

From Human-Environment Interaction to Environmental Informatics (II): the Sustainability evolution as requirement of Knowledge-based Society

PhD stud. **Bogdan CIORUȚA**¹, Assoc. Prof. Eng. **Mirela COMAN**², Stud. **Alexandru LAURAN**²

¹Technical University of Cluj-Napoca - North University Centre of Baia Mare, Office of Information and Communication, 62A Victor Babeș str., 430083, Baia Mare; bogdan.cioruta@staff.utcluj.ro

²Technical University of Cluj-Napoca - North University Centre of Baia Mare, Faculty of Engineering, 62A Victor Babeș str., 430083, Baia Mare; comanmirela2000@yahoo.com | alexandru.lauran@cunbm.utcluj.ro

Abstract: *The idea of sustainable development is without doubt the most used phrase, with reference to environment in the last half century. Sustainable development has been defined in many ways, but the most frequently quoted definition is from Our Common Future, also known as the Brundtland Report. Sustainable development - the development that meets the needs of the present without compromising the ability of future generations to meet their own needs - has continued to evolve as that of protecting the world's resources while it's true agenda is to control the world's resources. Environmentally sustainable economic growth refers to economic development that meets the needs of all actors involved without leaving future generations with fewer natural resources than those we enjoy today.*

The purpose of this paper is to focus on the durable form of contemporary development as a stable relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life at least as good as our own. The idea of green economic growth, synonym to the prevalent concept of 'Sustainable Development', is not new, many cultures over the course of human history have recognized the need for harmony between the environment, society and economy.

Keywords: *Sustainability, knowledge-based society, circles of sustainability, sustainable communities*

1. Introduction

The idea, and the concept itself, of sustainable development - as the latest over-time consecrated version of sustainability - is, by far and without doubt, the most used phrase, with reference to environment, and not only, in the last half century. The concept of sustainable development (SD) has been defined in many ways, but the most frequently quoted definition is taken from Our Common Future, known as the Brundtland Report, released by The United Nations in 1987 [1]. Sustainable development - *the development that meets the needs of the present without compromising the ability of future generations to meet their own needs* [2] - has continued to evolve as that of protecting the world's resources while it's true agenda is to control the world's resources. Environmentally sustainable growth - as part in the three pillars of the sustainability pyramid concept (Fig. 1) - refers to economic development that meets the needs of actors involved without leaving future generations with fewer natural resources than those we enjoy today.

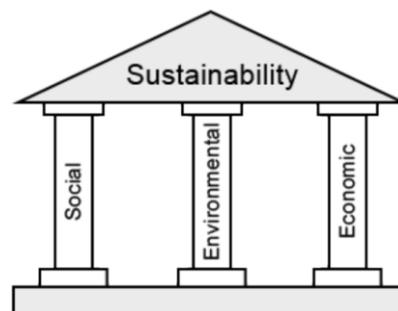


Fig. 1. The three pillars of the sustainability concept: social-environmental-economic

The purpose of this paper is to focus on the contemporary sustainable development as a stable relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life at least as good as our own.

2. From environment protection initiatives to sustainability

2.1 Environmental protection initiatives

Although from a practical point of view, the voluntary concern for nature protection has accompanied man since ancient times, sporadically appearing after the 1st millennium BC, the concept of protection the environment remains the fruit of modern society (Fig. 2) - being outlined in agreement with science evolution, which underpins the progress of the communities [3, 4]. In addition, the idea of green economic growth, synonym to the prevalent concept of ‘Sustainable Development’, is not new, many cultures, over the course of human history, in particular after “the environment” gained its place in the public international and national agenda, have recognized the need for harmony between the environment, society and economy [5].

Era of over exploitation	Era of environment protection	Era of scientific management	Era of environmental management	Era of conservation and development
before 1850	1850 - 1900	1900 - 1930	1930 - 1980	after 1980
Post industrial revolution damage to environment	Realisation of damage and efforts through national legislations	Adopted more scientific approach to conservation	More public involvement and a doption of conservation strategies	The idea of sustainable development

Fig. 2. The timeline of the environmental conservation concept

Protecting the environment is essential to the quality of life of present and future generations in all kind of industrialized societies or communities [6]; the current challenge is to combine environmental protection with continuous economic growth in a sustainable manner. In the field of environmental protection, there are a large number of organizations that conserve, analyze and monitor the environment in different ways (Fig. 3), all of which can be both global and regional, as well as national and/or local.

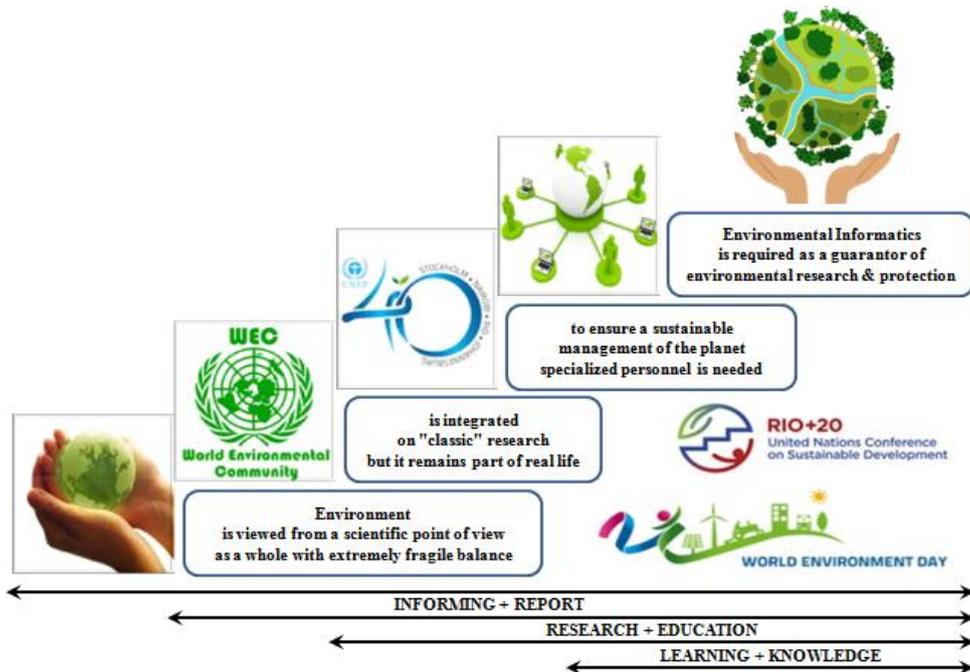


Fig. 3. The main issues specific to environmental protection initiatives

The United Nations Environment Program (UNEP) - was established immediately after the United Nations Conference on Human Environment held in Stockholm in 1972. UNEP is mandated to coordinate the integration of environmental protection policies across the other sectors, in order to ensure sustainable development - an aspect that remained in the attention of the next international events (Fig. 4).

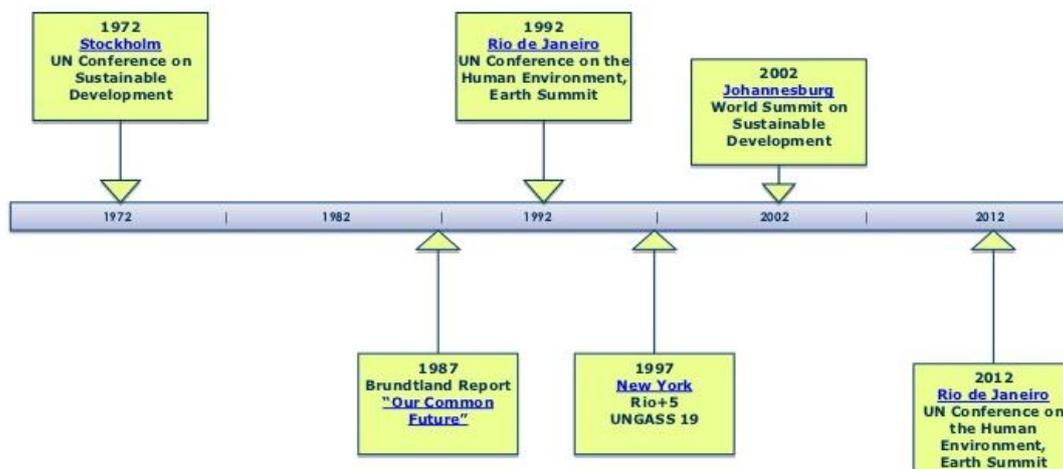


Fig. 4. The main international conferences regarding the environment protection

The UNEP mandate has been permanently strengthened, currently acting to implement the decisions taken at the highest political level at the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 at the World Summit on Sustainable Development held in Johannesburg, 2002 and the Rio+20 Summit.

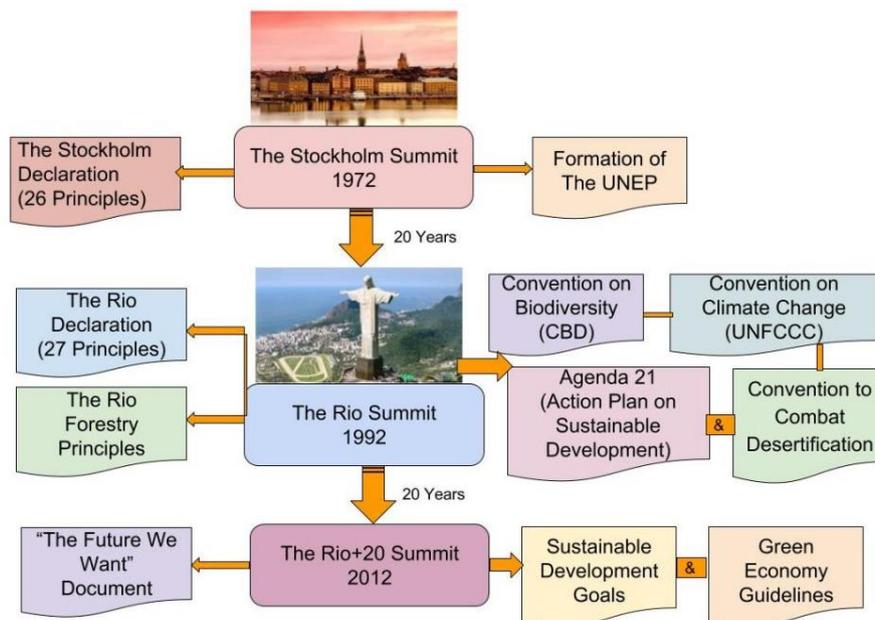


Fig. 5. The global environmental summits [3]

Sustainable development in terms of international events (Fig. 5) is defined by a number of issues, including among others [8, 9]:

- compatibility between the anthropic environment and the natural environment;
- equal opportunities between generations that coexist and succeed in time and space;
- putting ecological security at the forefront instead of maximizing profits;
- the compatibility of the national development strategies with the requirements of extending the interdependencies in a geo-economic and ecological plan;
- ensuring overall welfare with a focus on the quality of sustainable economic growth;
- organic integration between natural and human capital within a global category that redefines its economic and social goals and extends its time and space horizon;
- moving to a new strategy where the objectives of economic and social development are subordinated both to man's development and environmental recovery.

2.2 Defining and exploring the sustainability concept

There is no universally agreed definition on what sustainability means. There are many different views on what it is and how it can be achieved. The idea of sustainability stems from the concept of sustainable development which became common language at the World's first Earth Summit in Rio in 1992. The original definition of sustainable development is usually considered to be:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Bruntland Report for the World Commission on Environment and Development (1992)

Since then, there have been many variations and extensions on this basic definition. Many argue that sustainability has been hijacked and twisted to suit government and business that really want to continue with business as usual (Fig. 6).

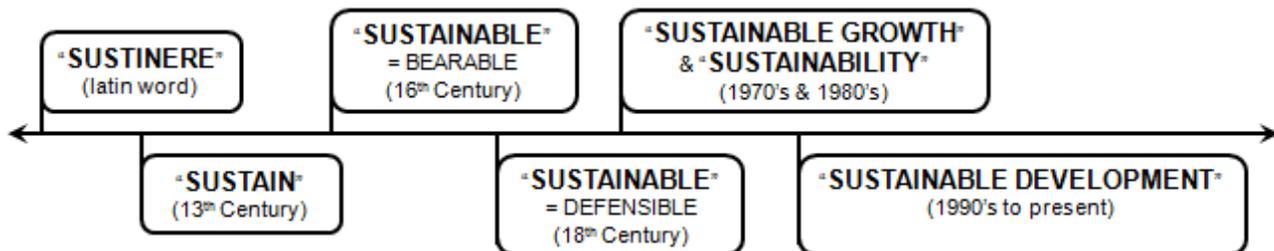


Fig. 6. Exploring the sustainability concept over time

The quotes below will provide some ideas on what constitutes sustainable development and sustainability [10].

- "A process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations"
(The World Commission on Environment and Development)
- "Sustainable development is a dynamic process which enables people to realise their potential and improve their quality of life in ways which simultaneously protect and enhance the earth's life support systems"
(Forum for the Future)
- "In essence sustainable development is about five key principles: quality of life; fairness and equity; participation and partnership; care for our environment and respect for ecological constraints - recognising there are 'environmental limits'; and thought for the future and the precautionary principle".
(Forum for the Future's Sustainable Wealth London project)
- "The environment must be protected... to preserve essential ecosystem functions and to provide for the wellbeing of future generations; environmental and economic policy must be integrated; the goal of policy should be an improvement in the overall quality of life, not just income growth; poverty must be ended and resources distributed more equally; and all sections of society must be involved in decision making"
(The Real World Coalition, 1996)
- "We cannot just add sustainable development to our current list of things to do but must learn to integrate the concepts into everything that we do."
(The Dorset Education for Sustainability Network)
- "A sustainable future is one in which a healthy environment, economic prosperity and social justice are pursued simultaneously to ensure the well-being and quality of life of present and future generations. Education is crucial to attaining that future."
(Learning for a Sustainable Future - Teacher Centre)
- "The first and perhaps most difficult problem, one that seldom gets addressed, is the time frame...Is a sustainable society one that endures for a decade, a human lifetime, or a thousand years?"
(The shaky ground of Sustainable Development in Global Ecology, 1993)

Sustainability is a set of conditions and trends (path, direction) in a given system that can continue indefinitely, and sustainable development is a strategic process of continuous change (tools) - having different meaning (Fig. 7) - in the direction of sustainability.



Fig. 7. Sustainability having different meaning to different people

Sustainability has different meaning to different people:

- *engineer perspective*: "...the process of designing or operating systems such that they use energy and resources sustainably, i.e., at a rate that does not compromise the natural environment, or the ability of future generations to meet their own needs";
- *architect perspective*: "...architecture that seeks to minimize the negative environmental impact of buildings by efficiency and moderation in the use of materials, energy, and development space";
- *economist perspective*: "...The use of various strategies for employing existing resources optimally so that that a responsible and beneficial balance can be achieved over the longer term";
- *farmer perspective*: "...the farming act using principles of ecology, the study of relationships between organisms and their environment...as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term".

Sustainability concepts include among others:

- long-term balance between economic, social and environmental goals (look ahead 20-50 years, understand the connections);
- limits to natural, social, and built systems (live off the interest of community capital, don't degrade or use it up);
- inter- and intra- generational equity (share with future generations and current inhabitants, local sustainability in harmony with global sustainability rather than at expense of others).

As well, the main directions for action, detailed by sector and time horizon, on sustainable development in the context of the knowledge society, are [8, 9]:

- the rational correlation of development objectives, including investment programs in an inter-sectoral and regional profile, with the potential and capacity to support natural capital;
- accelerated modernization of education and training systems, public health and social services, taking into account demographic developments and their impact;
- generalized use of the best available economically and environmentally-friendly technologies in investment decisions, and firm introduction of the eco-efficiency criteria in all production and service activities;
- ensuring food safety and security without compromising the requirements for maintaining soil fertility, preserving biodiversity and protecting the environment;
- meeting the international standards of life quality;
- anticipating the effects of climate change and developing both long-term adaptation solutions and inter-sector contingency plans, including portfolios of alternative solutions to crisis situations generated by natural or anthropogenic phenomena;
- protecting and capitalizing on the cultural and natural heritage by revitalization in modernity of traditional ways of living, especially in mountain and wetlands.

Sustainable design, as described above, becomes and engage a new level of perception, design, and enterprise (Fig. 8), based on the recognition that humans are a major part of our planet's processes. Thus our effect on these processes must become more optimal in order to sustain ourselves, other species and the planet as we know it.

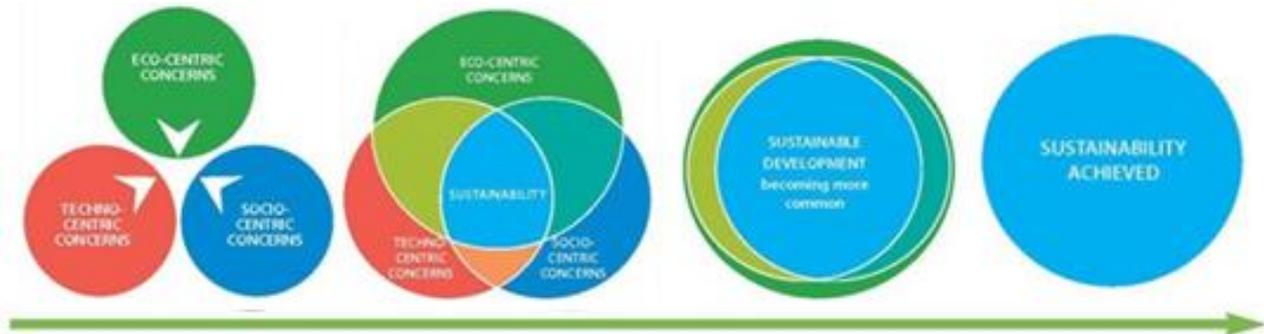


Fig. 8. The three pillars of the sustainability concept: social-environmental-economic

In the transition from the eco-socio-technocentric concerns trinom (where for the first time information technologies have produced unprecedented changes in society in all its aspects) [11] to sustainability (Fig. 9), there is an advanced form of sustainable development, in which the spectrum of definitions and concepts is folding and complements some design considerations.

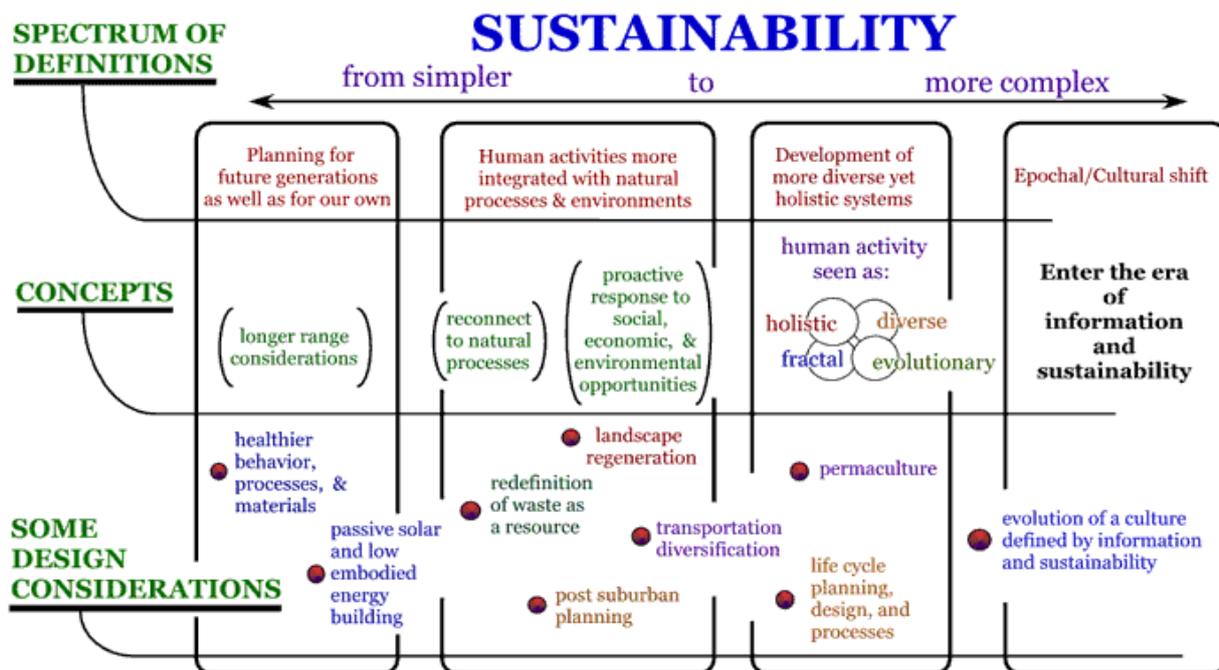


Fig. 9. Sustainability spectrum of definitions, concepts and design considerations [12]

3. Sustainable Development concept evolution

3.1 SD concept-diagram with 3 parameters (Venn diagram)

The term “sustainability” has two connotations in the context of an social-ecological system (SES). First, sustainability is a goal state that includes the maintenance of the environment and human well-being. Second, sustainability also means the durability of a given state over time.

The 2005 World Summit on Social Development identified sustainable development goals, such as economic development, social development and environmental protection. This view has been expressed as an illustration using three overlapping ellipses (Fig. 10), indicating that the three pillars of sustainability are not mutually exclusive and can be mutually reinforcing. In fact, the three pillars are interdependent, and in the long run none can exist without the others.

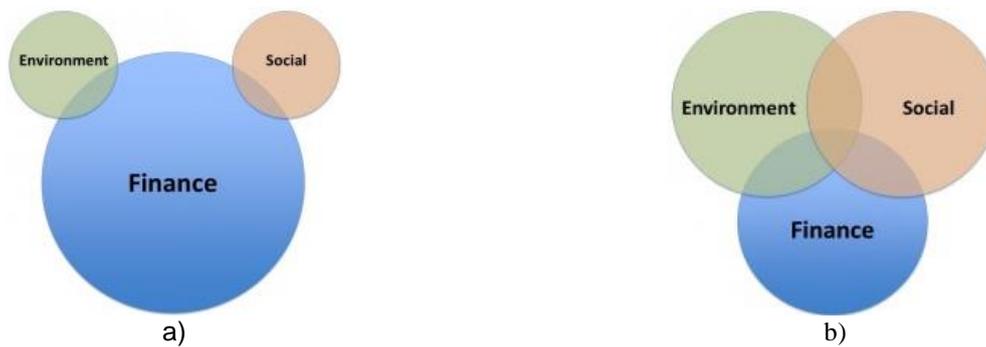


Fig. 10. Examples of the SD concept-diagram with 3 parameters:
 a) “Mickey Mouse” model; b) Shallow model - separate yet connected systems

Remaining at the sustainable development concept-diagram with 3 parameters, we discover, in the vast literature of the environment protection, a series of models (Fig. 11) of which we mention the following, as being the most relevant and frequently used in defining the principles of the current society development.

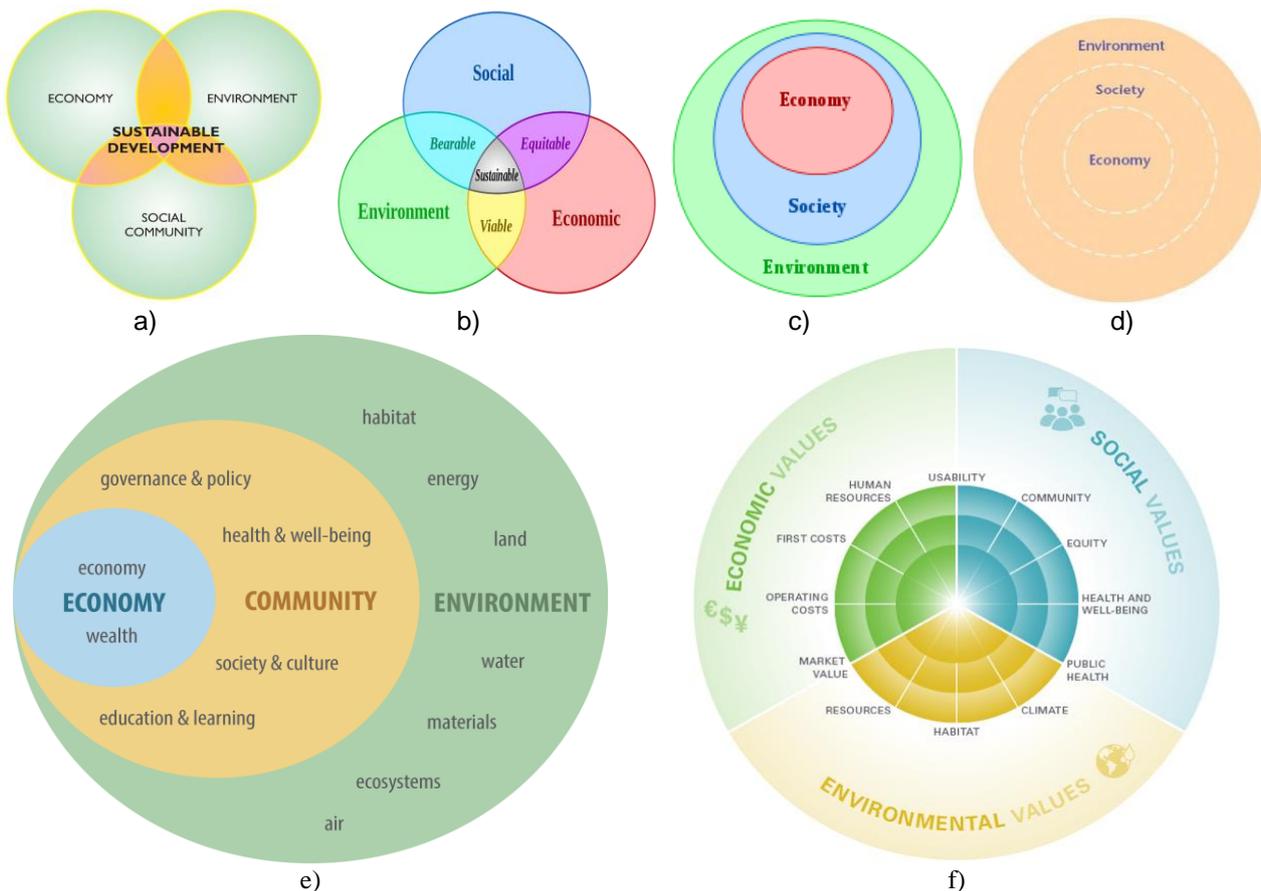


Fig. 11. Examples of the SD concept-diagram with 3 parameters (Shallow or overlapping circles models):
 a) Venn diagram model; b) overlapping circles model; c) nested-dependencies model; d) “bullseye” model;
 e) nested-dependencies model; f) the sustainable performance wheel model

3.2 SD concept-diagram with 4 parameters (circles of sustainability)

More recently, using a systematic domain model that responds to the debates over the last decade, the *Circles of Sustainability* approach (Fig. 12) distinguished four domains of *economic, ecological, political* and *cultural sustainability*; this in accord with the United Nations, UNESCO, and in particular the Agenda 21 for culture which specifies culture as the fourth domain of communities sustainable development.

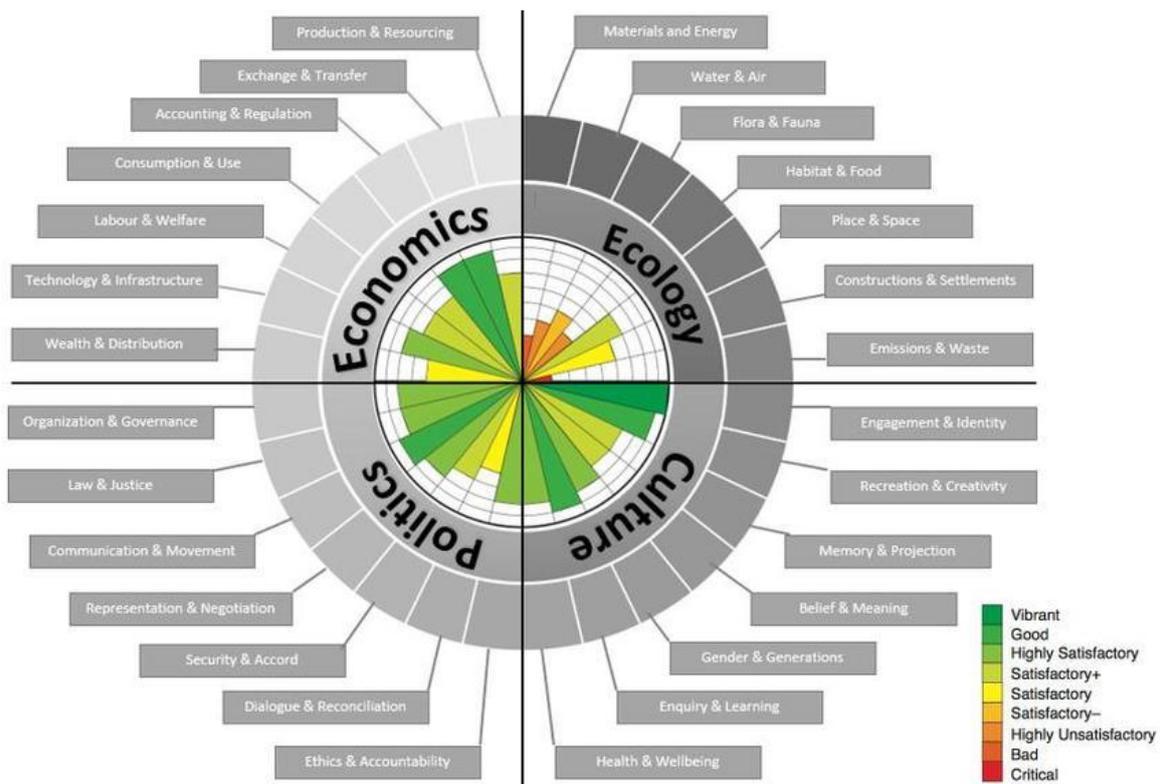


Fig. 12. Examples of the SD concept-diagram with 4 parameters - circles of sustainability [13]

3.3 SD concept-diagram with 5 or more parameters (sustainable communities)

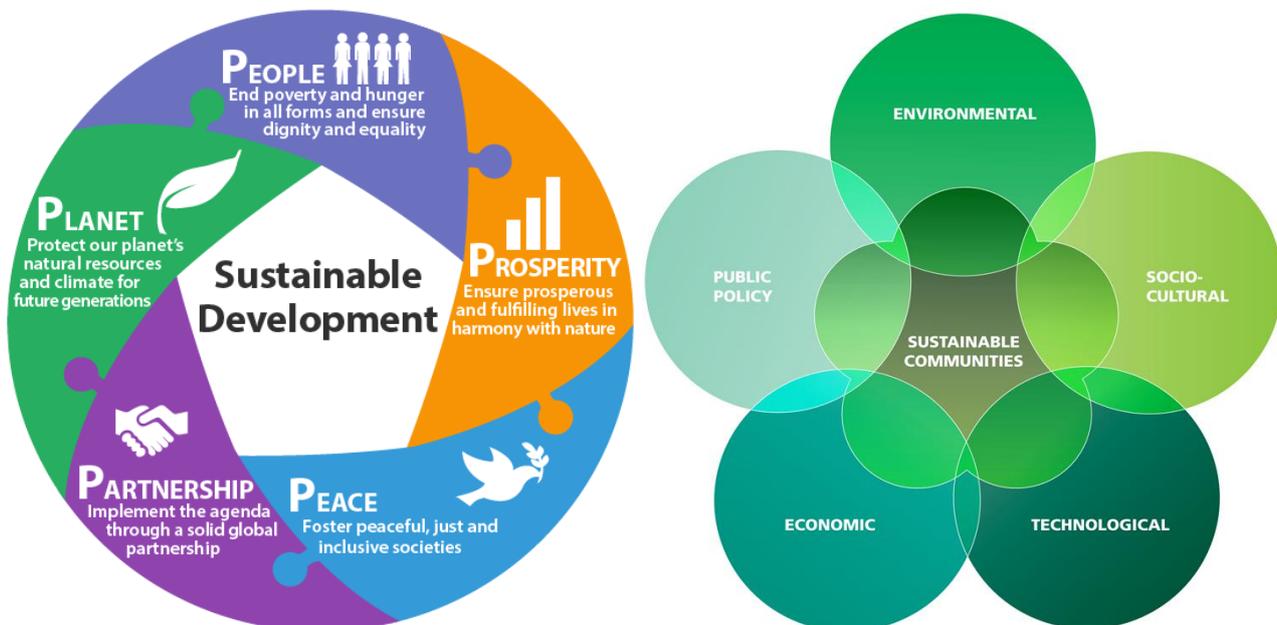


Fig. 13. Examples of the SD concept-diagram with 5 parameters [14, 15]

The transition from a community developed by sustainable principles (via circles of sustainability approach) to a community designed and cultivated, from the very beginning, as a sustainable one, involves the appearance and consideration of at least one new element - governance (Fig. 13). Considering all the models so far, we managed to synthesize and compare the considered approaches, the results of the comparative study being exposed in Table 1.

Table 1: Observations regarding the sustainability concept representation

No.	Sustainability by		Sustainable linkage	Observations
	representation	content / description		
1	SD concept-diagram with 3 parameters	Venn diagram model	weak link	models that establish an incipient connection, only among the essential elements
		overlapping circles model	weak link	
		nested-dependencies model	weak link	
		“bullseye” model	weak link	
2	SD concept-diagram with 4 parameters	<i>Circles of Sustainability</i> approach	weak to medium link	patterns that establish an incipient relationship, but they also look at the community
3	SD concept-diagram with 5 or more parameters	<i>Sustainable Communities</i> approach	medium to strong link	patterns that establish a strong link, they have in mind the community and its specificity

In line with the observations mentioned in the table above, an eminently new model for sustainable development can be defined, with reference to 5 aspects of the contemporary world - closely related to the main global goals for sustainable development - that require a particular attention (Fig. 14), namely: a sociable, a clean, a productive, a resilient and a thriving world.



Fig. 14. Sustainable Development in connection with the main global goals of Knowledge-based Society

This latest model - which can be adapted to the demands of knowledge-based society and environmental informatics - is, by far, the one that best defines the concept of sustainable development, being equally capable of encompassing the main international preoccupations with reference to the community and its sustainable development.

4. Conclusions

The concept of sustainable development had as its starting point the global ecological crisis of 1929-1933 and later developed through the incorporation of all economic and social spheres, and now sustainable development is the new path of humanity. Sustainable development has been conceived as a solution to the ecological crisis caused by intensive industrial resource exploitation and the continuous degradation of the environment, and primarily seeks to preserve the quality of the environment.

Sustainable development promotes the concept of reconciling economic and social progress without jeopardizing the natural balance of the planet. The idea underlying this concept is to ensure a better quality of life for all the inhabitants of the planet, both for the current generation and for future generations.

In the context of Knowledge-based Society, sustainable development brings in the forefront a new set of values that will guide the future model of economic and social progress, values that focus on man and his current and future needs, the natural environment - protecting and preserving it, and mitigating the current deterioration of ecosystems.

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