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Textbook on

**SOCIAL AND ECONOMIC
POTENTIAL
OF SUSTAINABLE
DEVELOPMENT**

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This textbook is prepared by scientists from 15 countries. It deals with the theoretical and practical aspects of sustainable development. The textbook focuses on complex relationships between human beings, biosphere and economy. The book represents a unique supplementary reading material in addition to lectures on sustainable development for both bachelor and master's students, and their instructors. It also targets other interested in sustainable development parties such as environmental experts and/or companies, unions, NGOs, government authorities and others.

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Sustainable Development Shapes a New Way of Thinking (Preface)

Having defined an increase in social welfare and security of a human being safety, as well as his strive to live and create in harmony with nature as the main goal of a country's development, equipped with fundamental principles, formulated by the UN Conference on Environment and Development (Rio de Janeiro 1992) currently many countries, including Ukraine, begin their transformation process, which due to its character and resource utilization, investment policy, science, education, technological change, nation security will comply with current and future needs, and will create favourable conditions for transition to sustainable development (SD).

Sustainable development is a viable solution to one of the largest problems of humanity. In fact, it is about the very existence of human civilization compelled to search for an answer, whether or not the global community would be able and willing to mobilize the required mechanisms to allow future generations to meet their needs and to live and develop on their own.

Since the adoption of the SD concept in 1992, the world community has designed and published dozens of fundamental documents and recommendations, held hundreds of symposiums, conferences, and forums associated with the concept. However, as matter of fact currently the achieved results significantly diverge from the earlier formulated goals, and the world socio-economic situation remains disturbing. One of the reasons for this is that despite all the efforts the SD concept has not been broadly accepted by the public. In particular, extremely poor coverage of the SD concept in education remains a very important issue. There are no special disciplines and almost no required literature, and traditional courses are not properly reformatted. Although for a decade and a half the whole world has been living under a new ideological doctrine, nonetheless annually new graduates start their careers with the ad-hoc knowledge of the SD concept. As well there is no targeted retraining of current professionals, even though living, thinking, making decision and acting under new circumstances must also be new.

The timeliness of the textbook is not only in its pioneering effort in the field of SD in Ukraine, but also in its practical application, namely the development of practical instruments for the socio-economic potential of the SD concept. Fortunately the authors pay much attention to the dynamics and inner content of the studied phenomena. The authors interpret components of the SD concept not as static, but as constantly evolving self-developing systems, including non-material managerial systems, models, real economic structures and social systems.

Apparently and without exaggeration, this textbook can be viewed as a new generation of educational literature. Its materials, many of which could be parts of a monograph, are presented to students in an easygoing and acceptable way. Such an approach is beyond any doubt. Closing the gap between scientific ideas and their broad implementation is a reality of time. The importance of this statement is especially magnified with respect to the SD concept which plays a decisive role in the destiny of the whole mankind. It is encouraging that researchers from 15 countries have participated in its design. It is a double pleasure that the textbook's place of birth is Ukraine.

Without any doubt publication of this textbook is a significant scientific and academic event. It is remarkable that despite vast geography of the authors, they appeared as a strong homogeneous team of specialist with similar views able to create solid, rich in content, well systematized and easily acceptable studying material. This is a significant achievement of the editorial board, which is a collaboration of the Ukrainian and Belgian Universities – Sumy State University and Free University of Brussels – both well known for their previous experience in the field.

B.V.Burkinsky

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Introduction

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This book contains selected and summarized fragments of the international textbook “Social and Economic Potential of Sustainable Development” (in Russian).

The international textbook intends to familiarize students with the biological, ecological and economic aspects of sustainable development. Each of these aspects has its own homeostasis and metabolism. Sustainability of the homeostasis is a distinguishing feature of the first two systems. Humans can only survive under the physical and chemical conditions that prevail in the ecosystems. In turn, these parameters depend on the physical and chemical properties of the natural environment. Therefore, the main problem of sustainable development can be seen as deviations from a balanced equilibrium in ecosystems as a result of human activity.

Continuous population growth (a quantitative cause) and consumption (a qualitative cause) are the main reasons for the disequilibria. To prevent pressure on the natural environment, economic system must constantly respond to these drivers of destruction. It is most necessary to reduce the pressure per unit of goods and services produced and consumed. Therefore, the goal of social and economic development should be:

- To maintain homeostasis of the “human species” (biological humans). This reflects the human dimension of sustainable development (SD).
- To maintain homeostasis of the supporting natural systems. This reflects the ecological dimension of SD.
- To provide goods and services by the economic system. This reflects the economic dimension of SD.

To achieve these goals, two other systems that do not have their own metabolism and homeostasis, should be included in the approach:

- The social individual, who is part of the biological individual;
- The social system (the community of people), which exists on the basis of economic system.

The Socio-individual determines the economic human. This “homo economicus” is a major factor in production and consumption. The social and economical aspects of a man combine with the biological human in a physical body. Consequently, harmony between these three human aspects is necessary for a proper economic system.

These considerations have driven the structure of this textbook.

This textbook emerged from the need to act urgently on sustainable development. We feel the threats for the environmental, social and economic issues. We have no time to experiment with strategies on sustainable development. This textbook collects different essential aspects of how the international community understands SD today.

To this end the project promoters attracted the leading scientists on SD from 15 countries (Australia, Belarus, Belgium, Ghana, Germany, Italy, Canada, Republic of China, the Netherlands, Moldova, Russia, Ukraine, Czech Republic, Switzerland, and Japan) to contribute to this textbook. The most recent research results on sustainable development are presented in an easy and understandable way. The book targets those who feel responsible for future generations, and for present day students.

This textbook is also on a quest for a common conceptual field, which allows the representatives of different countries to start the study of such a complex phenomenon as *sustainable development*. This is of utmost importance, in view of the common international problems, the international community currently faces and which call for urgent solutions.

The textbook equally aims to remove barriers of misunderstanding (barriers including language), which, unfortunately, still continue to exist between west and east (post Soviet) scientific schools. For a number of English language papers, the key terms in the original language are indicated between brackets. These interlanguage “bridges” facilitate understanding of the concepts, and provide the reader an opportunity to understand deeper the original ideas. We consider this useful in a teaching process.

This textbook results from a project in which Ukrainian and Belgian researchers cooperated (the Department of Economics at Sumy State University, Economic Research Centre (Ukraine) and the Department of Human Ecology at Vrije Universiteit Brussel (Belgium)). Publication of the textbooks in Russian and English (Economics, 1998; Environment, 1998), (Basics, 2005), two study guides (Basics, 2005; Basics, 2006), a textbook (Basics of Ecology, 2006) and a monograph (Methods, 2005) preceded the publication of this textbook.

Collaborators of the Sumy State University, and Economic Research Centre (Sumy) prepared the manuscripts for publication.

Knowledge has a unique ability to result in new knowledge. This is a paradoxical multiplication (field broadening) effect. Currently humanity “knows more” about sustainable development. We seem to know even more about it than fifteen years ago, when the concept first appeared. We urgently need to proceed from flat to deep understanding of SD. This textbook aims at contributing to this transition of knowledge. The next step is absolutely new knowledge.

The authors hope that this textbook will add to understanding of the principles, mechanisms and methods of sustainable development. They equally hope it will pave the road to solutions to vital problems based on sustainable development.

The editorial board is grateful to all authors, who participated in the preparation of this textbook; reviewers, who improved the content, and all others, who took an active part in the prepublication activities. State Fund of Fundamental Research, JSC Khimprom, Enterprise «Spetsoborudovanie» are the co-sponsors of English version publication.

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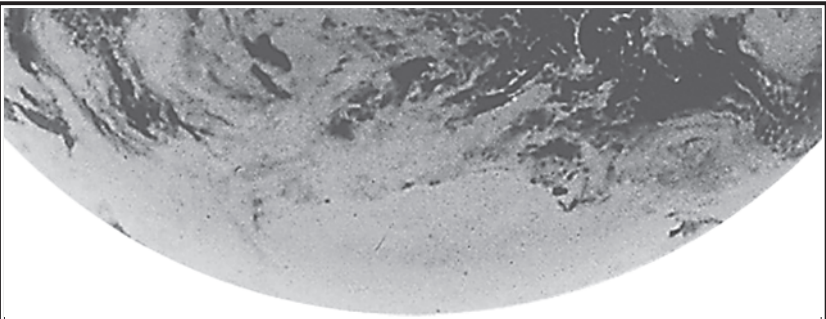
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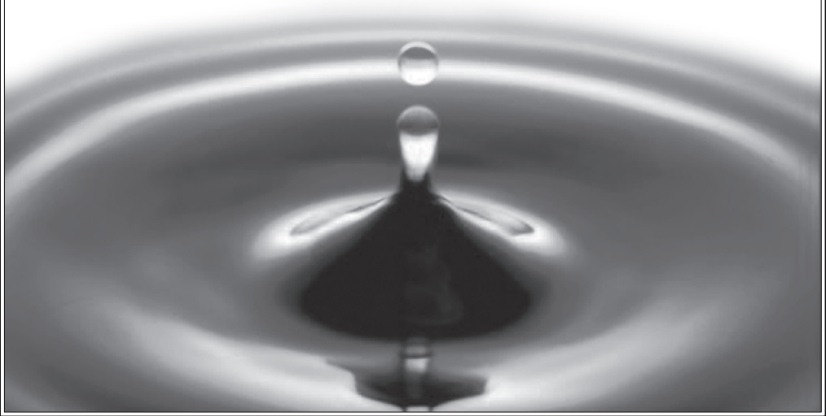
This textbook is a team project. We have had an opportunity to work with an excellent team of professionals from 15 countries. In particular, we wish to thank scientific editors for their valuable comments. They really did an outstanding work. We are especially grateful to *Yuri Yevdokimov*, PhD, Associate Professor of the Department of Economics at the University of New Brunswick (Canada); *Emmanuel K. Boon*, PhD, Professor of the Human Ecology Department at the Vrije Universiteit Brussel, Brussels (Belgium), Accra University (Ghana); *Oleksandr Romanko*, Ph.D. Candidate, Department of Computing and Software at the McMaster University, Hamilton, Ontario (Canada); *Oxana Kobzar*, PhD, Portfolio Analyst, “Essent Energy” LTD, s’Hertogenbosch (The Netherlands), who read all or parts of the manuscript and gave very helpful and useful comments that were incorporated into this text. It tremendously improved the general outlook of the English version of the textbook.

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Luc Hens
Leonid Melnyk



PART I
PREREQUISITES TO
SUSTAINABLE DEVELOPMENT



1.1. Fundamentals of systems sustainable development

Deep understanding of sustainable development prerequisites requires researching fundamentals of systems development. Detailed analysis of mechanisms and factors of development allows introducing the diagram of their integral interaction (Figure 1.1.1).

The *system* is a material and information entity (whole) consisting of different components. The system possesses properties that are not present for its components (the entity is greater than the sum of its components). The *development* is irreversible, directed and logical change in the system.

The main postulates of the mentioned mechanisms are the following:

1. Only *open stationary systems* are able to develop.

The *openness* of the system means that it carries out the metabolism, i.e., exchange of material, power and information with the environment. The metabolism serves as a source of free energy entering into the system and removes vital activity wastes from it.

If the system is stationary, it means that it is able to maintain stable (sustainable) dynamic equilibrium – *homeostasis*. The homeostasis is characterised by a dynamic relative constancy of system's composition and properties. It is needed for maintaining the required difference in physical and chemical potentials (temperature potential, chemical potential, electromagnetic potential, etc.) between the system and the environment, as well as between separate components within the system. The system can exist only carrying certain homeostasis values that fall into very narrow intervals of the mentioned potentials.

The deviation of the system's parameters determining the level of homeostasis from the system's optimal values leads to damage in its functionality or to termination of its existence as a self-developing system. To change the homeostasis level it is necessary to reorganize the whole system, i.e. to introduce radical changes to interactions between the system's components.

Prerequisites to Sustainable Development

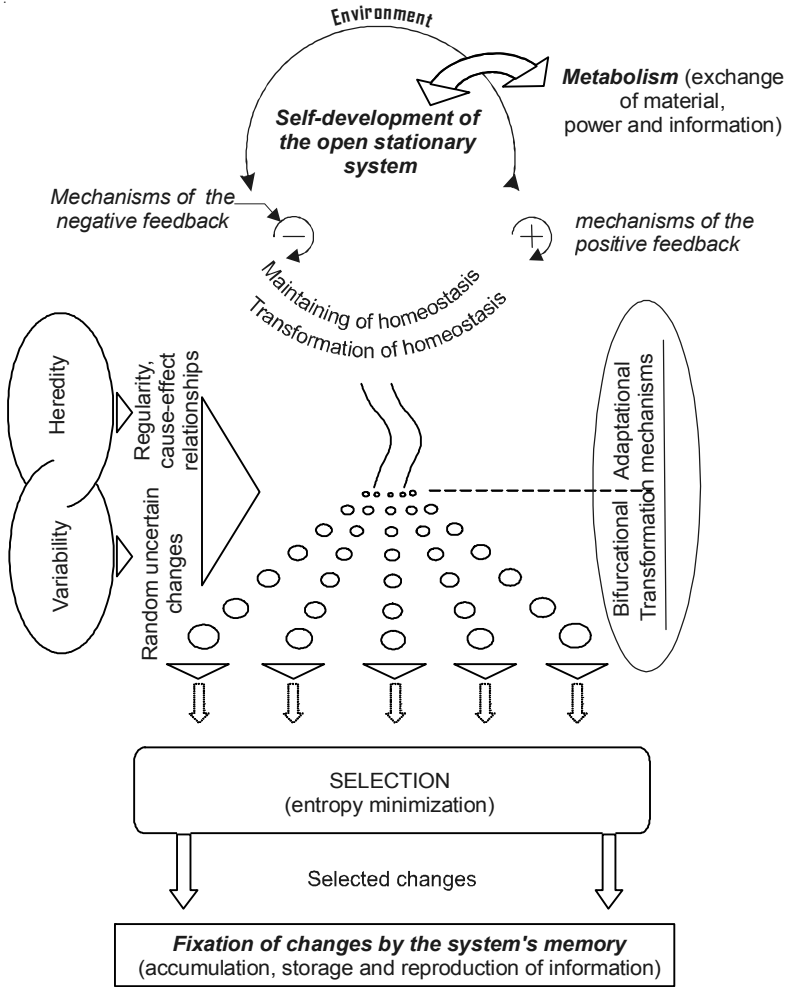


Figure 1.1.1: The integration diagram of development mechanisms and factors

Open stationary systems include inanimate structures exhibiting cooperative behaviour, live organisms, ecosystems, social organizations (firms, associations, markets, microeconomic systems).

2. To *carry (maintain) homeostasis* the system uses the mechanisms of the negative feedback that are aimed at compensating the influence of environmental factors. *Negative feedback* mechanisms act in an opposite direction to the influencing factors. To implement the mechanisms of negative feedback the system has to spend *free energy*.

3. In case the system's energy balance is disrupted and the total energy consumption by the system becomes larger or smaller than the free energy inflow, the system gets reorganised. So, the system changes its homeostasis level increasing or reducing it accordingly (if the system is elastic enough for such a reorganisation). *The change in homeostasis level* and related to it reorganisation of the system's structure is achieved by using *positive feedback mechanisms*. Those mechanisms require free energy as well.

4. The system's development is accomplished due to interaction of three groups of factors: *variability, heredity, selection*.

Variability provides *random uncertain* fluctuations, i.e., deviations from the system's equilibrium state.

Heredity guarantees *regularity* of changes. It is determined by *cause-effect relationships* between the processes. Due to this feature *the future is dependent on the past*.

Selection chooses the most effective states of a system, i.e., the changes that the system has experienced. *The selection criterion* is the minimization of the system's entropy. It means that only those states of the system with *the maximum information value* can be selected. Eventually, this leads to *minimization of dissipation* (irreversible dispersion) of energy. Thus, only the most effective states of the system survive.

5. The mentioned factors of development can be implemented by the system via two classes of mechanisms: adaptational and bifurcational.

Adaptational mechanisms implement functions of variability, heredity and selection under the rule of preserving the main characteristics of the existing system, i.e., within the limits of the same biological organism, ecosystems, firm, country.

Bifurcational (branched) mechanisms implement the mentioned functions on the basis of consecutive change in qualitatively new system states that lose the main characteristics of their predecessor, although keeping hereditary links with it. Biological organisms generations change, firms restructuring, radical change of a form of government, etc. are the examples of such processes.

Bifurcational mechanisms allow reaching the most favourable conditions for development. Discontinuity and branching allow the system to “forget” the former, less effective state and to select a new, more effective one (or new ones) using multivariant search. The same mechanisms not only assure irreversibility of the process, but also implement another important property of fixing the occurred changes. Bifurcational mechanisms are much more effective in comparison with adaptational mechanisms as they allow considerably increasing the rates of development.

The origin of the intellect with its ability to form and select *virtual bifurcations* allowed accelerating the processes of development significantly (functions of variability, heredity and selection). It played the role of impulse in avalanche-like rates acceleration in nature evolution. The computer era reinforced these processes.

6. Information fixing of the changes that have happened is the last stage in every cycle of the system’s development. The system memory plays the leading role here. *The memory* has the ability to *accumulate, store and reproduce* information. In fact, new standards of the system’s behaviour are fixed there. The system will function according to them until new changes come and get fixed. To function for the system means to duplicate and reproduce the system processes of vital activity repeatedly. Thus, the memory serves as the mean for fixation of the most effective system states. As we see, the memory is the last and very important component of every development cycle.

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