Investigation of Environmental Services Valuation towards inter-organizational system frameworks of circular economy

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Abstract

Environmental sustainability is a contentious issue that entails an integrated research upon the environmental impact on human health, natural systems, and natural resources in physical units, while the limitations and the challenges that are derived from an environmental services valuation (ESV) –based on monetary values that involve ecosystem disservices with associated negative monetary values– has to be further co-evaluated. In an environmental approach, the ESV refers to the benefits offered to human beings by wetlands, which include provisional services (including timber, food and water), regulating services (including regional climate regulation and flood regulation), supporting services (including soil formation, biodiversity and nutrient cycling), as well as cultural services (including recreational and aesthetic values). In a socio-cultural approach the ESV is increasingly advocated in gaining more attention in the ecosystem service research agenda.

In the relevant literature the interrelation between ESV and circular economy has been sparsely addressed, but it is anticipated that the adaptation of ESV to humans' well-being sustains variable ecological, social, and economic values. In parallel, evaluating ESV in monetary units can be proven an effective tool to activate the citizens' responsibility and awareness upon environmental protection, which could further promote the transform from traditional economy calculation systems towards an integrated calculation system of economy- environment

In this study, a mechanism upon the relationships among institutional pressure, the relationship with management, sustainable LCA values, and circular economy valuation were examined. It was proven that sustainable LCA management practice is a determining parameter in promoting the improvement of the circular economy capabilities of organizations, while the main deterring parameters with negative moderating effects upon inter-organizational perspectives were also determined.

Keywords: *resource efficiency, environmental services valuation, circular economy, inter-organizational goals, social externalities, environmental externalities*

1. INTRODUCTION

In the relevant literature it has been reported of implementing practices for a circular economy that pave the way companies do business, especially in the manufacturing industry. A typical framework of circular economy necessitates a transformation of both production

and consumption systems. In this respect, the conventional approach for creation, fabrication, and commerce of marketable products is challenged. These challenges are also reflected to the development of new proficiencies needed to track system transformations, especially in alignment with design and engineering. It is also noteworthy that the design of a product directly influences the way a value chain will be managed, thus, building circular and globally sustainable value chains inevitably points out a fundamental change in the design norms. In response to this necessity ESV should be proven an effective tool that serves as guidance for manufacturing companies seeking to tackle climate change under to contexts of: sustainability, re-thinking education, and environmental engineering (De los Rios and Charnley, 2017).

The human asset as an "anthropogenic material stock" of wealth has been also investigated under the context of circular economy. It is stressed out that as building and infrastructure artefacts constitute a valuable reservoir of secondary raw materials, in the same socio-economic context, "anthropogenic material stock" should be understood as a future capital stock that must be systematically managed and exploited. In such a research work, the authors quantified the huge accommodation of raw materials in the built environment, in association with the annual rate of growth of this observed stock of goods and the annual rate outflow from this stock in Germany. It was also signified that long-term monitoring of the anthropogenic stock is needed, as an important tool in the evidence-based development of a model to (Schiller etal., 2017):

- incorporate and to improve closed-loop material flows.
- support politics of securing supply of raw materials.
- effectively coordinate the norms of ESV towards the anthropogenic orientation of circular economy.

The key point of circular economy in alignment with ESV is to keep resources within the economy when products no longer serve their functions so that materials can be used again and therefore generate more value. In this respect, the unit in which resource efficiency and circular economy are measured determines both the ease of acceptance by policymakers and the direction in which green policy will change contemporary societies. The most conventional approach to assess resource efficiency and circular economy uses mass, a radical approach is to measure both resource efficiency and circular economy in terms of the market value of "stressed" resources, since this "circular economy value" (CEV) –contrarily to the ESV– it incorporates the elements of scarcity versus competition as well as taxes representing urgent social and environmental externalities. The CEV of resources responds automatically to the locality and time at which resources are used (Di Maio etal., 2017).

The need of applying the principles of ESV in CEV is pronouncing in those industrial plants in which conventional methods of wastewater disposal are directly causing severe environmental impacts in the local territories. Such a case that has been reported is the pork industry in Catalonia that plays a foremost and representative role in the Spanish pork sector. In this industrial sector, beyond the economic benefits, conventional practices in the pork industry are explicitly causing a number of environmental impacts that need to be dealt with. Within this framework, the environmental performance of traditional linear pork chain in Catalonia was evaluated through a LCA approach. Subsequently, it is noteworthy the advantages of moving towards a closing loop production system, where resource efficiency and waste valorisation are prioritised over final disposal options (Noya etal., 2017).

Besides, the association of CEV with ESV can provide a theoretical framework of successful green production practices of eco-industrial park firms, and it is especially

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adaptable to large-scale socio-environmental systems and to wider conceptual entities. In another research study it was stated that an eco-industrial park is related to the practical application of sustainable supply chain management at an industrial park level. In a relevant study, the mechanism and relationships among institutional pressure, supply chain relationship management, sustainable supply chain design, and circular economy capability was investigated using data collected from eco-industrial park firms in China via 363 questionnaires. Besides, sustainable supply chain management practice is proven an utmost importance parameter that promotes (Zeng, etal., 2017):

a) the improvement of the circular economy capability of companies, and
b) the coercive pressure, normative pressure, and mimetic pressure exert different degrees of negative moderating effects.

Another attribute of the CEV and the ESV functionality is the phenomenon of transition from one socio-environmental phase to another. This dynamic behaviour has been also reported from the transition towards "zero waste" and circular economy. This attribute constitutes an alternative framework to the dominant "take-make-waste" model of production and a viable approach for addressing climate change. In this CEV and ESV conceptual linkage, business plays predominately a key role in this transition, since a growing number of companies are establishing waste reduction goals, such as "zero waste to landfill" as part of their sustainability commitments. In this context, while the Global Reporting Initiative (GRI) guidelines are providing standardized indicators for measuring waste reduction through different methods, the majority of these methods measure outputs versus the impacts of source reduction, reuse and remanufacturing.

In a similar study, in a survey conducted from eight biotechnology and pharmaceutical companies in alignment with their waste reduction performance and management, it was concluded that: a) companies rely primarily on recycling and waste-to-energy practices to reduce waste and defer to "zero-waste-to landfill" goals rather than focusing on environmentally preferable methods like source reduction and reuse; b) in lieu of standardized reporting, companies report inconsistent waste data that often lack effective indicators for measuring and promoting source reduction and reuse; c) employee awareness and engagement for advancing "zero waste" and circular economic business practices is undeveloped.

In a response to the above CEV and ESV context, a rigorous modelling upon "Expanded Zero Waste" practice, it was proposed. In this modelling, additional indicators were introduced as necessary components for measuring outcomes and impacts of circular business strategies, where employee engagement is seen as a critical strategy for identifying and implementing innovative sustainability approaches and initiatives.

2. LITERATURE OVERVIEW UPON ESV DEVELOPMENT WITHIN THE LAST 10 YEARS

In the relevant literature it was reported a wide spectrum of studies whose objectives were originated from the principles of ESV. Attempting to manipulate the plethora of the relevant literature production, it was undertaken a systematic literature search at the *Scopus* database using relevant key-words at October 2016 and its outcome was succinctly presented in the following Table 1, being grouped in reverse chronological order and in alphabetical list from the last name of the first authors at these studies. A more descriptive analysis is presented in the accompanying text narrative.

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***Table 1** Global literature overview upon the last twenty years research for ESV*

Reference	Conceptual Framework
Calvet-Mir etal. (2016)	The authors aimed at advancing the understanding of the relation between gender and environmental perceptions. The study concluded that women gave a higher value than men to all ecosystem services, while gender socialization influenced the way people interact with and value the environment, including highly managed environments such as home gardens.
Schaubroeck etal. (2016)	For a sustainable future, we must sustainably manage not only the human/ industrial system but also ecosystems. To this end, this study quantified the environmental impact (on human health, natural systems and natural resources) in physical units and uses an ESV based on monetary values.
Tolessa etal. (2016)	The authors assessed the land use/land cover (LULC) dynamics and its associated changes in ecosystem service values for the Toke Kutaye district (ca 72,700 ha) in the central highlands of Ethiopia. Four satellite images of the study area, distributed between 1973 and 2014 were analyzed using Arc GIS software to assess the LULC changes of the area.
Li etal. (2015)	This study investigated the ESV perspectives in the Napahai Wetland, as a typical plateau wetland in the Hengduan Mountain Area, China, with characteristic geography and abundant biodiversity. The authors assessed the value of ecosystem services in the Napahai Wetland using the market pricing method, the replacement cost method, the shadow engineering method, the cost expenditure method, and the contingent valuation method (CVM).
Sarkki and Karjalainen (2015)	The authors of this study examined how local-level practitioners (such as the state forestry enterprise, tourism entrepreneurs, reindeer herders, a local NGO and a local hunting association) performed ESV through argumentation to promote certain interests in practical governance in the context of a forestry debate in Northern Finland. The study showed that monetary valuations may escalate disputes instead of providing neutral information.
Scholte etal. (2015)	A socio-cultural approach to value ecosystem services was increasingly advocated and is gaining more attention in the ESV research agenda. Therefore, this paper reviews the concept of socio-cultural values within the ecosystem service framework; the social and ecological factors that determine socio-cultural values; and the methods by which socio-cultural values can be assessed.
Sinha and Mishra (2015)	Contingent valuation method (CVM) was used for calculating willingness to pay (WTP) for different ecosystem services in a Hariyali Sacred Landscape (HSL) of the Indian Himalayas. The study concluded that local people identified six direct and seven indirect ecosystem services with HSL.
Chen and Yao, (2014)	This study summarized connotation, classification and assessment methods of wetland ES. Some suggestions were outlined, proposing that more attention should be paid to the systematic, integrity evaluation system establishment of wetland ecosystem service in the future wetland ESV and management in China.
Mukherjee etal. (2014)	The authors denoted that ESV is a complex process as it includes several dimensions (ecological, socio-cultural and economic) and not all of these can be quantified in monetary units. The aim of this study was to conduct an ESV for mangroves ecosystems, the results of which could be used to inform governance and management of mangroves. An expert-based participatory approach (the Delphi technique) was adopted to identify, categorize and rank the various ecosystem services provided by mangrove ecosystems at a global scale.

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Table 1 *(continued)*

Reference	Conceptual Framework
Colombo etal. (2013)	This study investigated the sensitivity of choice experiment values for ecosystem services to "attribute non-attendance". The authors considered three cases of attendance, namely that people may always, sometimes, or never pay attention to a given attribute in making their choices. This methodology enabled a series of models to be estimated.
Johnson etal. (2012)	The authors of this study stressed out that while there is significant uncertainty about the biophysical production of ecosystem services, there is additional uncertainty about the value of services. To this end, this study explored how uncertainty associated with valuation of ecosystem services in agriculture affects the ranking of land use alternatives in terms of social net benefits. The research objective were the comparison among four land use scenarios in the Minnesota River Basin, USA, by combining a range of value estimates for these services with varying estimates for returns from agricultural production.

Another noteworthy orientation of the ESV development was proposed by Scholte etal. (2015) who denoted that the ESV principles underlie a monetary interpretation of value, individual utility, and rational choice, whereas there are undermined other social perspectives and values on the importance of ecosystems for human well-being. The authors introduced a socio-cultural approach to value ecosystem services that gained more attention in the ecosystem service research agenda. To this end, the socio-cultural perspectives on ecosystem services were valued in the light of the concepts of "cultural ecosystem services" and "socio-cultural values". They concluded that the clarifications of the concept of socio-cultural valuation and the structured listing of the available methods enabled a better integration of socio-cultural values into ecosystem service assessments and support researchers to choose methods from the available portfolio. The following Figure 1 depicts the determinants and their interrelation of socio-cultural values of environmental systems.

A limitation of many ESV models that describe the determinants of environmental values and behaviour, is that they focus on how individual motivations influence environmental behaviour, without reviewing contextual factors. Moreover, another social-driven viewpoint upon ESV focus on environmental sustainability is the difficulty experiencing those private firms that own natural ecosystems and are driven in operating sustainable practices in management decisions. This difficulty stems from their inability to balance the environmental value of conserving these ecosystems against potential profits that could be captured through their business development (Scholte etal., 2015).

2.1 Functionality of CEV and ESV

The main components of circular economy (CE) that are actually linked to the ESV principles, are the following: Reuse, Maintenance, Remanufacture, Recycle, Biodegradable, Energy Recovery (Singh and Ordoñez, 2016). Besides, in an integrated socio-economic approach the determining CEV and the ESV principles are linked to each other according to the flows and routes in Figure 2.

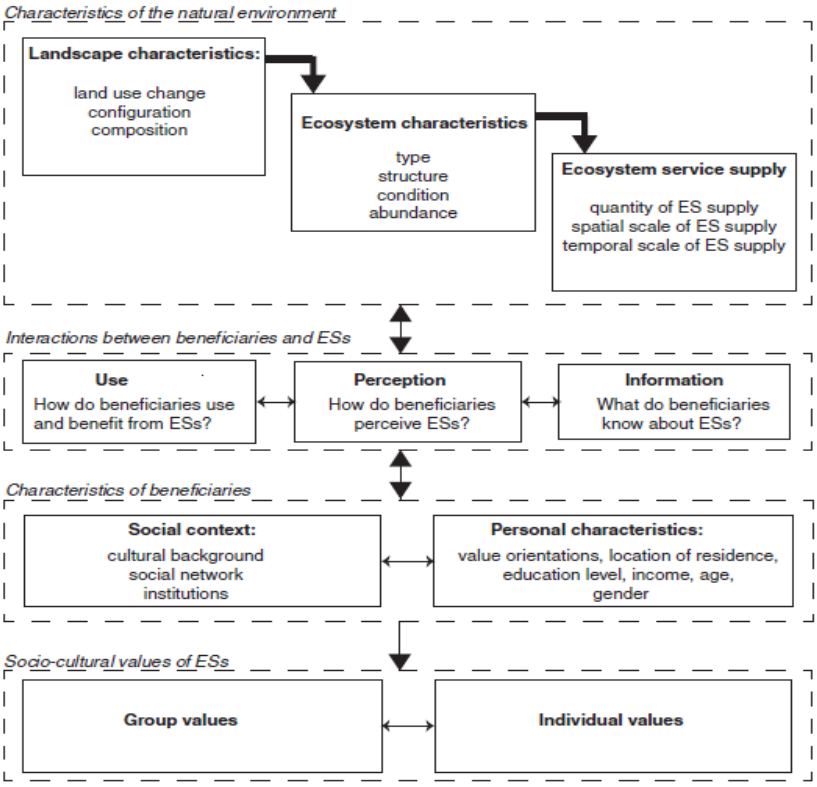

Figure 1 *Determinants of socio-cultural values of Environmental Systems (ESs). Source: Scholte etal., 2015*

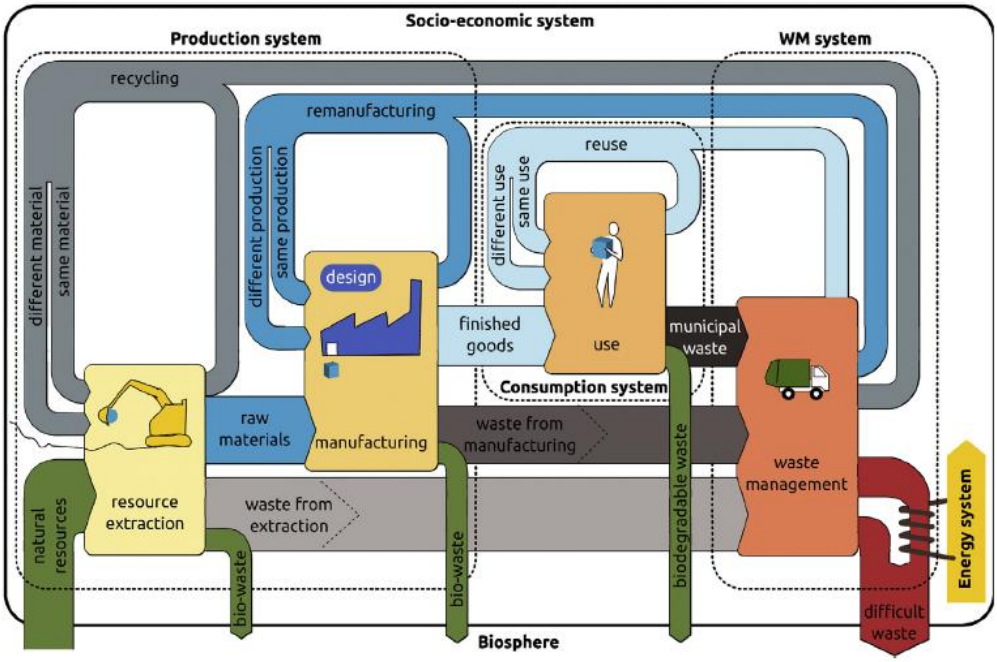

Figure 2 *A modeled scheme of CEV and ESV routes, under an integrated flow-chart of inter-organizational processes. Source: Singh and Ordoñez, 2016, p. 348.*

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The measurements of progress in achieving a circular economy, analyzed under a life cycle approach regarding the pillars of social, economic and environmental impacts of a product throughout its full life cycle—from raw material extraction to end-of-life (EoL) recycling or disposal. Broadbent, C. (2016) investigates the steel's recyclability and demonstrates the benefits of recycling steel to achieve a circular economy. Incorporating this recycling methodology into a full LCA demonstrates how the steel industry is an integral part of the circular economy model which promotes zero waste; a reduction in the amount of materials used and encourages the reuse and recycling of materials (Figure 3).

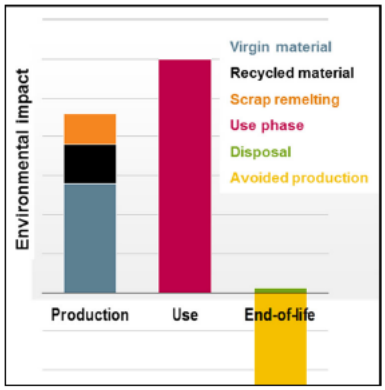

Figure 3 *The relative environmental burden and contribution of product systems that use both primary and recycled steel inputs. An end-of-life approach Source: Broadbent, 2016*

However, the processes of CEV and ESV towards an integrated socio-economic scheme are subject to the investigation of their functionality and the analysis between different cases formulates possible implications for both managers and research. Rugierri etal. (2016) studied the factors that affect inter-organizational cooperation for three cases of circular economy (sanitary ceramic, edible oil crop and wood transformation) and proposed a meta – model of inter-organizational functionality as analyzed in Figure 4.

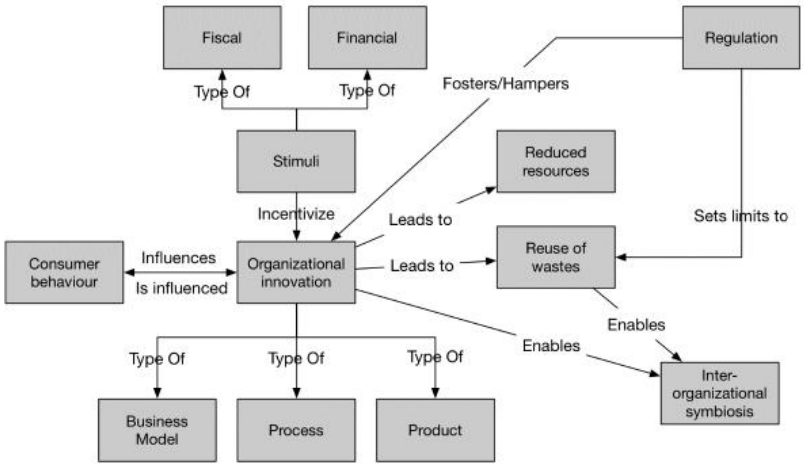

Figure 4*. Flow-chart depicting a meta-model of inter-organizational functionality in a circular economy. Source: Ruggieri etal. (2016).*

The above analysis in the inter-organizational framework of the circular economy reveals the complex factors that affect the relationship between the related preferences and behaviours. Therefore, a more extensive investigation needs to be implemented and accompanied with a critical review in a wider time frame.

3. CONCLUSIONS

This paper investigates a new value-based indicator to assess the performance of inter-organizational systems, in terms of "resource efficiency", "environmental valuation" and "circular economy". Particularly, even though most of the methodologies developed so far in the relevant literature measured resource efficiency on the basis of the environmental burden of the resource relative to the value of output, in this research work under the term of "inter-organizational system frameworks" there are not merely included entrepreneurial or business patterns, but a wider spectrum of environmental, social, economics, and cultural patterns that are inherently sustaining a dynamics of organizational functionality. Under these research objectives, the key point of circular economy is to keep resources within the economy when products no longer serve their functions so that materials – at the built environment or as "anthropogenic stocks"– can be used again and therefore generate more value. The socio-environmental "crossroad" in which resource efficiency and circular economy are measured greatly affects both the ease of acceptance by policymakers and the direction in which green policy will change local societies in a sustainable manner. This interdisciplinary approach is also determined by the elements of scarcity versus competition, as well as by taxes representing urgent social and environmental externalities, especially in developed economies. One the other hand, the difficulty of coordination between CEV and ESV resides in the inherent difficulty to standardise –thus make profit – a product from something (in this case the wastes management) that is not standard. Subsequently, a strategic plan of a marketable product is drawn, presently, under the concept where producers put in less and less value into products, which leaves less value for recyclers.

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