Building and Environment 46 (2011) 1023–1037

Contents lists available at ScienceDirect

Building and Environment

journal homepage: www.elsevier.com/locate/buildenv

Assessing concerns of interested parties when predicting the significance of environmental impacts related to the construction process of residential buildings

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ARTICLE INFO

Article history:
Received 9 June 2010
Received in revised form
13 October 2010
Accepted 11 November 2010
Available online 18 November 2010

Keywords:
Environmental impact
Impact significance determination
Environmental management
Environmental management system
Building
Construction process

ABSTRACT

The most common challenges and obstacles encountered by construction organizations during the process of implementing and using environmental management systems are related to the inherent peculiarities of the construction sector. Several studies have shown that one of the issues involving the greatest level of uncertainty is the identification and assessment of environmental impacts. In order to improve the identification of the significance of environmental impacts of construction projects and sites, which will lead to greater efficiency and robustness in environmental management systems, this paper extends the systematic approach for identifying and assessing potential adverse environmental impacts at the pre-construction stage presented in Gangolells et al. (2009) by introducing the assessment of the concerns of interested parties. By considering concerns amongst internal and external interested parties, one can assess the significance of environmental impacts taking into account not only the severity of the impacts but also local perceptions and international challenges, thereby ensuring that the determination of the impacts' significance is appropriate to the particular socioeconomic and biophysical environments surrounding construction sites. In order to quantitatively measure concerns among internal and external interested parties for each of the 37 environmental impacts related to a construction project, we developed corresponding indicators and assessment scales with the help of a panel of experts. A series of χ^2 tests conducted over 76 new-start construction projects clearly revealed that the severity of environmental impacts is not correlated with the concerns of interested parties. The development of a formal quantitative method and the subsequent definition of a threshold make it possible to obtain advance knowledge of the significance – and, therefore, the acceptability – of each potential environmental impact for a particular construction project. A total score for each construction project alternative is also obtained, so the improved methodology provides a consistent basis for comparing construction companies and construction sites. Finally, two case studies are presented in order to demonstrate the benefits of the improved methodology.

1. Introduction

According to Griffith and Bhutto [1], quality management systems have successfully been implemented by contractors over the last 25 years, formerly as BS 5750:1978 [2] and in recent years by ISO 9001:2000 [3] and ISO 9001:2008 [4]. The construction industry has the third highest number of ISO 9000 certificates among all industrial sectors worldwide [5]. Construction-related firms accounted for 7% of all certified companies in all industrial sectors worldwide in 2000 [6], with approximately 28,600 construction-related companies having a quality certificate. In the construction industry, environmental certification ISO 14001: 1996 [7] or ISO 14001:2004 [8] is relatively infrequent compared with ISO 9001 [5], for which 9095 certificates were awarded in 2006 [9]. According to official data provided by the European Commission in February 2009, an Eco-Management and Audit Scheme (EMAS) had been adopted and implemented by 216 construction organizations [10].

Environmental management systems are most common among manufacturing facilities, which are relatively stable over time and have a longer and more extensive history of environmental regulation [11]. The low environmental certification rates in the

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doi:10.1016/j.buildenv.2010.11.004

construction sector are attributed to the uncertainty caused by the application of traditional standard-based management systems at the project level [1]. Unlike ordinary manufacturing industries, the construction industry makes complex [12] and unique products and includes a wide variety of construction techniques and systems. Moreover, in the construction sector the place of production must necessarily be the place where the product is going to be used [13]. The construction industry typically involves short construction periods and is largely exposed to outdoor conditions. For this reason, according to Hoyle [14], systems are frequently applied to isolated parts of organization in the construction sector rather than to whole organization, and their efficacy has, therefore, been questioned.

Environmental aspects are the focus of environmental management systems, since a company implementing ISO 14001:2004 [8] builds the system to address these aspects [15]. Various indicators point to the fact that a dominant aspect of the implementation and upkeep of an environmental management system is associated with the planning stage, especially as relates to the subsystem for identifying and assessing environmental aspects and impacts [16].

Having recognized environmental impact identification and assessment as a central feature in the development of environmental management systems [16] and taking into account that the identification and assessment of environmental impacts is considered to be one of the issues involving the highest levels of uncertainty [17], the purpose of this paper is to improve the assessment of construction-related environmental impacts within the framework of the implementation of environmental management systems in construction companies. Improving the identification of the significance of environmental impacts of construction projects and sites will lead to increased efficiency and robustness in environmental management systems. In addition, the environmental performance of construction projects and sites will be improved given that the relevance of each environmental aspect at a particular site is predicted prior to the construction stage. Significant impacts are highlighted in advance and it is possible to plan a range of on-site measures for mitigating them. Gangolells et al. [18] significantly contributed to overcoming the main obstacles related to the process of implementing environmental management systems in the construction sector by developing an innovative methodology for predicting the severity of the environmental impacts associated with the construction of new residential buildings. However, as mentioned in ISO 14001:2004 [8], the concerns of interested parties should be considered in the assessment of environmental impacts. The assessment of the interested and affected parties is even more important in highly site-based industries, such as the construction industry, where the context may be multivariate in nature. Assuming that the significance of an environmental impact depends not only on its severity but also on the degree of sensitivity to environmental impacts of habitats, species and communities within the geographical areas affected by construction projects and society as a whole, the aim of this research is to extend the approach presented in Gangolells et al. [18] for identifying and assessing potential adverse environmental impacts related to the construction process of residential buildings by introducing the assessment of the concerns of interested parties.

This article starts by exploring the methodological framework for the identification and assessment of environmental impacts established by standards ISO 14001:2004 [8] and ISO 14004:2004 [19]. Taking into account that both standards highlight the need to better understand how the concerns of interested parties actually modify the significance of an environmental impact, this paper includes this extra criterion in the framework proposed by Gangolells et al. [18]. So as to quantitatively measure the concerns of internal and external interested parties for each of the 37 environmental impacts related to the construction process, particular attention is paid to the development of indicators and assessment scales. The results of χ^2 tests of independence conducted over 76 new-start construction projects show no relationship between severity and the concerns of interested parties. After a formal quantitative method is proposed to determine and rank the significance of each environmental impact in a particular construction project on the basis of its severity and the concerns of interested parties, the level of acceptability of a potential environmental impact is established. Two case studies are then presented to demonstrate the benefits of the improved methodology. Finally, conclusions are presented and recommendations for future research are made.

2. Environmental impact assessment within the scope of ISO 14001:2004

The ISO 14001:2004 [8] standard requires a planning process to identify and assess the environmental aspects that characterize a company's activities in order to later implement environmental programs addressing those environmental impacts found to be significant. As stated by Burdick [20] and Ghisellini and Thurston [21], the process of assessing and identifying the environmental aspects and impacts and the methodology used to rank the significance of the aspects are fundamental stages within the process of implementing environmental management systems. In fact, assessing the significance of environmental impacts is the basis for structuring the planning phase and for organizing the environmental management system as a whole [16]. Environmental impacts not considered to be significant are not currently managed by the environmental management system.

Previous studies such as those provided by Põder [17], Ghisellini and Thurston [21], Zobel et al. [22], Babakri et al. [23] and Zobel and Burman [24] have revealed that the identification and assessment of environmental aspects and impacts is the most problematic issue in implementing ISO 14001:2004 [8]. In fact, the methodological framework established by standards ISO 14001:2004 [8] and ISO 14004:2004 [19] gives only general principles for the assessment of environmental aspects [17]. ISO 14001:2004 [8] does not provide a rigorous definition of significant aspects [16] and literally states that 'although there is no single method for determining significant environmental impacts, the method used should provide consistent results and include the establishment and application of assessment criteria, such as those related to environmental matters, legal issues and the concerns of internal and external interested parties'. Unfortunately, ISO 14001:2004 [8] does not provide any further explanation as to how these components of significance should be interpreted [17]. Therefore, the ISO 14001:2004 [8] standard grants the companies a greater degree of freedom in establishing their overall environmental impact, leaving significant room for adaptation and indeed interpretation [15].

ISO 14001:2004 [8] defines environment as 'a surrounding in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelations'. Hence, the terms 'environment' and 'environmental impact' have broad meaning in the context of environmental management, encompassing both biophysical and socioeconomic environments [17]. For this reason, the ISO 14001:2004 [8] standard explicitly recommends taking into account the concerns of interested parties when assessing the significance of environmental impacts. ISO 14004:2004 [19] defines interested party as 'a person or group concerned with or affected by the environmental performance of an organization'. Therefore, effective impact significance determination must include a thorough understanding of contextual