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Strengths-Weaknesses-Opportunities-Threats analysis of carbon footprint indicator and derived recommendations

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ABSTRACT

Demand for a low carbon footprint may be a key factor in stimulating innovation, while prompting politicians to promote sustainable consumption. However, the variety of methodological approaches and techniques used to quantify life-cycle emissions prevents their successful and widespread implementation. This study aims to offer recommendations for researchers, policymakers and practitioners seeking to achieve a more consistent approach for carbon footprint analysis. This assessment is made on the basis of a comprehensive Strengths-Weaknesses-Opportunities-Threats or SWOT Analysis of the carbon footprint indicator. It is carried out bringing together the collective experience from the Carbonfeel Project following the Delphi technique principles. The results include the detailed SWOT Analysis from which specific recommendations to cope with the threats and the weaknesses are identified. In particular, results highlight the importance of the integrated approach to combine organizational and product carbon footprinting in order to achieve a more standardized and consistent approach. These recommendations can therefore serve to pave the way for the development of new, specific and highly-detailed guidelines.

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1. Introduction

Human influence on the climate system is clear (IPCC, 2013). In response, the United Nations Framework Convention on Climate Change has developed various initiatives, promoting the creation of national greenhouse gas (GHG) inventories. However, these inventories are built on the premise described by IPCC (1996), including only domestic GHG emissions. Within this framework several countries have reduced domestic emissions, although world GHG emissions continue to grow (Peters et al., 2013). This emphasis on solely domestic emissions is proving ineffective, and particularly in the new context of free-trade agreements.

New schemes based on emissions embedded in imports are therefore needed to implement all the available strategies. In this context, the concept of carbon footprint (CF) has been used to express consumption-based emissions from a territorial point of view (Davis and Caldeira, 2010). Demand for low CF may be a key factor in stimulating innovation while prompting politicians to promote sustainable consumption. The CF indicator now span several scales, allowing the analysis of everyday consumer products through to business, households, cities, counties and countries (Minx et al., 2009; Peters, 2010).

Although the CF indicator has been very successful in terms of reaching a great audience, some researchers have pointed out different problems related to CF analysis (see, e.g. Cagiao et al., 2012; Carballo-Penela et al., 2012; Finkbeiner, 2009; Jensen, 2012; McKinnon, 2010). In particular, one of the most common issues highlighted by researchers is the methodological divergence between product and corporate CF (Alvarez and Rubio, 2015a; Carballo-Penela et al., 2009). This divergence avoids the comparability among methods, reducing the consumer confidence on footprints information. Under these circumstances, there is a need of studies that include a complete assessment of the CF indicator from a strategic management perspective.

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Strategic management tools should be considered as a means of objectively devising guidelines for improving the CF indicator, as they offer a competitive and adapted methodology to elaborate strategies. A wide range of strategic management tools have been developed to assist in compiling these intelligent strategies (Rao et al., 2009), including the Strengths-Weaknesses-Opportunities-Threats – or SWOT – analysis, a widely-used tool for achieving both a systematic approach and support for decision making (Kessler, 2013).

1.1. The carbon footprint

Sustainable development indicators are needed to provide a solid basis for decision-making (Čuček et al., 2012). The CF is a sustainable development indicator which has emerged in the last few years as a general description of the GHG emissions produced by human activities (Wiedmann, 2009). In spite of being one of the most important environmental indicators (Hoekstra and Wiedmann, 2014) there is still some confusion with regard to the meaning of the term, what and how measures (Jensen, 2012; Wiedmann and Minx, 2008).

Wiedmann (2009) states that the CF term could be derived from the ecological footprint (EF) concept, formulated by Wackerangel and Rees (1996). The footprint family indicators are defined as a set of consumption-based indicators that calculate the environmental burdens imposed on the environment by human society (Fang et al., 2014). The CF is worth highlighting among these indicators due to its widespread implementation (Jensen, 2012; Peters, 2010; Wiedmann and Minx, 2008). Since a footprint is a quantitative measure which describes the appropriation of natural resources by humans, in the EF context, the CF represents the land area required to sequester the CO_2 emissions from fossil fuel combustion (Čuček et al., 2012). This land-based definition of the CF is not the most used by researchers, the media and the public in general nowadays. From a business perspective, it is stated that the CF collects the GHG emissions caused by organizations or the production of goods and services. Although there still exist different definitions of the concept (see Table 1), the CF is usually understood as the full amount of GHG emissions that are caused by an activity (Wiedmann, 2009).

Whereas the existence of different meanings of the term does not seem to be a problem for the development of the indicator, the methodological standardization clearly does. Current CF methodologies can be divided in two scientific fields that have adopted the term after decades of academic development – the Life Cycle Assessment (LCA) and the corporate-based analysis –. These fields have led to the divergence of product and corporate CF. In fact, two of the leading schemes for CF standardization are the Technical Report (ISO/TR 14067:2013) and the Technical Specification (ISO/TS 14069:2013) (ISO, 2013a, 2013b). Both standards have yet to obtain the consensus necessary before they can be considered ISO standards, and will therefore be publicly available for three years in order to resolve any issues and improve their understanding.

The interest in the CF indicator has ended up in a great variety of calculation methodologies and "calculators" of all kinds, leading the public to confusion and hesitation (Cagiao et al., 2014; Wiedmann et al., 2011). As an example of this variety, 62 and 80 different initiatives and methodologies, respectively for product and corporate CF, were identified in 2010 (Ernst & Young France and Quantis, 2010; Marsh-Patrick, 2010). These include, for example, the PAS 2050, Bilan Produit or BP X30-323.

In addition to ISO standards, one of the more successful CF standards is the above-mentioned PAS 2050 (BSI, 2011). Based on process LCA schemes, this standard was developed by the Defra, the BSI and the Carbon Trust.

The European International Reference Life Cycle Data System (ILCD handbook) also contributes to the standardization of CF analysis. This handbook covers all aspects of conducting an LCA, including questions such as: 1) requirements for assessing the emissions and resource consumption associated with a product in terms of impacts on the environment; 2) how to gather data on resource consumptions and emissions that can be attributed to a specific product or 3) how to create LCI data sets regarding emissions and resource consumption (JRC-IES, 2010a).

Under the frame of the Greenhouse Gas Protocol Initiative, the World Resources Institute (WRI) and the World Business Council for sustainable Development (WBCSD) have also developed standards for reporting and accounting GHG emissions from corporations (WRI and WBCSD, 2004); the product life cycle (WRI and WBCSD, 2011a) and the corporate value chain (WRI and WBCSD, 2011b).

The European Commission is also making a great effort in developing standards for products and organizations EF, including the CF indicator. These standards are not finished at this moment but the European Commission has released different documents including a Commission Recommendation to measure and communicate the life cycle environmental performance of products and organizations (European Commission, 2013).

Finally, the current implementation of the CF indicator applies two techniques to quantify life-cycle emissions. On the one hand, process analysis (PA) is the conventional bottom-up method for LCA used to define and describe the specific operations under

Table 1
A summary of some definitions of the CF concept in the literature. Own elaboration from Wiedmann and Minx (2008).

Source	Definition
POST (2006)	"A 'carbon footprint' is the total amount of CO2 and other greenhouse gases, emitted over the full life cycle of a process or product. It is expressed as grams of CO2 equivalent per kilowatt hour of generation (gCO2eq/kWh), which accounts for the different global warming effects of other greenhouse gases."
Carbon Trust (2006)	"… the total emissions of greenhouse gases in carbon equivalents from a product across its life cycle from the production of raw material used in its manufacture, to disposal of the finished product"
GFN (2007)	"… the demand on biocapacity required to sequester (through photosynthesis) the carbon dioxide (CO_2) emissions from fossil fuel combustion"
Wiedmann and Minx (2008)	"The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product."
Browne et al. (2009)	"… the land area required to sequester the greenhouse gas emissions associated with the transport, disposal, recycling and/or composting of household waste generated"
Hertwich and Peters (2009)	"… it refers to the mass of cumulated CO_2 emissions, for example, through a supply chain or through the life-cycle of a product, not some sort of measure of area"
Wiedmann (2009)	"… an attempt to capture the full amount of greenhouse gas emissions that are directly and indirectly caused by an activity or are accumulated over the life stages of a product output analysis"

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