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Article

Circular economy: Between theory and practice

Amfiteatru Economic Journal

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Suggested Citation: Negrei, Costel; Istudor, Nicolae (2018) : Circular economy: Between theory and practice, Amfiteatru Economic Journal, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 20, Iss. 48, pp. 498-509, <https://doi.org/10.24818/EA/2018/48/498>

This Version is available at:

<https://hdl.handle.net/10419/196446>

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CIRCULAR ECONOMY – BETWEEN THEORY AND PRACTICE

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<p>Please cite this article as: Negrei, C. and Istudor, N., 2018. Circular Economy – Between Theory and Practice. <i>Amfiteatru Economic</i>, 20(48), pp. 498-509.</p> <p>DOI: 10.24818/EA/2018/48/498</p>	<p>Article History Received: 29 December 2017 Revised: 5 March 2018 Accepted: 8 April 2018</p>
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Abstract

Misunderstanding terms like cyclicity, circularity, and nonlinearity can bring about confusion and endanger a good idea, tested by industrial ecology and widely known as “dematerialization of the economy”.

That is why the main objective of the present article is to clarify the concept of “circular economy” and explain its relation with the operating laws of the economic system and the new scientific breakthroughs in systemic ecology. A secondary aim is to identify the means through which the dematerialization of the economy operates, to highlight its limits, by underlining the difference between economic growth and development and waste generation.

The research methodology comprises the following stages:

- Identifying the problems encountered by the concept of “circular economy”
- Coming up with an analysis of the “cause-effect” relationship
- Identifying the main opinions about “circular economy” expressed in the literature
- Assessing to what extent the idea of “circularity” in economics has been validated.

The aims of this research have led to the necessity of reaching an agreement between concepts like the economy of functionality, the adaptive economy and the specialization-integration relation.

Keywords: circular economy, entropy, dematerialization, industrial metabolism.

JEL Classification: A10, D04, O13, Q01, Q53

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Introduction

Knowledge has always combined theory with practice, analysis with synthesis, and this justifies, if still necessary, the theoretical, methodological and practical attempts made to discuss “circular economy” during different scientific debates.

Such a concept that infers the idea of an “economic perpetuum” cannot be found in real life, as it is based on a mechanistic, vision which simplifies complex reality: “the economic process is thought to be like a closed system or a circular flow for the simple reason that, ever since its early days, analytical economics has been related to mechanistic epistemology” (Goergescu-Roegen, 1979, p.457).

The successive significant philosophical ideas about the Universe viewed mechanics and quantity as being less important than nature and quality. This provided us with a single explanatory framework valid for both physical phenomena and for those regarding life and socio-economic aspects, a framework of thought where time is considered fundamentally reversible.

An economy is an open system, namely one that makes both material exchanges and energy ones; if material flows can be “circular” to a certain extent, energy flows are unidirectional, because the entropy law is a strictly objective law of nature.

For these reasons we cannot talk about “circular economy” as a concept.

However, we have to underline the fact that, due to the perseverance of the mechanistic view, the concept of “circular economy” appeared in some articles. But in fact, this term was used to refer to the ciclicity of the real phenomena and processes, basically to the ciclicity of natural phenomena and processes.

“The aim of the circular economy (...) is to reproduce the quasi-cyclic functioning of natural eco-systems” (Bourg, Granjean and Libaert, 2006, p.139).

This type of objective, meant to slow down the entropic process, ignores the fact that in the natural environment the mentioned process takes place automatically, while in an economy it refers to the decision made by the human factor and it involves a recovery, reuse, recycling activity (RRR); moreover, RRR can be achieved by consuming a certain amount of energy, respectively by turning low entropy into high entropy (Goergescu-Roegen, 1979).

However, it can be easily noticed that the metabolism of the present technical-productive system is not based on a high level of connectivity typical of the natural environment¹ regarded as a system. But linear technologies prevail, which underlines the energy intensive nature of goods and services production.

In fact, it is precisely from such a perspective that we can consider industrial ecology as being the same as circular economy. Industrial ecology has shown it was necessary to slowly replace linear technical-productive processes with nonlinear ones, in order to dematerialize the economy in practice. We have to notice that the nonlinearity of the technical-productive systems does not refer to their “circularity”.

In order to avoid the inconsistencies between the form and the background, we aimed at dealing with the following aspects:

- The limited extent to which the laws of nature can be found in economic theory and practice;
- The compatibility between specialising in goods and services production and the necessity to promote nonlinear technologies;
- The alternative names for: "circular economy"; the economy of functionality, the adaptive economy.

1. Literature review

The concept of "circular economy" is to be found in the specialized literature in relation to its occurrence and feasibility which overlap with the attempts to recognize and analyze the biophysical base of the economy. The physiocrats thought that an economy had to offer the necessary conditions to perpetuate "the circular production processes", while the neoclassicists were preoccupied by capital reproduction, like amortization and investments, without being able to find a solution to natural resources (Franchoux and Francois, 1995, p.82).

Taking into consideration that the natural environment is a vital production factor (Negrei, 2004), there are important limitations as far as the circular economy and economic processes are concerned, especially if we think that economic processes involve not only goods and services operations (production, intermediary consumption, stock fluctuation, etc.) but also distribution and financial operations.

Georgescu-Roegen (1979, p.458) demonstrated the applicability of the entropy law on economic processes among others, and reached the conclusion that: "even if we take into consideration only the physical side of the economic process, the latter is not circular, but unidirectional".

The above mentioned conclusion was corrected later on, which means that, given the open nature of the economic system, this can avoid the entropy law to a certain extent, provided that it stays far from a stable balance (Faber, Manstetten and Proops, 1998; Vădineanu, 2004). In fact, long before, Leontief supported the substitution of the "re-production point of view", namely flows' circularity, with the "scarcity point of view", namely the physical base of the economy, although in the end the input-output analysis does not deny the real meaning of the "circular economy" concept.

The analogy between the natural environment as a system and the economic system from a cyclic, respectively circular point of view is not justified, as there are easy to spot differences:

- "while in the natural environment there is only a mix-up when it comes to the economic process, we can also talk about some separation activity" (Goergescu-Roegen, 1979, p.458)
- "the real product of the economic process does not consist of a flow of waste, but of the ability to enjoy life (Goergescu-Roegen, 1979, p.459).

Popescu (1985) and Bourg Dominique et al. (2006) have a more practical approach to the concept of "circularity" in economy.

Popescu (1985, p. 205) comes up with the concept of “active circular process” which she defines as a “multidimensional method to think and organize the production processes with multiple finality”. Basically this means an interdisciplinary, technological, territorial and administrative integration effort. The author thinks that the main aim of applying circular-active processes is “getting specialized according to raw material composition criterion, not according to the final products criterion”.

We can find out that the aim of “circularity” is the production process, more precisely only one part of it, not the process as a whole.

Bourg, Granjean and Libaert (2006, pp.139-149) consider industrial ecology to be the same thing as circular economy, as dematerialization methods, by means of reducing specific material consumption, doubled, as much as possible, by “loops of the material cycles”. The authors think that “the key objectives in the circular economy development are related to the intensive energy, waste-free production, waste use, recovery of the renewable resources (water, for example) and the development of industrial activities with respect to the environment”.

To summarize, the circular economy might refer to closing some material flows, as much as technological knowledge and the socioeconomic and political context allow it, which in fact denies the idea of circularity, because the economy as a process refers to a much wider domain. In any case, as we have already underlined, economics is not only about material mix-up processes, but also about separating it, which amplifies its entropic nature.

From a wider perspective, Badescu (2014) completely disagrees with a “circular economy”, to such an extent that he disapproves of the philosophy that underlies global decisions. This is a systemic conversion philosophy, not a co-existence one, which weakens among other things the primordial physical core of the socioeconomic system, namely the “natural environment”.

In conclusion, in our opinion the “circular economy” concept presented in specialized literature is underlined by the following aspects:

- The critical level of the conceptual consensus is not reached;
- Specialized terminology lacks accuracy ;
- The discipline itself registers a small number of approaches, especially methodological and practical ones;
- Difficulties in multi-, but especially inter-disciplinary approaches;
- Disagreement between the form and the content of the “circular economy” concept”.

2. Dematerialization of socio-economic complexes

The occurrence of the “circular economy” concept (through its content, not form) is triggered by the degradation of the relationship between the economic system and the natural environment regarded as a system. From a causative perspective, the main triggering factors of the conflicting condition between the two systems (figure no. 1) are related to the social and human capital, technical-productive factors and knowledge factors. Their analytical effects lead to a decrease in the natural environment’s self-sustainability capacity and the amplification of socio-economic imbalances.

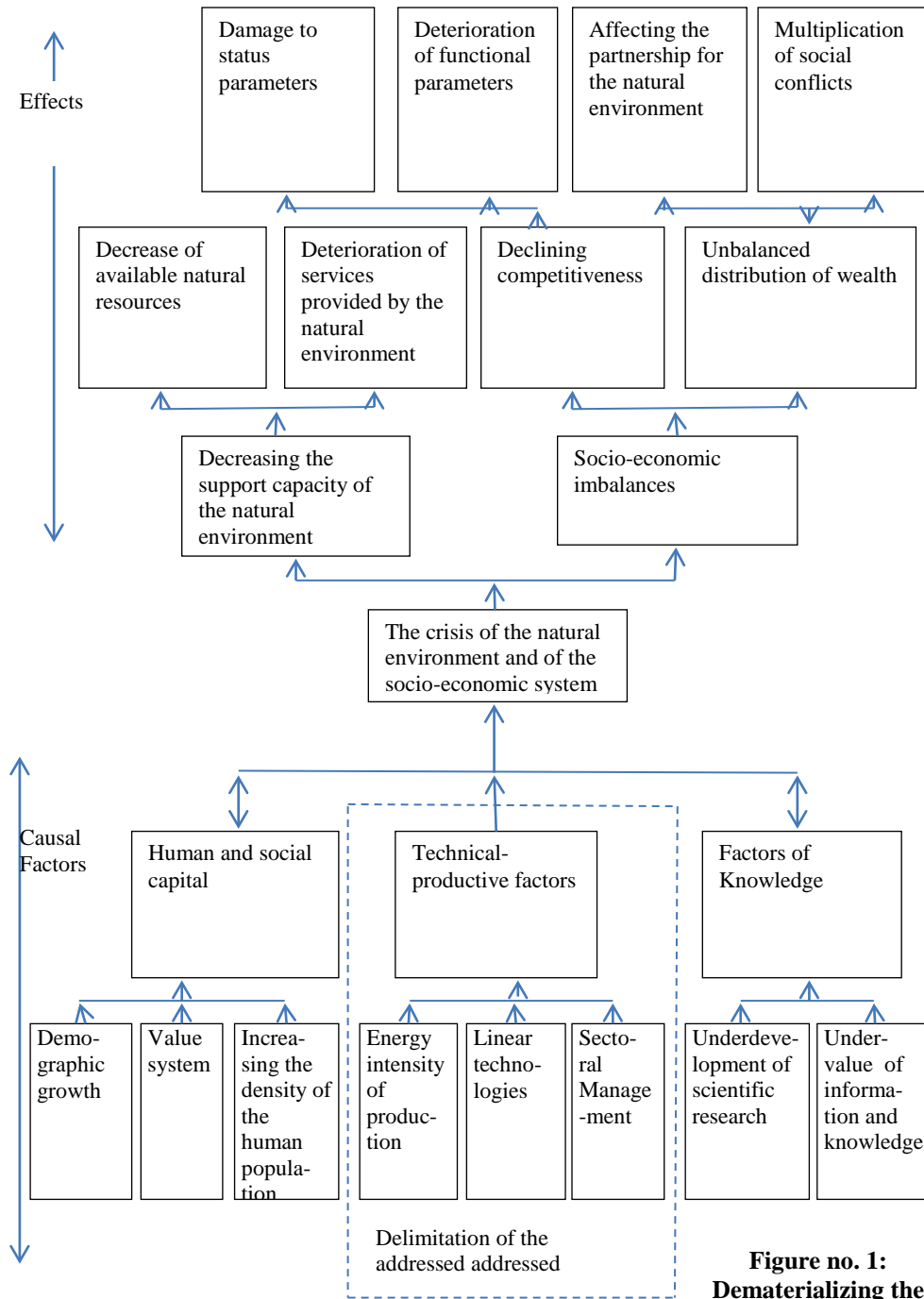


Figure no. 1:
Dematerializing the development of socio-economic complexes

Source: Negrei, 2016, p.64

The main aims of industrial ecology, a type of ecology that generally tends to be known as "circular economy", are: the energy intensive nature of the nowadays technologies, the linearity of the technical-productive systems and the sector management approach.

We think that epistemology is another source of the difficulties encountered in the dematerialization process of the development of socio-economic structures. As a proof there is the name itself – "circular economy", stemming from a mechanistic, quantitative view.

The theoretical background and the autonomy of sciences appeared at the end of the 18th century, when it became separated from religion, politics and morality.

The trend in economic thinking that made a contribution to this evolution belongs to the physiocrats, those who supported the power (kratos) of nature (physis) – figure no. 2.

Even if these lines of thinking failed by promoting geocentrism and biocentrism, what is essential for the present research is the fact that an economy's initial theoretical framework, as well as the practical one, is based on the laws of nature, as much as they could be known at that time. Thus, the physiocrats admitted that competition in nature operates within divine limits and with the help of a providential balance, an idea that can be found in Adam Smith's works when he describes free market competition. However, this idea failed when it came to market fundamentalism.

In the same way, labour division in nature could also be seen in an economy, but, according to the mechanistic view, this "failed" when applied to high specialization and linearization of the technical-productive processes.

As a consequence of this option, the socio-economic system registered significant increases in volume and size, at the cost of simplifying the relations with the external environment in general, especially with the natural environment.

Botnariuc (1999, p.17) states that such a situation is characterized by a "surface deficit", or, metaphorically speaking, by the "defoliation" of the economy. (When the object's increase in volume is registered in cubic units, its increase in surface is registered in square units, which, in the case of the socio-economic system leads to a conflict between the ever increasing need for input and the ever decreasing possibility to have access to it by taking advantage of its diversity and heterogeneity. In other words, the specialization of the economic system narrows down its connectivity to a heterogeneous environment).

In comparison, the mechanistic model, which was a source of inspiration for the neoclassical standard economic theory, built its theoretical frame based on the industrial revolution and the invention of machines.

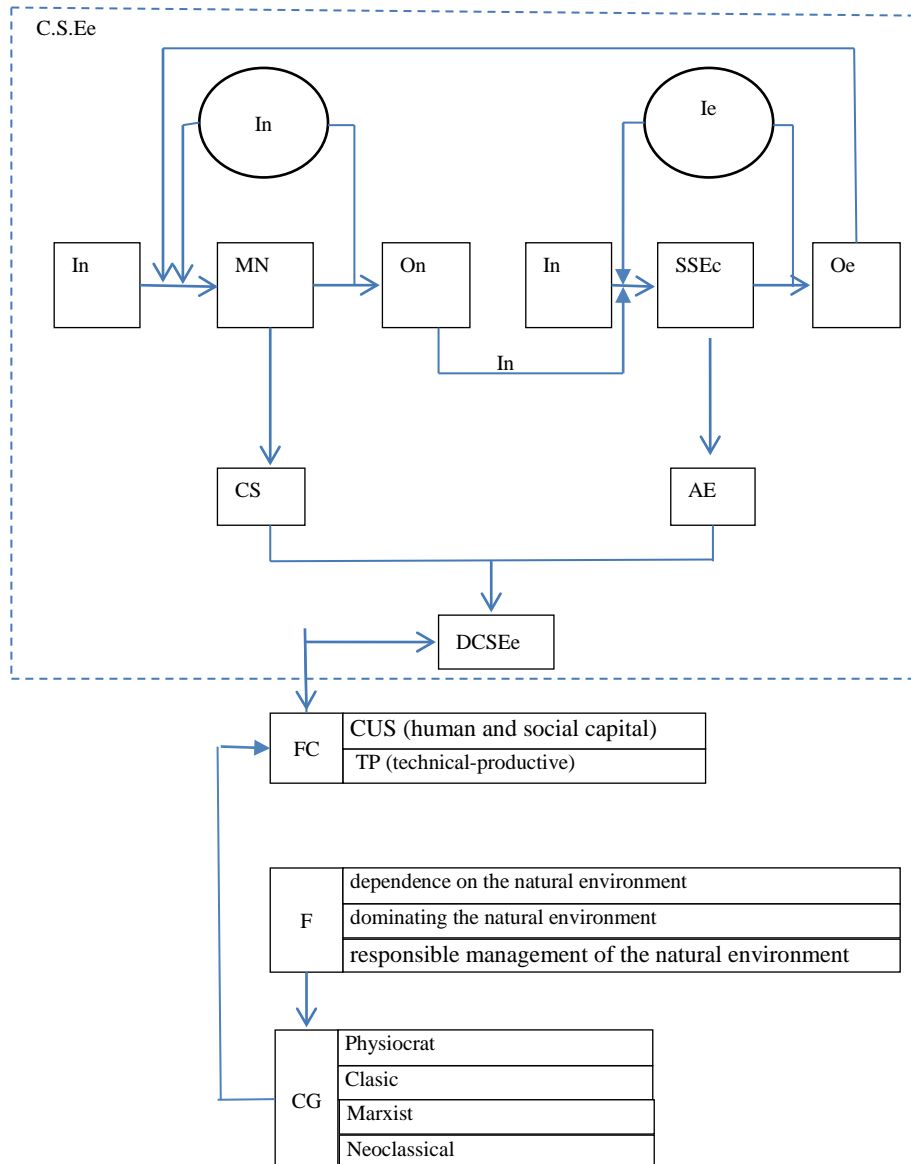


Figure no. 2: The cybernetic model of the socioeconomic complex

Source: Negrei, 2016, p. 64

- Notes: CSEe – socioeconomic complex
- MN – the natural environment
- SSEc – socioeconomic system
- SBD – available bioproductive area
- SBN – the required bioproductive area
- DCSEe – development of the socio-ecological complex
- FC – command factors
- F – phases of the SSEc-MN relationship
- CG – current economic thinking

The importance of mechanics led to the occurrence and amplification of the conflict between the socio-economic system and the environment as a system (Gore, 2007; Wijkman and Rockström, 2013), and the answer to this was given in the context of industrial ecology, related to the idea of circular economy.

The mechanistic, physical and quantitative oriented view is the main factor that triggered the conversion of the natural environment as a system by the socio-economic one (Bădescu and Bădescu, 2014).

This conversion has been taking place for a while although the relations among real entities are no longer dominated by cognitive archetypes, namely by the initial, genetic, natural wisdom. This has been replaced by knowledge based on essential, speculative experience, related to a subculture dominated by greed, envy and evil.

From this perspective, coordinating relations between the systems become subordinating ones and co-existence is replaced by system conversion.

3. The irreversibility of economic systems

We think that in order to overpass these theoretical and practical economic limits, the result of a segmented, preponderantly quantitative approach, it is necessary to take more advantage of the new scientific breakthroughs in systemic ecology, which should be the starting point of adaptive management (Vădineanu, 2004). This should ensure the co-evolution (not subordination) of the environment and the socio-economic system (Negrei, 2004).

Thus, systemic ecology gives us the necessary knowledge to understand the complete cycle in the development of a system (natural, anthropogenic) and the connectivity between the development cycles within ecological hierarchy – panarchy¹ (Vădineanu, 2004)

Applying this knowledge to the relations between the socio-economic system and the natural environment leads to the promotion of the concept of a socio-ecological complex seen as an elementary spatial unit to design and make development strategies and policies operational (figure no. 2).

The circularity of material flows between the two systems cannot disobey thermodynamic laws, which are laws of nature.

The parameters framework of the process (figure no. 3) underlines the existence of some absolute restrictions that define the irreversibility of the economy as a system (it excludes circularity). Of course we are taking into consideration the fact that the hierarchically inferior systems can avoid the entropy law to a certain extent (the second time arrow) at the hyper-system and ecosphere level, while entropy is continuously increasing (the first time arrow).

The natural capital (NC) supplies renewable (RES) and non-renewable (NRES) eco-systemic services seen as material flows.

Their quantity, quality and structure is limited by obeying the correlation between the regeneration rate (rr) and the input rate (ir) on one hand, and the sampling rate (w) on the other

¹ Panarchy = the interdependency between the development cycles of the components from the same hierarchical level and the ones of components from other hierarchical levels (local, regional, macroregional, global)

hand. Otherwise we can reach a situation in which the eco-systemic services are overexploited and the natural background of the socio-economic system becomes vulnerable.

Anti-entropic flows generated by the natural capital shape the volume of the accessed eco-systemic services (AES) subject to transformation (TF) according to the consumption demand (C).

The three mentioned processes (AES, TF, C) also generate entropic flows (ef) regarded as waste (W). Some of it is recovered, reused, recycled (anti-entropic flows in accordance with the circular economy) making a contribution to rebalancing AES and C. The “non-circularized” waste is treated (T) and as a result we get a certain amount of leftovers (E). These are reintroduced into the natural circuit by the natural environment within its limited capacity to “process” pollutants (A).

If $E > A$, there are entropic flows (ef) that amplify the natural environment crisis and undermine consumption.

Beyond the satisfaction degree for the three categories of restrictions ($w < ra$; $w < II$; $E > A$), AES TF C and T involve unidirectional energy consumption (entropic) as well as material losses (E).

Given the above described situation, the economic system is irreversible and we can not talk about circular economy.

From a practical point of view, promoting the non-linear technical-productive systems (such as the natural systems), in order to accelerate the process of economy dematerialization (reduce the specific consumption of raw material and energy), means finding solutions to “close” to a large extent the flows specific to different socio-economic activities.

In this way the circular economy is an action, among many others, that tries to correct rather than prevent, and this limits its effectiveness. That is why a collective effort is needed, along with the decrease in the amount of deposited waste out of the total waste production. Economic activity has to focus mainly on mechanisms that can help reduce waste production.

If the above mentioned demand is satisfied, the next issue to be looked into is how large is the scale at which circular economy is designed and put into practice: organization, industrial plant, region, etc.

The mentioned issue has to be discussed from the perspective of the scale effect on waste RRR. In our opinion waste, especially that with a high pollutant potential, is to a smaller extent the result of “auto-consumption”, which would mean collecting it from extended areas, therefore incurring high economic and environmental costs, due to transportation. This will deteriorate the energy balance of the circular economy.

Once the spatial scale of the circular economy established, the next step is to set up priorities. This will require the effort to think about criteria based on which things are prioritized, such as:

- Resource scarcity;
- Ecological vulnerability of the area;
- The importance of different activities for the local, regional, national economy;
- The strategic nature of some socio-economic activities.

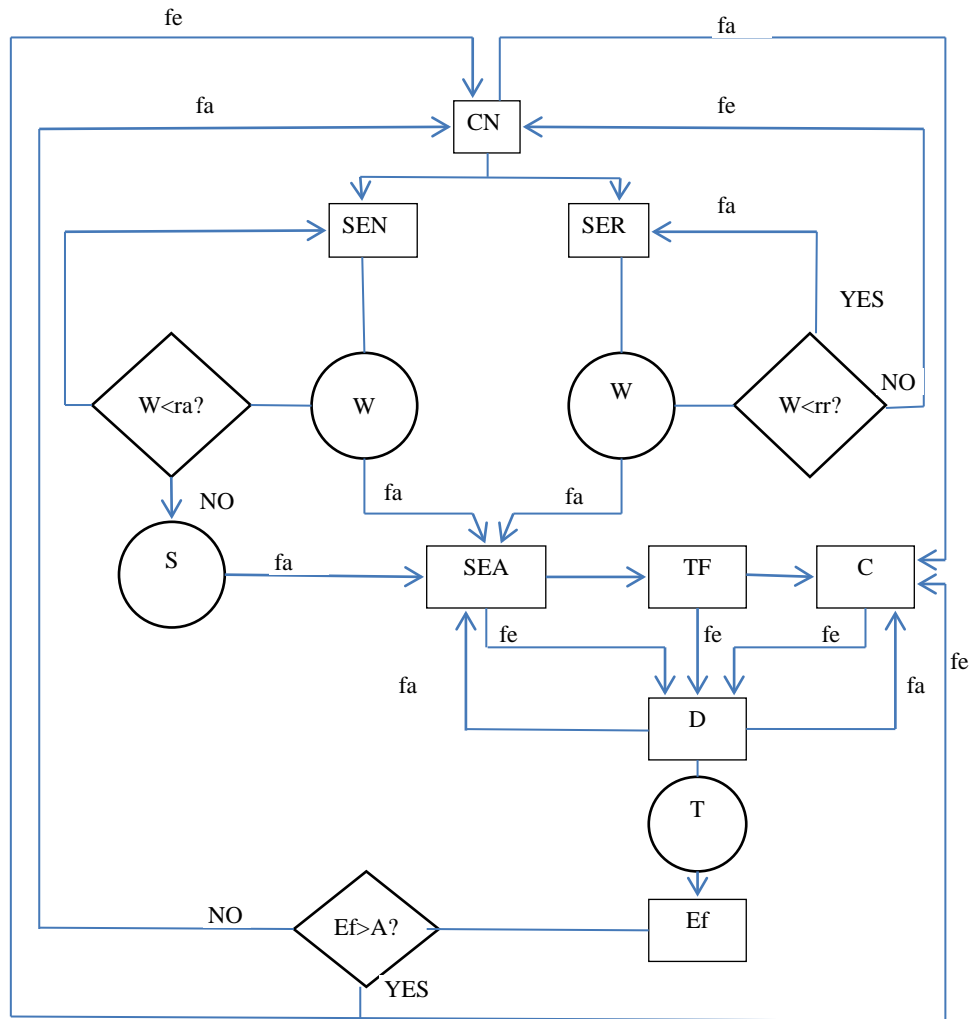


Figure no. 3: Reversibility of the economic system

Source: Negrei, 2016, p. 64

- | | |
|---|---------------------------|
| Notes: CN – Natural capital | C – consumption |
| SEN – non-renewable ecosystem services | D – waste |
| SER - renewable ecosystem services | S – substitution |
| SEA – ecosystem services accessed | T – treatment |
| TF – transformation | Ef – final emissions |
| A – cap. Of pollution processing by the natural environment | rr – rate of regeneration |
| W – sampling rate | fa – anti-entropic flow |
| ra – feed rate | fe – entropic flow |

The set of measures taken by the European Commission in 2015 regarding circular economy includes instruments and mechanisms that help accelerate the transition from a consumption-based economy (economy of disposable goods!) to one based on the quality and reliability of goods and services. At least in its early days such an option will lead to an increasing trend in prices, with a negative impact on demand.

This is why we think that the “economy of functionality” might be the solution (Bourg, Granjean and Libaert, 2006, p.150), an economy where what is sold is not that much the products themselves, but the benefits they bring (giving maintenance services when the situation requires it).

How will the responsibilities of the owners of the goods and also those of the stakeholders be assigned and managed?

The more and more widespread technological interconnectivity within the organization, by means of those structures that allow waste auto-consumption/circularity of material flows, will lead to revising the practical processes through which goods and services production gets specialized and customized.

It is very likely that the diversification of the technological means and job/career choices will affect competitiveness, decreasing the availability for “circular economy”.

In order to get over such an obstacle we can make better use of the advantages of waste auto-consumption:

- A balanced use of materials;
- Environment damage reduction.

The production oriented organization must be stimulated to increase waste “auto-consumption” and to avoid environment damage caused by waste.

Conclusions

- The laws of nature are a source of inspiration for economic thinking and practice;
- The way it is formulated, circular economy contradicts the second law of thermodynamics, namely the entropy law;
- Through its content, in fact circular economy aims to close material flows by means of adequate technical-productive processes; this issue has been dealt with for a long time when referring to production integration and active circular processes;
- The options should take into account adaptive socio-economic systems and rethinking the idea of production specialization. Specialization and super-specialization triggered the productivity crisis because they undermined the innovative and adjustment potential through the unidirectional use of the human resources;

We think that in order to design a circular economy and put it into practice, further research needs to be carried out with a view to the following aspects:

The spatial scale to design circular economy and make it operational; setting priorities to apply the circular economy, instruments and mechanisms to support technological

interconnectivity and the impact of the circular economy on the specialization and customization processes and implicitly on economic competitiveness.

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