

## Selection and prioritisation of assessment measures for campus environmental management

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**ABSTRACT:** The implementation of environmental management on campus can be a valuable tool for raising environmental awareness, promoting sustainability learning and forcing environmental issues into the management mainstream. One key aspect or necessary condition for a successful environmental management effort is the presence of an effective environmental assessment initiative. In this study, the environmental management assessment initiatives for a Taiwan campus using evaluation criteria in a hierarchical structure were analysed. The analytic hierarchy process was used to prioritise the appropriate assessment measures for providing a directional tool to measure progress toward the concept of a *sustainable campus*.

### INTRODUCTION

During the past ten years, there has been increased public and government attention to the harmful effects on the environment and natural resource degradation of business and industry. Many companies have adopted Environmental Management Systems (EMS), such as ISO 14001 and BS 7750, to minimise pollution, use resources efficiently, and lower the risk of polluting accidents as a comprehensive way of addressing environmental compliance issues. The implementation of EMS on a campus represents a bridge between the academic, social and business world, thus, it can be a valuable tool for raising environmental awareness and promoting sustainability learning in the mainstream of management issues [1][2]. Educational institutions should be totally committed to advancing knowledge which is able to add value meaningfully to the long-term goal of a fully sustainable environment [3][4].

Some but not all essential elements of an environmental management system are being implemented by colleges and universities in Taiwan and environmental management assessments (EMA) are being conducted through all educational institutions including elementary schools by local environmental enforcement agencies. However, local government capabilities, particularly in environmental management system knowledge and assessment skill, need to be strengthened, since EMA is often complex, sometimes cumbersome, and interconnected as a specialist area of management disciplines. Furthermore, the measurement frameworks have not been universal and comprehensive. Thus, this article aims at developing a simple EMA model to be applied to a vast array of internal and external environmental assessment applications in campus to foster environmental and overall management skills.

### THE EXISTING EMA PRACTICES IN TAIWAN CAMPUS

EMS is implemented via an iterative and continuous process, where environmental management practices will be continually improved and evaluated by regular environmental assessments [5][6]. Hence, EMA plays an important role in the quest for successful environmental management. However, environmental assessors have to acknowledge the different dimensions and complexity of environmental problems, through a more proactive attitude and the development of integrated assessment tools [2]. Since there is a shortage of reference literature on EMA on campuses, an attempt is made to develop an EMA model by investigating the initiatives proposed by the local environmental enforcement agencies in Taiwan.

The education sector in Taiwan has not only discovered that the activities and physical structures on campus can have significant impacts on the environment but it also realised that the educational implications of environmental management application on campus, especially for elementary and high schools, are more important in the long term. Therefore, local environmental enforcement agencies have started assessing the campus by setting environmental evaluation measures in four widely used initiatives including: *Green Campus* and *Sustainable Campus* developed by

Ministry of Education; *Green School* by Taiwan Normal University, and *Environmental Excellence School* by Environmental Protection Administration. These EMA initiatives provide simple measurement frameworks for internal or external environmental audit before a comprehensive EMS is implemented. However, they face new work constraints and have to develop new assessment schemes to survive in a context of rapid changes as a result of globalisation. Each of them is isolated in a single region and has not been particularly prominent in Taiwan. In this study, seventeen environmental assessment measures (as shown in Table 1) from those four EMA initiatives, which are particular for Taiwan elementary and high schools, are summarised.

## DEVELOPING A HIERARCHICAL STRUCTURE FOR EMA

Area of concerns on the aspects of the EMA in campus was summarised in this discussion with twelve experts including three local environmental enforcement agencies, two ecologists, four EMA administrators and three assessors in education sector. Four major evaluation criteria including sustainability; operational feasibility, innovation and continual improvement are identified to be used for the prioritisation of the assessment measures for environmental management.

Then, a hierarchical structure of defined goal evaluation criteria, with environmental assessment measures, is developed. Evaluation approaches are linked to long deliberation about how to estimate the contributions of each individual assessment measure to campus environmental performance. Figure 1 illustrates the hierarchical structure explained above. This structure serves to prioritise environmental assessment measures, which ultimately contribute to the goal for maximising environmental performances in campus.

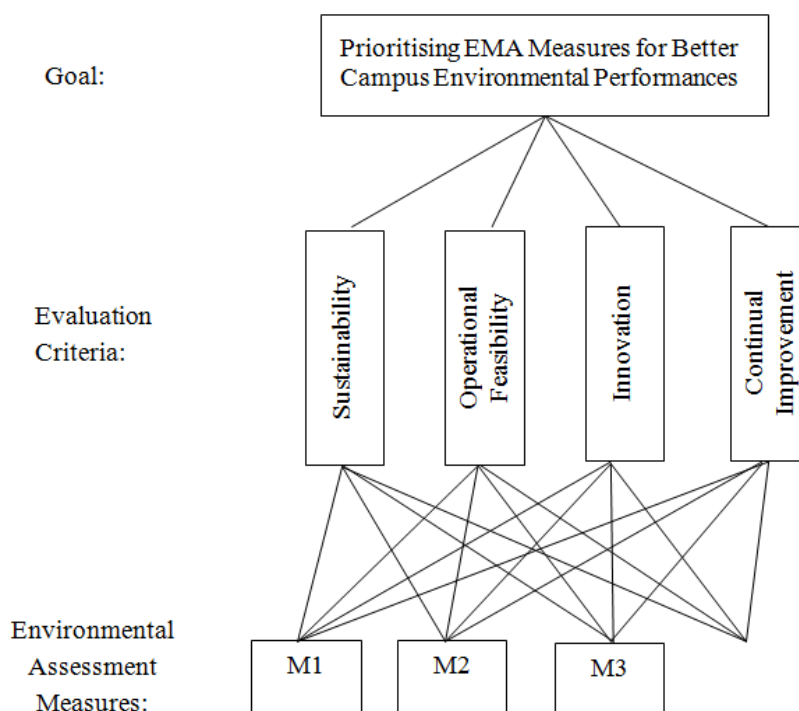


Figure 1: The hierarchical structure for prioritising the evaluation measures.

Analytic hierarchy process (AHP), initially developed by Saaty, is applied for prioritisation of environmental assessment measures that are evaluated against the criteria in this hierarchy [7]. Expert Choice, a computer software package, is used to measure and synthesise the evaluation criteria and environmental assessment measures using pairwise comparisons to arrive at a prioritised list of assessment measures for EMA.

## ENVIRONMENTAL ASSESSMENT MEASURES WITH PRIORITY

The evaluation judgments need to be compared to add a weight factor to each criterion. A measurement questionnaire was developed with each judgment compared at a peer level in terms of importance to the goal with the same sample of experts. The criteria were compared for their relative importance to the goal such as *Equal*, *Moderate*, *Strong*, *Very Strong* and *Extreme*. The verbal responses are then quantified and translated into a score on a nine-point scale. The weight factor of each evaluation criterion was calculated as shown in parentheses: sustainability (0.256); operational feasibility (0.294), innovation (0.212) and continual improvement (0.238). The evaluation judgments were repeated to put weight factors to the environmental assessment measures for each individual criterion. The overall weight factors of the environmental assessment measures, with their priorities (as shown in Table 1), were calculated as the evaluation results of AHP.

Table 1: Summary of environmental assessment measures.

Categories and Environmental Assessment Measures	Weight Factor	Priority
Curriculum design:		
Particular design to promote sustainability learning	0.062	7
Most curriculum design to raise environmental awareness	0.042	11
Health and safety related curriculum	0.126	1
Facilities:		
How green is the building	0.040	12
How much is the ecology area in campus	0.033	14
How well are the conditions of the plants	0.075	5
Environmental management performance:		
Waste reduction and recycling	0.047	9
Resource conservation (paper, water)	0.109	2
Energy efficiency (electricity, oil)	0.067	6
Pollution prevention (air, waste water, noise, toxic materials)	0.026	16
Use of green-label products	0.019	17
Administrations and planning:		
Internal or external audit for environmental management	0.086	4
Plans for improving environmental performance	0.045	10
Environmental management elements	0.029	15
Activities:		
Outdoors activities are designed for sustainable awareness	0.036	13
Public participation (campus communities, alumni, partners)	0.055	8
Community services or projects	0.103	3

The results in Table 1 indicate that among seventeen environmental assessment measures, health and safety related curriculum, with the highest priority value, was the most important one. Resource conservation was the second-most important. Moreover, the overall inconsistency of the input judgments 0.06 is within the acceptable ratio of 0.1.

In view of the heterogeneous structure of most universities, the focus is on the EMA initiatives to be implemented in elementary and high schools in this study. It may be one of the reasons why the results are not consistent with previous research on universities [5]. For example, at the curriculum level, the acquisition of environmental and sustainability knowledge at all campuses seems to be relatively unimportant to be an ongoing goal in this study.

## CONCLUSIONS

The implementation of environmental management at Taiwanese campuses is increasing, but most of the work is directed *via* external assessment by local environmental enforcement agencies. Under the circumstances, cross-institutional environmental assessment is needed to advance strong initiatives and assist lagging schools. In this study, an evaluation hierarchical structure was developed to prioritise the appropriate assessment measures for providing a directional tool to measure progress of environmental management implementation and toward the concept of a *sustainable campus*.

The proposed structure also provides a critical link between environmental performances on campus to the resources for allocation, by ranking the assessment measures according to the relative importance of their contribution to the overall performance. It ensures that the school management team has the same understanding of resource contribution to environmental performance for developing sustainable strategies. Although circumstances vary considerably between each campus, it is an adaptation of the evaluation model to the contingent factors relevant to different campuses for the assessment of their performance contribution in a school.

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