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Sustainable production and consumption in the automotive sector: Integrated review framework and research directions

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ABSTRACT

This paper reviews previous studies on sustainable production and sustainable consumption in the automotive sector. The paper develops an integrated review framework to understand the sustainable challenges and drivers in the production and consumption stages. Our sample is based on 42 relevant articles published between 2004 and 2014 in major academic journals listed in the Association of Business Schools Academic Journal Quality Guide. The analysis indicates that most of the studies have focused on the production stage rather than the consumption stage and have mainly evaluated the economic and environmental dimensions with little or no consideration for the social dimension of sustainability. The majority of the papers discuss sustainability issues in the context of developed countries. However, there has been a growing interest in emerging nations during the last three years especially in the Chinese context. Our findings suggest preeminent future research directions with respect to integrated production and consumption stages that could be helpful for the automotive sector to develop long-term sustainable business models.

Keywords: Sustainable production; Sustainable consumption; Automotive; Supply chain

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1. Introduction

In 1987, the World Commission on the Environment and Development described sustainability as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (Ashby et al., 2012). Ten years later, Elkington introduced the concept of the triple bottom line 3BL (De Medeiros et al., 2014) which states that sustainability combines social, environmental and economic dimensions. These three factors should be simultaneously considered by any organization which attempts to shift towards sustainable practices.

Producing and consuming goods in a sustainable way is one of the most challenging targets for individuals as well

as public and private corporations (Subramanian and Gunasekaran, 2015). With respect to environmental sustainability, governments drew up an international legal framework that set carbon emissions and recyclability targets for industries, in response to the threat of climate change (Gerrard and Kandlikar, 2007; Hitchcock, 2012). Consumers also play a role in maintaining environmental sustainability by being vigilant with respect to the energy efficiency of their goods based on eco-labels (Akenji, 2014). Concerning the social dimension of sustainability, producers are responsible for the welfare of their employees and the safety of the goods they sell. The material content of manufactured products is strictly recorded and goods are recalled by global corporations whenever traces of toxic material are detected (Lee and Klassen,

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2008). Individuals can opt for socially sustainable consumption by blacklisting any brand suspected of unethical practices (Gimenez and Tachizawa, 2012) or by buying fair trade products (Akenji, 2014).

The impacts of manufacturing activities on climate change and natural resources' depletion have been identified by organizations such as the Intergovernmental Panel for Climate Change (IPCC, 2014). In the case of greenhouse gas (GHG) emissions, industrial and transport activities respectively represent 21% and 14% of global direct GHG emissions and 11% and 0.3% of indirect CO₂ emissions (IPCC, 2014). Among the various economic sectors, the automotive sector is a large contributor because GHG emission is generated at production and consumption of motorized vehicles. Thus, this industry is confronted with many sustainable challenges such as the need to handle automotive residues (Passarini et al., 2012) or to offer affordable transportation modes (Sharma et al., 2014). Worldwide, the number of new automobiles continues to rise every year, with 72 million new passenger cars produced in 2014 compared to 69.5 million units in 2013 (ACEA, 2015). The carbon dioxide emitted by motor vehicles causes environmental and health hazards that public and private organizations can no longer ignore (Lee, 2012). The waste generated by End-of-Life Vehicles (ELV) constitutes another challenge due to its heterogeneity and its increasing quantity. From 2010 to 2015, the number of European ELV's is expected to rise by 40% and to reach 14 million tonnes (Passarini et al., 2012). Developing countries are also becoming automobile consumers and subsequently, face similar problems of sustainability. For instance, in China, where major cities are congested and heavily polluted (Schroeder, 2014), the number of private cars may reach 159 million in 2020, which is over 30 times more than in 2000 (Wang et al., 2011).

Several studies have been conducted to explore how automotive companies integrate sustainability requirements in their daily procedures. Koplín et al. (2007) expose the process followed by one leading Original Equipment Manufacturer (OEM), Volkswagen AG, to incorporate sustainable dimensions into its supply chain practices. Taylor (2006) and Khan (2008) illustrate several cleaner production strategies which can be adopted by automotive firms. Many scholars (Brent and Visser, 2005; Lee, 2011; Sun and Li, 2014) analyse how environmental criteria can be included in the list of operational performance indicators that managers should monitor. Several literature reviews of sustainability dimensions in production, supply chains or practices context have been published in the last ten years (Gerrard and Kandlikar, 2007; Erol et al., 2010; Ashby et al., 2012; Gimenez and Tachizawa, 2012; Tseng et al., 2013; Martínez-Jurado and Moyano-Fuentes, 2014). However these studies examine the question of sustainability either for the whole supply chain but in multiple industries or in the automotive sector but for a limited scope of activities. For example, Tseng et al. (2013) present the current practices for sustainable production and consumption in Asia and expose opportunities for future development but there is no specific focus on the automotive sector. Erol et al. (2010) analyse the Turkish reverse supply chain for four sectors including the automotive industry while Martínez-Jurado and Moyano-Fuentes (2014) conduct a literature review of lean, supply chains and sustainability in which the automotive sector is included. Gerrard and Kandlikar (2007) concentrate on the automotive industry to analyse the impacts of European ELV Directive on only two steps of the product life cycle: product engineering and the treatment of used vehicles.

The present literature review complements these papers by providing a study focused exclusively on the automotive industry and by including both the production and the consumption stages. This approach has been chosen to give an overview of sustainable production and consumption for the automotive industry worldwide. Our study aims to identify the current state-of-the-art research which considers the sustainability question for the whole automotive life cycle, from raw materials to End-of-Life (EoL). This study addresses the following questions:

- i. What are the main challenges to and drivers of sustainable production and consumption in the automotive industry?
- ii. What concepts, methodologies and tools have been used so far for achieving sustainable production and consumption?
- iii. What more needs to be done to move closer to more comprehensive sustainable practices in the automotive sector?

The remainder of the paper is organized as followed. In the next section, the boundaries of the study are defined by explaining the assumptions made to define the product life cycle. The sampling methodology is described in Section 3. The outcomes of the content analysis are reported in Sections 4–6 respectively for production, consumption and the combined stages. A comprehensive analysis is provided in Section 7 to highlight some findings on the sustainable dimensions covered, the main drivers and challenges identified as well as the chronological and geographic distribution of the papers. Section 8 answers the research questions and suggests potential future research directions. In Section 9, the paper concludes by summarizing the main findings of this study and by indicating its limitations.

2. Review framework

To illustrate how sustainable production and consumption could operate in reality, we provide an anonymous case study of a global commercial vehicle OEM called Company A which follows the Advanced Product Quality Planning (APQP) methodology (Kusar et al., 2014) and which is compliant with quality and environment management standards.

Company A is a leading producer of heavy and medium duty trucks which started its operations in Europe in the beginning of the 20th century and expanded over time to become a global actor in the commercial vehicle industry, employing about 100 000 people worldwide. It has manufacturing facilities in more than 15 countries and sells its vehicles in all the continents. From its origin, Company A has promoted the values of quality, safety and care for the environment. Truck owners perceive Company A's products as high quality, efficient and reliable.

Company A has always included sustainability into its strategies and aims to offer sustainable transport solutions to its customers. This approach is reflected in all its business processes and is embedded in its employees' way of working.

First, Company A's code of conduct expresses the culture and values shared across the entire group and encourages employees to act in a sustainable manner in their daily work. Annual personal objectives related to sustainability are a financial incentive for each employee to take environmental or social initiatives at their own level.

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