

Circular Economy: promoting business and environmental sustainability on local, community-based project

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Abstract

The CE is a concept that can be pursued to move towards an economy in which what is regarded as waste today can enter the economic cycle again as a resource. The concept of a CE acknowledges the constraints of limited natural resources and offers an approach to cope with them to move towards a more economically, socially and environmentally sustainable world.

The aim of this thesis is promoting business and environmental sustainability on local, incentivating a CE system using IS as a tool.

Using IS as a tool means to analyse regulation at the Eu and national level, understand the barriers and drivers, especially in the waste management field. Important contribution has been done by the literature, where Critical Factors, suitable Business Models, Coordination Policy Level, IS type of approach, help to frame, while case studies and stakeholders help to square the circle.

Keywords: Circular Economy, Industrial Symbiosis, Sustainable Development, Municipality, Regulation, Policy.

1. Introduction

The European Union's economy is currently losing a significant amount of potential secondary raw materials present in the waste stream.

In 2011, the European Union produced a total of about 2.5 billion tonnes of waste; As for urban waste, for example, only a small amount was recycled (40%), while the rest was placed in landfills (37%) or incinerated (23%), with a loss

of about 500 million tonnes of waste that could have been recycled or reused. (EC COM (2014) 397 final). In a more resource-efficient perspective, *turning waste into resources* is a decisive factor for closing the loop in a CE (EC COM (2014) 397 final, s.d.).

The overall goal of the thesis is to contribute to promoting business and environmental sustainability on local through the IS tool, in order to define possible barriers and drivers for a development of CE activities at a community level. A "*shape funnel pattern*" framework has been developed in order to achieve the following goals: *A comprehensive literature review of the CE related concepts (with a major focus on IS tool)*; *A comprehensive understanding of the Barreiro context* analyzing and comparing examples of CE projects and international case studies in order to get relevant contribution points for improving actual CE examples and suggesting new ones in the Barreiro context.

The research methodology used includes both a qualitative and quantitative approach. Interviewees have been selected with the goal of gaining insights from stakeholders at the international, national and local level. A survey was chosen for the generation of quantitative data and ADAO (Associação Desenvolvimento Artes e Ofícios) has been used as observation point.

2. State of the Art

2.1. Sustainability concept

According to Sachs (2015) definition, sustainable development is supported by three domains, recognized as "economic, environmental and social" or "ecology, economy and equity" (United Nations, 2014) which keep on staying into equilibrium.

Environmentalists such as Robèrt (2002) agreed that if we continue at this rate of environmental consumption, we will soon get to a point where the threshold of environmental capacities is reached. Thus, there is one specific goal: to make cities inclusive, safe, resilient and sustainable.

2.2 Industrial Ecology

Industrial Ecology stems from the Sustainable Development concept, framing the strategies to guide industrial societies to mimic the most sustainable systems on earth, the natural systems.

2.3 Circular Economy

There is still confusion in the literature on what is CE, and it has been demonstrated by the fact that nowadays there are 114 different definitions (Kirchher, Reike, & Hekkert, 2017). It includes, in addition to the concept of recycle, strategies that improve the *reuse*, *repair* and recycling of products; strategies to stimulate *new consumption patterns*; the potential to establish *new business models*.

2.4 Industrial Metabolism

It is a concept that has some methods associated allowing to study the way how systems consume resources identifying where to act.

2.5 Industrial Symbiosis

It is a branch of industrial ecology that operates on the inter-firm level, and creates synergies optimizing flows of material, energy and capital between actors involved.

Industrial Symbiosis is a strategy to support the path towards Circular Economy/Industrial Ecology.

2.6 Sinergistic benefits

The first type is the *by-product synergy* that involves the use of a previously unused by-product as an input material in another facility reducing waste. The second is the *utility synergy* which can lead to economic savings due to the economy of scale (CECP, 2007). A

third synergy is the *supply synergy* among co-located customers and suppliers (no or short transport distances) (CECP, 2007).

2.7 Key differences

After having seen all the key definitions of the concepts, important would be to analyze which is the most suitable concept, and how it connects with the CE.

Analyzing SD, IE, Me e IS, through key dimensions related to the CE definition above, it emerges that between the already cited concepts the IS is the most suitable term because it is the only concept who deals with "business models".

2.8 Development steps

From an organizational point of view, IS can be realized according to different models (Simbiosi Industriale ENEA).

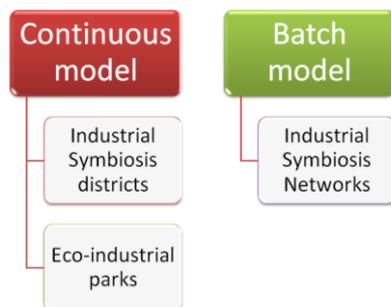


Figure 1: Organizational Models of IS. Source: adapted from (Simbiosi Industriale ENEA)

IS Districts includes development experiences such as those of Kalundborg, that is, phenomena of the development of mechanisms of Industrial Symbiosis in more or less extensive territorial areas.

It belongs to the *bottom-up* approach: the system of business relations is born independently from a specific programming and on the basis of specific agreements between two actors.

The second case belongs to a *top-down approach*, as the eco-industrial park is programmed, designed and managed based on the principles of ecology and IS.

Networks for IS differs from the other two mentioned, because it is much less constrained and allows the implementation of interventions of IS variables in time and space.

Chertow (2000) offers three approaches to facilitate *self-organized* IS development: *Existing by-product synergies*;

Existing organizational relationships. It can be hotbeds for the sprouting of IS activities;

Anchor tenant model for which one or two large industries with large input and output quantities can drive the system and attract other industries to locate in the vicinity (Chertow, 2000).

Behera (2012) research can be useful for understanding the development of a *planned network*, made of three steps: *Exploring new connections*; *Feasibility study*; *Commercialization*.

From the successful self-organized examples, Chertow together with Ehrenfeld (2012) suggest also a three-stage model of maturity of exchanges:

1. *Sprouting*: A single or a few exchanges are formed on a random basis and their feasibility tested. Limited networks of exchanges are formed.
2. *Uncovering*: The networks are recognized for creating environmental value. Both goals and range of membership are broadened.
3. *Embeddedness and institutionalization*: Further expansion of the network becomes intentionally driven by an institutional actor normally formed during stage 2

2.9 Critical factors

There are some critical factors for success and limitation of an IS network. Brand & Bruijn (1999) who suggest five categories of barriers: *-Technical factors* concern the flows of materials and energy and the technology needed to achieve exchanges of said flows.

-*Informational factors*; information about needs and capacities is crucial in identifying possible exchanges or utility synergies.

-*Economic factors*: Economic barriers are present throughout the process of establishing IS connections.

-*Political factors*: Policies and regulations may serve both as drivers and barriers for IS

-*Organizational factors*: All involved actors, public, private and other organizations must be willing to cooperate and commit themselves to the development process.

3. Comparison EU and US policies

From the comparison the information which come up soon are: CE in US belongs to a *bottom-up* approach, and in EU there is *top-down* approach; US is closer to an unplanned model, and EU to a planned model; looking at the approach step EU seem to be at the 2° stage *Feasibility study* (Behera, Kim, & Lee, 2012), because CE EU business models are reflecting different stakeholders' requirements. Looking at Critical factors (Brand & Bruijn, 1999), both US and EU overpass *Technical Factors* for obvious reasons like being part of the most advanced and industrialized countries. *Economical* and *Political* factors can group together: both are a problem in the US case, and a unclear/confused factor in the EU case (Technopolis, 2016).

4. Case Studies

In this chapter, 5 cases of circular cities are presented, chosen because of its importance and contribution to the master thesis.

4.1 London

One the main example of Circular Cities Network by Ellen MacArthur Foundation, which wants to be, as the COO of LWARB, Wayne Hubbard affirmed "[...] *the world's best CE city*" at the North London Waste Authority's Waste Prevention Exchange.

On the organizational point of view, London is a hybrid approach because it is using the "*top*

down" approach (Chertow, 2007) and the "*willing approach*" (*batch approach*). The business model has identified between the action areas which shows how the goal is not purely political, but economical too, and according to the development step, it belongs to the *Uncovering and Feasibility Study cases*, (Chertow, 2000) (Behera, Kim, & Lee, 2012).

4.2 Kalundborg

The famous Danish municipality for having been the first world example of IS, but which among its projects has some who belongs to circularity.

Kalundborg is an example at the "*Embeddedness and Institutionalization* stage, bottom up model.

In Kalundborg businesses, politicians and citizens alike all share a common responsibility in creating a sustainable local community, and all this system has been rewarded during these decades with significant CO₂-emission reductions, and job opportunities in the Municipality.

4.3 Devens

Eco-efficient district 50 kms far from Boston, US, well known for its circularity and with staff certified as *Zero Waste Associated*.

It belongs to a *top down* approach even if appears a Coordinator Body (Mirata, 2004). A particularity is that the Coordinator Body is not a Governal entity, but a no-profit one. Devens is at an *Embeddedness and Institutionalization* stage (Chertow, 2000), and factors like Organizational and Political are very important (Brand & Bruijn, 1999).

4.4 Helsinki

Always on the top position of cities for sustainability and environmental sensibility.

Helsinki fix perfectly into the *Batch Model* (NISP, s.d.), where Motiva is the Coordinator Body (Mirata, 2004), who acts at regional level (Costa, Massard, & Agarwal, 2010).

According to the Development Step, it can be said that the Finnish model is very mature and steady (*Embeddedness and Institutionalization*), (Chertow, 2000), and very complete, with more than an institutional partner.

4.5 Ljubljana

The Green EU Capital in 2016, which in a few years has achieved to generate 41% less waste per capita than the European average.

Ljubljana is also a *top down* approach, but still at the *Uncovering* (Chertow, 2000) and *Feasibility Study* (Behera, Kim, & Lee, 2012) stage. At the local level, the real facilitator to a CE transition is the Waste Management Center in Ljubljana.

4.6 Analysis

The author, analyzing the Coordination Policies Level (Costa, Massard, & Agarwal, 2010) and Types of approach (Simbiosi Industriale ENEA, s.d.) has noted that at the National Level corresponds a Top Down approach, while at the Sub-National Level corresponds a Batch/Top Down approach, which is joined in the case of London.

To summarize, policies and regulations are still the main drivers/barriers in a CE adoption, and at their different level correspond top down (National), or batch-bottom up (Sub-national). The up-cycling model seems to be suitable to each level or type of approach, and associations are present actors mostly in cities where there is top down / National coordination policy level.

5. The Portuguese study: Barreiro

Barreiro is a municipality of 77.000 inhabitants located in the District of Setubal, and it is only 25 minutes by ferry from Lisbon.

Barreiro has a long story about textile, cork, steel industries and mechanical services among the others, and nowadays these “special abilities” are visible in different associations, where it is common to find core activities, related somehow to CE, such as

sculptures and paintings with unused or wasted materials; repairs and creative objects with unused or wasted materials, permaculture, etc. Those activities are related with reuse, repairs, and up-cycling.

5.1 Amarsul

It is the environmental agency in Barreiro which is, due to the Decree-Law No. 104/2014, its shareholder. Amarsul has the exclusive concession of the South of Tagus area.

Although AMARSUL is a mature company, there are still some issues which make its operations somehow cumbersome, such as: divergent interests of municipalities as shareholders and clients of the company.

5.2 Analysis

Up-cycling, recycling, re-use, composting, items exchange are visible activities, but they don't look like “*business strategies*”, they look actions during a normal daily life.

In Barreiro there are different barriers (Brand & Bruijn, 1999):

- 1) *Information*: An information program would be needed.
- 2) *Political*: lack of driving force, despite the volition, and said above. Barreiro belongs to the National policy and regulation level (Costa, Massard, & Agarwal, 2010).
- 3) *Financial*: incentives are definitely needed to boost CE activities.

5.3 CE projects in Barreiro

Relevant CE examples in Barreiro are taken into account. They are *not defined* as approach (Simbiosi Industriale ENEA, s.d.), also because they are at the first stage, the *sprouting* (Chertow, 2000).

Comparing these examples with some similar ones from case studies might bring an important contribution to Barreiro and its circularity:

1. In Barreiro the company Oleotorres converts used oils into biodiesel, candles and soap. The same Oleotorres gives money (in the form of donations) to 2 firefighters stations. In Devens there is a similar project: a food producer sends its used oils to a soap producer company.

In Helsinki there is a circular example where the main stakeholders are the waste management company, supermarkets, and bio-fuel producer. These two projects may give contribution to Barreiro, such as informing private company to join the project, in order to collect more used oils, achieving both environmental and economic gains.

2. Barreiro has also some projects which belong to reuse, up-cycling, repairs. They might create a kind of network, since each of them has its own role:

-Barreiro-ecological Christmas trees competition: it aims to sensitize schools, and population in general, to the advantage of reusing materials, and in the creation of new objects. Its role in the network could informing citizens, with workshops, activities, etc.

-Bethel Portugal is a non-profit institution that provides social and moral support to people who are victims of social exclusion, acting with repair furniture and sold to the community. Through initiative like the Barreiro Ecological Christmas trees, they might have more notoriety. This hypothetic network could look at the Furniture Reuse Network in UK, and create its own product and brand.

6. Validation

The first part of primary data collection for this project consists of semi-structured with 22 key persons divided in three main groups: international, national and local.

The aim of these interviews was to know their general perception on the CE concept, their perception of barriers, why companies and citizens should be more aware about CE. These interviews precede the questionnaire

survey in order to get a broader view from locals, especially people who deal with CE activities, and adjust and reinforce the research question. Two steps of coding have been used

- a) generating meaningful data units;
- b) classifying and ordering these units.

Table 1: Keywords extracted

Key themes extracted	
a. Closing the loop	n. Green Jobs
b. R&D	o. New targets/programs
c. Barriers	p. Buzz word du jour
d. Economic Model/Growth	q. Related topic/program
e. Awareness	r. Technology
f. Waste Management	s. Demand
g. Goals	t. Bureaucracy
h. Valorization	u. Sub-national level
i. Education	v. Saving
j. Benefits	w. Stakeholders' engagement
k. Creativity	x. Coordination body
l. Business Model/Strategies	y. CE Tools
m. Taxation	

Question 1: *Closing the Loop* has been the most reported key theme (remanufacturing, reuse, repair, recycling, (EC COM(2015) 614 final)), Furthermore, at the three levels some differences can be found: at the international level, CE is a driver for “*valorising resources*” through EU programs and projects, while at the national level it is an “*opportunity to grow*”. At the local level, it can be seen that keywords are more related to daily matters, like “*waste management*” and “*awareness*”.

Question 2: Reasons behind CE projects are similar in all the three levels: *valorisation of materials, economic benefits and political goals* (EC COM(2015) 614 final) (Accenture, 2015).

Question 3: Although the question was regarding benefits, at the national and local level appears keywords like the mentioned “*barriers*” by Brand and Brujin (1999), missing *awareness* from citizens and stakeholders.

Question 4: Issues are *lack of innovative technologies*, and *R&D investments* at the international level, *low landfilling taxes* and a missing *Sub-National policy level* (Costa, Massard, & Agarwal, 2010) at the national level. At the Barreiro context, *lack of incentives, programs* at the local level, *demand and awareness* from the population.

Question 6: at the national level, it is to be hoped *different levels of taxation*, which incentive CE practices, and on the way around, penalize waste production. At the local level, a *sub national policy level* is needed (Costa, Massard, & Agarwal, 2010).

Question 7: *No long-term vision, difficulties to compete with traditional business* (linear), *waste regulation*, and a slow *bureaucracy*, are the issues found, while at the local level *financial resources* are needed.

Question 8: bottom up actions are needed, like *information, creating a network* of CE, and entities who “help” in CE practices, like a *coordination body* (Mirata, 2004).

7. Questionnaire

The author, since has spent 3 months in Barreiro, hosted by an association (ADAO), has had the opportunity to see daily CE applications, and get to know the associative context. It has been thought to a quantitative method for understanding and analyzing problems, needs, and capabilities of the association ADAO. An on-line questionnaire has been done taking in consideration the “up-cycler” side, and the “buyer” side too.

54 persons answered, 24 upcyclers, 30 buyers. The first part aimed to know if the picking was a barrier, if a prize, like a tax reduction could incentive a CE system, if people trust repaired objects, if a platform could be useful in a CE system. The second part aimed to know if upcycling is a hobby or a job for some of them, if finding materials-objects is difficult, where they find materials-

objects (the last two questions aimed to know if the regulation was a barrier), which materials they use, and which kind of work they do, and problems in their business.

8. Conclusions

The author, thus, agrees that the *Existing Synergies* in Barreiro, created under a “*Self-organized association movement network*”, should be used as a springboard to develop other exchanges and stimulate a CE system (Chertow, 2000).

Trying to stimulate a CE system in Barreiro, would be theoretically possible through a top down approach, but the author has found some issues. In Portugal, Waste Legislation and Policies are at the *National level*. If the Policy was at the sub-national level local government could act as a bridge between national government and local companies.

As already analyzed by the author, higher recycling rates are a good thing, because it means less waste into landfills, but it doesn't prevent waste from being generated in the first place. Preventing waste in the first place by exchanging, refurbishing and reusing products and components instead of recycling makes much more economic sense. (Accenture, 2015). Upcycling and IS can bring a further contribution to CE, and stimulate an exchange network, something important at the local level. With these two tools, and trying to stimulate an exchange network the author would avoid barriers coming from the Portuguese waste regulation, as the already mentioned adoption life-cycle approach, with the lack of local policy level (Costa, Massard, & Agarwal, 2010), and deals with some of the Factors mentioned by Brand and Brujin (1999): Technical and Political.

The suggested model was reviewed twice, during the interviews to Nuno Cavaco, Barreiro Municipality Councillor Assessor, to Joao

Lopes, Barreiro Municipality Head of Planning, Environment and Mobility Division, and with the Vice Mayor Sofia Martines again, and it was agreed which could be a strategy with the actual resources in Barreiro, and its strengths.

9. CE future proposal

The author has done a Business Model Canvas, for a clear understanding of a possible CE system in Barreiro, at the actual condition and resources. The first two blocks, the most important according to Osterwalder et al. (2010):

9.1 Customer Segments

It describes the classes of people and organizations to which aim. The main goal is to involve the local community of Barreiro, (citizens, hobbyists and students), and to disseminate and promote upcycling, recovery and reuse activities. The service favours skilled craftsmen and unemployed, who can take advantage of this opportunity for their work.

9.2 Value Proposition

It is the realistic promise of the value of products and services, based on the tangible benefits for a particular customer segment. In this proposal target is a member of a community, as hobbyists or an associate, or simply, students. Main activities are self-production, repairs, restorations, artworks. Summarizing the other five blocks (without cost structure and revenues), it was assumed that even without calls/grants and resources, the Municipality, together with associations and citizens, can boost CE, giving: Small incentives; Spaces and building; Technical advices; Communication channels; Free transportation for goods and people; Old furniture. To fill the two missing blocks, cost structure and revenue stream, some other assumptions were done analyzing the four Municipal taxes: Water bill; IMI (property tax); IUC (car tax); Derrama commercial tax.

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