REGIONAL PERFORMANCES IN THE CONTEXT OF A TRANSITION TOWARDS THE CIRCULAR ECONOMY: STRUCTURING THE ASSESSMENT FRAMEWORK

Catrinel Elena COTAE
Ion Mincu University of Architecture and Urban Planning, Bucharest, Romania
catrinel.cotae@gmail.com

Abstract
In the light of the Europe 2020 strategy, a new economic concept aiming to provide a sustainable development pathway by transforming the production cycle and optimizing the use of resources becomes more and more promising. Toiling with the current sustenance issues of the widespread linear "take-make-waste" economic model, the circular economy concept promises to generate major economic, societal and environmental changes, by enabling an integrated recirculation of resources in the value chains. This paper elaborates an approach to capture the multidimensionality of the concept by developing an adaptable assessment framework to support further empirical analysis and potential implementation actions. Defined as CMEF framework, the proposed taxonomy aligns with constructs characterising sustainability science, addressing a prospective and an operational dimension. In this regard, the integrated propositional analysis is used to enforce the duality of the model, ensuring a broad understanding of the conceptual background, while providing the decision making organisms with tools to identify the priorities and real chances of success.

Key words: *circular economy; performance indicators; assessment; framework; integrative propositional analysis;*

JEL Classification: *R110; R120;*

I. INTRODUCTION

More than 40 years ago, the think-tank "Club of Rome" was drawing attention in the study "The limits to Growth" [LtG] on the transience of fossil fuels and natural resources, pointing towards the complex problems of long term exploitation, reflected on the economic and natural environment (Meadows *et al.*,1972). Although controversial and received with high doses of scepticism, LtG analysed 12 scenarios for the period between 1973 and 2100, pointing out the same number of possible directions towards which the global economic development might be heading for. According to the study, even if actions targeting the reduction of human ecological footprint are enforced, slow decision-making towards an overall sustainable development would, in the end, irreversibly diminish the capacity of ecosystems to provide raw materials and goods for the population (Randers, 2012). The erosion and depletion of productive capacity of ecosystems initiates a deep economic downturn, with global effects. Further recent studies (Turner, 2008) followed the reiteration of the LtG study scenarios by replacing this approach with accurate, real data (whereas the initial study used projected and forecasted data) collected for the 1970-2000 period. After replacing the data and rerunning the models, the validity of the "standard run" scenario is confirmed, once more. The robustness of this baseline projection points out that factors such as population growth, industrial production - supported by continued intensive exploitation of non-renewable resources - and pollution, channel the global future towards an ecological and economic collapse, near the half of the 21st century. The main reason for a continuous decrease of ecosystem provisioning capacity is the linear production model, an operation following the "take-make-waste" principle (Turner, 1993). It is becoming increasingly clear that sustenance cannot be achieved when still relying on unidirectional production models in which only raw materials are an input in the value chain – a trend sustained by tardive reintegration of disposed materials in productive activities. Post-recession economic growth predictions and steady increases in supply-demand relationship aggravate the issue of resource depletion on a global level. Subsequently, business actors voice concerns regarding the operational risk exposure, visible in the price discontinuity and the supply variation of raw materials. This new challenge adds up to the already very competitive business climate and sharp, relatively unpredictable, variations in resource prices (Ellen MacArthur Foundation [EMF], 2012).

A possible mitigating action is to design a development model capable of addressing the wide range of resource and environment-related problems. A good candidate for this construct is the circular economy (CE). Even if the concept behind the model is not new and although many scholars claim to have refined the principles behind the actions, it can hardly be traced back to one specific author or year. CE relies on the principles

characterising ecological systems, where outputs serve as inputs for other processes (EMF, 2012). It promotes the minimization of non-renewable resource exploitation and the adoption of clean technologies, focusing on maximizing the benefits derived from the reuse of waste (Andersen, 2007). Related actions become increasingly visible in the last two decades, especially in the economic sector, where they appear as alternatives to unsustainable patterns of trade, production and consumption (Preston, 2012). Subsequently, the emerging production model is defined by measures regarding material recirculation and closed loops in production chains.

Given the multidimensionality of the concept, its main characteristics are to be addressed from two perspectives, one regarding the key intervention domains and the other discussing the expected outcomes, as they are essential in mitigating the current environmental issues. The main intervention areas are the production chains and consumption patterns. A change in these sectors is more likely to spark a broad response within the existing economies, laying down the prerequisites for technological, organisational and societal innovation across the value chains (European Commission [EC], 2014a). A number of outcomes can be targeted through existing policy planning mechanisms, as the success of the endeavour depends on the implementation scale and, naturally, on national priorities concerning economic development. Consumer behaviour is a also subject to change as new business models relying on different production cycles - actively engage customers in recycling and refurbishing actions (EMF, 2012). Another result of the shift towards more elaborated recycling practices, proposed within the CE, is the reconsideration of design. Product design plays a leading role in determining the environmental impact of consumer goods (Tischner et al., 2000) and it needs to be adapted accordingly. Different components of electronic devices or appliances are designed in such a way that, after they are disassembled, the pieces can be reused in order to produce either completely new items (if components are reconstructed and then reused) or partially recycled, "refurbished" models (parts and components are fixed and then included in new components). Transformation is also needed in agriculture, energy and transport as these sectors are contributing to the rapid pace of resource depletion. In energy production, the circular practices are enforcing the efforts targeting efficiency by proposing a cascading use of available resources. This action implies that, at a certain stage, at least one product is used as a material (Keegan et al. 2013). A similar approach is envisaged for agriculture. Learning from the successful Chinese experience, the circular agriculture model is centred on conserving available materials, land, water and energy (Geng et al., 2008). In transport systems circularity is reflected by the (1) overall technological advancement leading to improved design concerning engines and vehicles and (2) an integrated use of materials and resources representing outputs of other activities – e.g. used cooking oil. Engines are designed to consume fuels that are less harmful for the environment and population (Nieuwenhuis and Wells, 2000). A good example is the DME (dimethyl ether) engine that uses liquefied gas - synthesized from a variety of bio based feedstock or natural gas and then allows the reuse of exhaust emissions through gas recirculation processes (EGR) (Bøgild-Hansen and Mikkelsen, 2001).

New connections between traditional activity sectors, the focus on resource consciousness and the emergence of new, niched business opportunities loom an increase in national innovative capacity and in employment options (Kok et al., 2013) while creating the premises for economic sustainability. From here on, the challenge is to calibrate the new production patterns to the global dimension of present economies, while overcoming low competitiveness features and general development level.

Given the numerous obstacles, it appears that this concept is a long way from becoming a functional process characterising the global economy. The internationalisation of CE is, at the time being, wishful thinking; yet, as a strategy, it represents a reasonable development alternative for the too-rapidly evolving countries facing sustenance issues. Studies (EC, 2014a, Yong et. al, 2012) show that the main challenges in implementation come from societal resilience, high investment risks associated with low financing opportunities, a limited alignment of stakeholder initiative with public incentives, national and international weak policy coherence, all aggravated by a lack of proper measurement tools. In spite all this, a noteworthy example of successful policy implementation is China. Here, the circular practices are coordinated at a governmental level and conducted in designated pilot-territories (Zhijun and Nailing, 2007). The Chinese development strategy entails three major aspects: clean production, eco-industrial parks and eco-cities, underlining the multidimensionality – both territorial and operational – of the proposed policy. Similar measures are deployed worldwide, although most of them address separate issues such as land use, waste management and resource depletion.

European Union integrated the circular concept within the 2020 development strategy, following the initial actions included in the Manifesto for a Resource Efficient Europe and Roadmap to a Resource Efficient Europe (EC, 2012a; EC, 2012b). Subsequently, the flagship initiative regarding resource efficiency in the EU aims to increase economic performance while fighting the threat of resource depletion, to provide secure supplies of essential materials, and to reduce the environmental impact of resource use. A policy mix targeting these objectives was launched in the summer of 2014, focusing on increasing recycling capacity by strengthening the regulations regarding landfilling and incineration and by raising the targets and steeping the penalties. In detail, the package originally contained six legislative proposals amending the articles concerning waste management, packaging, vehicles used batteries, batteries and electronic waste (EC, 2014b). In 2015, the EU's efforts to adopt the CE as a development strategy are reoriented towards creating a new set of rules that will

ensure effective implementation. It is expected that the initial policy mix proposals will be withdrawn to make way for an improved, more ambitious share, as the Vice-president of the EC, Frans Timmermans declared on the Parliament hearing at the end of December 2014 (Crisp, 2014). In a context of continuous position reconsideration, backed up by a slight operational uncertainty, the investigation regarding the implementation challenges and opportunities is offering now, more than before, a wide range of research directions. Still considering the major areas of intervention proposed by the initial policy mix on CE and although its withdrawal is imminent, the implementation of the concept in Europe is a matter of time, being supported by the EU Environment Ministers and receiving strong signals from the business sector and environmental monitoring authorities (Flynn, 2014). In addition, estimates of Ellen MacArthur Foundation in partnership with McKinsey, show that by capitalizing various flows of materials or household waste, it is possible to unlock a huge economic potential, estimated to average earnings ranging from 270 and 290 billion Euros and up to 600 billion Euros on the long run (until 2025) in material cost savings (EMF, 2012).

Within this conceptual framework, the paper aims to contribute to the existing literature by proposing an adaptive framework for measuring implementation potential and operational results of regions during a transition towards a different type of economic development: the circular economy. This research adds to the existing work in the field by addressing both the epistemological basis of the concept and the implementation process. For doing so, we design a flexible model that is characterised by multilevel assessment actions during feasibility analysis and by the integrative prepositional analysis (IPA) during operationalization. The rest of the article is comprised of key notes on model design followed by a presentation of the main principles shaping the proposed framework. This section describes the structure of the envisaged construct. In order to point out the territorial performances, the discussion section will delineate how the framework relates to the existing administrative boundaries. The last part of the paper includes concluding remarks.

II. KEY NOTES ON STRUCTURING THE CONCEPTUAL FRAMEWORK

Before plunging further into interdisciplinarity, we aim to identify the characteristics of an assessment system for CE, considering its multidimensionality and broad connections. The supporting goal of the paper is to structure an adaptable framework that will portray the overall complexity of the concept, learning from the successful implementation examples and bringing them closer to operationalization in the EU. The particular approach carried out throughout this paper entails the assessment of implementation potential of CE while targeting its future operationalization. Four steps are deployed in this methodology: (1) synthesis of the principles used in framework design throughout sustainability science research, (2) investigation of main CE conceptual components, (3) micro-design of the envisaged construct, focusing on relationships between components, (4) macro-design of the adaptable framework, proposing enforcement measures. Based on prominent studies concerning the role of assessment process in determining the research consistency (Cormier and Suter, 2008; Gulikers et al., 2004), some generic models stand out: (1) the causality loop diagram approach, in which one process directly or indirectly influences another creating full or partial feedback relationships, (2) the hierarchy of components, where the elements are regarded according to their importance in the context, (3) the network array in which components are characterised both by causal relationships and contextual importance. We will continue with a brief review of commonly used frameworks in environmental, social and economic studies, as the future construct will entail aspects from all of these domains. The concepts behind CE mostly overlaps frameworks designed to address the field of environment (Tomás et al., 2004), ecology economics (Costanza et al., 1997) and human ecology economics (Allen, 2008). Environmental indicator frameworks target data gathering for statistical purposes, further leading to performance assessment in projects with possible environmental effects, impact monitoring of certain economic activities and, on an integrated scale, sustainability evaluation of development measures conducted by different authorities. The assessment scale is implicitly adapted to the specific frameworks, ranging from local to global. Human ecology economics display a holistic approach on humanities and physical sciences in conjunction with a baseline orientation towards the economic representation of ecologic systems. The assessment models are broad and propose complex adaptive systems and feedback loops that spark cascading effects. However, according to Allen et al., (2011, p. 3) the fundamental components of a HEE framework are human populations, belief systems, social agreements, physical environments and resources.

An analysis of notable models (of the DPSIR, SDI, ISO 14031, STRESS, JSEM, Hierarchy of Indicators [HOI] and Human Ecology Economics [HEE] frameworks) (Tomás et al., 2004), reveals a set of characteristics that are regarded for inclusion in the proposed construct. Regardless of the type, the investigated frameworks (1) target an in-depth systemic analysis of the phenomena (Carr et al., 2007), (2) measure efficiency responses of different legal and natural mechanisms and (3) provide structured data concerning a specific domain and offer a guideline for further data collection. However, common problems of the assessment frameworks in use are the insufficient information about the structure and behaviour of the systems in which decisions are made,

misconnections between indicator categories, unbalanced focus on only one aspect of the analysis and misinterpreting components (Hertin et al., 2001). Yet, in his work concerning human ecology economics, Allen et al. (2011) advocates for an inclusive framework for portraying a different type of development for the targeted territories (in that case, the countries in the Eastern Europe). This aspect is elaborated in Kates et al., (2001) work on sustainability science, in which a set of criteria defining research stages is defined: (a) wide range of spatial scales, (b) account for temporal inertias and process urgencies, (c) handle functional complexity and (d) recognise multiple perspectives and usable knowledge within science and society.

Henceforth, addressing the issues posed by the existing assessment models and focusing on integrating the main characteristics of CE, we can underline the guidelines shaping the proposed framework: (1) the construct is characterised by prospective and adaptive macro-processes (identified as initial assessment and adjustment mechanisms); (2) entails clear territorial differentiation and present a multilevel approach while focusing on vertical and horizontal linkages that characterise the territories; (3) presents a clear set of components, equally addressing the environmental, economic and societal aspects, relevant for the assessment topic; (4) includes a decision making system and its desired behaviour; (5) addresses the complexity of relationships of complex subsystems. Moreover, given the operational orientation of the CE concept, the necessity of formulating a policy implementation model is obvious. A general classification of the elements included in such a system is provided by Quevauviller et al. (2005), pointing towards problem framing, policy development, policy implementation and policy evaluation. However, we argue that this classification does not fully reflect the particular approach of the study and, thus, some adjustment should be deployed, siding with Wuelser's et al. (2012) approach on structuring complex issues in core analytical perspectives.

III. AN ADAPTIVE FRAMEWORK FOR MEASURING POTENTIAL AND PERFORMANCE

The challenge of the methodology is to address a relatively volatile domain undergoing numerous changes, while aiming to obtain an adaptable construct, depicting ante and post implementation conditions. Aggregating such a framework requires a set of conceptual and operational tools. For doing so we rely once more on the perspective on economy of human ecology of Allen et al. (2011), following the conceptual approach on policy making presented in Quevauviller et al. (2005) and in Wuelser et al. (2012) and the operationalization of the INDICAMP framework constructed by Tomás et al. (2004). Henceforth we distinguish between multidimensionality, operational orientation, analytical perspectives, interlinks and system complexity, concepts that need to remain a constant characteristic of the proposed adaptive framework. With these in mind, the supporting structure of the proposed model is to be regarded on two distinct dimensions.

The first tier describes potential assessment and ante-implementation monitoring processes. It is constructed on a knowledge based perspective (Wuelser et al., 2012) in which an integrated, networked use of information helps provide valuable input on addressing the investigated domains. Here we regard the potential

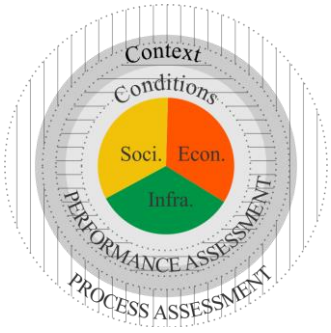

Figure 1 – The first tier: multidimensional territorial assessment

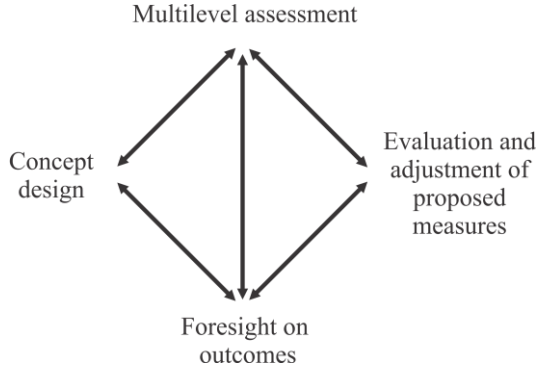

Figure 2 – The second tier: operationalisation level

for implementation on two different territorial levels, corresponding to the national and regional administrative boundaries. Subsequently, this differentiation has the advantage of delineating between national processes and sub-national performances. The author's perspective on process evaluation on a national level is based on including the broad set of elements that cannot be regarded at an inferior level: the administrative and institutional authority, legislative consistency, macroeconomic stability, basic education system, technological readiness and innovation levels, business sophistication, pressures on the environment concerning waste management infrastructure and energy production. Sub-national performances have a territorial correspondent on the regional level, measuring the different outcomes of activities concerning recycling practices, health system, higher education, labour efficiency and market size, and the level of local societal development (Sandu, 2011)

and resilience. Concisely put and pertaining a sense of spatial delimitation, these elements can be grouped under three main components defining the concept: societal characteristics, dedicated infrastructure and economic development level. This approach partially follows Allan's et al. (2011) extensive research on economic implications of human ecology, by using a conceptual reference system (ibid, p. 8).

Following a causality loop diagram approach, the second tier presents the interwoven processes of concept design and adaptive mechanisms used during operationalization, with respect to Quevauviller et al. (2005) and Wuelser et al. (2012) perspectives regarding the formulation stages of a policy implementation model. Based on continuous feedback loops and adaptive management actions, this tier encourages ongoing refinements and subsequent improvements to management and monitoring programs (Noble, 2000). In this particular structure, conceptual design presents the policy range pointing out priorities and overall orientation of the proposed measures, whereas outcome foresight is an exploration of practical implications. These two first components play a leading role in structuring the adjustment mechanisms. All the components are sustained by multilevel assessment which entails ante-implementation evaluations of the territorial situation. This feature defines part of the systemic adaptability because it refers to an action that can be adjusted according to the prospective or operational conditions in which the system is used.

Both tiers overlap in the final design of the proposed CMEF framework – conceptualisation – monitoring – evaluation – foresight – (Figure 3), yet how does this system work? When switching from a prospective to an operational usage, the framework is enforced by adding the perspective of integrative propositional analysis (Figure 4). As part of the emerging science of conceptual systems (Wallis, 2014; Wallis and Wright, 2014) IPA is a tool for rigorously evaluating "maps" (understood by the original authors as the actual conceptual systems) based on their structure (ibid, pp. 5). Although usually applied at an organisational level, the IPA perspective can be adapted to fit a different context, given we regard CE in a systemic way. Within this approach, in order to generate a fully-fledged operational structure, we would have to go back to the theoretical background, investigate primary and most importantly, resulting concepts and then re-evaluate the total span of policy implications. We expect the implementation priorities to become more obvious, increasing the chances for success of a proposed policy. Extending the IPA and applying it on policy making ensures a broad understanding of the challenges, making it easier for decision making organisms to reflect on the opportunities for implementation and chances of success.

IV. DISCUSSION

In this chapter we will discuss the potential of the CMEF framework from a conceptual, methodological and territorial perspective, explaining its expected effectiveness in practice. The use of concatenated logic (Wallis, 2014) as a main principle substantiating the duality of the framework entails a deconstruction of the CE concept prior to implementation but after the initial prospective measures. This allows a better understanding of the „founding blocks", useful in (1) underlining the connections between the policy's components, (2) easy identification of main domains (as they result from deciphering individual or overlapping concepts), (3) sketching a first set of priorities based on major intervention domains.

Secondly, methodologically speaking, the CMEF framework embeds a step-by-step description of the

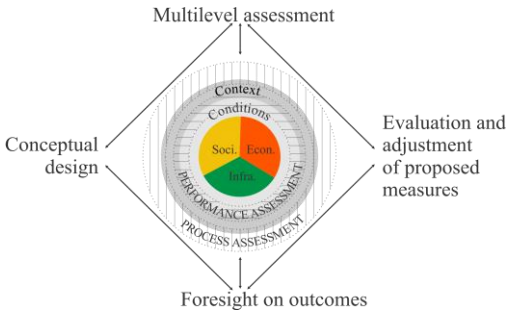

Figure 3 – Schematics of the CMEF assessment model

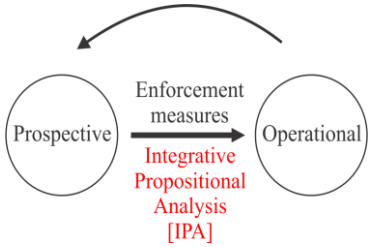

Figure 4 – Adaptation of CMEF model using IPA

assessment process while setting directions for future policy operationalization. Furthermore, the framework design is flexible. This characteristic is defined by using the integrated propositional analysis as an enforcement measure. It enables a prospective model to assess a post-implementation situation with little structural changes. Within this understanding, the main advantage of using roughly the same system in ante- and post-implementation evaluation is represented by measurement consistency. In addition, the multidimensionality of the concept is entailed in the concentric presentation of context versus conditions, respectively, process

assessment versus performance assessment. This means that for e. g. production or social conditions are connected to a context and that performance recorded in these areas has to be adjusted according to the overall functionality of the processes to which they contribute. Such an orientation points out the importance of vertical linkages between territorial levels, an aspect guiding broader EU policies (e.g. the Cohesion Policy). This leads us to the perspective targeting the territorial dimension of the concept. Within this understanding, it is hardly possible to evaluate a region without looking at the bigger picture. Given the proposed structure, regional potential and performances can be determined in an integrated manner. Consequently, the regional "circular" measurements need to be adjusted according to the national situation. The vice-versa relationship is possible but not mandatory, as it is portrayed in recent emerging research concerning regional and national authority (Marks et al., 2008). Following the conceptual delimitation of CE, an evaluation of regional "circular" potential is initialised by analysing available data concerning the performances within the recycling sector and performance parameters defining societal wellbeing and regional drivers of change.

V. CONCLUDING REMARKS

By further developing this adaptive framework, we are able to determine whether the transition towards a CE is a matter at hand. We expect the CFEM framework to allow (1) an integrated indicator assessment, defining both the regional and the national pre-implementation conditions (2) a clarification of the main investigation domains, (3) the policy guidelines before and after implementation, (4) the expected pressures and challenges of the existing situation, enabling a clear concept design, (5) the creation of tools for mapping a set of possible post-implementation adjustment mechanisms.

Overall, this conceptual approach hopes to spark a broader discussion regarding integrated methods for measuring the outcomes of CE, proposing an assessment perspective, useful for further empiric analysis. This article has suggested an alternative research dimension, combining several perspectives on framework development with an in-depth analysis of the concepts. Finally, the purpose has been to construct an adaptable framework, providing conceptualized schematics of a model suitable for investigating the transition towards a sustainable development and usable as a reference point in analysing regional potential and determining implementation priorities.

VI. ACKNOWLEDGEMENT

This work was supported by the project "Excellence academic routes in the doctoral and postdoctoral research – READ" co-funded from the European Social Fund through the Development of Human Resources Operational Programme 2007-2013, contract no. POSDRU/159/1.5/S/137926.

VII. REFERENCES

1. Allen, R. (Ed.) (2008). Human Ecology Economics: A New Framework for Global Sustainability, Routledge, Oxon.
2. Allen, R., Bedford, N. & Margitay-Becht, A., (2011). *A "human ecology economics" framework for Eastern Europe,* International Journal of Social Economics, 38(3), pp. 192-208.
3. Andersen, M. S. (2007). *An introductory note on the environmental economics of the circular economy.* Sustainability Science, 2(1), pp. 133-140.
4. Bøgild Hansen & J., Mikkelsen, S.E. (2001). *DME as a Transportation Fuel. Project carried out for The Danish Road Safety and Transport Agency and The Danish Environmental Protection Agency,* http://www.trafikstyrelsen.dk/~/media/Files/Publikationer/Engelske_pub/dme_eng.ashx, accessed on March 6, 2015.
5. Carr, E. R., Wingard, P. M., Yorty, S. C., Thompson, M. C., Jensen, N. K. & Roberson, J. (2007). *Applying DPSIR to sustainable development*, International Journal of Sustainable Development & World Ecology, 14(6), pp. 543 – 555.
6. Cormier, S. M. & Suter, G. W. (2008) *A framework for fully integrating environmental assessment*. Environmental Management, 42(4), pp. 543-556.
7. Costanza, R., Cumberland, J.H., Daly, H., Goodland, R. & Norgaard, R.B. (1997). *An Introduction to Ecological Economics*, Danvers, MA, CRC Press.
8. Crisp, J. (2014). *Circular Economy package to be ditched and re-tabled*, http://www.euractiv.com/sections/sustainable-dev/circular-economy-package-be-ditched-and-re-tabled-310866, accessed on December 28, 2014.
9. Ellen MacArthur Foundation (2012). *Report: Towards the Circular Economy - Economic and business rationale for an accelerated transition*, http://specials/Towards_A_Circular_Economy.pdf, accessed on December 1, 2014.
10. European Commission (2014a). *Scoping study to identify potential circular economy actions, priority sectors, material flows and value chains*, http://www.ieep.eu /assets/1410/Circular_economy_scoping_study-Final_report.pdf, accessed on December 11, 2014.
11. European Comission (2014a). *Roadmap to a Resource Efficient Europe* http://ec.europa.eu/environment/resource.pdf, acessed on February 2, 2015.
12. European Comission (2014b). *Moving towards a circular economy*, http://ec. europa.eu/environment/circular-economy/, acessed on February 2, 2015.
13. European Comission (2012a). *Manifesto for a Resource Efficient Europe*, http://eur opa.eu/rapid/press-release_MEMO-12-989_en.htm, acessed on February 25, 2015.

14. Flynn, V. (2014). *Ministers urge EC to back air quality, circular economy,* http://www.endseurope.com/38021/ministers-urge-ec-to-back-air-quality-circular-economy, accessed on March 5, 2015.
15. Geng, Y., Zhu, Q., Doberstein, B. & Fujita, T. (2008). *Implementing China's circular economy concept at the regional level: A review of progress in Dalian, China,* Waste Management, No. 1, pp. 1-7.
16. Tischner, U., Schmincke, E., Rubik, F., & Prosler, M. (2000). *How to Do Ecodesign?: A Guide for Environmentally and Economically Sound Design*, ed. German Federal Environmental Agency, Verlag form GmbH, Frankfurt am Main.
17. Gulikers, J. T. M., Bastiaens, T. J. & Kirschner, P. A. (2004). *A five-dimensional framework for authentic assessment*, Educational Technology, Research and Development, 52(3), pp. 67-86.
18. Hertin, J. F., Berkhout & S. M. Schepelmann, P., (2001). *Indicators for Monitoring Integration of Environment and Sustainable Development,* Enterprise Policy, Science and Technology Policy Research, Brighton, University of Sussex.
19. Hyman, J. B. & Leibowitz, S. G. (2001). *JSEM: a framework for identifying and evaluating indicators*,Environmental Monitoring and Assessment,66(1), pp. 207-232.
20. Keegan, D., Kretschmer, B., Elbersen, B. & Panoutsou, C. (2013). *Cascading use: A systematic approach to biomass beyond the energy sector*, Biofuels, Bioproducts & Biorefining, no. 7, pp. 193-206.
21. Kok., L., Wurpel, G. & Ten Wolde, A. (2013). *Unleashing the Power of the the Circular Economy. Report by IMSA Amsterdam for Circle Economy, http://www.circle-economy.com/wp-content/* accessed on November 28, 2014.
22. Marks, G., Hooghe, L. & Schakel, A. H. (2008a). *Measuring Regional Authority*, Regional & Federal Studies, 18(2), pp. 111 - 121.
23. Meadows, D.H., Meadows, D.L., Randers, J. & Behrens III, W.W. (1972). *The Limits to Growth: a Report for the Club of Rome's Project on the Predicament of Mankind.* New York: Universe Books.
24. Nieuwenhuis, P. & Wells, P. (2000) *The Automotive Industry and the Environment*, TJ international, Cornwall, England.
25. Noble, B. F. (2000). *Strengthening EIA through adaptive management: a systems perspective*, Environmental Impact Assessment Review, No. 20, pp. 97–111.
26. Preston, F. (2012). *A Global Redesign? Shaping The Circular Economy – briefing paper,h*ttp://www.ecoconnect.org.uk/download/Shaping, accessed on March 5, 2015.
27. Quevauviller, P., Balabanis, P., Fragakis, C., Weydert, M., Oliver, M., Kaschl, A., Arnold, G., Kroll, A., Galbiati, L., Zaldivar, J.M. & Bidoglio, G. (2005). *Science-policy integration needs in support of the implementation of the EU Water Framework Directive,* EnvironSci Policy, 8(1), pp. 203–211.
28. Randers, J. (2012). *The real message of The Limits to Growth: a plea for forward - looking global policy*. Gaia, 21(2), pp 102 – 105.
29. Sandu, D. (2011). *Disparitati sociale in dezvoltarea si in politica regionala din Romania,* International Review of Social Research, 1(1), pp. 1 - 30.
30. Tomás, B. R., Caeiro, S. & De Melo, J.J. (2004) *Environmental indicator frameworks to design and assess environmental monitoring programs*, Impact Assessment and Project Appraisal, 22(1), pp. 47-62.
31. Turner, G. (2008). *A comparison of the limits to growth within thirty years of reality*. Socio-Economics and the Environment in Discussion, http://www.manicore. com/Turner_Meadows_vs_historical_data.pdf, accessed on November 26, 2014.
32. Turner, R.K. (ed.) (1993). *Sustainable Environmental Economics and Management,* Belhaven Press, London.
33. Wallis, S. E. & Wright, B. (2014). *The science of conceptual systems: its history and usefulness for improved decision-making and organizational success*, http://meaningfulevidence.com/wp-content/uploads/science_of_conceptual_ systems1.pdf, accessed on February 3, 2015.
34. Wallis, S.E. (2014). *Propositional analysis for evaluating explanations through their conceptual structures, in Modes of Explanation: Affordances for Action and Prediction*, M. Lissack and A. Graber, Editors. Palgrave MacMillan: New York.
35. Wuelser, G., Pohl, C., & Hirsch Hadorn, G. (2012). *Structuring complexity for tailoring research contributions to sustainable development: A framework.* Sustainability Science, *7*(1), pp. 81-93.
36. Yong, G., Fu, J., Sarkis, J. & Xue, B. (2012). *Towards a national circular economy indicator system in China: an evaluation and critical analysis*, Journal of Cleaner Production, No.1, pp. 216-224.
37. Zhijun, F. & Nailing, Y. (2007). *Putting A Circular Economy into Practice in China,* Sustainability Science, 2(1), pp. 95-101.