Selected Postulates of Science Development Deterministic Chaos Versus Eastern Philosophy

Wiktor H. Adamkiewicz
Technical University of Gdañsk, Gdynia Maritime Academy,
E-mail: olga@vega.wsm.gdynia.pl.

Abstract

The aim of this paper is to present the author's opinion on the methods used in scientific research whose results are to be applied in practice. It mainly refers to the research whose results describe global problems. This paper's role is also to attract attention to the necessity of system consideration of the anticipation problem (Adamkiewicz, 1997a, 1998b, 1998d, 1998c, 1998e). This view may be justified on the basis of many sources as well as the author's own research. The process of economic, cultural and social globalization was given as an example of a process in which aticipation plays an essential role (Adamkiewicz, 1995a, 1996, 1997b, 1997e, 1998a, 1999b). Activity anticipating the future should at the same time involve a whole set of such processes. Separate consideration of every process included in the set leads to neglecting the effect of synergy (Adamkiewicz, 1997c, 1997d). At present each particle process is analysed separately applying the non-system methods. These methods are incorrect (Adamkiewicz, 1989, 1990a, 1990b, 1999c). It is a mistake to use, for example, Maslow's Needs Hierarchy Theory, Pareto's Rule and other methods (Adamkiewicz 1997a, 1999c). The discussed processes take place in arranged social-economic-technical systems. The author postulates the application of proper methods of their analysis. It refers to the theory of chaos due to the non-linear nature of the processes. It also refers to the forecasting methods applied in technical sciences. These methods, based on the theory of change, are the basis of current designing as concept preparation for any social, economic or technical activities. It is also important to draw the attention to the fact that after a period of fascination there is now a backward trend as far as system and cybernetics methods are concerned. Such harmful tendency may be reversed by arousing interest in the philosophy of the East among certain groups of scientists. This philosophy, on the contrary to the philosophy of the West, is based on system perception of the world.

Keywords:

Globalization, Chaos, System Theory, Economics, Eastern Philosophy.

1. Introduction

Remarks included in the work refer to those areas of science which should broaden their field of research in order to counteract the threats that the humankind faces nowadays (Henderson H., 1990). Generally speaking, we ought to appeal to everyone to be willing to acknowledge progress caused by globalization processes which change the world from day to day (Soros G., 1999).

The correctness of scientific considerations, the deriving hypotheses and theories, is proved, among others, by their practical usefulness. It also refers to the problem of anticipation analysed within the association of CHAOS. Exact recognition of the essence of anticipation has significant practical importance. Free activity may be efficient only on the basis of proper future anticipation. The so-called methods of forecasting which serve this purpose are not very efficient. The main weakness of the forecasting methods derives from the fact that they are based on the analyses of processes which have been isolated from the environment. It means the lack of the system approach to the processes subjected to research. There is no possibility of efficient solutions to practical problems without system analysis of the occurring processes. Success of technical sciences is based on system way of thinking. The design methods whose essence involves extensive analysis of the problem is the practical meaning of such approach.

It is necessary to undertake action as far as research methods are concerned (Adamkiewicz, 1989, 1990a, 1990b, 1995b, 1997a, 1997b, 1997e, 1998a, 1998b). We should return to the early concepts of System Theory (Adamkiewicz, 1998d, 1998e).

2. Thesis

There was a eventful development of science in the 19th and 20th century. The visage of the world has changed. We seem to understand our surrounding reality better, and also our own personality. Meanwhile, a great majority of people assess these changes only as technical achievements which conquered the world. Distances have changed and time has shortened. This resulted in the globalization of economic activity as far as finance, markets, competition and products are concerned.

However, we have not been able to solve social problems. It seems that in this respect new threats caused by various factors including globalization emerge. Their description and undertaken actions are more and more naive. Therefore, it indicates that social sciences do not keep pace with the development of technical civilization. It is especially vivid in economics and management sciences. The main cause is the small range of research of system character.

However, there is a field which owes its incredible success to the strict system method of thinking and operating. We should add that this method not has been based on theory just recently. Experience of many generations of creators was the only basis for operation. This refers to all kind of products created by engineers. It is not true that great scientists are the direct authors of the eventful development of technical civilization. They have only given the impulse, an idea which had to be implemented in life. The worked out theories and discovered laws are an extreme simplification of reality described by means of the reduction approach. Scientists specializing in technical sciences have adjusted such theories to reality. These second level theories belonging to technical sciences were also an insufficient basis for descriptions of the working of engines, cars, planes, lasers, atom bombs, etc. They only determined the borders of practical actions which cannot be crossed due to simple physical reasons. However, the basis comprised the method of working out engineering tasks, respect for the predecessors' experience and peaceful cooperation of specialists from various fields. This last feature involves a specific organization of de-

signing and implementing the projects. It was also created without the interference of management sciences on the basis of simple logic involved in the execution of complex tasks. Recently, the Design Theory based on the philosophical Theory of Change has been created. According to this theory „Designing is a conceptional (informational) preparation of all kinds of activities." General System Theory and the philosophy of cybernetics are both treated as a certain style of reasoning and operating.

As far as the system approach is concerned, clear changes have been introduced in the frame of science about chaos. It is an attempt to look at the whole reality from system point of view. System observation results for example in the statement on the unity of fractal image of the world in the following order: from the general to the detail. Therefore, an image of anything which is subjected to research should be based on a sequence of models or selected elements of this sequence analysed in the following order - from the most general to the most detailed. A detailed model should refer to the form of system which will be the essence of research. It should be stressed that in practical activity such way of reasoning has been applied for a long time. The construction, machinery and device designers follow this pattern. It is impossible to create a reasonable vision of any system starting from the design of its elements.

3. The Background of the Problem

The aim of the present paper is to draw attention to the necessity to undertake efforts leading to search for research methods and solution of global problems. These are practical tasks. Conflicts arising in various parts of the globe result from economic causes (Montbrial, 1999). Local crisis elicit stormy social protests. These protests create an opportunity to take over the power by extremist leaders of movements and ideologies. Instead of the expected progress there is a backward development of the local social system. (G.E. Lasker, 1997).

Essential problems deal with the economy globalization processes which brought many benefits (G.Soros - World Economic Forum - Davos, January 1999) but also cause serious threats. They are caused by system errors (T.Koizumi, 1998). The errors are caused by applying wrong tools while planning development of companies which take part in the globalization process (W.Adamkiewicz, 1999). It happens so, because globalization problems arising in the scientific activity as well as politics are considered only in macroeconomic scale. We can observe increasing necessity to change paradigms such as the Industrialization Kuznet's Theory (UNDP, „Human Development Report" 1994; Bruno Michal & Squire L., 1996; Stiglitz J., 1998; and the publications of the Nobel Prize'98 winner - Amartya Kumara Sen and his numerous followers). Under the influence of these ideas, the World Bank and the Monetary Found are said to consider the need to include the HDI (Human Development Index) apart from the GNP (Gross National Product) in their analyses, as the basis for the assessment of social and economic development. For several years the UN - UNDP agenda includes the HDI in its analyses. However, direct economic activities, undertaken by various companies, also by banks, are analysed only on the level of microeconomics. It means that the main paradigm is the theory of supply and demand, worked out by Adam Smith about 250 years ago. Undoubtedly, this theory is the founda-

tion for market economy. However, practical activity is not based on this theory. During the period of over 200 years, many methods of solving practical problems have been devised. Some of them have been created 100 years ago and do not suit present reality at all. Applying these tools cases serious errors during the execution of globalization processes.

The next error is taking into account only big corporations in the analysis of globalization. Still, the current OECD reports: „The Economic Impact of Technology 1998" and „Technology, Productivity and Job Creation 1998" express satisfaction from development based on the High Technology products (in the OECD countries, of course). Therefore, we make an error by omitting the fact that the current economic development including decreasing of the unemployment depends mainly on the development of the SM sector (small business). It is obvious that the development of the SM sector does not be directly sponsored by the global investor, because it is beyond the range of his business and competence. However, such possibilities involve joint forces of direct and financial investors along with local authorities. Therefore, the investor must give up the microeconomic routine and participate also in the analyses on the macro level. It means the necessity to consider products as development parameters also in the macro terms. There may be accounts referring to countries who are subjected to the global expansion but they are not published. Whereas such works appear in the developed countries, for example: „Public Regulation and Incentives" (Technological Forecating and Social Change 36, 313-335, 1989) dealing with the expected increase in the welfare of the U.S.A resulting from globalization processes. The work is a summary of „The Electronic Supervisor: New Technology, New Tension" - Section 4 published by the U.S. Congress, Office of Technology Assessment (OTA-CIT-333, U.S. Government Printing Office, Washington D.C.). We may suggest that this problem should be dealt with in case of poor countries currently undergoing globalization and the same method should be used.

The author is convinced that sociological analysis should create initial basis for practical and economic decisions. Especially the efficiency of economic activities depends , to a large extent, on proper assessment of the social awareness level (Parra-Luna, 1998). Nowadays, such assessment is based on the decision-makers' intuition. Negative consequences of such decisions are evident with the naked eye. We should remember that positive (in a wide sense) development of societies largely depends on economic development (Henderson H., 1990, Sirgy, 1988). Proper development means the ability to survive in the changing conditions. The main problem is then the possibly correct determination of the current development conditions. On the basis of identification of the existing conditions we should work out a forecast of their changes in the future. On this basis we should determine the strategy of system development. It is routine research carried out by all international cosporations participating in the globalization of economy. It is also performed by many governments by supporting development on the world scale. The effectiveness of such actions is decreasing. It would be worthwhile to consider the cause of such situation. We should notice the fact that globalization of markets and competition has appeared just recently. Globalization of products has led an even shorter life. Therefore, the assessment of development on the global scale simply lacks experience. In this respect, the economy is still based on the theory created by Adam Smith over 200 years ago. Marketing science is

based on it as well. Thus, all forecasts are carried out according to the principles of company performance at a homogeneous market. However, nowadays, it is not a single market but many various markets.

At the same time mathematical approach used in economic sciences separated them from other social sciences including sociology. Nowadays, economic analysis are based on abstract assumptions. Consideration deals with economic development as the process which is independent from other processes taking place in the environment.

The lack of correlation among sociological analyses is especially significant. Fortunately, this part of problem is currently discussed by many scientists. The work (Tetsonuri Koizumi, Lundstedt, 1998) deserves spécial attention. It is a lengthy treatise dealing with many problems referring to mistakes made during analysis of economic development connected with the lack of consideration for the culture existing in the analysed area. The problems have been discussed in a profound way. The method for creating social analyses has been presented. The method is based on an interesting theory suggested by the authors.

According to the author the most significant global process is the current huge and growing development of technical means (Adamkiewicz, 1995a, 1996, 1997, 1997e) This development will proceed faster and faster because it is in its initial stage. We should remember that development of technical sciences is a stormy process and it is the kind of scientific field where the development is regular and also complementary. Achievements in any given discipline of technical sciences are immediately assimilated in others. Thus, the limits of the possibilities of technical means development are shifted more often and faster in directions which have been considered „science fiction" so far (Freeman, Perez, 1990). Parameters which may be acquired by technical means far exceed the popular image of technology. It does not refer to the „High Technology" exclusively but many prosaic everyday matters (Adamkiewicz, 1998c, 1998f). Physical aspect of globalization involves standardizing the products on the whole world scale. It refers not only to products of material nature (goods) but also all kinds of services. They become the aim of desire for people all over the world. By the way, in various parts of the globe, people become aware of their material poverty, not for the first time. However, this aspect of globalization is not subjected to scientific afterthought.

Usage of technical means forces changes within other sciences including humanistic, social sciences and even within the activity of religious communities. Technical equipment are only treated as relatively convenient aids facilitating the activities. Their creative role in culture and sociology is barely noticed. Indeed, new methods of affecting economy and society are being created and they include the awarness of the current technology means existence. However, this awareness results only in working out advice dealing with the ethical application of technical equipment.

4. The Problem

The aim of scientific activity is to perceive and describe reality, the reality which is surrounding us or existing within us. The aims are determined by the research creators. The choice of aims depends on creativity, knowledge, erudition and philosophical views.

Scientific activity also results in the application of knowledge during the execution of various kinds of practical activities. Until recently there was a growing tendency to use scientific thought for such purposes. The peak of this progress took place in the 19th and at the beginning of the 20th century. Applications dealt not only with new technology but also society organization; the effects varied. However, the current development of science becomes more and more distant from practical needs. Success is achieved mainly by technical sciences and disciplines whose aim is to create the theoretical bases for designing new products. The development of other fields of science has no greater impact on what is happening in the world. We should stress the fact that this opinion is not a negative assessment of scientific activity itself. The obtained results are impressive in all the intensively developing fields of knowledge. Unfortunately, they are partial results dealing with separate fragments. They are created on the basis of simplified models. These models must be adjusted to the possibilities of methods and tools used by a given scientific discipline. Tools are becoming less efficient as they were designed for a different regional scale of activity. Thus, tasks for scientists appear as it is necessary to change some of the paradigms. Nowadays, such need arise quite often. The new paradigm is accepted by scientists and practicians, but it does not result in the search for new tools for practical activity. Obviously, it is impossible to obtain the approval of changes of general paradigms in the theory of economy. However, we can attempt to modify the basis of some of the faulty method commonly applied as a professional routine. The author indicates one of the directions in the search of new tools to control expansion. When these tools are adjusted to the current socio-econo-techno situations they allow for conscious execution of transformation. They may also help to determine the truthful assessment of the expected effect of synergy which the investor wants to achieve.

5. To Take the Example from Technical Sciences

All creators of the new technology are aware of the imperfections of scientific description of reality. Therefore, designers and constructors would not create anything if they based their activities exclusively on scientific knowledge. Such knowledge only serves to determine general range of their creative search. The rest involves intuition supported by system approach to the problem. Yet, the development of technology is based on mathematical models only to a small extent. A big number of decision derives from the experience acquired by generations of technology creators (see: The Engineer's Great Charter produced at Massachussets Institute of Technology - U.S.A.). Therefore, every prototype of a technical product is tested in laboratories. It would not be necessary if all the significant features of a product resulted from calculations. Thus, the situation is different from the general opinion. Final design decisions in technology are not at all based on scientific knowledge. They just cannot cross certain limits determined in sciences.

It is worthwhile taking a closer look at the present civilization progress which is shaped, among others, by new products appearing on the market as the creations of „high technology." Not only the initiated know that „high technology" is not based on scientifically jus-

tified discoveries. A large part of new technologies is based only on the stated experimental facts and it is not supported by theories describing these facts.

The development of technical sciences has also a significant influence on the mentality of creators in all scientific disciplines. We do not mean the development of products including computer science. We mean the myth about the sources of technology success based on incorrect understanding of the essence of its development. Therefore, we do not acknowledge the fact that technical actions have always been applied with the use of system approach. The use of cybernetic and system ideas was a natural consequence of this state. There are publications in which the authors advise to apply system approach in treating problems, just as in technology where designers (according to these authors) first carefully design bearings, clutches and gear wheels and then assemble the machine. If we proceeded this way no working machine could be created.

6. Deterministic Chaos

The creation of the theory of chaos probably is the beginning of a great revolution in world science. It is possible that there is a chance to create an entirely new description of reality. Research on the nonlinear character of natural phenomena has been undertaken. The notion of universality. Repeatability appearing in complex systems in the form of fractals has been subjected to research. These are the milestones. However, it seems that today research on chaos still remains within the frames of traditional fields of science. Thus, we forget that it is not only a new research method but also a new way to perceive reality. Therefore, it is a new philosophy of understanding reality. Briefly put, research on chaos involves the observation that the descriptions of phenomena presented so far perceive them in isolation from the environment.

The positive phenomenon among the considered problems is the fact of undertaking efforts to apply the theory of chaos in economic sciences. However, at present, we feel the insufficiency of this progress. Even in the research of chaos we usually limit it to the range of a particular tradition scientific discipline. Therefore, we are unable to free ourselves of the dependencies resulting from historically attributed ways of describing phenomena.

The author suggests making the next step and using a non-scientific basis of reasoning in the research of chaos, such as for example, the methodology of designing. The main reason for this suggestion is a system performance in designing and methods of combining various fields of science intuitively. The proposal is based on verified correctness of prognoses obtained by means of designing methods. At present, there are attempts to apply the designing methods in the economic analyses and preparing managerial decisions (Garies, 1990, 1992).

7. The Cooperation Between Cultures

Dalaj Lama, the spiritual leader of the Tibetan nation and the winner of the Nobel Peace Prize, said that: „Current world makes us accept unity of the humankind. In the past isolated communities could afford to think that each of them is principally distinct. Some of them could even exist in total isolation. However, today, everything that happens in one

region may influence other regions. Our new interdependence involves a combination of our own and others' interests".

The present time is characterized by the globalization of all manifestations of economic and political activity. Therefore, we have to undertake research on the development of societies on a global scale (Adamkiewicz, 1998a). The results of this research are absolutely essential in order to make people who have influence on global economy and politics aware of the differences in the behaviour and expectations of social groups in various parts of our globe. There are also different systems of values according to which society behaves (Tetsonuri Koizumi, 1997). Nowadays, economic and political decisions are made by economists as well as politicians on the basis of the assumption that all people perceive the proposed economic and political changes in the same way. This approach is dangerous as it causes serious perturbations in various parts of the globe because the undertaken acitvities are understood in a different way than their authors' intentions. Some of the authors of the political and economic decisions are aware of the existing differences but they believe naively that their way of understanding the world will be accepted enthusiastically everywhere. Such decision-makers appear to think that economic missions should be linked with specifically understood civilizational mission. They do not want to acknowledge the fact that the economic and even political mission may be accepted whereas the „civilizational" will be connected with conquest.

In connection with the development of globalization processes it is essential also to introduce dialogue between cultures. The present form of civilization was built by two big cultures: the „East" and the „West." There are no rational bases to claim the priority of any of them. Differences should not be assessed exclusively in terms of the practiced religions. Differences included in the current forms of religious beliefs should be taken into consideration while preparing for economic expansion in order to avoid unnecessary conflicts. Whereas in the scientific activity attention should be paid to widely understood ways of life organization.

At the same time our scientists circles are not interested in the philosophy of the „East." It is treated as a set of mistic publications. Information on certain aspects of eastern civilization are already available in „our" bookshops but most of them are popularizing publications. However, some of these proposals are worth attention. They deal with the relations between man and the environment. The problem lies in the origin of these practical recommendations.

According to the author's opinion, the eastern principles of life organization result from similar research to the ones that we based our scientific knowledge. It means that they are based on the observation of phenomena existing in the real world. However, these observations were made on the basis of system perception of the nature's unity which we have noticed recently and partially. This research was surely based on paradigms deriving from general philosophy adopted in the East. However, our science also develops according to our philosophy and largely in accordance with our beliefs.

Therefore, it is worth pondering on the question: how come does the „Eastern" proposal of Pa-Qua net at the same time refers to the organization of a building plot, a house, a flat, a room and also a desk's top. Yet, it is the same situation when we observe the analysis of

the fractal picture of reality known from the research on deterministic chaos. Kata's systems resemble our anticipatory systems too (Koizumu Tetsonuri, 1997). There is no place for giving more examples in this paper. However, it is essential to stress the statement that the mentioned principles have their rational (numerical) references. These rules are also presented in a graphic way similar to the way the engineers use. The author suggests, however, to consider the fact that evidence in most of scientific disciplines involve inductive generalization of few empirical facts. Then, why not acknowledge the fact that hundreds of years of environment observation could in another culture lead to discoveries useful in practice?

8. Methodology

8.1. Holistic Approach

Researchers dealing with various disciplines and participating in various works contribute to the notion development of system sciences but their contributions do not affect one another and do not sum up to the possible extent. It is as if the pioneers of system thinking and acknowledging mutual existence felt obliged to express their intuition in their own language, fearing what they could lose if they tried to work it out in another language. (Churchman, 1979). As the motto for this chapter of current paper author dare to cite Eric Schwartz (1998):

„A holistic approach is that of an iquirer who is aware that the world is not only an pile of objects, not even an aggregate of interacting objects, but is a complex and ever changing unity of which hi is a part. This entity has a fractal structure, being made of other smaller such unities which are rhemselves built in the same way. The heart (and the difficulty) of the holistic approach is the realization that these unities are also wholes with properties own which are, by definition, not definable in terms of parts or components"

Multidisciplinary holistic approach to research is the main condition of science development and especially obtaining results close to the existing reality (Mingers, Brocklesby, 1996). Only such results have a chance to become the basis of practical action. In order to achieve it, searching for special methods is not essential. The idea of interdisciplinary research has been formulated by the first creators of the systems theory and cybernetics. We only have to accept these ideas in the original version. This means that they should be understood in isolation from the field of science we deal with. Neither should we make an attempt to adjust cybernetics and the system theory to knowlegde structures and paradigms obtained by means of the reduction approach. In this respect we should draw our attention to some widely spread scientific views.

The majority of the author's public appearances aim at justifying the necessity to return to the „roots" in cybernetics and system theory. The development of some of science disciplines based on cybernetic and system development has not lead to their closer cooperation. There is still a dispersal of efforts. Lately, similar opinions have been expressed by many authors. In this respect the works of philosophers from the Jagiellonian University (Cracow, Poland) deserve particular attention; especially (Heureka, 1980, 1983). The listed

authors claim that there are two radical research attitudes according to which the object subjected to research may be:

- object-separate from-the reality (object-itself as the self), or: man-separate from the reality;
- object-as part of-the reality (object-as an element of-a whole), or: man-as part of-the reality.

The present paradigm of our civilization derives from the first approach and deals with unlimited possibilities of scientific cognition. In system research two paradigms derive from both approaches:

- first paradigm - objects with system features are identified without determining the whole reality as a system;
- second paradigm - assumes that the whole reality is a system and identifies the researched systems within the reality.

Second paradigm means that every object is a part of system reality and thus it is fully determined by the reality and dependent from it. If we assume that the universe is a system, then we can say it has no irrelevant elements, relationships or properties. There are no elementary and specific regularities referring only to some narrow class of phenomena or objects in this vision of the world. This is the system denial of rightness of the orthodox reductionism. In practical applications there is a tendency to take a middle approach between first and second.

8.2. System Sequence of Models

Author intends to present methodological proposal for the application of the General System Theory in the humanities (Adamkiewicz, 1998d). It would be wise to appeal to the scientists dealing with philosophy, sociology, psychology, history, philology and other sciences to make an effort to carry out social research in global scale. Their intention should aim at providing access to the results of research in economic and management sciences. Thus, we should conduct research with the awareness of ecomomic needs.

We should come back to Ludwik von Bertalanffy' idea of the GST and instantly reject the view stating the lack of possibility to apply the GST in social sciences. Such view results from the association of the GST with technical sciences.

Many definitions of systems have been created within the GST. Most of them may be reduced to the statement that system is a set of elements and a set of relations joining elements within the system and the relations between elements and the environment. Elements as well as relations may have a material, energetic or informational character or they may be abstract notions. Application of such definition may serve any research possible to carry out: complexity, synergy, emergency, evolution etc. Methodological problems include the following:

- determining the position of the system observer (researcher),
- determining the limits of the researched system,

- determining the quantity and nature of system elements (material, energetic, informational, abstract),
- determining the nature of ties (relations: material, energetic, informational, abstract) joining elements within the system and those joining the system (as well as its elements) with the system's environment,
- determining the nature of processes taking place within the system and concerning changes within the material, energetic, informational or abstract range.

The main aim of cybernetic/system research is to discover and analyze synergy effect in the studied object and its environment (Adamkiewicz, 1997c, 1997d). It is possible only when research is of interdisciplinary nature. The only method to discover the effect of synergy is the research of the whole process taking place in the studied system. It is extremely important for the needs of such transformation to treat the cybernetic and system idea jointly (Adamkiewicz, 1998d). Both complementary ways of reasoning are the basis for solving interdisciplinary problems. The essence of the problem is to subordinate research process to system rules. We must start from determining the aim of research and the studied object according to system rules. Activities complying with the rules compulsory for a given science discipline should be undertaken after this preliminary stage. If the order of action is reversed we have no guarantee to obtain system approach results. It means that determining a real picture of synergy is impossible. Problems which are worth considering from the cybernetic point of view are the following:

1. Intuition and its position in the research process.
2. The form of elements comprising reality: matter, energy and information.
3. The notion of the relationship between elements which form a system and joins it with the environment.
4. The notion of synergy, which has been formulated in the ancient times as: „the whole is more that the sum of its parts" is always the main aim of system research.
5. The notion of a process whose analysis is always the main aim of each research. However, it often happens that the researcher does not specify the definition of a studied process which leads to a large freedom in interpreting the obtained results.
6. Complexity of reality which cannot be subjected to research without simplifications. Therefore, it is necessary to determine the elements of reality which are significant as far as the aim of the undertaken research is concerned in a conscious and nonarbitrary way.
7. The notion of a system which is the basis of system thinking because it determines the way to isolate the area we want to study from the surrounding reality. The notion of a system directly implies the sequence of research procedure which is the draft of research procedure.
8. The notion of hierarchical decomposition of a system which facilitates the introduction of complicated considerations. It also facilitates the determination of elements and significant relationships.
9. Rigours of system method.

Re.1. Intuition. It is a difficult problem to assess the rightness of making decisions based on intuition in the research process. Every intuitive decision may be considered as a non-scientific activity. Generally, science allows for making intuitive decisions only at the beginning of a research process while determining the aim, range and object of research. It is worth adding that the application of mathematics in many science disciplines is universal also because of the need to avoid the accusation of using intuition in scientific study. It is known that the fields of mathematics are based on assumptions deduced intuitively too. Also, the application of mathematics is accompanied by intuitive decisions deriving from the necessity to adjust the description of a studied area to the possibilities of the applied field of mathematics.

The essence of cybernetics and system theory is, however, solving interdisciplinary problems. It implies necessity of determining the research aim and the studied object with system approach. It also indicates the necessity to include various science disciplines in the research. Every discipline introduced to the research is an action based on intuition.

Re.2. Elements. The most difficult task while applying cybernetics within the frames of traditional science disciplines is the way to describe reality subjected to research. It is generally agreed that only physical elements may serve as the objects of research. Energy and information are treated as attributes of physical reality. In cybernetics and system theory matter, energy and information are independent forms of existence which comprise the world. Technical sciences have overcome this problem.

Re. 3. Relationships. Determination of relationships between the elements of the system is the next detail which is extremely important in system research. The relationships refer to the influence of the elements of the system on each other and their influence on the environment of the system as well as the influence of the environment on the system. The relationships transfer material, energetic and informational actions. The relationships are processes in their nature. In technical sciences the types of relationships are classified with great detail. Such classification does not seem appropriate for other disciplines of science.

Re. 4. Synergy. Determining synergy is or should be the aim of cybernetic research. In the real world any two elements influence each other changing the course of processes which occur in each of them separately. Next, these two elements influence others, and so on. It is possible to discover and determine the effect of synergy only in case when the system as a whole is subjected to research.

Re. 5. Process. The next significant element of cybernetic research is determination of the process which will be the object of research. All scientific research consists in the analysis of variation in the studied object. It is essential because only then we can try to recognize the effect of synergy. It should be done even in the easiest cases. For example, when we study any partial variation we deal with the following order of system states:

1. State before the change takes place;
2. State when the change takes place;
3. State after the change.

Re. 6. Complexity. The notion of complexity has been frequently considered by scientists. It is not necessary to use these definitions while organizing interdisciplinary research. However, the necessity to take all elements of the system and all relationships existing in the system into consideration should be assumed as a working assumption. It is apparently not feasible. However, the possiblity to carry out this assumption derives from the notion of decomposition and aggregation. Particular groups of elements and relationships should be joined in groups. They are independent subsystems in our research. Therefore, it is necessary to define the whole system at the highest level of complexity. However, decomposition at lower levels will only deal with those elements and relationships which will be subjected to research.

Re.7. System. A significant element of cybernetic research is the isolation of reality area which we want to study. This area should be qualified as a system. It must be a whole area. We cannot just select elements arbitrarily according to procedure recognized in a given field of science. After having identified the system we can concentrate on the research of the selected elements of the system. Then, we will know what part of the system we study and what role this part plays in the whole system. The definition of a system is generally known. It is a set of elements joined with each other and the environment by a set of relationships.

Re. 8. Hierarchical decomposition of system. Decomposition of a system consists in the determination of subsystems in a system subjected to research followed by the determination of subsystems of the already determined subsystems, etc. Decomposition allows to carry out complicated considerations. It also facilitates the determination of elements and significant relationships.

Re. 9. Rigours of system method. In order to meet the needs of research defined as „system research" it is necessary to comply with the following rules while creating the models; these rules may be called the rigours of the system method (Mazur, 1976):

- Precision rigour concerning precision required in separation of the system from the environment. It is independent of the simplification level in the system model.
- Functionalism rigour - the system should be seperated from the environment according to its functions (carried out processes) and not the spacial separation.
- Invariability - the definition of the system must remain unchanged in the course of the whole research.
- Completion rigour - the division of the system into subsystems must be complete.
- Separation rigour - the division of the system into subsystems must be separable.

Taking into account the above mentioned rigours may be simplified by applying the so-called method of generalization during the identification of the system. The method is based on the previous identification of the supersystem which should contain the researched system.

9. References

1. Adamkiewicz W.H., 1990b, Designing the Management System as a Set of Subsystems of Differently Oriented Aims. 10th INTERNET World Congress on Project Management - "Management by Projects". Austria, Vienna.
2. Adamkiewicz W.H., 1990c, The Method of Aiding the Designing of the Management Systems. 11th International Cost Engineering Congress and 6th AFITEP Annual Meeting - The French Association for Cost Estimating, Cost/schedule Control and Project Management. France, Paris.
3. Adamkiewicz W.H., 1995a, The System of Instrumental Civilization. 14th International Congress on Cybernetics, Symposium on Synergistic Effects of Local and Global Developments on our Lives and on our Future. Belgique, Namur.
4. Adamkiewicz W.H., 1995b, „System's models for designing the organisational restructurization of companies during the process of the ownership changes".Publ. in the book: "Critical Issues in Systems Theory and Practice", ed.K.Ellis, Plenum Publishing Corporation, New York.
5. Adamkiewicz W.H., 1997a, Remarks on a Multidisciplinary System Approach Applied to the Socio-Econo-Techno Complexes as the Anticipatory Systems. CASYS International Journal for Computing Anticipatory Systems, Volume 1 (pp. 15-34). Association „CHAOS", Liege, Belgium.
6. Adamkiewicz W.H., 1997b, Global Analysis of Civilization Development as a Requirement for Peaceful Coexistence. In: Advances in Sociocybernetics & Human Development, Volume V (pp. 95 - 100). The International Institute for Advanced Studies in System Research and Cybernetics, Windsor, Ontario, Canada.
7. Adamkiewicz W.H., 1997c, Synergistic Effects of the System of Instrumental Civilization on the Global Economy. In: Research-in-Progress: Advances in Interdisciplinary Studies, Volume IV (pp. 13-17), The International Institute for Advanced Studies in System Research and Cybernetics, Windsor, Ontario, Canada.
8. Adamkiewicz W.H., 1997e, Investigations on the Influence of the Global System of Instrumental Civilization on the Global Economy & the Mathematical Approach for Soft Systems Analysis & Evaluation. In: Systems for Sustainability: People, Organizations and Environments, Plenum Publishing Corporation, New York.
9. Adamkiewicz W.H., 1998a, The Model of the System of Instrumental civilization as a Tool for the Civilization Development Prediction. In: Advances in Sociocybernetics & Human Development, Volume VI: Culture of Peace: Design Issues and Cyberspace Technologies (pp. 42 - 47). Ed.: Lasker G.E., The International Institute for Advanced Studies in System Research and Cybernetics, Windsor, Ontario, Canada.
10. Adamkiewicz W.H., 1998b, Current Needs of the System Development of Science. Philosophy of the System Research Versus Reality. In: Research-in-Progress, Volume V-A (pp. 11-15) Ed.: Lasker G.E., The International Institute for Advanced Studies in System Research and Cybernetics, Windsor, Ontario, Canada.
11. Adamkiewicz W.H., 1998c, Necessary changes in the universities development strategy connected with the service sector domination in the global economy. Proceedings of the

Global Congress on Engineering Education (pp. 373-377). @ 1998 UICEE - UNESCO International Centre for Engineering Education. Krakow, Poland.
12. Adamkiewicz W.H., 1998d, Proposal for System Approach to Humanities. Proceedings of the 15th International Congress on Cybernetics. Symposium: "Synergistic Effects of Local and Global Development on our Lives and on our future". (pp 636 - 641).
13. Adamkiewicz W.H., 1998e, Forgotten Possibilities to Use Norbert Wiener's Idea Proceedings of the 15th International Congress on Cybernetics. Symposium: "Essence and History of Cybernetics". (pp 541 -546).
14. Adamkiewicz W.H., 1998f, Engineering innovations in small and medium-sized enterprises as the requirement for economic development. Proceedings of MARIND'98 - Second International Conference on Marine Industry, Vol. 1, Section 1 (pp. 27-32). Varna, Bulgaria.
15. Adamkiewicz W.H., 1999a, The Bases of an Algorithm for the Civilization Development as a Social & Managerial Problem in Evaluation & Design. In: Research in Progress (pp. 6 - 10). Ed.: Lasker G.E., The International Institute for Advanced Studies in System Research and Cybernetics, Windsor, Ontario, Canada.
16. Bruno M., Squire L., 1996, The Less Equal The Asset Distribution The Slower The Growth. The Newsletter about Reforming Economies no 9-10/1996;
17. Churchman West C., 1979, The System Approach and its Enemies, Ed.: Basic Books, Inc., New York.
18. Gareis R., 1990, Management by Projects. Keynote to Proceedings 10th INTERNET World Congress, Vol. 1 (keynote), Manz-Verlag, Vienna.
19. Henderson H., 1990, From Economism to Systems Theory and New Indicators of Development. Technological Forecasting and Social Change, Vol. 37, pp 213-233.
20. Heureka (Mudyń K, Latała A.,Siwek Z.,Niezgoda R.), 1983, Dwa paradygmaty, czyli w poszukiwaniu myślenia hipersystemowego. Projektowanie i systemy, tom V, Ossolineum, Wrocław.
21. Jenner R.A., 1992, Dissipative Enterprises, Chaos and the Structural Characteristics of World Class Lean Organizations. Paper to be presented to the 2nd Western Academy of Management International Conference: „Perspectives on Integration" at Katholieke Universitetit, Leuven, Belgium.
22. Kensei Hiwaki, 1992, View from Japan: Assymetric in the Evolving Eropean-Japanese Dialogue. In: Toward Political Union. Planning a Common Foreign and Security Policy in the European Community. Ed.: Reinhardt Rummel, Westview Press, Boulder - San Francisco - Oxford.
23. Koizumi Tetsonuri., 1997, Kata and Kata-Thinking in Eastern and western Thought. Advances in Sociocybernetic and Human Development. Volume V. Ed.: Lasker G.E., The International Institute for Advanced Studies in System Research and Cybernetics Windsor, Ontario, Canada.
24. Koizumi Tetsonuri., Lundstedt S.B., 1998, Mind Culture and Economy: The Morphology of Socio-Economic Systems. In:Cybernetica, Vol. XLI, No 2/3/4-1998.
25. Lasker G.E, 1978, Mathematical Modelling of Mobile Systems. In: Progress in Cybernetics and Systems Research (pp. 98 - 116), R.Trappl (Ed.), Vol. 3, 1978, Hemisphere Publishing Corporation, Washington, D.C..

26. Lasker G.E., 1997, A design for Peace - in Search of a Kinder, Gentler and More Compassionate World with Freedom, Peace, Love and Happiness for All. In: Advances in Systems Research for Peace. How to Replace a Culture of War by the Culture of Peace, (pp. 163 - 174). Ed.: Lasker G.E., The International Institute for Advanced Studies in System Research and Cybernetics Windsor, Ontario, Canada, Lomeyko V., UNESCO, France.
27. Mingers J., Brocklesby J., 1996, Multimethodology: Towards a Framework For Critical Pluralism. Systemist, Vol. 18(3).
28. Montbrial T. (Chief of The French Institute for Foreign Affairs), 1999, The Interview for „Polityka", Warsaw, Poland.
29. OECD (Organization for Economic Cooperation and Development), 1998, Report: The Economic Impact of Technology 1998.
30. OTA (U.S. Congress, Office of Technology Assessment), 1987, Section 4 of The Electronic Supervisor: New Technology, New Tension. OTA-CIT-333, U.S. Government Printing Office, Washington D.C., september 1987.
31. Parra-Luna F., 1988, An Axiological Approach to Social Systems. Advances in Cybernetic Modelling in Social Systems. Ed.: Lasker G.E., The International Institute for Advanced Studies in System Research and Cybernetics Windsor, Ontario, Canada (pp 35 - 40).
32. Schwartz E., 1998, What is Holistic Approach ? International Congress for Cybernetics, Abstracts, Namur, Belgique.
33. Sirgy M.J., Mangleburg T.F., 1988, Toward a General Theory of Social System development: a Management/Marketing Perspective. Systems research, Vol. 5, Noo 2.
34. Soros G., 1999, The interview for Project Syndicate. Translation in: „Rzeczpospolita", Warsaw, Poland.
35. Stiglitz J., 1998, More Instruments and Broader Goals: Mowing toward The Post-Washington Consensus, WIDER.
36. UNDP, 1994, Human Development Report 1994, New York-Oxford 1994.