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A proactive model in sustainable food supply chain: Insight from a case study

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ABSTRACT

Recently more and more companies are adopting proactive sustainable strategies and developing sustainable supply chain management practices. Researchers identify Closed-Loop Supply Chain (CLSC) models as one of the major contributors to realising sustainable operations. Such models typically use flows concerning the products only as the unit of analysis.

This paper intends to provide a basis for developing new CLSC models, extending them to recovery resources from general outputs (e.g. unavoidable waste) with no value in terms of products. The new models affect also the configuration of the CLSC, with different set of resource suppliers and logistics providers.

The case study analysed in this paper derives from the food sector, in which the waste produced is reused as a resource, avoiding the disposal of different materials through resource-recovery activities that allow waste to be returned to the main supply chain as valuable inputs to configure a new supply chain.

The principal objective of this study is to create a new sustainable model of CLSC using and recovering waste from meat processing. A profitability indicator, an energy self-sufficiency one and a qualitative assessment of social implications are introduced to evaluate global sustainability opportunities for activating new loops.

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1. Introduction

In the contemporary business world, focus is not only placed on reducing costs to increase profits, but there has been a shift towards achieving sustainability and a balance between social responsibility, environmental preservation and economic prosperity. These factors are led by the objective of achieving sustainability (Akkerman et al., 2010; Bogataj and Bogataj, 2007; Bogataj et al., 2013, (in press); Carter and Rogers, 2008; Corrêa and Xavier, 2013; Manzini and Accorsi, 2013; Sarkis et al., 2011). Evidence in the current literature increasingly finds that firms are moving towards more proactive sustainability strategies and developing sustainable supply chain management practices (Gunasekaran and Spalanzani, 2012; Wu and Pagell, 2011; Battini et al., 2014; Ortolani et al., 2011; Bouras et al., 2009). However, ultimately, research into the area of sustainability has reached a point where supply chains need to be considered from new perspectives (Brandenburg et al., 2014; Pagell and Shevchenko, 2014). Research identifies CLSC practices and models as one of the major contributors to realising sustainable operations, through the recovery of value from product-recovery. For these reasons, there is increasing attention on finding ways to create more efficient, lower cost, and sustainable closed-loop systems.

For instance, the European Commission adopted a new ambitious 'circular-economy package' at the end of 2015 as part of its strategy to move into a more competitive resource-efficient economy. The package has been designed to address a range of economic sectors, including waste. Furthermore, CLSC management research is responding to European Commission research priorities, calling for new business models to be identified in the Horizon 2020 programme. A recent study by the McKinsey Center for Business and Environment (2015) provides new evidence that a circular economy, enabled by the technology revolution, will allow Europe to grow its resource productivity by up to three per cent annually. These new business models stress the need to increase product lifespans, material reuse, recycling and recovery, which leads to a closed-loop processes and new business model, particularly in the food industry.

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A CLSC is referred to as 'reverse logistics' (Das and Chowdhury, 2012; Kumar and Putnam, 2008; Lai et al., 2013; Rogers et al., 2012; Faccio et al., 2014, 2011) or 'product-recovery management' (Fleischmann et al., 1997; Östlin et al., 2008; Thierry et al., 1995; Toffel, 2004). Generally, in CLSC models, all types of waste residues, such as returned products and/or their components, are fed back into the value chain and firms face the complexity of having to decide between different reprocessing operations. The models developed by those scholars have product flows as their unit of analysis, and aim to reintroduce returned products and/or their components into the forward flow by implementing reprocessing operations such as direct reuse, recovery, recycling remanufacturing, refurbishing or repairing (Bogataj and Bogataj, 2011, Ferguson et al., 2011; French and LaForge, 2006; Guide and Van Wassenhove, 2001; Jayaraman et al., 1999; Schenkel et al., 2015). These processes allow firms to save resources, reduce costs, enhance their competitive position, improve their green reputation, meet sustainability goals and enhance customer loyalty (Atasu et al., 2008; Blackburn et al., 2004; Govindan et al., 2015; Mollenkopf et al., 2011; Russo et al., 2016; Souza, 2013). Bell et al. (2013) demonstrates that given the scarcity of natural resources, CLSC strategies may enable firms to gain comparative advantages in resources and lead to long-term superior firm performance. Practitioners are perceiving the urgency of that challenge as for example the CEO of Danone that pointed out "*we need a comprehensive response to tackle growing resource scarcity, which both drives the efficient use of those resources through the supply chain and brings healthy food to as many people as possible*" (Magnin, 2016).

As a result, there are calls for research to identify new quantitative methods and models, specifically developed and adapted to the planning, design and control of CLSC systems and their performance. There is still much room for the development of new models and solution approaches for helping the decision-making process in CLSCs, especially in the process industry (Stindt and Sahamie, 2014). Circular models such as the CLSC involve networks of businesses that generate new economic value through the continuous exchange of resources facilitated by innovative logistics and supply chain ecosystems. These systems operate with the particular objective of helping managers and practitioners to create a lower cost and sustainable closed-loop systems that use all kinds of waste in the process industry to recover new resources.

In this context, an industry sector that is receiving growing attention is food waste because the large scale of food waste's negative environmental, social and economic effects is becoming increasingly evident. Food waste is increasingly recognised as central to a more sustainable resolution of the global waste challenge across supply chain (Gibbs and Salmon, 2015). The global relevance of food, the dynamics of the industry, and the decisions of the policy makers qualify this industry to receive strong research focus on how to build a new sustainable business model through CLSC modelling.

Currently, there is specific technical knowledge about how to convert the waste of food processed (e.g. the waste resulting from the slaughtering processes in the meat industry) into an output of a new supply chain that they could be returned to other chains through CLSC (Chen et al., 2016). However, there is a limited knowledge of specific CLSC model, about an overall managerial point of view able to define new loops in the supply chain and to evaluate them.

The contribution of our approach is going beyond that traditional model of CLSC (Govindan et al., 2015), including the resource recovery from food waste into the configuration of new closed loops in the food supply chain. In the traditional CLSC model (Fig. 1), it can be noted the waste goes to disposal stage of supply chain and this approach analyzes the flows concerning just the products, without any considerations about the other outputs, typically unavoidable process waste, generated by each actor of supply chain.

Considering the resource flow in the CLSC brings to new configurations of the networks and as a consequence to new models for the design and management of CLSC to include also resource recovery into traditional approaches.

For example, the introduction of new resource recovery plants from the unavoidable waste, as new loops in the supply chain, will affect the configuration of the network, avoiding the necessity of external sources for primary resources, such as electrical or thermal energy. New logistics providers will be required to manage the waste flows from the production phase to the recovery facilities. It will be relevant to consider these aspects in the traditional problems, such as inventory management, network design, production scheduling.

The purpose of this paper is to provide a basis for the development of a new kind of CLSC, beginning from an analysis of the meat industry. This study will analyse the slaughtering waste that is reused by recovering new resources and configuring it to a new

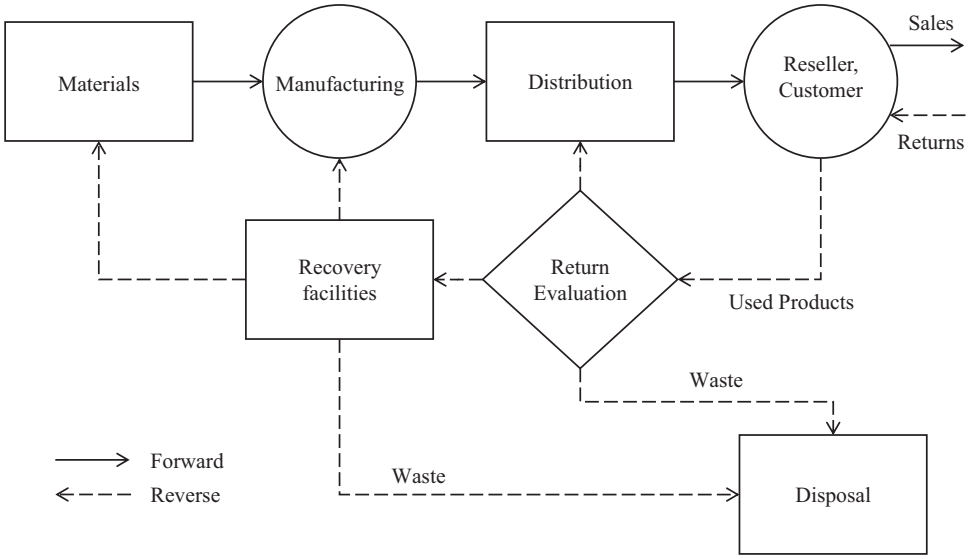

Fig. 1. Traditional CLSC. Adapted from Govindan et al., 2015.

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