, governments and firms after ratifying the system. To achieve these objectives, a questionnaire survey was mailed to all certified firms in the region, in which around 58% of responds were promote.

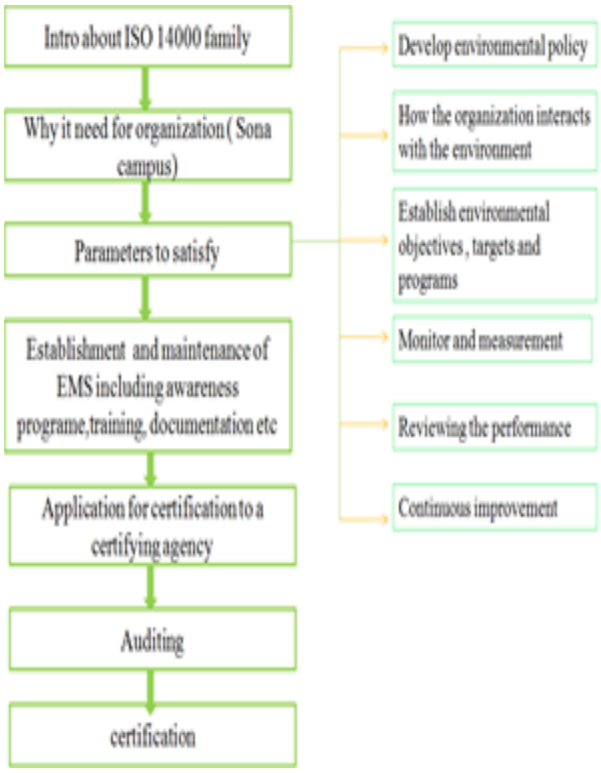
Yersiniosis and David G. Wareham (2005) aimed to explore the link between continual development and the ISO 14000 Environmental Management Series of Standards, with particular reference to the ISO 14001 standard. The ISO 14000 series is in principle an impressive system to manage an organization's self-prescribed environmental goals; however, its main limitations are that it does not require the demonstration of environmental performance. The paper closes with conjecture that despite these shortcomings, the essence of the ISO 14000 series of standards is in sympathy with the notion of sustainability.

Chin Kwai Sang *et al.* (1999), prepared a model to evaluate the benefits/costs ratios of implementing ISO based EMS and to decide whether or not to implement it. Competitive position in the global market place, delinquent of the considerable costs incurred from its implementation. This is upheld by a moderately bigger advantages/costs proportion concerning actualizing ISO 14001 based EMS, rather than threatening.

Del Brio and Beatriz Jorquera (2003) aimed to analyse the influence of external environmental pressures on the decision to obtain certification to the ISO 14001 standard. An induction of the creators incorporates perceiving that affirmation is one stage toward natural greatness and Total Quality Environmental Management (TQEM). They centered only around ISO 14001 standard when discussing ecological administration frameworks' accreditation, since an order of this standard was identified in Spanish modern organizations. It has been found that some of the external pressures are a restriction for the companies, but others can become a fortuity in those companies having the intention to improve this study will give better results after pursuit of the model in any sector.

Frank Montauban *et al.* (2006), described those environmental systems and processes by the same approach used by its predecessor, the ISO 9000 quality standards Being generally new, plentiful inquiries have emerged with respect to the effect of these new guidelines on both the corporate natural administration framework and corporate execution. The results indicate that, even though ISO 14000 has accomplished relatively limited acceptance, there is strong evidence to indicate that this series of standards can positively impact both the performance of the ERM initiatives such as the Environmental Protection Agency's (EPA) 33/50 program.

3. METHODOLOGY



The above flowchart shows the methodology of ISO 14001 certifying process in an engineering college (Sona campus). It helps to achieve better management of current and future environmental risks. Opting for ISO 14001 certification reduces environmental liability such as consumption of materials and energy; also, it minimizes the environmental impact of products, activities and resources. This certification helps the organization to meet and maintain regulatory and legislative requirements.

3.1 About the Educational Institution (Sona Campus)

Sona has a reputation as a provider of quality technical education. It offers 9 UG and 14 PG

programmes and training opportunities to a wide cross-section of students from across the country and beyond.

The institute inculcates in students the skills to become effective learners, critical thinkers and responsible citizens who will be able to meet the challenges of the future. All the students have ample prospects to perform well and excel in their chosen fields. Sona's sharp focus on quality education, R&D initiatives and training has turned it into a premier technical institution. Offering a dynamic learning environment, Sona's tangible facilities range from a splendid lush green campus to world-class infrastructure. Its academic programmes, extra and co-curricular activities are synergized with industry to make learning more real, relevant and receptive to changing trends. This campus has about 30% area covered with greeneries and the temperature inside the campus is maintained about less than two degrees from outside. Flora and fauna are maintained in this campus. This campus also has GRIHA certified green buildings with less energy consumption, waste materials utilization, orientation of building to get light and ventilation naturally.

4. WASTE MANAGEMENT

Table 1 shows the various solid wastes produced in Sona campus like solid waste, e- waste, food waste and construction waste and they are disposed safely without causing any pollution and it can be recycled. From this Table, it can be observed that most of the solid wastes are effectively managed and recycled to some extent.

Table 1. Waste management

Type of waste	Disposal	Recycling, if any
Mild steel (chips) from Manufacturing laboratories	Sent to scrap area	
PCB board/ IC chip from power Electronic and Micro-controller lab and other e-wastes	Sent to scrap area	
Wastage of food and Plastic cover disposal.	Sent to scrap area and recycled	Used as manure for plants and trees in and around the campus; Biogas plant is provided
Wasted printer ink cartridge	Sent to scrap area and recycled	Wasted batteries are disposed by selling for second-hand usage per month
Wastages from construction site (wood, paint)	Sent to scrap area and recycled	Pollution caused due to construction because of constructing equipment and it can be checked by Air quality control board (AQCB)
Paper waste		Effectively recycled for producing files, office covers, bags and paper cups, etc.; paper concrete bricks are produced using waste answer papers as innovative products

Fig. 2: The chip (Mild steel) and Rheostat

The above Fig. 2 shows the image of chips and rheostat. Among those chips are the waste materials generated from manufacturing laboratories and it is mostly made up of mild steel material and it is disposed to the scrap area; rheostat instrument, used in Electrical Machines laboratory, is a source of waste.

5. BEST PRACTICES IN SONA CAMPUS

5.1 Air Quality Monitoring System (AQMS)

It is mainly used for identifying the parameters like SO_2, NO, NO_2, NH_3, CO, O_3, benzene, rain, solar radiation, wind speed and wind direction. Air quality is monitored by UV rays. It should measure around 500 sq. mt. Fig. 3 shows the Air quality monitoring system. Fig. 4 depicts the way in which it is used to continuously monitor the quality of air through LCD display. The measurements are taken based on parts per million (ppm). Unit: ppm ($\mu g/m^3$).

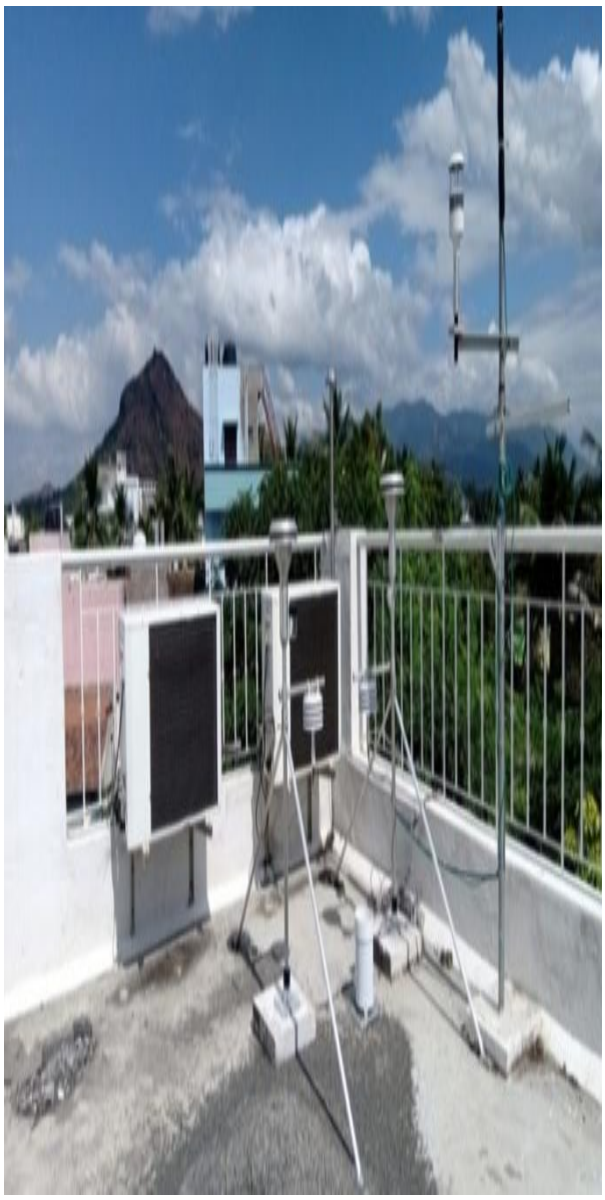


Fig. 3: Air Quality Monitoring System

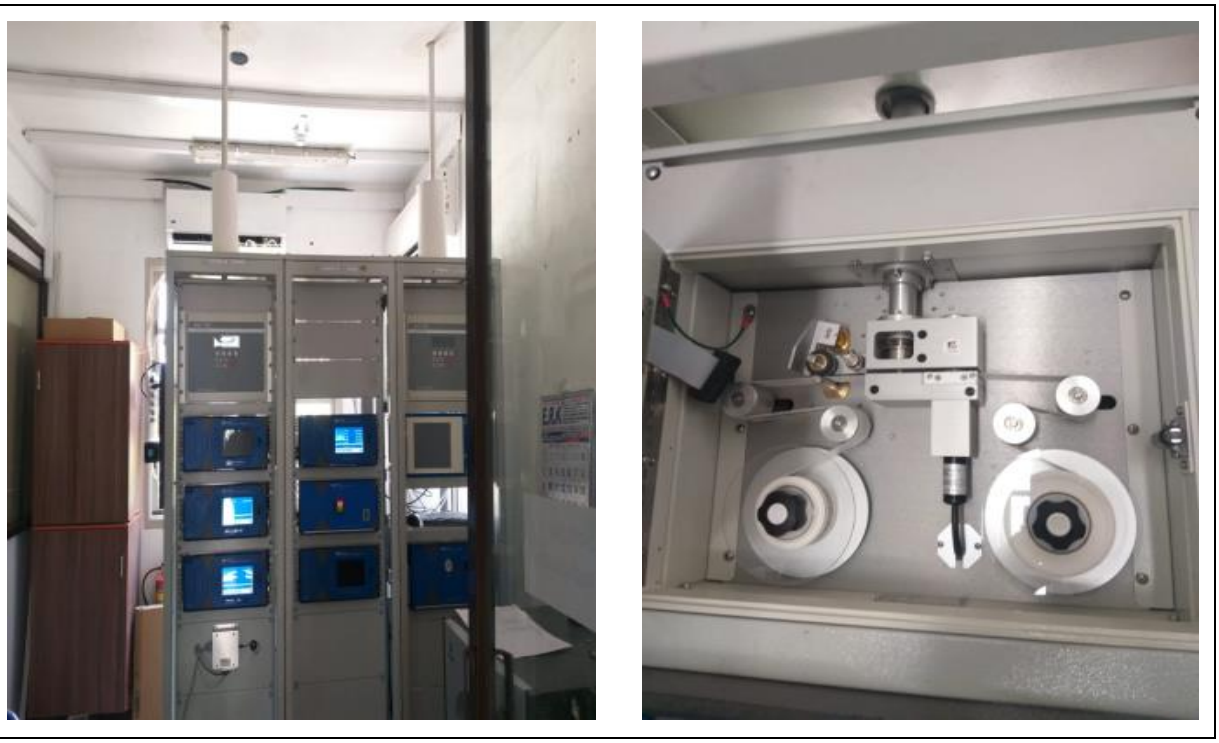


Fig. 4: Air Quality Readings

Table 2. Air Quality Standards

S. No.	Parameters	Standard limit	Raw value
1	SO_2	80 µg/m^3	-
2	NO	0	1.3 µg/m^3
3	NH_3	400 µg/m^3	10 µg/m^3
4	CO	4 µg/m^3	0.822µg/m^3
5	O_3	180 µg/m^3	124.6 µg/m^3
6	Benzene	5 µg/m^3	-
7	Wind speed	50 m/s	1.0414 m/s
8	Wind direction	-	215.380
9	Pm 10	100 µg/m^3	51 µg/m^3
10	Pm 2.5	60 µg/m^3	30 µg/m^3

5.2 Solar Energy

Sun-powered vitality including creating power, giving light and warming water for residential, business and mechanical use.

5.2.1 Solar Plant Generation in Sona Campus

Table 3. A sample power generation through solar energy in Sona campus

S. No.	Location	Solar Plant Capacity (kW)	Solar Units Generated (kWh)	Cost / Unit (Rs.)	Cost saved by Generated Units (Rs.)	Total Cost Saved	Avg. Generated Units/Day/(kW)	EB MD Recorded (kW)	EB Consumption (kVA)	% of Saving
1	EEE Block	20.4	1604	6.67	10698.68		2.62			
2	CSE Block	30	2255	6.67	15040.85		2.51			
3	CSE Block	21.6	1332	6.67	8884.44		2.06			
4	Main Block	10	803	6.67	5356.01		2.68			
5	Green Building	10	693	6.67	4622.31		2.31			
6	First Year Block	5	386	6.67	2574.62		2.57			
7	Security Cabin	3	0	6.67	0.00		0.00			
Total of College			7073			47176.91		390.4	74802	8.64

5.2.2 Lighting Loads

Table 4. A sample of Lighting usages and its units in Sona campus

S. No.	Particulars	Units	Watts	Hours	Days	Total	Units
1	Tube lights	568	40	6	260	35443200	35443.2
2	Other lights	256	72	6	260	28753920	28753.92
3	Street Lights	42	60	12	365	11037600	11037.6
4	Fan	1568	50	6	260	122304000	122304
5	AC	830 T	1079000	3	240	776880000	776880
6	Solar Lights	10	11	12	365	481800	481.8
7	Solar Energy						
	Capacity	100	kW				
	Annual generation	134703	units				

5.3 Digital Campus

To reduce the usage of papers, Black Board software is used which provides academic digital learning with 8000 user-licenses (Blackboard Learning Management Software). Lectures, assignments, videos, animation and quizzes are uploaded and posted on the Blackboard platform. Lecture Capture Systems (LCS) is

installed in all class rooms in the college. More installations are in the pipeline. The lecture sessions are posted (after necessary editing) on the LCS portal to be viewed by students any number of times. Consistent assessment and adaptive tests are conducted using customized MOODLE e-platform. Laboratory courses are run through MOODLE virtual laboratories. Management Information System (MIS) is used for better time management and to improve the efficiency of office activities, store students' data and improve the quality of reports. The digital circulars are sent through 'Sona Times'.

Table 5. Study of environmental aspects and impacts of various activities

S. No.	Activity	Environmental Aspect	Environmental Impact	H/M/L	Control Measures	Yes/ No	Suggestions
1.	Water use (in restrooms).	Usage of power Water Land, flora & fauna	Resource depletion water resource depletion Health issues	Medium	Establish baseline for water consumption Use non-potable water where applicable Capture rain water for landscaping needs Install low flow fixtures and faucets Raise awareness of water conservation efforts	No	Improve water recycling
2.	Transportation and vehicle use	Heat emission Air emission Water Land, flora & fauna	Resource depletion Air emissions	High	Obtain information on current fuel consumption and establish baseline data and system for tracking progress Public transportation Telecommuting Alternative fuels Walking or biking to work Fuel efficient vehicles	No	High Land, flora Land, flora the campus
3	Use of paper and paper products, printer supplies, and other items	Usage of power Heat emission Air emission Water Land	Resource depletion Landfill space Air pollution, if burn	High	baseline on amount of paper purchased Increase electronic correspondence Develop/ encourage electronic forms Double-sided copying	Yes	
4	Procurement	Air emission Water Land, flora & fauna	Solid waste Hazardous waste Landfill space	Medium	Establish process to determine and implement process for purchasing environmentally preferable products	No	Avoid using plastics around the college yards
5.	Usage of AC	Usage of power Heat emission	Global warming Air quality	Medium	Turning off AC when not in use.	Yes	

6. ENVIRONMENTAL ASPECTS AND IMPACTS

Table 5 represents the environmental aspects and impacts of various activities in the organization. The table gives an insight into various environmental aspects and throws light upon the possible control measures. In this way, any organization can choose a greater number of activities and assess their environmental impacts, paving way for continuous improvement and better implementation of Environment Management System (EMS).

7. RECOMMENDATIONS

From the above study the following recommendations were suggested;

- Recycling prevents the emission of many pollutants and save huge resources. The organization has taken steps to recycle some of the wastes produced and proper strategies can be implemented to have zero waste campus.
- Promoting environmental awareness is an easy way to become an environmental steward, creating a bright future for the organization.
- Having more online courses and digital class rooms can reduce the environmental impacts.
- Awareness programmes need to be conducted periodically to maintain environment-friendly campus.
- Use of efficient equipment (for maintaining lawns and gardens) can reduce pollution from vehicles.
- Encouraging faculty and students to bring out innovative ideas and products from the wastes will yield better results.
- Use of recycled products and other eco-friendly products and use of energy star equipment for printers, machineries will reflect positively upon the degree of environment-friendliness of the campus.

8. CONCLUSION

ISO 14001 provides an effective framework for developing an environmental awareness. An organization, particularly educational institution, with ISO 14001 certification will be a cultural hub inspiring its students, faculty members and workers and inculcate environment consciousness. All staff and students shall be encouraged to participate in specially designed e-learning courses covering the environmental issues and sustainability. Any educational institution is recommended to go for a systematic approach towards getting ISO certification to make its campus a green one, thereby setting an example for the society around.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

Chin Kwai-Sang, Simon Chiu and Rao Tamala, V. M., An evaluation of success factors using the AHP to implement ISO 14001-based EMS, *Int. J. Qual. Relias. Manag.*, 16(4), 341-361(1999). https://dx.doi.org/10.1108/02656719910248226

Curkovic, S. and Sruoufe, R., Using ISO 14001 to promote a sustainable supply chain strategy, Business Strategy and the Environment, *Wiley Interscience*, 20(2), (2010). https://dx.doi.org/10.1002/bse.671

Del Brío Jesúsángel and Beatriz Junquera, Influence of the perception of the external environmental pressures on obtaining the ISO 14001 standard in Spanish industrial companies, Int. *J. Prod. Res.*, 41(2), 8(2003). https://dx.doi.org/10.1080/0020754021000024175

Elefsiniotis, P. and Wareham, D. G., ISO 14000 environmental management standards: their relation to sustainability, *J. Prof. Iss. Eng. Ed. Pr.*, 131(3), 208-212(2005). https://dx.doi.org/10.1061/(ASCE)1052-3928(2005)131:3(208)

Frank Montabon, Steven A. Melnyk, Robert Sroufe and Roger J. Calantone, ISO 14000: Assessing its perceived impact on corporate performance, *J. Supply Chain Manag*., 36(1), 04-16(2000). https://dx.doi.org/10.1111/j.1745-493X.2000.tb00073.x

Gawaikar, V. G., Anand G. Bhole and Lakhe, R. R., Validation of performance of ISO 14001 through developed model, *Int. J. Hum. Cap. Urban. Manag.*, 2(4), 293-302(2017). https://dx.doi.org/10.22034/IJHCUM.2017.02.04.005

Mohammed, M., The ISO 14001 EMS implementation and its implications: a case study of Central Japan, *J. Environ. Manage.*, 25(2), 177-188(2000). https://dx.doi.org/10.1007/s002679910014

Padma, P., Ganesh, L. S. and Chandrasekharan Rajendran, A study on the ISO 14000 certification and organizational performance of Indian manufacturing firms, Benchmarking: *Int. J.*, 15(1), 73-100(2008). https://dx.doi.org/10.1108/14635770810854353