Education and Technology Transfer in Informational Fields as the Part of Globalization Process

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Abstract: It is discussed some educational and research aspects connected with informational technologies. Automation and control educational problems are considered. The issues of practical interest for Ukraine and Europe research and technological development discussed. Some new models with associative memory property are described. The description of new speciality 'social informatics' is proposed as the example of implementing the post- industrial society needs.

1. Introduction

Now all recognize the challenges of new millenium: globalization, fast changes of life and environment, new technologies, new world order, communicational networks, global financial crisis's, sustainable development, AIDS and many others. The main source of such challenges lies in the nature of whole world as a large complex object. In such circumstances the role of global management and control very important. Such management now is implemented by leaders of states, international organizations (OON, UNESCO, EC, World Bank), transnational structures (financial and mass- media).

Global tasks need the management of high quality. Very often the control follows rough brutal forcing under object of control (society) without taking into account opinion of populations. One of example of brutal reconstruction was in the USSR with dozens millions of the victims. F.Hayek also told about dangerous of total control.

One of the sources of brutal management lies in the concentration of power in the governance institutions. But the second follows from existing basic system of education in high and just primary and secondary schools. This is because of the entirely new characteristics of global society. If we accept the recent concepts on future society (Bell, Fukuyama, Castels, Drucker and others), then the "holon" will be postindustrial society. The main distinctive feature of them will be informational technologies. And one of the key problem will understand of interrelations between individuals and society. Of course there are a lot of theories for mankind in humanity sciences, investigations of human factor in automation and control, theories of rational choice in economics, game theories and so on. But it appears that recently we only begin to pose such problems and

solutions will be found in interdisciplinary approach on the base of new type models. At many scientific, near- scientific and general congresses, conferences, meetings the idea of re-orientation informational, physical, mathematical sciences to the problems connected with society was proposed [Ba 00, Ki 00, Eu 00]. But it appeals that now humanity sciences are too verbal as to be instruments in all cases. And technical sciences doesn't take into account socio-economical aspects in existing formal approaches.

So it may be proposed as postulate that in future socio-economical problems will become one of the main issues also of automation and control. This follows the necessity of reconstruction of the education system and in particular in AaC. Moreover the technology transfer (especially in informatics) demands the new approaches. Such problems are very important for future collaboration of Ukraine and developed western countries (especially in the field of informastics). Now we have entirely new situations and bifurcation points in searching the ways for future development as for Ukraine as for European Community. For acceptance correct solutions in strategically planning deep understanding of situation and consensus in actions is necessary.

Thus in this paper the author proposes some considerations on this issues following from the author's experience in the university teaching, considering European technology transfer systems and from new models for socio-economical process. As author hopes considered questions may be useful as the subject of discussions and as some propositions to collaborative investigations and development infrastructure for technology, knowledge, computer products and specialists transfer.

2. Approaches for Considering Educational Problems

Recently the author succeeds in supporting new type models for society as large socio-economical system with many interconnections and with culture as collective memory. Proposed models allowed making definitions to such notions as civilization by A.Toinby, C.Hantington, sustainable development, organizational and life-cycle of large systems, science as integrity of knowledge and organizational structures. In models above the society is described as the collections of individuals or more large objects such as firms, institutions, organizations and so on. There are a number of parameters for their description. Different bonds connect these objects. The dynamical laws in models give a little number of stable states (patterns) which corresponds to civilizations or operation way of subsystems and so on. Thus the models are neuronet types with associative memory property. Much more detailed description of models just as applications to socio- economical systems, geopolitical prognoses for Europe, life-cycle, sustainable development are in [Ma 98, 99, 00] and others publications.

The science as the complex subsystem of human society may be described in the frame of approach above. Of course the development of elaborated models demand many efforts but the general principles of modeling give the possibility to understand some regularities and yet make some prognoses. The science consists of system of scientific knowledge and also infrastructure and organizations. The elements of scientific system

are physical laws, researches, scientific organizations and interconnections. This system has a long history of development and unique scientific system is stable structure with intrinsic internal regularities. Such approach allows many subsystem of society (for example sees mass media). The second is existence of different types of science organizations just like different culture type. Of course some intrinsic properties are common for all science types. But there exist essential differences in sciences. Namely this aspect of models may follows some practical consequences for science in Europe.

Also the economics, politics, manufacturing, education have familiar structure as subsystem of whole society but of course the elements and bonds are specific. This structure is the basis for strict formalization of arguments and approach of networks in society considered in [Ca 98]. So there exist a lot of different growing, evolving and with many interconnections networks. All sub-networks have their specific own attractors as the states. Such attractors are the part of global attractor of whole system. Remark that it exists the threshold of the size of network after which the properties of network essentially change. And for example for NGO such IFAC or EUROSCIENCE it may exist disable threshold in size and activity for receiving new quality of operation. Interrelations of sub- networks are very important for considerations the inter-influence problems between education, technology transfer, West/East countries and so on. The fields of intensive interrelations between different sub-nets are the regions with high creative abilities (creative zones). This zone includes elements from different networks and gets possibilities of forming new connections between these elements. This allows creation of new local sub-nets with new quality. This process recently is more evident in interdisciplinary investigations in the border region between scientific disciplines. Also the presumable creative zones may be zones of interaction West/ East, economics/science, mathematics/humanity sciences.

And what is the educational system and what is their role in society life? As it appears our considerations allows considering from new point of view also some educational problems. Of course further investigations may be long and difficult but we may suppose as background the models of associative memory property based on elements with internal structure [Ma 99, 00]. From such point of view accepted educational system creates the internal mentality structure of individuals as elements. And it is especially useful to consider this processes in the frames of proposed models (or alternatively in some cases in the frames of multi- agent approach). The main goal of educational system should be reflected in the internal structure of elements. Remark that the main two goals in education may be formulated as next: 1) learning to receiving maximum profits (American system), 2) searching and searching the new knowledge (Prussian system).

Different environment should lead to different goals and internal structures. This also lead to possibility of exchange by leading ideas and elements to many possible consequences for education (as theoretical as practical).

3. Some Problems of Educational System

First of all we will discuss some issues in the field of automatic and control education and training (briefly AaC). Automation and control have the best and more elaborated tools for solving problems of management and control. Of course there exit another empirical approaches: strategic management, logistics, gaming and simulation approach. All this tools accumulated the experience of experts. But it is no doubt that in future these approaches will be formalized and accumulates in AaC. May be the development of AaC will be next. Classical (pure technical) applications of AaC will be developed. For such problems new development of control theory will be need based on recent mathematical, physical and another achievements. But new applications will shift automation and control to the control of society processes and to the micro-level control in the cells, organisms. We especially stressed also the problem of management in education. Thus the needs of automation and control will follow to the stressing (explicitly or implicitly) three main groups in education:

I. Theory of automation and control for self- development of AaC.
II. Classical (mainly technical) applications.
III. Applications to the new fields of interest.

So the education for AaC should be different for different educational groups. In the first group the main curriculum should be mathematics, physics, control theory in abstract variants. Second and third groups also should have fundamental knowledge in curriculum above, but should be more forwarded to practical problems. Second group also should have basic knowledge on technology. But the third should receive basic knowledge in new fields of applications: socio- economical or biological or microphysics. There also exist possibility of graduations within groups I-III. The indexes extend from numerical specialists on practical applications of existing methods and tools to forwarded researches with large background and skills to creating principally new ideas and products. It is evident that first educational group should prepare forwarded researches (just as third group). The second group should mainly prepare the specialists for traditional applications.

In this place of the paper we would like to pose some remarks about bachelor and magistr degrees. On my opinion existing level of bachelor (with approximately four years of learning) is insufficient in applied mathematics curriculum (and in particular in automation and control). May be it will be useful to have 5-6 years training as for bachelors as for magistr but with different content of education (especially at fourth, fifth and sixth years of education). Remark that in Ukraine now we have special named for such gradation: specialist (engineer) and magistr. And I am sure that the level of simple programmist is not enough for the goal of recent complex manufacturing. But in any case the distribution of the students by the groups I-III depends essentially on the needs of given society and infrastructure developing in given society. This distribution may be, is and should be different for industrial countries, developing countries, West and East Europe and so on. And it should be determined by fundamental needs of society. But such distribution is not directly proportional to index of development and may be the subjects of special research projects for IFAC DECOMAS community. Here we would like to pose one idea for future education process in AaC. Thus far the high school have prepared the individual as the basic result of education. But because of complexity and interdisciplinary of recent problems it would be useful to prepare as basic element and result of education the group of specialists for definite problem. The psychological

adjustment, difference of skills, different preferences should be taken into account and the members of group may be the next: specialist with system's point of view, theorist-analytic, idea's implementator, practicists and employer (programmists for example).

Now we can discuss some general problems taking into account considerations before. Recently we can see increasing need in automation and control specialists. But the difficult problem is the relative reducing students, which will to receive full volume AaC education. Familiar reducing exists also in mathematics, physics in developed industrial countries and mathematical community also searches the ways of this problem solution [Ba 00, Bu 00, Ki 00]. But the absolute number of student in many countries increases. Many students from AaC curriculum go to programming after the institute graduating. At the same time we should think about preparing and reproducing specialists in AaC. May be it will be useful next draft analogy. The drivers and car mechanics exploit the cars. But without industry with designers, engineers the car production is impossible.

Familiar considerations may be applicable from global point of view to postindustrial (informational) society. Here we proposed some issues following after reading very interesting document - Dr.P.Busquin "Communication of EC on 18 January 2000, “Towards a European Research Area“ [Bu.00]. Now the word globalization became the common for society. The Europe is one of the subjects of this process. But there are as successes as failures in globalization. Bright example if obstacles for technology transfer in former USSR countries. One of the reason is a little amount of foreign investments (in UKRAINE only about 3 milliard dollars by last 7 years). The source in the low level of industry activity (GNP of Ukraine about 35 milliard dollars per year). Because of such matter of state the science and high technology in former USSR State are in especially bad state. For such reason the European Research Area may become the only real perspective for science in NIS. In such circumstances it is evident the importance of Technology Transfer infrastructure. But it is developed such system as flexible mainly non-governmental system for supporting research and business. Ukrainian Branch of Euroscience Working Group of Technology Transfer (see [Eu 00]) had prepared pilot version of WWW of Ukrainian Branch of Euroscience Working Group on Technology Transfer [Uk 00]. We tried to implement such ideas. But now we wish to consider some new aspects of future research area possibilities.

The aspects below will be closely connected with understanding globalization process. May be it sounds trivially but for such goals, but important are the theoretical investigations on postindustrial or post-economical world order (D.Bell, A.Toffler, F.Fukuyama, and others). One aspect (clearly formulated by P.Drucer) is especially important. Briefly, he told that in postindustrial world the main resource would be knowledge and information (more important then minerals, raw materials, fuels and so on). And one of the main components of such recourse is the carrier of knowledge that is individual. So the education of individuals is the process of improvement of recourse. Let us consider some consequences from such point of view. 1) Then the most developed industrial countries will demand more and more such resource. 2) The stores of this resource may be received from less developed countries. 3) The concentration of recourse may be different in strong dependence of working education system. Remark that in analogy with geopolitics and geo-economics in XX century there will be

concurrency between industrial countries in receiving clever individuals. Remark that now we already can see the beginning of such processes (USA, Germany, Japan). And there may be two ways. First to carry individuals to industrial countries with further teaching. It may remember the transportation of row mining. But it is known in mining industry that it is more profitable to carry concentrated recourses. This follows to conclusion of advantage of second way – to teach the individuals in domestic countries. Remark also that in postindustrial society and in future global world because of new communication and informational achievements the future manufacture will be very flexible and independent on the physical place of production.

So we can propose comments on the teaching aspects of European Research Area and the role of East Europe countries. It is well known that educational system in USSR had many achievements (in mathematics and physics). Thus such experience should be explore for the profit of all European community. And we can make some propositions: Support of "hot spot" of high level of education with orientation on world level. Supporting the prestige of such centers by high salary for staff. Protected such centers from bureaucratic control and corruption in domestic countries. Supporting the graduates of such centers by good opportunities for job as in industrial as in domestic countries. Protection educational programs from reducing of level by governmental control. Creation the most useful condition for free movement of sciences and scholars in Europe. May be it would be to introduce special SCIENTIST PASSPORT with the status near the diplomatical passport (or Nansen passport).

Successful implementation of this (and familiar programs) should open perspectives for science and moreover for all society in our countries to open society and to real integration in European community.

In less developed countries or countries in crisis (like former USSR states) we frequently head the invitation to reduce the level of education in AaC and in fact to prepare the simple programmist (especially now). But from global common goals of the whole mankind it will be more profitable to prepare specialists in education group I with abstract and theoretical thinking in former East Europe states (including former USSR countries). This proposition also support the fact that in the West countries (on the author's opinion) the young peoples doesn't wish to learned by long and difficult educational process to solution of very complex problems by involved methods. In USA a large part of investigations in mathematics, physics, informatics fulfilled by the peoples from India, China, Russia, Arabic countries, Poland and so on. At first glance this follows the concurrency with domestic specialists in industrial countries. But as it seems the concurrency will be excluded because of current growth in investigations. And in future the communication networks development will change the distribution of intelligence- consumer workplaces to domestic countries of specialists.

4. Social Informatics as the Example of Automation and Control and Humanity Sciences Synthesis

Till now the specialists on automations and control had deal mainly with mechanical or complex non-vital systems such as airplanes, space shuttles, power plants, factories, railway networks and so on. But recently all recognized that human factor and especially social psychology of large human systems would be one of the key problems. The global computerization and informatization gradually accelerate these processes of humanitarization. So in current conditions it is evident the necessity of creating and developing the tools for preparing the decision on the firm methodological background.

The classical achievements of automation and control should become one of milestone of future methodology. But for development the specialists on control and optimization in the fields of society life it needs to complement the strict mathematical approaches with humanity approaches, understanding the social processes and existing database. All this follows the necessity in preparing entirely new specialists, which can connect such different approaches in powerful methodology. This directly leads to the understanding of needs in creation of new education specialties with transdisciplinary directions. We in our Department of Mathematical Methods of System Analysis of Institute of Applied System Analysis (Kiev), headed by academician M.Z.Zgurovsky already created such specialty in the frame of applied mathematics.

Social informatics considers the problems of receiving, transformation, investigation, and modeling and explores the informational flows in large social systems and their models. Social informatics is complex interdisciplinary approach with deep knowledge from mathematics and physics, computer sciences, management and humanity sciences.

The specialist on social informatics will receive the skills on understanding the formal problems in large social systems. Our students also will receive the skills on such problem solutions from system analysis, mathematics, cybernetics, artificial intelligence, and optimal control. Our students have experience in recent database, program languages, communication networks such as INTERNET. Moreover they will apply the methodologies from humanity sciences: sociology, psychology, economics, politology, theory of learning. Also the geoiformational systems are one of the usual tools in work of our students.

We plan to support our graduates the positions in such job fields: creating the global and local mathematical models of socio- informational , socio- economical, ecological processes; mathematical modeling and optimal control of large social systems; construction, supporting the decision making systems for government, international organizations and firms; adaptation to Ukraine condition recent socio- informational systems and educational, investment, research projects and geoinformational systems in the frames of UN, EC, NATO, TACIS, TEMPUS and other networks and INTERNET networks; consultants and teachers on social informatics in high school, firms, ministry.

The titles of some educational disciplines in our department:
Fundamentals: Discrete mathematics; mathematical and functional analysis; probability theory and stochastic processes; linear algebra; differential equations; mathematical physics; nonlinear analysis; synergetic; methods of optimization; numerical methods; system analysis of social processes;

Computer sciences: Programming and algorithmical languages; operational systems; database; coding and information theory; object- oriented programming; neuronet methods; computer networks; artificial intelligence and expert systems; game theory and operational research;
Special and professional: the risk theory; management and marketing; social psychology; geoinformational systems; politology; philosophy; sociology; informational politics; management of informational- technology politics; supporting decision- making systems; micro and macro economics; the basis of law; ecology;

Introduction of new specialty has as achievements as some difficulties. In report we shell stressed many obstacles. Remark that the main is the very high inertia of educational system and moreover society as the whole. We also may compare the experience of another universities (Koblenz University, Surrey University some Ukrainian universities) in developing courses with mathematical modeling and social informatics [Tr 00]. Our curriculum is more mathematically saturated. One of the sources of this that now in Ukraine our main task is to develop the market of consumers of social informatics. Only further we hope to distribute the social informatic as mass profession.

5. Experience of Teaching on Social Informatics and Some Comments

In this subsection I display the four -year experience as the head of this new specialty and the prospects and tasks on the future. At the beginning we should say that there are several goals in creating such discipline especially for Ukraine (and may be for another former USSR countries). First is evident - the necessity in specialists in social informatics for the goals of informational - analytical support of decision-making in large organizations, structures and firms. The second of them is far forwarded and implicit. It concerned the development of open society in postcommunist countries. Such goal presumed orientation the young peoples on the civilization norms and on understanding the main globalization processes in recent World. So we hope to prepare our graduates to work under the slogan: "to make local solution you should thought globally". Remark that one of the issues of possible activity of them will be the technology transfer implementation (in connection with work of Ukrainian Branch of European Working Group on Technology Transfer).

For implementation such goals we introduce many interesting new issues in the learning processes. First topic is the schedule of educational disciplines. The mathematical background at the first three courses is very high with the level of mathematical faculty of university. Also we suppose to support the good level of social and humanity disciplines. And the glue of these rather distant disciplines is the set of new disciplines. Such disciplines are Mathematical modeling of social processes; Synergetic in social sciences; Elements of nonlinear analysis; Introduction to neural networks and others.

Also in our experience of teaching we found that also very useful is course "Introduction to social informatics". This short course (18 hours) is introduced in the beginning of education. Their goal is to orient the students in the skeleton of specialty and explain the role and importance of further different educational courses. Also it is important to

explain to the students their possible future perspectives and possibilities for business and research works. For the understanding of this courses the students should have only knowledge from schools and some knowledge received before in mathematical courses (elements of mathematical analysis, discrete mathematics, and computers). As the rule this course is very interesting to students especially with computer presentations of working programs and results.

Another components of educational process consist in involving the students in investigations through the research works from the 3-2 courses of learning. As the rule the heads of students work is high level specialists. It should be remarked that proposed by author new models for the processes in society (see for example [Ma 98; LM 98]) are one of the interesting background for such applications and diplomas.

Also our students received fresh information on the state of matter in recent processes including cybernetics, international security, system analysis by receiving information directly from materials of different western conferences, symposia and workshops. In our educational experience we also teach the students to apply geoinformational systems including professional systems as MapInfo, ArcInfo and geoinformational data base in Ukraine (described for example at www.isgeo.kiev.ua). For example, our students developed as diploma geoinformational applications to demography prognosing in Ukraine, election prognozing, flood prognozing for real regions. They also receive deep understanding of statistical and neuronet methods. For many processes they also develops the mathematical models. Another important question is development of distance education system in Ukraine. Iinteresting information is posed in the Distance Education Network developed under the head of Prof. V.Kuharenko (Charkov).

6. Dreams and Ukrainian Realities in Education and Technology Transfer

Introduction of new specialties has as achievements as some difficulties. In report we shell discussed such obstacles. Remark that the main is the very high inertia of educational system and moreover society as the whole.

The next is also connected to the inter-influences between society and educational system in Ukraine (and presumably not only in Ukraine). Our students (in high quality educational departments in universities such as National Technical University of Ukraine and especially in Institute of Applied System Analysis) received the deep understanding of fundamental sciences (mathematics, control and so on), excellent skills in programming and vide interdisciplinary approach in problems formulating. But after the graduating the institute they often cannot receive the adequate high level work in Ukraine. The common case for them is to go to the western countries. But frequently them received the job of programmist (may be with high salary). And again in such case they cannot reveal their potential for the profit of their firms.

The same is applied for high technologies developments in Ukraine. The researchers can't find the order on scientific and high technologies productions. As we suppose the decision may be following. For established researchers. It needs to develop the

infrastructure for junction the western order on scientific production and high- quality research groups in Ukraine. Remark that we already have experience of such junction in Ukrainian Branch of European Working Group of Technology Transfer. As to the educational problems we may proposed to develop the infrastructure for preparing students for western orders directly in the course of education. But there should be useful posed two conditions. First is to contact with high level departments. Second recommendation is to works directly with educational staff which learned the students. All such demands may be fulfilled through the NGO for technology transfer. Especially important for Ukraine now is collaboration in such problems with German. Recently there are more contacts in different levels. As the example we should mentioned German- Ukrainian Days in Kiev (and very interesting report of Dr. Yaroslav Pialek). Further collaboration will prospective for both countries.

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