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Life Cycle Assessment to support the quantification of the environmental impacts of an event

Sara Toniolo, Anna Mazzi, Andrea Fedele, Filippo Aguiari, Antonio Scipioni *

CESQA, University of Padova, Department of Industrial Engineering, Via Marzolo 9, 35131 Padova, Italy

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ABSTRACT

In recent years, several tools have been used to define and quantify the environmental impacts associated with an event; however, a lack of uniform approaches for conducting environmental evaluations has been revealed. The aim of this paper is to evaluate whether the Life Cycle Assessment methodology, which is rarely applied to an event, can be an appropriate tool for calculating the environmental impacts associated with the assembly, disassembly, and use phase of an event analysing in particular the components and the displays used to establish the exhibits. The aim is also to include the issues reported by ISO 20121:2012 involving the interested parties that can be monitored but also affected by the event owner, namely the event organiser, the workforce and the supply chain.

A small event held in Northern Italy was selected as the subject of the research. The results obtained show that the main contributors are energy consumption for lighting and heating and the use of aluminium materials, such as bars for supporting the spotlights, carpet and the electronic equipment. A sensitivity analysis for estimating the effects of the impact assessment method chosen has also been conducted and an uncertainty analysis has been performed using the Monte Carlo technique. This study highlighted the importance of the energy consumed by heating and lighting on the environmental implications, and indicated that the preparation and assembly should always be considered when quantifying the environmental profile of an event.

1. Introduction

In 2014, 2321 exhibitions were organised in Europe, involving 735 organisers, 659,335 exhibitors, 64.6 million visitors, and 24.7 million m^2 of rented space (UFI, 2015). In line with this important diffusion, exhibitions represent an occasion to share information, with a primary focus on the visualisation of ideas (Demir, 2012) and the business outcomes of participants (Yoon et al., 2012). Over the years, several studies have been conducted in the event sector, regarding, e.g., the service quality perceived by attendees (Chen and Mo, 2012), the prediction of the daily visitor attendance during festivals (Su et al., 2014), and the costs of hosting special events (Chirieleison and Montrone, 2013).

In addition, the event sector, which is known to have negative environmental influences (Cierjacks et al., 2012; Hottle et al., 2015; Ye et al., 2015; Gössling and Buckley, 2016), has also been studied, considering the related environmental aspects (Preston and Bank, 2012; Vinodh et al., 2012; Fumeaux and Rey, 2014; Manomaivibool, 2015). With regard to waste management, for example, Cierjacks et al. (2012) used operational performance indicators for festivals natural landscapes and Núñez et al. (2009) developed a methodology to evaluate the waste produced during assembling and dismantling stages associated with temporary structures at trade fair events in closed complexes.

The environmental burdens of events have also been investigated using the ecological footprint: Collins et al. (2009) applied the ecological footprint analysis to two mega sporting events; Andersson and Lundberg (2013) conducted a triple impact assessment of a music festival including the ecological footprint and Teng and Wu (2014) calculated the eco-footprint of a building project of an exhibition hall.

In parallel, other studies have explored the participation of key stakeholders (Laing and Frost, 2010), analysed the role of professional association in promoting sustainability (Dickson and Arcodia, 2010), and proposed environmental performances in sport facilities (Mallen and Chard, 2012). Furthermore, among these studies, Preston and Bank (2012) highlighted the importance of the environmental profile of a temporary structure of an outdoor sculpture in the USA. Others analysed the relationships between environmental services and visitor perception (Wong et al., 2015), the relationships between natural rehabilitation and recreational services (Polizzi et al., 2015; Harfst, 2015; Scheepens et al., 2016), and the application of the concept of sustainability to an architectural exhibition (Ren, 2016).

The recognition of the importance of sustainability in the event industry is also confirmed by the International Organization for Standardization (ISO), which published a specific standard in 2012: ISO 20121:2012 "Event Sustainability Management Systems -

* Corresponding author.
E-mail address: scipioni@unipd.it (A. Scipioni).

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Requirements with guidance for use" (ISO, 2012b). This standard was developed by the event industry working within the ISO project committee ISO/PC 250, Sustainability in event management. It specifies the requirements of an event sustainability management system and is applicable to all types and sizes of organisations that are involved in the design and delivery of events (ISO, 2012a). Among the approaches proposed by the ISO 20121 standard to assess sustainable procurement is Life Cycle Assessment (LCA). This methodology, standardised by ISO 14040 and ISO 14044 (ISO, 2006a, 2006b), is described as "a holistic approach which assesses the environmental aspects and potential impacts associated with the manufacture, use, and disposal of a product" (ISO, 2012b, p.37). In addition, ISO 20121 suggests that the choice of materials should be performed while considering the efficient use of all materials in buying and use as well as the full lifecycle (ISO, 2012b).

In the event sector, the LCA methodology have been used in several studies: Rivela et al. (2006) conducted a life cycle assessment of wood wastes through a case study of particle panels for a trade fair in Barcelona and Zeng et al. (2014) conducted an LCA of solid wastes produced during Shanghai Expo limited to greenhouse gases emissions. In addition, Lou et al. (2015) assessed the greenhouse gases emissions and other environmental impacts of the Shanghai Expo waste management system through LCA methodology focusing on global warming, acidification, nutrient enrichment and spoiled groundwater resources and Hou et al. (2014) applied a hybrid-LCA covering social and economic impact in addition to the environmental impact for a sediment remediation at the London Olympic Park. Others applied LCA-based approaches: Dolf and Teehan (2015) calculated the carbon footprint of spectator and team travel of small-scale sport university events in Canada and Scrucca et al. (2016) performed a multi-criteria decision analysis for a sporting event in Italy including the carbon footprint.

However, there remains a lack of uniform and shared approaches to analyse the environmental impacts of an event, in spite of the concern already expressed by Getz and Page (2016).

In this context, this study evaluates whether the LCA methodology, which has been developed for products, processes and services (Jacquemin et al., 2012) can be an appropriate tool for calculating the environmental impacts associated with the preparation, usage, and dismantling of an event and for supporting uniform environmental evaluations. Indeed the scope of ISO 20121 specifies the requirements for an event sustainability management system for any type of event or event-related activity involving different interested parties, such as event organizer, event owner, workforce, supply chain, participants, attendees, regulatory bodies and community. The organisation, which manages the event, shall identify its sustainable development issues and evaluate their significance associated with its event-related activities, products and services. In particular, with regard to environmental issues the following issues have to be considered: resource utilisation, materials choice, resource conservation, emissions reduction, biodiversity and nature preservation, releases to land, water and air (ISO, 2012b).

Thus, this study aims to evaluate the contributions of several components that are often used to set up an event including the environmental issues reported by ISO 20121 (ISO, 2012b) and involving the interested parties that can be monitored but also affected by the event owner, namely the event organizer, the workforce and the supply chain.

2. Methodology

The subject of this research was a trade fair, given the importance of this kind of event in the market as highlighted by Alberca-Oliver et al. (2015). The selection of the case study was based on two criteria: the related industry sector and the size (number of exhibitors). The industry sector chosen was "Engineering, Industrial, Manufacturing, Machines, Instruments, Hardware", which according to the data published by UFI (2015) can be representative for 164 events held in Europe in 2014. Several exhibitions related to this sector have less than 200 exhibits and thus a small indoor event held in Northern Italy in October 2013, with approximately 120 exhibits was selected as the case study.

The methodology applied to quantify the environmental impact associated with the selected event is LCA, in accordance with ISO 14040 and ISO 14044 Standards (ISO, 2006a, 2006b) and in line with ISO (2012b). The following four steps are performed: goal and scope definition, life cycle inventory analysis, life cycle impact assessment, and interpretation of the results.

A dimension that is not included in this analysis is the environmental burdens associated with visitors when travelling to the event and the related waste produced. This contribution, which is estimated to cover 54% of the total ecological footprint of an event, as quantified in a previous study by Collins et al. (2009), is not within the scope of this study. Indeed this study involves the interested parties that can be monitored but also affected by the event owner (event organizer, workforce and supply chain). In addition, this study highlights the contributions of the preparation, usage, and dismantling of an event (in line with Oliver Solà et al., 2007), which are rarely deeply analysed in the studies including the environmental aspects associated with participants and spectators.

2.1. Goal and scope definition of LCA

The main goal of this LCA is to analyse the entire event (i.e. 120 exhibits over 3 days) considering the organisation, the assembly, the utilisation and the dismantling stages. A further goal is to analyse the influence on the impacts of different elements such as energy consumptions, utilisations of materials and disposal of waste.

The realisation of the selected event occurs in four stages. During the organisation stage, the space is distributed; this distribution is accomplished by defining the volume and area of the stands using scotch tape and some plastic panels to arrange the exhibited content. In the assembly stage, different pieces are fitted together by assemblers to obtain the structures of the stands. The lighting equipment is assembled; the carpet is set down using scotch tape; the stands are assembled with display panels, chairs, and tables; the electrical system is prearranged; and the area is cleaned. During the utilisation stage, the stands are heated, and the exhibitors are helped via logistics activities. In the dismantling stage, the stands are disassembled, and the area is cleaned again.

The functional unit used, in line with the aim of the research, is preparing and holding an event, lasting three days, with 120 exhibitors and with 11,600 m^2 of occupied surface. Hischier and Hilty (2002) used a similar functional unit in their LCA study of an international conference, namely preparing and holding a 3-day conference and other authors expressed the results of their studies with reference to the entire event analysed (Zeng et al., 2014; Lou et al., 2015; Dolf and Teehan, 2015; Scrucca et al., 2016).

The system boundaries (Fig. 1) were defined while considering the main suggestions of ISO (2012b) and thus comprise the consumption of materials, energy, and water associated with the distribution of volume and area, the arrangement of the lighting equipment, the lay of the carpet, the arrangement of the electronic system, cleaning services, heating and logistics, the dismantling of the stands, and the final cleaning services. The treatment of waste produced during dismantling is included in the assessment. The system boundaries also include the assembly of the stands with expositive panels and their particular manufacturing activities, as shown in Fig. 2.

The impacts of on-site facilities construction are omitted, due to a lack of data and the relatively small impact on the result, in line with Whitehead et al. (2015).

2.2. Life cycle inventory analysis

For the analysis of the event under study, the main data are primary and referred to the selected case; they were mainly collected during the