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**The applicability of industrial symbiosis praxis to improving
the environmental sustainability of supply chains**

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The applicability of industrial symbiosis praxis to improving the environmental sustainability of supply chains

Over the last decades, environmental issues concerning supply chains have been growing in importance and taking a significant part of the wider debate on how industry meets the challenges of sustainability (Seitz and Wells, 2006). Due to pressures from various stakeholders, organisations are currently facing increasing challenges to integrate sustainable practices in the management of their supply chains (Faisal, 2010).

The environmental impact of supply chains is a complex problem which involves interconnected and interdependent organisations from different industries, sectors and geographical areas. Finding ways of involving the parts of a supply chain system in synergistic relationships aimed at minimising the overall impact of the whole system on the environment is likely to achieve better results than each part trying to do its best in isolation.

The adoption of sustainable practices in supply chains is a daunting task. Even when players in the supply system try to be consistent, it is very difficult to do it at a global level (Faisal, 2010). This implies that to integrate sustainability in supply chains it is imperative to understand the mutual relationships among the players in the supply system. Moreover, the ecological paradigm for supply chain management demands extended integration of sustainability values, where responsible management is a key function (de Brito *et al.*, 2008).

When exploring a conceptual framework for sustainable supply chain management, Svensson (2007) has identified a number of somewhat isolated, but to a certain extent replicated, views in the literature that strive to address issues concerning sustainable business practices and theory, namely: green purchasing strategies; green marketing; environmental marketing; environmental management; corporate social responsibility (CSR); sustainable supply network management, life cycle assessment, ISO 14000 standards, and so forth. This paper aims to add a rather young field of development to this list: industrial symbiosis.

The applicability of industrial symbiosis concepts, practices and approaches in supply chain management seems to be reasonably useful for supporting the development of eco-innovative approaches to improve the environmental sustainability of supply chains. In general, industrial symbiosis focuses on the flow of materials and energy through networks of businesses and other organisations as a means of achieving ecologically sustainable industrial development (Seuring, 2004). It tries to engage separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and by-products (Chertow, 2007). Collaboration and synergistic relationships are key aspects of industrial symbiosis initiatives. Such initiatives are expected to boost environmental integrity, social equity and economic prosperity of communities and regions (Bansal and McKnight, 2009).

Industrial symbiosis approaches such as '*cascading*' (repeated use of resources in different processes), '*loop-closing*' (repeated use of resources in same processes), the use of waste as feedstock to other organisations' processes, and the involvement of different layers of unconnected participants in symbiotic relationships, will be key managerial practices explored in the paper.

To delimit the discussion, the paper will focus upon the food supply chain. The environmental and social consequences of the food industry and its supply chain activities represent a global

challenge which requires innovative sustainable practices that are effectively achievable to the organisations involved. The food sector as a whole faces considerable challenges imposed by the limited availability of arable land and natural resources for food production on the one hand, and the continuous increase of food consumption dictated by the exponential growth of populations and livestock on the other hand. In 2008, the Cabinet Office pointed out the pressures of climate change on food production and the impact of food chains on the environment as some of the major challenges which need to be addressed before long (Strategy Unit, 2008).

In order to improve its accountability and responsibility toward new expectations of customers and the society, the food sector needs innovative ways of developing concerted actions and collaboration initiatives that improve not only intra-organisational processes within specific areas, but also the relationships and integration of inter-organisational processes that take into account the flow of both products and by-products across industries.

In general, the paper will critically discuss and identify potential links that can integrate cross-industry processes through the application of industrial symbiosis concepts and practices. The managerial implications here addressed will consider how organisations involved in a food supply chain system can get engaged in symbiotic relationships that can potentially improve not only their own environmental sustainability performance, but also the performance of the supply chain system they are part of.

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