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Multidisciplinarity, Interdisciplinarity and Transdisciplinarity: Theoretical Approaches and Implications for the Strategy of Post-Crisis Sustainable Development*

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Abstract. *The science of sustainability connects with many different disciplines and research areas in specific ways that implies the pursue of multi-, inter- and transdisciplinary researches. The paper proposes an insight into the key complex problems of sustainable economic development, by addressing this issue in relation to the concepts of multi-, inter- and transdisciplinarity, as well as exploring their implications and possible long-term effects on the post-crisis economic development.*

Keywords: multidisciplinarity; interdisciplinarity; transdisciplinarity; sustainability; crisis; complexity theory.

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1. Introduction

Sustainability has nowadays become a wide-ranging concept, which can be linked to every aspect of human life. It emerges at the meeting point of the three so-called “pillars” of sustainable development: social, environmental and economic sustainability (Figure 1). The pillars of sustainable development have in common the sustainability vector and other distinct features, according to the following scheme.

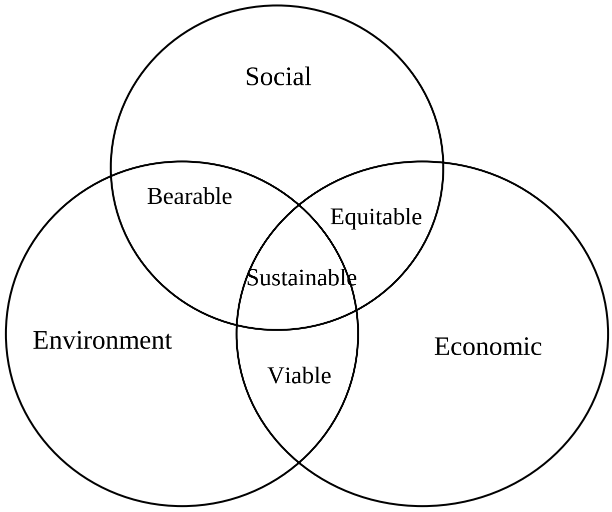

Figure 1. *Scheme of sustainable development at the confluence of the constituent parts*

Source: UCN 2006, *The Future of Sustainability. Rethinking Environment and Development in the Twenty-First Century*, Report of the IUCN Renowned Thinkers Meeting, 29-31 January 2006, http://cmsdata.iucn.org/downloads/iucn_future_of_sustainability.pdf

Since the 1987 Brundtland Commission report *Our Common Future* launched the idea that sustainability was the condition for satisfying human needs while avoiding environmental problems, a move toward more sustainable economic development emerged and many new techniques have arisen to help measure and implement sustainability.

Sustainability can be approached from different levels of reference, in time, space and from environmental, social and economic perspectives. The science of sustainability connects with many different disciplines and research areas and, being too complex to be fully understood using a single research method, specific ways of combining different disciplines have been envisaged. They are highlighted by the concepts of multi-, inter- and transdisciplinarity.

Multidisciplinarity results as a simple aggregation of different disciplines that preserve unchanged their specific perspectives. They share a relationship that is not interactive but rather cumulative and may work together to collaboratively create a more complex image of the reality. The subject of research can better reveal its various features when examined by different perspectives, using the methods and insights offered by several established disciplines.

Interdisciplinarity emerges from the process of combining and integrating various disciplines, along with their methodologies and assumptions. It involves crossing the traditional boundaries between sciences and mixing their techniques in the pursuit of a common goal. Methodologies and assumptions belonging to different disciplines are connected and modified in order to adapt to the needs of the research, creating new tools which allow for the investigation of difficult subjects that surpass the possibilities of a single discipline. In the field of economy, for instance, complex topics such as inflation, labour market, credit, stocks or exchange market imply various approaches that combine economics, mathematics, geography, politics, sociology, biology, physics and others.

Transdisciplinarity defines a research focused on problems that cross the boundaries of two or more disciplines, aiming at a holistic approach. It also implies concepts or methods that were originally developed by one discipline, but are now widely used by others.

The concepts of multi-, inter- and transdisciplinarity research are not antagonistic, but complementary, because they share the common goal of the understanding the reality. The main distinction between multidisciplinarity and interdisciplinarity lies in the relationship that the disciplines share: multidisciplinarity simply reunites a range of disciplines independently contributing to the investigation, while interdisciplinarity blends their methods generating new and improved tools, better adapted to the research topic. Transdisciplinarity goes beyond that, aiming at a unity of knowledge beyond disciplines, while the pursue of multidisciplinarity and interdisciplinarity always remains within the framework of disciplinary research.

Starting from these considerations, the paper proposes an insight into the problems of economic viability of sustainable development by addressing this issue in relation to concepts of multi-, inter- and transdisciplinarity and explores their implications on the post-crisis economic development.

General theoretical and methodological highlights of sustainability science

Sustainability science as a new area of scientific research was officially launched in 2001 in Amsterdam, at the World Congress "Challenges for the Changing Earth 2001" and is based on the concepts of sustainability and sustainable development (Komiyama, Takeuchi, 2006). Sustainability science is studying the development, integration and application of scientific knowledge about Earth systems, acquired in particular through holistic approach of geology, ecology, climatology, earth physics, oceanography, etc., in close coordination and interdependence with knowledge of Humanities field. The overall aim of sustainability science aimed at assessing, reducing and minimizing the consequences of human impact on planetary systems, in present and in the future, so that man can become a friendly manager (user) and a protector of Earth.

The concept of sustainability and its derivatives belong to a group of complex key concepts as equality, freedom, democracy, etc. and are the subject of ongoing scientific debate regarding the definition, scope and the possibility to be achieved in economic and social practice. Not surprisingly, there are about 300 definitions of sustainability (Ehrenfeld 2008). What is important though concerns its relationship, implicit or explicit, with the sustainable development and the environment, in a more or less interchangeable manner.

The fact that sustainability has been given so many definitions proves the following aspects at least:

- Real phenomena and processes subsumed under the category of sustainability are not only numerous but also complex and constantly moving, evolving or multiplication, differentiation;
- There is some doubt and confusion in the theoretical and methodological, because sustainability is a relatively new concept, specific emergent properties of complex systems (such as economic, social, environmental, technological, etc.). The subjective perceptions are various researchers/observers to examine the system of one or more ways, without fail settling holistic quality to meet the requirement of integrative unit;
- Sustainability is more quantifiable than measurable, which means that the metric system of quantitative indicators should be supplemented with qualitative assessments;
- Between the perception of "subjective" sustainability and show how its objectives are always the aspect of "failure" theories, working hypotheses (e.g. "caeteris paribus"), values and rules, in other words,

dichotomies objective/subjective involves Cartesian world observed by separating subjects observed objects (investigating, acting).

Sustainability is best defined as the possibility of certain natural and/or human systems to exist and work efficiently, now and in an undefined future.

Although associated with sustainable development, as opposed to it, sustainability is a category with a much broader scope. Sustainable development requires the ability to manage the economic and social development processes so that the land (environment) can support future generations in the same manner as the present ones (Brundtland Report, 1987) As a process, sustainable development is carried out continuously and “can not be achieved” a time limit.

What has been achieved so far for the cause and objectives of sustainability are but modest achievements on prevention/counter of “non-sustainability” which is emerging more strongly as a threat to the “economic, social and environmental pillars” on medium term development long, given the unanimous opinion that the current state of the Earth is unsustainable and unsatisfactory in terms of sustainability criteria. For now, non-sustainability measured in terms of quantity and of appropriate standards has constituted a factor of more dynamic emergence and awareness of the need to foster the transition to sustainability.

The measurement, quantification and reduction of non-sustainability based on complex calculations and evaluations, as well as application of specific combined methods of various sciences, has become a sine qua non condition of the underlying and implementation with better success chances some programs and strategies for the of sustainability economic and social development.

According to recent theoretical insights on sustainable development, the Brundtland Report definition was supplemented by the requirement to reduce adverse environmental impacts, in order to obtain more goods and services with less consumption of natural capital. This implies an increase of eco-efficiency which means reducing consumption of natural capital (or environmental impact) at a unit value or production of goods and services. Eco-efficiency increase is still a controversial issue in the literature. Since the nineteenth century, William Stanley Jevons’s (1865) thesis known as "rebound effect” or Jevons's paradox that technological improvements that increase the efficiency of a resource use tends to increase rather than reduce the rate of consumption of this resource. This paradox, based more on intuitive reasoning and theoretical deductions in terms of modern economic theories, was nuanced and customed in the sense that, besides reducing the amount needed for a given volume of production, improved efficiency reduces the relative cost of resource use, thus increasing the demand. The use of total resources will increase or decrease, depending on which effect predominates. Increased demand may or may not be large enough to offset the initial reduction in demand due to increasing eco-efficiency. Jevons Paradox occurs when the rebound effect is greater than 100%, exceeding initial efficiency gains. According to studies, the rebound effect in developed countries is generally low, so that eco-efficiency improvements, typically reduces total resource use.

In the case of a perfectly competitive market, in which the fuel is the only one input factor used and the only determining factor of labor cost, if fuel price remains steady, and the efficiency of its conversion to work is doubled, the actual price of labor will improve and, thus, one can buy twice as much work the same amount of money. If the work volume purchased increases over two times, therefore labor demand is elastic (price elasticity is greater than unity), then the amount of fuel used will not fall but actually increase. If the demand for labor is inelastic, the quantity of work purchased will be less than double and, in this case, the amount of fuel used will decrease.

A more comprehensive analysis should also take into account that there are several types of production inputs (fuel, machinery, labor) and that other factors besides inputs cost (e.g. a non-competitive market structure) can also affect the price of labor. All these factors tend to reduce the effect of fuel efficiency on the price of labor, thus reducing the rebound effect, making Jervons paradox to occur with a lower probability. In addition, any change in fuel demand will affect fuel prices and labor prices.

The Jevons paradox has been revised in the 80s (Khazoom and Brookes, 1987) in the direction of adding some arguments that the reduced energy consumption by increasing economic efficiency will simply lead to an increased demand for energy, for the entire national economy. In 1992 Saunders has hypothesized that improving energy efficiency, increase rather than reduce energy consumption in accordance with the Khazoom – Brookes postulate, in two ways: increased energy efficiency makes energy cheaper, which encourages an increased consumption (rebound effect); a higher energy consumption at the macroeconomic level will lead to a higher rate of economic growth, which in turn will increase again the volume of energy use, in the whole economy.

At the microeconomic level of an individual market segment, even if the rebound effect acts, the increased energy efficiency typically reduces energy consumption (rebound effect is usually less than 100%). At the macroeconomic level, a more efficient and therefore cheaper energy use may face the problem of market price increases due to more powerful manifestation of restrictions caused by depletion of fuel deposits and the inability of other competitive unconventional energy sources.

The rebound effect was also analyzed by Nicholas Georgescu-Roegen (1971, 1975, 1975a, 1975b, 1981) which supported the idea of economic “decrease” (décroissance économique) for the purpose of carrying out a production model and consensus to reduce waste and avoid unnecessary consumption of natural capital based on a mix of policies that promote the transition from “high” to “low” entropy so as to slow the process of gradual dissipation of matter beyond the possibilities of “reassembly” (reuse) of it. Georgescu-Roegen advocates decreasing the negative phenomena of production and consumption patterns that were exhausting the natural capital.

Sustainability science is faced with three ways of thinking in terms of economic growth in an environment with finite resources, namely:

- positive growth supported by the World Commission for Environment and Development, OECD, World Bank;
- zero growth;
- negative growth (Nicholas Georgescu-Roegen).

The thinking of Harlem Brundtland (Our Common Future, 1980) is more attractive because he supports continued economic growth combined with improving efficiency in energy and materials use. Underlying this thinking lies the idea that energy efficiency improvements make possible a positive rate of upward economic growth without increasing demand for energy carriers such as gas and oil. However, the problem with this approach to energy efficiency that would solve all energy problems, however, is that there is no certainty that the more efficient use of energy will automatically proportionately reduce the request for it. The rebound effect is a way to answer this question, being defined as that part of the originally expected energy savings resulting from improved energy efficiency that is lost due to environment-efficiency-economy interaction.

In a very consistent study, A.P.A. Musters (1995), analyzing the effects of complex issues of “rebound” effects for energy and other production factors, reached the following conclusions:

- following the rebound effect, some of the expected savings resulting from improved energy efficiency is lost due to the interaction energy-economy-environment;
- consumers conduct themselves so that they do not seek to minimize energy costs but rather want to maximize utility;
- the rebound effect is more than the optimistic assessments made by supporters of efficiency and lower than energy pessimists fear;

- reducing the rebound effect can be achieved through energy efficiency measures;
- policies that restrict consumption of various natural resources;
- because of the rebound effect, improving energy efficiency can not be regarded as a new source of energy supply.

As recommendations, the author suggests the research of the rebound effect in terms of its size and concept and the need to reduce the entropy by reducing and preventing pollution, as well as by eco-innovation.

Sustainability science also deals with success/failure mechanisms of capitalist market competition in terms of the capacity to ensure long term sustainability.

Thus James Gustave Speth (2008) points out that the American form of capitalism, with its imperative of continuing growth and dominated by profits, competition, outsourcing costs, short term and future discounts is causing deep environmental non-sustainability. Moreover, current ambientalism is deeply inefficient in terms of stopping and reversing the current trends. Environmental strategies underway in the last two decades, based on a narrow pragmatism and a limited focusing are unable to cope with the scale and complexity of current and future challenges of transition to sustainability.

Such strategies do not act on the root causes of the system that should be changed from within, through a major transformation. They should aim, first, human welfare, avoid low-control consumerism and the accumulation of personal wealth and promote simple, sober and austere lifestyles, less hurried, more spiritual and more restful. According to Speth's, the modern capitalist system must be radically transformed, and post-growth society must forget the growing production and consumption.

The distinction that is being made between strong and weak sustainability comes just in support of substantive reforms towards public-private partnership, social values, given that the environment is the most comprehensive “public good” and that rivalry and competition – specific to the private sphere – should not affect (undermine) its capacity to support the sustainability for “everyone” on the short, medium and long term.

Multidisciplinarity, interdisciplinarity and transdisciplinarity – the requirements of sustainability research

R & D and innovation in sustainable development area implies to a greater extent outstanding efforts of professionals from various fields and scientific disciplines due to the growing complexity of economic and social processes and phenomena and the need to respond to the challenges of increasing environmental risk as well. Therefore, we will refer further to many important aspects of multi-, inter- and transdisciplinarity in RDI, as prerequisites for adequate results in theoretical, methodological and practical approaches.

Multidisciplinarity is a non integrative combination of scientific disciplines, in which each discipline retains its own working methodologies and assumptions without changes or development work in other subjects within multidisciplinarity.

Multidisciplinarity differs to interdisciplinarity in how the relationship between scientific disciplines manifests itself through acquisitions or mutual borrowing of theories, methods or assumptions. Thus, within the multidisciplinary relationships, cooperation between scientific disciplines may be “mutual and cumulative, but not interactive” (Augsburg, 2005, p. 56).

Interdisciplinarity involves settling of new working practices and assumptions of each discipline involved. In this respect, we may give the example of sustainability science that has customizations in virtually all scientific disciplines (ecology, economics, sociology, medicine, chemistry, earth sciences, etc.), which are combined into new methods of integrative research. Typically, the emergence of new paradigms is due to transition from one phase to another in the progress of science and technology, such as the shift from mechanics (mechanization) to electricity and superconductivity (electronics, informatics, etc.), which allowed more intensive acceleration of the sequence of processes, up to their quasi-simultaneity.

An interesting type of interdisciplinarity is the relationship between physical sciences and economics which have generated the so-called new scientific disciplines. Econophysics, as a research area that applies theories and methods originally generated by Physics, addresses economic problems especially in the areas of uncertainty, stochastic processes, nonlinear dynamics and financial markets. The term was first used by Eugene Stanley (2006), in the mid 90s to denote a series of researches conducted by physicians for problems related to market and prices. As a result, journals specifically devoted to econophysics studies emerged and the contributions published came from several renowned physicists.

Interference between physics and economy is rooted much more distant, starting from elasticity theory, multiplier, accelerator (JM Keynes) and oscillator, if not the optimum of Vilfredo Pareto (1897), who first observed differences in income distribution between socio-professional categories, currently analysed by econophysics with the power law model (power law distributions) applied to forecast the price of capital and other processes in financial markets.

The main tools of econophysics are the probabilistic and statistical methods, chaos models, self-organizational models, models for forecasting earthquakes (Ball, 2006) etc.

Since economic phenomena are the result of the interaction of a multitude of complex and heterogeneous factors such research is carried out using the methods of statistical mechanics and taken to the specific economic behavior of individuals starting from the laws governing the interaction of physics particles. Other areas of physics that have found application in economics: fluid dynamics, classical and quantum mechanics (including so-called classical and quantum savings), the diffusion laws, gravity models, chaos theory (Mantegna et al. 1999; Bouchaud, 2006, Chakrabarti et al, 2006, McCauley, 2004, Chatterjee, 2005, Mirowski, 1983, Sornette, 2004).

Interdisciplinarity involves researchers and professors from many fields of science, in order to achieve common goals or solve complex problems that can not be satisfactorily studied by only one field of science. In the economy, for example, complex phenomena such as inflation, foreign exchange and credit, labor, etc. imply multidisciplinary approaches involving the fields of economy, geography, politics, sociology, biology, physics, chemistry, etc.

In other words, interdisciplinarity involves studying a phenomenon (domain) from several combined points of view, based on complementary methods and usually results in the generation of new tools for analysis and forecasting to better understand the phenomenon. Therefore, the common goal of understanding, analysis and forecast a particular topic, requires, from the perspective of interdisciplinarity, the combination of different research methods, specific to certain disciplines. Precisely for this reason, interdisciplinary research programs are based on the widely accepted view that the traditional scientific disciplines are unable to resolve a major problem now facing science in general, and economy, society and environment, in particular.

A number of disciplines of Economics (macro and microeconomics, finance, international and domestic trade, labor, etc..) gave insufficient attention to analyzing the impact of technological progress since the twentieth century, particularly that of ICT, nanotechnology, bioinformatics, molecular biology. Currently, interdisciplinary research teams are trying to eliminate this shortcoming by complementary efforts.

Interdisciplinarity is also considered as a solution to the adverse effects that excessive specialization may generate. Encyclopedists time has passed and now, given the great volume of accumulated knowledge in all fields of science, news and career recognition is based on professional expertise of researchers, which becomes more narrow, but gains depth. Interdisciplinarity comes to fill any gaps of specialization in science, enabling cooperation, consultation and mutual support from specialists in various fields, having common goals, objectives and common problems that transcend scientific disciplines through a series of general challenges. The result from interdisciplinary collaboration is to identify new solutions, methods, mechanisms and research tools for one or more of the sciences, as a result of induced complementarity between them.

Challenges of multi-, inter- and transdisciplinary research

In a multidisciplinary research program, as opposed to interdisciplinary, two or more scientific disciplines cooperate and associate without integration. Each discipline develops its own objectives, its results and builds new paradigms and methods, and integration, where appropriate, can be made successively or by a third party. Multidisciplinary teams are made up of people from different areas (disciplines), different scientific professions, working together as stakeholders to cope with common challenges. If multidisciplinarity, difficulties can occur in connection with the decomposition or separation in aspects of the common problems and their resolution based on the knowledge of each field within a single project. Multidisciplinary teams may be faced with communication problems, compatibility, common language and terminology, terms and permanence of cooperation etc.

Addressing these challenges running on repeated experiences of work in multidisciplinary projects will lead to effective and creative results. Sometimes, multi scientific staff can have dual qualification, creating the possibility that as a single person replaces two professions in a multidisciplinary team. However, multidisciplinarity does not result in an increase or decrease the number of scientific disciplines as for interdisciplinarity.

Interdisciplinary research projects rely on researchers from different disciplines and professional staff to create and apply new knowledge, working together as equal stakeholders to solve a common problem or to achieve a complex goal, common to all participants. Interdisciplinary teams' main problem consists in identifying, shaping new knowledge or scientific sub discipline, which exclude the existing perimeter. Such a challenge, as complex as difficult, requires very close interaction and effective cooperation of specialists from several fields of science to identify and enhance new knowledge/subfields of science. Interdisciplinary research teams members have professional qualifications in one or more fields of science, and skill and experience of interaction, cooperation in a multidisciplinary area, the prerequisites for identifying new sub domain problems, aspects of science. The requirement of qualification and professionalism of the members of interdisciplinary research teams is one of the conditions that lead to increased research and reduce the number of academic disciplines. Another category of scientific cooperation which envisages sustainability refers to transdisciplinarity which usually involves the abolition of borders, barriers between scientific disciplines.

In most cases of transdisciplinarity, there is a strong transgressive overlapping of the legalities of different scientific disciplines, in order to find new areas of knowledge and expand its development resources. Transdisciplinarity involves complex processes of integration and correlation of knowledge belonging/not belonging to scientific disciplines and their application in order to research complex phenomena and processes, poorly understood or new, emerging in the economic and social life or in the environment.

Transdisciplinarity is based on the use of independent methods and theories from several disciplines and their application to shape, structure and understand various phenomena and processes of society and nature. The basic idea of transdisciplinarity relates to the argument by which scientific knowledge can not be regarded as belonging to or coming from only a single field or subfield of science. Transdisciplinarity occurs when a philosophy, a philosophical movement or a general hypothesis applies to other fields of science and forms new complex systems, legitimates relationships and structures.

Transdisciplinary research projects involve the participation of professionals from various fields to form research teams in joint scientific conditions of each of the participants and shared knowledge of staff are similar in order to elucidate a common problem. The concepts of “postmodern” transdisciplinarity considers scientific knowledge generation not as an attribute impacting in a horizontal plane, but the outcome of a multitude of research teams, in a vertical plane, outside academia.

Transdisciplinary scientific production can be generated from organized structures in the less complex communities, including those randomly produced scientific results of the individuals or collective research groups, leaders or members of those groups.

Interdisciplinary projects are characterized by an intensive cooperation between the participating researchers that must develop a proactive and responsive attitude to other disciplines which interface with its own discipline, abandoning the tendency to consider the precepts and imuable in the scientific field that the researcher is specialized in. They must overcome barriers to perceive science as a new “soft” interdisciplinary field, without the rigor and vigor of mature disciplines with practical experience and theoretical and methodological lengthy. Therefore, by novelty, fragility and vulnerability specific to the begun of any scientific field, interdisciplinary face serious obstacles in terms of career prestige and strength, obtaining funds, promoting and supporting the needed policy mixes. The high risk and vulnerability of an interdisciplinary research project is what make evaluators be reluctant to award high scores to interdisciplinary projects. On the other hand, evaluators may be insufficiently skilled to understand the value and methodology of an interdisciplinary project.

Interdisciplinary researche requires a certain degree of autonomy in their conduct. Any “imperative coordination” or “narrow dominance” of one of the traditional scientific disciplines, participating in an interdisciplinary project, may inhibit or damage the new scientific contribution of interdisciplinary research. In an interdisciplinary scientific team, a scientific discipline should not be considered “superior” to the others or opposed to them. Applying the principle of “par in parem non habet imperii” (the peers have no empires) premise seems to be adequate for ensuring the effectiveness of transdisciplinary work. This interdisciplinary project prerequisite for efficiency should not deny the need to establish priorities and, where necessary, the hierarchy imposed by clear and objective reality.

Multi-and interdisciplinary research are facing difficult problems regarding the supply of the necessary funds for projects. Both the academic research, institutes and industry prefer projects with a lower risk from traditional fields of science, the receptivity to new being poor. Funding restrictions are most strongly felt in situations of recession and economic and financial crisis, as is the case of subprime crisis in the US in September 2008, which spread in the whole economy.

Given the opposition that multi- and interdisciplinary research faces, it is necessary that it becomes, through the results, methodology and application status, a well defined quasi-autonomous scientific discipline, with its own resources to finance programs. This will allow easier entry to specific R & D and innovation market. Nanotechnology, biotechnology, biomedical engineering, biochemistry, etc. are many and interdisciplinary scientific fields that have managed to overcome major obstacles to ensure the financing.

Interdisciplinary research, field of synthesis of scientific knowledge, of interdependence of scientific and epistemological disciplines, facilitates the study of phenomena and processes with high complexity and importance that can not be understood through isolated mono-disciplinary approaches. Sustainability science is interdisciplinary by its very content because it analyses the possibilities of further complex economic and social progress of mankind, on an indefinite time horizon, taking into account the need to maintain ecological balance and good functionality of natural and human capital, in terms of intra- and intergenerational cooperation, welfare and growth, through a new vision.

Interdisciplinarity is based on a new flexibility and institutional configuration of research, reducing its fragmentation and isolation on traditional disciplines. Whilst acknowledging the still relatively low degree of synthesis and accuracy of research methodology, the supporters of interdisciplinarity consider of paramount importance to educate the younger generation, to inform and involve managers, leaders and citizens with new knowledge that provide opportunities for implementing, information and analysis, evaluation and synthesis of multiple sources, in order to better underline the decisions at different levels of economic and social aggregation.

Opponents consider that interdisciplinary research in this area is unfounded, unrealistic and that many of the questions raised can be resolved with existing tools of traditional scientific disciplines. Such a concept began to take an increasingly small number of supporters.

It is promising that the universities in Romania note a focus on interdisciplinary curricula for a wider training of graduates that may find a job easier. Romanian research programs, National Strategy for Research, Development and Innovation are linked to interdisciplinary guidelines of the EU FP7, 2007-2013 and the European Research Area policy regarding sustainability science. Issues of sustainable development in Romania and internationally are virtually included in research programs of most universities in our country, where research centers in this area were created and operate and cooperate with similar institutions on a national or international level (UN, EU, EEC, etc.).

Academic and research institutions of sustainability in most countries have increased and have acquired scientific consistency precisely because the "sustainable attribute" is associated with various areas of economic and social activities.

In England and the Netherlands operate various programs such as Bachelor, Masters and PhD, as well as interdisciplinary research centers with a broad spectrum, devoted to sustainability science, including social sciences, economics, environment, technology, mathematics, systems theory etc. Sciences Po University in Paris (France) was interdisciplinary since its establishment in 1873, including economics, law, political science, business and sociology. In the US, there are several universities of interdisciplinary orientation: The Center for Studies of Interdisciplinarity (http://csid.unt.edu); The Faculty of Graduate Studies, University of British Columbia; Fairhaven

College in Bellingham, Washington; Stanford University (Bio-X program - biology, computer science, medicine, engineering); University of Pennsylvania, etc.

Sustainability science has become one of the most requested and fertile fields of international scientific cooperation within which function multi-and interdisciplinary networks of researchers from different countries, which directly or indirectly involve international organizations and research centers with public and/or private participation.

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