

Chapter IV

Review on Environmental Management Performance in Construction Business

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1 Traditional measures for implementing environmental management in construction business

The report by the Chartered Institute of Building (CIB, 1989) identifies four areas of improvement for environmental performance in construction activities, namely, efficient use of energy and natural resources; carefully selecting environmentally friendly building materials and the control of toxic chemicals and dangerous wastes; pollution control, clean technologies, recycling and waste management; and environmental education via intensive training. These principles are considered effective particularly during the design and construction period. For example, shifting a building's orientation to gain maximum natural lighting during design can save energy use, and the control of harmful waste generated during construction can mitigate the pollution to the environment. Typical measures for protecting the environment from implementing construction projects can be grouped in three areas: governmental regulations; economic measures and environmental management systems (EMS).

Governmental Regulations

The environmental impact of construction activities has triggered governmental alarm worldwide, thus all governments have implemented various policies and regulations for controlling such impacts. For example, many regulations specify that the emission from construction activities should not exceed any maximum allowable for any pollutant. Other regulations require construction enterprises to include the prevention of air pollution in their construction plans, and the funds and resources as needed to implement the prevention of air pollution should be included in the overall project planning. Such regulations have already extended the environmental

performance of buildings to wider range of building facilities in those developed countries and regions.

The Hong Kong government has been introducing various measures for controlling the environmental problems caused by construction works. The Environmental Protection Department (EPD) established in 1986 is responsible for implementing legislations to control pollution, to monitor environment conditions and to promote the awareness of environmental protection. There are a number of legislations imposed by the Hong Kong Government for controlling environmental performance during implementing construction projects, including the following typical regulations:

- ❑ The Air pollution control (Open Burning) regulation (1996) prohibits the open burning of construction waste. The Ozone Layer Protection Ordinance (1989) controls the manufacture, import and export of ozone depleting substances including those used for construction purposes.
- ❑ The Waste disposal ordinance (1980) controls illegal dumping of construction wastes and other wastes, such as chemical waste.
- ❑ The Noise Control (General) Regulations (1989) specifies that noisy works such as percussive piling must not be carried out between 7 pm and 7 am and on general holidays.

Similar legal regulations have been established for protecting the environment during construction activities in other countries. However, it seems that the effectiveness of applying these regulations is limited, for example, in Hong Kong construction industry, the CIRC (2001) notes that convictions for environmental offences in 1999 involving construction activities increased by approximately 40%. The study by Shen and Tam (2001) reveals that legal requirements are not effective measures for implementing environmental management in Hong Kong construction. According to the study, a significant proportion of construction professionals in Hong Kong considers that the implementation of environmental legislation will increase business expenses, thus restrict business development. Many professionals consider that environmental legislation is likely to restrict an organization. Better effectiveness can be gained if measures or actions are taken from a company's own initiatives.

Economic Measures

Businesses by nature are profit-driven. Generally, the activities bearing extra cost will not attract businesses' interests. Existing research works have noted that the principal reason for companies not to adequately invest in environmental management programs is due to cost factors (Griffith, 1996a; Ofori et al., 2000; Shen & Tam, 2001; Tam et al., 2001). Thus, the focus of promoting environmental performance has shifted to economic measures such as incentive programs and the energy efficient design. These measures can allow contractors to financially benefit from improving environmental performance. And the following discussions present several typical measures.

Incentive Program

Incentive program intends to bring a "win-win" result between environmental protection and business interests through engaging a "green construction" or "green building" process. A "green building" is usually defined as a building designed, constructed and used in a way that minimizes negative environment consequences from both an economic and a life-cycle perspective, thus contributing to the attainment of sustainable development (Stum, 2000). A typical incentive program for encouraging construction businesses to implement environmental management has been introduced by the Hong Kong government. The Building Department (BD), the Lands Department (LandsD) and the Planning Department (PlanD) in Hong Kong issued a joint policy Green and Innovative buildings in 2001 (BD, LD & PD, 2001). In this policy, a list of "green features" of buildings is described:

- ◆ balconies
- ◆ wider common corridors and lift lobbies
- ◆ communal sky gardens
- ◆ communal podium gardens
- ◆ acoustic fins
- ◆ sunshades and reflectors
- ◆ wing walls, wind catches and funnels

These green features are considered environmentally beneficial. For example, balconies can allow sunlight and fresh air into the interior, thus can reduce the dependence on man-made lighting and ventilation. This practice not only contributes to energy save, but also to decreasing greenhouse gas emissions. The communal sky gardens provide natural ventilation, greenery and recreational garden space for communal use. The wing walls, wind catchers

and funnels also promote natural ventilation. The acoustic fins militate against unwanted or excessive noise (BD, LD & PD, 2001).

Along with environmental benefits, the incentive program introduced in Hong Kong offers numerous advantages to businesses. According to the policy, if any of these features are implemented, they are excluded from the Gross Floor Area (GFA) and Site Coverage (SC) calculations provided that this area does not exceed 8% of the total permitted GFA for the development (BD, LD & PD, 2001). Thus, the program encourages clients to provide balconies, communal sky gardens without adding extra costs to the overall project. As building clients are taxed based on the project's GFA and SC calculations, balconies and other items will not be taxed if they do not exceed 8% of the total permitted GFA (BD, LD & PD, 2001). On the other hand, the value of the projects are increased if green features are adopted, thus the client can achieve higher profitability by advertising the green features.

The Energy Efficient Design

Energy efficient design is promoted as the methodology for allowing both environmental friendliness and cost effectiveness across the project life cycle. The implementation of a construction project will consume energy for various construction activities (EPD Report, 1999; CIRC, 2000; Poon, 2000; Shen et al, 2000; Best, 2001). However, a constructed building itself continues to consume energy and other environmental resources long after the construction period. Janda & Busch (1994) estimate that 57% of electricity used in developed countries are consumed directly by buildings. Therefore, the improvement of environment protection by reducing life cycle energy consumption is promoted and the practice of green building has been introduced. A green building approach has been proven effective in reducing energy consumption. Sullivan (1998) suggests that a green building can be designed to use 50% - 70% less energy than a typical building, for example, by designing properly the placement of windows or the orientation of the building, the benefits of natural sunlight can be maximized. According to the study by Smith (2001), in a typical energy efficient building in the US, the annual electricity costs were reduced by 40% and improved lighting and thermal comfort of the occupants were significant contributors to productivity. Savings from the reduction of energy consumption and the increase in worker's productivity is estimated at US \$2 million per annum (Smith, 2001).

While economic measures for implementing environmental management are

considered adequate, limitations exist in application. The study by Shen and Tam (2002) suggests the incentive program still does not encourage active involvement from the industry. Implementing green features in construction business is considered extra investment with little return in the industry practice. In fact, it is true that the benefits from practicing these environmental protection measures can only be realized in the long term. But construction businesses are generally driven by short term profit-making (Zhang et al., 2000; Tai, 2000). Further, the benefits of green features practice are generally shared by the building users or occupants but not necessarily by the project clients or builders, thus, clients and contractors have not much incentives or at least are not keen to implement the practice.

Environment Management System (EMS)

The establishment of an environmental management system (EMS) within a construction business is promoted for improving construction environmental performance (Cascio et al., 1996). Existing research works have developed various environmental management systems such as ISO 14000, Hong Kong's Hong Kong Building Assessment Method (HK-BEAM) (CETC, 1996), UK's Building Research Establishment Environmental Assessment Method (BREEAM) (Baldwin et al., 1998), Canada's Building Environmental Performance Assessment Criteria (BEPAC) (Cole et al., 1993) and the US' Green Building Challenge (GBC assessment framework) (Cole & Larsson, 1999).

ISO 14000 provides guidelines for an organization to establish environmental management objectives and commit itself to effective and reliable processes and continual improvement. Cascio et al. (1996) points out that ISO 14000 can bring all employees and managers into a system of shared and enlighten awareness and personal responsibility on protecting the environment. The major specifications of applying ISO 14000 include setting objectives and targets; implementing environmental management programs such as materials recycling and waste management; increasing employee involvement and communication; increasing communication between project parties; increasing efficiency in utilizing resources and energy; and motivating continual improvement.

These local environmental management systems such as HK-BEAM, BREEAM, share the principles of ISO 14000. For example, HK-BEAM assesses the environmentally friendliness of buildings by examining the criteria adopted for design, operation, maintenance and management of residential

and commercial blocks (Tai, 2000). Buildings which meet the HK-BEAM criterion will be awarded a certain rating. Prospective buyers and /or tenants can obtain an independent assessment of environmental performance of the building prior to purchasing or leasing the property.

Adopting an EMS demonstrates a company's commitment to environmental management and improves its corporate environmental image and reputation, thus attracting potential clients (Shen & Tam, 2001). However, it seems that EMS has limitations in application. In the current practices, environment assessment schemes (BREEM, BEPAC, GBC and HK-BEAM) are voluntary programs. Existing studies raise the doubt that voluntary schemes can be effective in bringing the true improvement of environment performance (Chau et al., 2000). Rothery (1995) notes that the establishment and operation of an EMS within a construction firm will not necessarily result in an immediate reduction of adverse environmental impact. The implementation of these measures is given less attention to that the measures themselves. The CIRC (2001) also notes that ISO 14000 as a management system is a guideline and real environmental benefits will come from its effective implementation. A construction firm can set environment management objectives and run environmental programs but neither will be effective if the objectives are not clear and realistic and the programs are not implemented properly. Obtaining the ISO 14000 certification is usually considered as an indication of good environmental performance. However, as pointed out in the study by Stenzel (2000), "Having a certificate doesn't mean you have a clean company... The bad guys who pollute will still do it and they'll have a certificate."

2 Existing Problems in Implementing ISO 14000 in Construction

Construction businesses are under increasing pressures to improve their environmental performance from regulatory bodies, competitive markets and the improvement of public environmental awareness. These developments have been challenging the practice of construction businesses who give little attention to environmental performance. Construction companies traditionally adopt an "end-of-pipe" environmental control practice. Although various approaches have been developed for helping construction businesses in improving environmental management performance, the discussion in the previous section suggests that the effectiveness in improving environmental performance in construction business is limited. The barriers exist and limit the improvement of environmental performance within construction activities, and these typical barriers are examined as follows.

Clash between cost and environmental performance

Cost is one of the most important factors affecting management decisions for any business. The tendency to award construction contracts to the lowest bidder highlights the importance of cost to construction businesses. The report by CIRC (2001) suggests that cost-orientation practice in the Hong Kong local construction industry leads to the minimum commitments by construction participants to improving environmental performance. Typically, contractors may “cut corners” by using inferior quality materials, or hiring semi-skilled employees at a lower wage or engaging in poor environmental protection practice in order to make better profit. In fact, the implementation of environmental management will induce costs. The study by Griffith (1996a) indicates that implementing environmentally friendly policies can incur a potential increase of 1% to 5% to a project’s overall cost. Tam et al (2000) note that cost factors are one of the main reasons for many companies not to adopt an EMS. The application of ISO 14000 and HK-BEAM will incur extra costs for equipment, staff training, human resources and technology for protecting the environment, such as water treatment and the application of noise-barrier materials (Shen & Tam, 2001). For example, the charge for a single assessment of using HK-BEAM was HK\$ 75,000 in 1999 (Tai, 2000). The survey by Ofori et al (2000) shows that the top reason for not implementing ISO 14000 in Singapore construction is that the benefits from the implementation will not outweigh the costs incurred. There are other findings echoing that the increase of management costs is the major barrier to implementing environmental management in construction practice (Shen & Tam, 2001; Tam et al, 2001). It seems that whenever the clash between cost and environmental management exists, environmental management is more readily sacrificed.

Environmentally passive culture within construction industry

It is rare for construction businesses to initiate environmental protection measures. The survey by Tan et al (1999) to the Singaporean construction professionals showed that construction firms were aware of the environmental impacts of their activities but were not environmentally proactive. Construction firms implement EMS because of external stimuli such as clients’ insistence, market forces or statutory regulations (Tan et al, 1999). Ofori et al (2000) observe that the most effective measure for promoting ISO 14000 among contractors was financial incentives or market driving. Contractors would only seek for environmental performance certification if clients demanded it. It seems common among construction businesses that environmental management measures are taken simply to conform to public

pressure or take advantage of receiving possible incentives. Nevertheless, implementation of environmental management can only be effective in construction industry if the practice is implanted in the psyche of construction personnel.

Lack of client's support

Contractors undertake construction works in response to client requirements. Where the client shows little interest in improving environmental performance, there will be no incentive for the contractor to invest in EMS. The client's role in encouraging environmental management is vital. As Tan et al (1999) note, a client's environmental commitment will filter down through the design and construction processes via the choice of consultants and contractors. Project clients should be the driving force in promoting environmentally conscious construction. However, the practical support from clients is generally weak (Shen & Tam, 2001). Many clients have little knowledge about ISO 14000 (Ofori et al, 2000). Zhang et al (2000) observe that clients are often concerned with immediate or short term results and they care little about the potential benefits of improving environmental performance that may occur in the future.

Furthermore, the widely applied multi-tier subcontracting system such as in Hong Kong construction presents more difficulties for clients to communicate effectively with other project parties. Thus environmental performance by contractors and subcontractors can not be effectively monitored (Shen & Tam, 2001). The difficulty of communication is further complicated by the fragmented nature of the current mode of construction project organization in which various processes from design to commissioning proceed in sequence with littler interaction from each other (CIRC, 2001). The lack of participation by project clients in the issues of construction environmental performance leads to the lack of implementing environmental management along the whole chain of multiple project organizations. In fact, the effectiveness of improving environmental performance in construction activities needs the full cooperation from all project parties. And the common goal of implementing environmental management has to be clearly communicated from project client to all parties.

Clash between contract time and environment performance

Contract time is generally defined as the maximum time allowed for the contractor to complete the entire project (Herbsman et al, 1995). Early completion of a construction project can better make contributions to investment return and a delayed delivery will normally cause clients loss of

business opportunities and potential profits. Delay in public projects may even create social and public problems such as traffic congestion (Drew, 1999). Thus, clients often push contractors to finish the project in contract time or earlier, resulting in that contractors often work under pressure to a tight schedule. As long as they are awarded the project, they are under pressure to finish on time. Where contractors fail to meet contract time, fines are normally imposed. However, incorporating environmental protection will involve time consumption. For example, in the process of executing activities such as piling, contractors are only allowed to work in a specified period of time in order to reduce noise pollution. Proper waste management will need more time for waste sorting-out. A clean project site needs more cleaning procedures. These measures contribute to improving environmental performance. However, they will consume extra time. Therefore, whenever construction time is tight, these environmental performance measures will not be properly implemented. Adequate environmental protection is only achievable if resources including time are provided.

3 A framework for improving project environmental performance

The understanding about the problematic areas in implementing environmental management in construction leads to the proposal of a framework for improving the environmental performance in committing a construction project. The above discussion reveals that current modes of environmental protection including governmental policies, economic measures and management systems are of limited effectiveness. The perception of cost increase, time consuming and resource consumption by construction professionals discourages the implementation of environmental management in construction industry. There are some proactive firms adopting an EMS approach, but this approach has not been echoed by the whole industry. Various studies have been conducted in trying to find solutions for improving environmental performance in construction. For example, Tse (2001) suggests imposing governmental policies forcing construction firms to establish EMS standards within their organizations. Hill and Bowen (1997) suggested that environmental management should be stated as a requirement in contract specifications. These measures, however, are considered as external driving forces for pushing construction professionals to implement environmental management. As pointed out in the previous section, better effectiveness will be gained if internal forces are readily present. In other words, when construction organizations become proactive in adopting environmental management, the improvement in

environmental performance in the industry will be in evidence.

The above review to the existing problems in practicing ISO 14000 systems provides a basis for proposing a framework for improving a contractor's environmental performance, and this framework is shown in Fig.4-1. The framework has incorporated the elemental principles embodied in ISO 14000. The ISO 14000 system allows the integration with other existing management system such as quality/health and safety system.

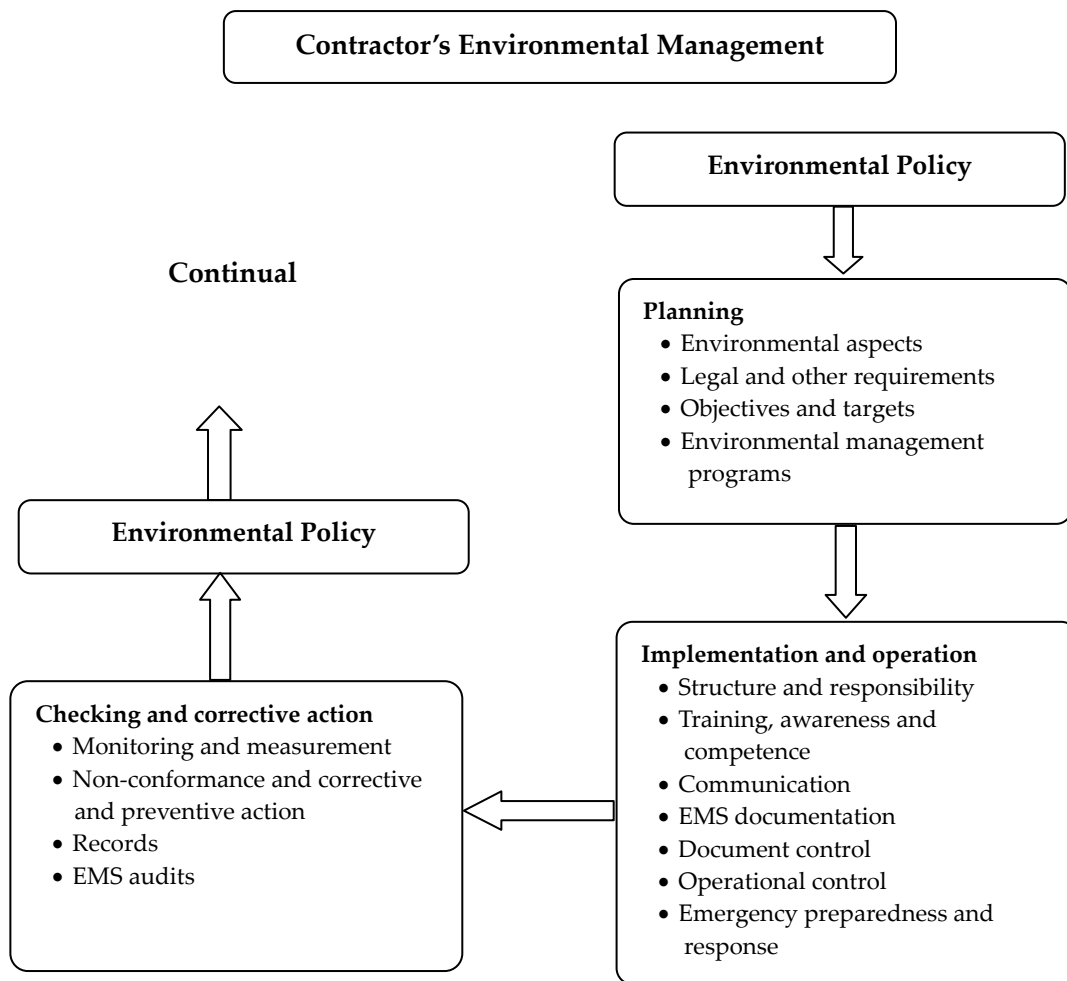


Fig.4-1 The management framework for improving contractor's environmental performance

Environmental Policy

The environmental policy within an organization is a organizational commitment to the environmental protection from top management. This

policy specifies the objectives of environmental management across all activities in the organization's business. The policy contains a commitment to prevention of environmental pollution and continual improvement in environmental performance. The policy is designated to comply with relevant environmental legislation in order to avoid convictions. Further, this policy is unique to a particular construction business, taking into account the firm's own background and nature of business. The policy should be available to the public and communicated to all employees within the organizations.

Planning

Planning is important management function to ensure that the whole organization is working towards the objectives defined in its environmental policy. The major activities in planning include to identify the areas affecting the environmental performance; to identify the requirements defined in environmental policy; to identify internal performance criteria; to plan specific targets of implementing environment management; and to schedule environmental management programs in order to fulfill its objectives and targets.

Environmental aspects

A construction firm should firstly identify those areas which have environmental effects in its business activities, and find out those areas which have more significant impacts on the environment. Identifications are also needed for those areas which may be beyond the the concerned contractor's own activities, but the contractor has influence, such as the construction methods adopted by subcontractors, and the delivery methods by suppliers.

Legal requirements and interior criteria

A construction firm needs to identify the regulatory requirements applicable to its business activities. Regulations on environmental management are in different forms, including those specific to the activity (e.g., site operating permits); those specific to the organization's products or services; those specific to the relevant industry; general environmental laws; and authorizations, licenses and permits.

Contractor also needs to identify internal priorities and criteria in line with its environmental management policy. Particularly, attention is needed to those areas where standard environmental management systems such as ISO 14000 do not specify, for example, the criteria for supplies, energy management and transportation, and others.

Objectives and targets

Based on the identification of internal criteria and external requirements on environmental performance, a construction firm needs to establish operational objectives and targets in documentation. These objectives and targets must be in line with the defined environmental policy. Targets must be specific and measurable. Measurable environmental performance indicators should be established in order to assess whether objectives and targets are achieved.

Necessary resources should be planned in order to achieve the defined objective, and this plan should be an important part of the overall business plan within the contractor. For example, the additional time is needed to implement environmental management systems and should be included in project schedules. This is to avoid project delay while environmentally friendly practices are held.

Environmental management programs

Based on the environmental objectives and targets defined within the business, environmental management programs or action plans can be developed and scheduled into business activities. Necessary resources and responsibility must also be defined and allocated to individual departments and personnel to ensure achieving the objectives and targets.

Implementation and operation

Implementation mechanisms and procedures need to be established to ensure that all activities within the business are working towards the specified objectives and targets, and these activities are under proper control. The key procedures and mechanisms for implementing the organizational environmental policy include the follows:

Organizational structure and responsibility allocation

Within the organizational structure, a construction firm needs to designate a role or position such as management representative (MR) at head office level to assume the responsibility and authority for implementing the organizational environment management system. This management representative should also be available at site management level. The MR at head office will be able to ensure that the managerial staff on each site is responsible for dealing with environment issues on particular sites. In many

cases, this management role may be incorporated with quality management role.

Training, awareness and competence

A construction company needs to identify the training needs for implementing environmental management within the organization and ensure that employees at all levels across the organization have received relevant training pertaining to their job. Procedures should be established to ensure that employees can be effectively communicated with the environmental policy and management action. Employees should be equipped with the knowledge of understanding the significant environmental impacts from their operations; their roles and responsibilities in achieving conformance with organizational environmental policy; the procedures of dealing with environmental problems. In particular, those personnel who undertake the tasks having significant environmental impacts must be competent (Cascio, 1996). The guideline for training procedures defined in ISO 14000 can be used as the major reference for establishing organizational training procedures.

Communication

Proper communication between individuals and departments within the organization is essential for achieving the effectiveness of implementing environmental performance. The company needs to develop proper procedures for ensuring that the environmental activities will be effectively communicated internally and externally. Effective communication can exert a synergy for implement organizational commitment; raise awareness among organization staff of the environmental policies, objectives, targets and programs; identify environmental problems in organizational activities and assist in taking corrective actions. The provision of appropriate information within and outside the organization will encourage staff to work towards a shared goal of improving environmental performance, and help the public understanding of organization's efforts and progress in pursuing better environmental performance.

Environmental management system documentation

The documentation of company environmental management system should be developed into a manual to provide easily obtainable guidelines. According to the study by Whitelaw (1997) environmental management documentation system is structured into four levels, namely, environmental manual, environmental procedures, environmental work instruction and the

reference materials such specifications, standards and records. The environmental manual covers all environmental policy, requirements of EMS. It explains “why, how, and what to do”. The manual provides direction on how company’s environmental policy is implemented. It explains in detail how the requirements on environmental performance will be satisfied. The manual also includes the work instructions that provide direction on how the environmental management procedures are to be implemented.

Document control

Controlling measures should be defined for ensuring that environmental documentation for use is most updated, and that the current versions of the documents are available to all individuals and departments when and where the activities or tasks are undertaken. Documents need to be periodically reviewed, revised and approved by authorized personnel prior to their application. The obsolete documents should be promptly removed from all points of issue and use. Furthermore, documents should be kept in alternative formats such as in electronic form, on a central network, to ensure that all location and personnel can have access to the updated information easily.

Operational control

A contractor should develop operational procedures to control activities associated with those activities or areas which have environmental impacts, for example, raw materials handling and storage; on-site construction process; transportation and storage of chemical products, and others. These procedures should be able to provide operational instructions to the operatives, such as those operations dealing with chemical waste management, dust control, storm water and wastewater management, noise control and energy-saving. The operations by suppliers and subcontractor can have significant environmental impacts, thus supervision procedures are needed to monitor their activities. A mechanism is needed to ensure that suppliers and subcontractors are aware of their environmental duties and responsibilities to improving the project environmental performance. The establishment of this mechanism will contribute to overcoming the lack of co-operations among project parties.

Emergency and response

Potential emergencies about environmental impacts or damages exist throughout the life of construction project, particularly, on site activities, and these emergency potentials need to be identified. Procedures for dealing with these emergency potentials should be developed. It is important to ensure

that all staffs who are within the areas of emergency potentials have good knowledge and are aware of what to do in the event of an emergency. For example, a lorry carrying chemical materials to the site can be in an emergency of commit a spillage, the appropriate procedures to deal with the spillage must be developed. Periodic testing of emergency procedures is required to verify that they will work in practice (Uren et al, 2000).

Checking and corrective action

Monitoring, measuring and evaluating are among the major activities of implementing an EMS effectively within a business.

Monitoring and measurement

A contractor needs to develop documented procedures for monitoring and measuring on a regular basis the actual environmental performance by referring to the environmental objectives and targets defined within the organization. The performance should also be checked against relevant environmental legislation and regulations. For assuring the quality of monitoring, the contractor needs to ensure that monitoring equipment is calibrated and maintained thus the reliability of monitoring data is allowed. It is important to ensure that comprehensive monitoring records are maintained, either at head office or at site level. It is also important to decide whether a generic procedure or set of procedures will be sufficient, or whether each site needs to develop its own methodologies for undertaking monitoring (Uren, 2000).

Non-conformance and corrective and preventive action

A company should develop adequate procedures for investigating the non-conformance if any and the procedures for carrying out corrective and preventive action. The investigation process must be recorded. Control and evaluation must be conducted to ensure that any preventive action taken is effective.

Records

Records are evidence of the ongoing operations from implementing EMS and should cover a wide range of data collected from operational activities. These data typically include relevant environmental regulations and policies; license/permit record; complaint records; training records; inspection, maintenance and calibration records; monitoring data; product identification record; pertinent subcontractor and supplier information; incident reports;

information on emergency preparedness and response; records of significant environmental impacts; audit results; management reviews, and others (Cascio, 1996).

EMS audit

A construction firm needs to establish programs for carrying out periodic environmental management system audits to determine whether the EMS conforms to planned policies and has been properly implemented and maintained. The audit programs should be established to cover the system scope, frequency of use, implementation methodologies and allocation of responsibilities. Audits may be performed by personnel from within the organization or by external parties invited by the organization. The professionals undertaking the audit must be trained and should be given the environment to do so objectively and impartially. EMS audits can be integrated with the organizational quality /safety auditing practice, thus reducing the need to examine areas such as training records and document control twice (Uren, 2000).

Management review

The top management within a construction organization needs to undertake management review on a regular basis to determine any changes needed to the organizational environment policy and EMS to date. This review should cover not only the organizational activities at project or site level, but also the developments of innovations in the construction industry; the response from environmental stakeholders such as the public, the requirements from customer, the complaints and comments from internal and external parties; and progress evaluation on objectives and targets.

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