Chapter 28
Achieving Environmental Sustainability Through Industry 4.0 Tools:
The Case of the "Symbiosis" Digital Platform

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ABSTRACT

Almost all firms are involved in challenges linked to Industry 4.0 that represent a new logic for business models focused on innovation, technology, and sustainability. In this domain, the support and integration of digital innovations is assuming ever greater importance and a key role is played by the so-called "industrial symbiosis." Looking more in depth at industrial symbiosis literature, which practically developed within the engineering domain, it is clear that most of its particular traits can also be found in management literature when referring to value co-creation, especially in the business to business domain. Given the above, the aim of this work is twofold: to analyze the role of Industry 4.0 digital platforms as a tool for the development of environmental sustainability and to understand how Industry 4.0 as a whole can support the achievement of environmental sustainability goals. The only Italian case will be used to validate the proposed theoretical framework.

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INTRODUCTION

The Fourth Industrial Revolution – i.e., Industry 4.0-, today involves the majority of firms and institutions and emerges as a new logic for business models focused on innovation, technology and sustainability (Pan et al., 2015; Burritt, 2016; Piccarozzi et al., 2018). In this domain, integration of digital innovations in industrial production is assuming ever greater importance and a very important role is played by the so-called "industrial symbiosis" (IS). IS, a term introduced in 1992 by Robert Ayres (i.e., Ayres 1989, 1994) and then adopted by other scholars (i.e., Hawken, 1993; Chertow, 2000), involves "traditionally separate industries adopting an integrated approach aimed at generating competitive advantages through the exchange of materials, energy, water and/or by-products" (Chertow, 2000, pp. 314).

Looking more in depth at the literature on IS, which practically belongs to the engineering domain, it is clear that most of its particular traits can be found in management literature when referring to value co-creation, especially in business to business (B2B) environments. Indeed, "*the co-creation view starts with interactions as the locus of value and platforms of engagements with individuals are the locus of value creation, and co-creative enterprises follow a single principle: they focus their entire organization on the engagements with individuals*" (Leavy, 2014, p. 11). In this context, digital platforms can be understood as engagement platforms (i.e., Ramaswamy & Ozcan, 2014), therefore tools which can provide valuable support for both the development of value co-creation processes among firms and IS (please see section Background). Indeed, through digital platforms it is possible to coordinate, manage, promote and create synergies between firms (de Reuver et al., 2018) which are essential for realizing both value co-creation processes and IS. Defined as above, digital platforms can be framed in the so-called external (industrial) platforms which can be understood as "manegeable objects" that organizations purposely manage to bring multiple parties within the industry together" (Gawer & Cusumano, 2014, p. 8). Inside these digital platforms firms collaborate generating various network effects and, as consequence, building an ecosystem able to support various firm activities, especially innovative ones, on behalf participants in the platform ecosystem (Gawer & Cusumano, 2014).

Moreover, these same platforms can be a valuable tool for orienting firms further towards sustainability (i.e., Garg & Buyya, 2012), in particular environmental sustainability, without neglecting the economic perspective (saving costs of management services, infrastructures and natural resources, increasing productivity, reducing firm dependence on non-renewable resources; Brousseau & Penard, 2007).

However, online platforms can also be understood as tools pertaining to Industry 4.0 in that they are the *locus* of interactions needed to implement the smart factory, for example (i.e. Erro-Garcés, 2019) or to collect, store and manage data (i.e. Klingenberg et al., 2019), etc. In this domain it can be easily said that Industry 4.0 technologies can contribute significantly to solve demographic, climate and productive resource changes, all issues which today are among the priorities in the environmental sustainability domain (Pan, 2015; Prause, 2015, 2017; Frolov, 2017; de Sousa Jabbour, 2018). Indeed, from the connection between objects, systems, people and value co-creation processes, online platforms enable and support useful information exchange in real time leading to both optimizing the use of resources and supporting the development of new strategies and actions towards environmental sustainability, where information and data are of paramount importance (i.e. Klingenberg et al., 2019).

Given the above, the aim of this work is twofold: to analyze the role of Industry 4.0 digital platforms as a tool for the development of environmental sustainability and to understand how Industry 4.0 as a whole can support the achievement of firm environmental sustainability goals. The role of industrial platforms, in this domain, has been completely neglected by literature, while some more studies are