Poland 21st Century Infrastructure for „Global Great Transition” (Eco – Info – Communalism) Scenarios Looking for Future System Research Solutions

Lucyna Bogdan[1,2], Andrzej Straszak [1,2,3], Jan Studzinski[1,2]

[1]Systems Research Institute of Polish Academy of Sciences, Warsaw, Poland
bogdan@ibspan.waw.pl, studzins@ibspan.waw.pl
[2]Wlodkovic University, Plock, Poland
[3]Elblag School of Humanistic and Economics Studies, Elblag, Poland
Andrzej.Straszak@ibspan.waw.pl

ABSTRACT

ICT, R&D and education are vehicles for generating and distributing information and knowledge which can be environmental, educational or R&D in nature and worldwide as well as countrywide in scope. Scientific conferences and congresses combine environmental, R&D and educational topics with the huge dissemination potential of informatics to implement access to environmental, R&D and educational data and research finding as information and knowledge offering on the World Wide Web. This paper is looking for clarifying how Info-Infrastructures based on exchange of research results, information sources and newly developed applications stimulate knowledge integration and competence building countrywide for example for Poland as well as European Union-wide. A systemic view of the EnviroInfo, EduInfo, R&D Info-Infrastructures is presented.

Keywords: Systemization, ICT Revolution, Knowledge Civilization, Eco – Info – Infrastructure, Visions.

1. INTRODUCTION

We are living in the very beginning of the very novel civilization era where knowledge becomes the decisive productive and societal resource [3]. It is subsequently necessary for all countries and societies to understand in more details how knowledge is created and used. Multidimensional, dynamic and systemic approaches are surely necessary to understand the multifaceted characteristic of this new civilization. Such micro-theories of knowledge creation and application for today and tomorrow as well as long–term visions are very much needed e.g. to construct hardware, software and org-ware (org-design) systems supporting this creations using computational intelligence and the multidisciplinary experiences in construction of computerized decision and policy support systems.

The concept of the new civilization era starting in Japan over 30 years ago as the concept of the information society and very soon but also over 30 years ago in Poland as the concept of cybernetics-based economy [4] but it was about 10 years ago adopted by European Union in response to the US concept of an information infrastructure. Vision of Knowledge Civilization [8] is based on a new integration by systems science as the discipline concerned with multi methods and tools of intercultural and multi/interdisciplinary integration of knowledge engineering including soft, hard and org objective approaches. They open a huge perspective for solving current and future problems of mankind.

Knowledge-based economy succeeds only when business and knowledge industry come together as management real and/or virtual fusions. That is very difficult to achieve with no simple answers to the many uncertainties, risks and complexities. Polish business managers as well as politicians have to answer such questions. They need an assistance to do so. That is the role of Polish Sciences as well as of European Union institutions.

We are living in a time epitomized by very rapid technological changes, increasing environment complexity and uncertainty, intense global competition and interdependence among businesses. For an organization to succeed on a global scale, a radical shift in business procedures is required to understand how a new technological infrastructure and knowledge infrastructure can redefine your ideas of what business can be done and from where, when and how. The globalization of almost all economies and societies has created a real impulse of huge telecommunication and information technology infrastructure investments

which has resulted in a necessary but not yet sufficient information and knowledge infrastructure of the world.

The internet is global. The technology talent base is global in addition. Perspectives and policies on ICT in all societies are global too. We are living in the very beginning of the new civilization era where education [7] will play more and more important role. The Polish education sector especially university sector succeeded very well during last 15 years transitions. The number of university students increased over fourfold. The knowledge civilization will need in future up to 70 percent of workers with collage and university diplomas. The Polish education sector infrastructure is ready to do that on demand in the such future.

Unfortunately the Polish ICT infrastructure is progressing very slowly and is not ready on demand for knowledge organizations and knowledge workers yet and in the near future. The Polish environmental infrastructure is open to high-tech recovery and systemization based on automation and using computational intelligence and the experiences in construction of computerized decision support systems and will be ready on demand of the new civilization era.[2]

2. ROOTS OF KNOWLEDGE CIVILIZATION

> What we need is imagination. We have to find a new view of the World.
> *R.P. Feynman*
>
> Imagination is more important then knowledge
> *A. Einstein*

The celestial observers of antiquity took first steps on the long evolutionary path to the system research of today and to Knowledge Civilization of tomorrow. However their role was a purely passive one: to observe, but that could observe past, for present and future. Nevertheless human imagination may be was born due to some of the celestial observers. The ancient astronomers had no means with which to influence the dynamic behavior of the large scale system they studied; they collected data, transformed them into information, knowledge and used knowledge, information and data for successful forecasting of the future. The future resembles the past and the present discovering of the manual labor plus the observation of the flora and the fauna made agriculture civilization based on input-output processing systemic solution and agriculture knowledge implementation

Discovery by technical inventor the speed control regulator based on feedback systemic solution made industrial civilization feasible by widespread of the energy machines and manual labor as well as management skills (arts) and sciences and fast growing technical development. Designing by mathematical and technical sciences, research and development automatic data processing machines at the half 20^{th} century based on feed-forward systemic solution made Knowledge Civilization potentially feasible by widespread of the knowledge and research workers as well as automatic data, information and knowledge processing machines.

While the “data, information, knowledge and communication” as well as numbers of the Ph.D. and D.Sc. will arrange increase of the new systemic solutions which will be necessary for building of Creative Space [8]. Agriculture civilization had implemented small volume of knowledge, while industrial civilization had used much more large volume of knowledge. Knowledge Civilization will use huge volume of knowledge which will be needed by new systemic and ICT solutions.

3. NEW INFO-INFOSTRUCTURES FOR COMMUNICATION AND KNOWLEDGE SHARING

ICT is a new high-technology vehicle for generating and distributing information and knowledge worldwide in scope. Due to the famous Moore’s Law this vehicle is continuously improving and cheaper, more user friendly, more smart and ready for use of continuously growing data, information and knowledge. One innovative way to develop the WorldWideWeb further be through the semantic Web. Semantics is traditionally defined as the study of meaning of words, phrases, sentences and texts. Accordingly, the Semantic Web is a project that intends to extend the feature of the World Wide Web in a manner based on meaning, not more combinations of letters. With the aid of standards and processing tools an attempt is being made to create a universal medium for information and knowledge exchange. The Semantic Web is intended to provide a common framework that allows data, information and knowledge to be shared and reused across applications, enterprises, universities and community boundaries (Burners-Lee, 2005). Figure 1 shows a system diagram of relations between knowledge based society, knowledge based economy, science (including R&D), education, environmental and Info-Infrastructures. Figure 2 shows a system diagram of relations within Systemomatics including Enviromatics, Edumatics and R&D-matics. For example

Enviromatics is abbreviated “Environmental Telematics and Informatics”[5].

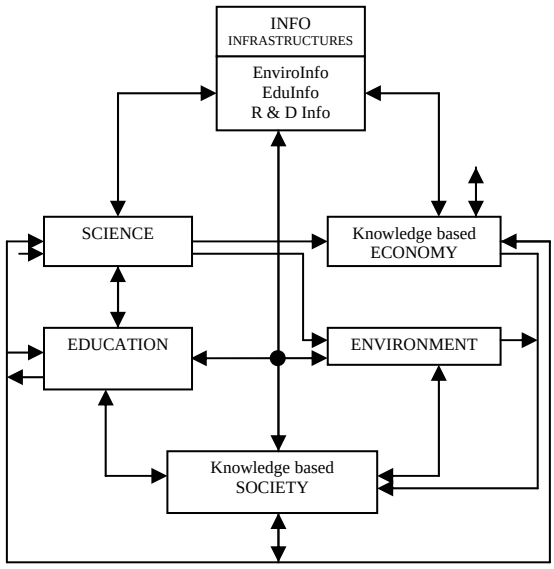

Fig.1. System diagram of basic relations

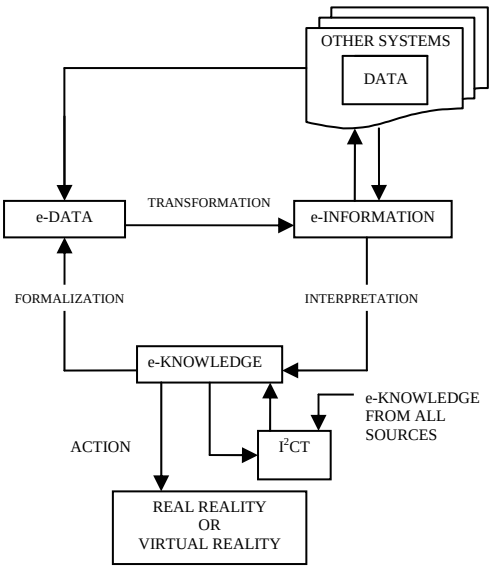

Fig. 2. Systemomatics (Enviromatics, Edumatics, R&D matics)

4. ENVIROINFO INFRASTRUCTURE

Accumulated environmental research findings and detailed measurements of environmental pollution incited the media to report on them, and thus boosted environmental awareness and political responses despite the opposition from many established interest groups. Improved awareness of environmental burdens stimulated organizational changes in governments, the establishment of National Environmental Protection Authorities and the foundation of new nongovernmental organizations (NGO’s). Environmental changes were recognized and findings on the interactions among the economy, society and the natural environment become increasingly apparent. The right to access the environmental information and knowledge, originally reserved for governments, improved the public’s insight into environmental information. Such access to environmental information attracted strong interest among he public in most European countries especially following the Stockholm UN Conference on the Human Environment in 1972.

The concept of sustainable development gained importance in 1987 with the United Nations Conference on Environment and Development (UNCED) and the report entitled *Our Common Future*. With the ‘Right to Know Act’ the US Government demonstrated at an early stage ways that administrations could address the issue of public information and knowledge in general. Subsequently, the EEC Council of Ministers passed the Council Directive 90/313/EEC on “Public Access to Environmental Information”, which has since then been replaced by Directive 2003/4/EC.[5]

The 6th EU Environmental Action Program “Our Future, Our Choice” (2002) recognized that we must decide on policies based on sound science. This is also reflected in the recently adopted 6th EU Framework Research Program which focuses on e.g. Climate Change, Biodiversity, Health and Resources. Such research is intended to help us to better understand the interactions among the economy, the environment and working and living conditions to formulate sound environmental policies.

All the trends mentioned above point to a steadily very fast growing amount of information and knowledge. In addressing individual environmental challenges scientists from different disciplines naturally take different viewpoints. Thus we see various approaches in the section headings *Climate Change, Nature and Biodiversity*, *Sustainable Production and Consumption*, *Environmental Health and Awareness Raising*, *Management of natural resources, effective environmental policy measures and legislation* addressed in the Environment DG 2005 management plan. The Environment and Climate Change are also included in the drafted themes of the 7th Framework Program in the section “Cooperation”, Information and Communication Technologies. Special reports also exist

such as “The attitudes of European citizens towards environment”. One of several results shows that 73% agreed that environmental conditions influence the quality of life and 88% approve the statement “policy makers should take environmental concerns into account when deciding in other policy areas such as the economy and employment “(http://europa.eu.int/comm/ public_opinion/archives/ebs/ebs_217_en.pdf).

Human influences and natural effects cause environmental changes in several spheres, which can be observed and condensed into information and indicators. The “social environment” is included here due to its important influence on the environment in terms of poverty, hunger, social exclusion, aging and unemployment as indicators of living conditions. [5]

The communication among environmental experts was facilitated by the ability to retrieve information from the Web using high bandwidth, and soon epistemic communities evolved into networks of scientists, most of whom were online. Activities of the European Environment Agency fostered the distribution of scientific and application-oriented environmental information and the implementation of Web technologies for EIONET, the Environmental Information and Observation Network in Europe. Countrywide, innovative environmental information systems such as *gein*®, the German Environmental Information Network (www.gein.de/index.html), the new version *Portal-U* (Vögele, 2005), the EEA information resources http://dataservice.eea.eu.int/ dataservice/ or Envirowindows (http://ewindows.eu.org) are examples of public access to environmental information are necessary for Poland. [5]
The fig,3 shows a vision of intensive knowledge structure of ontological support for multidisciplinary model –based problem solving for water system and management as example.[2]

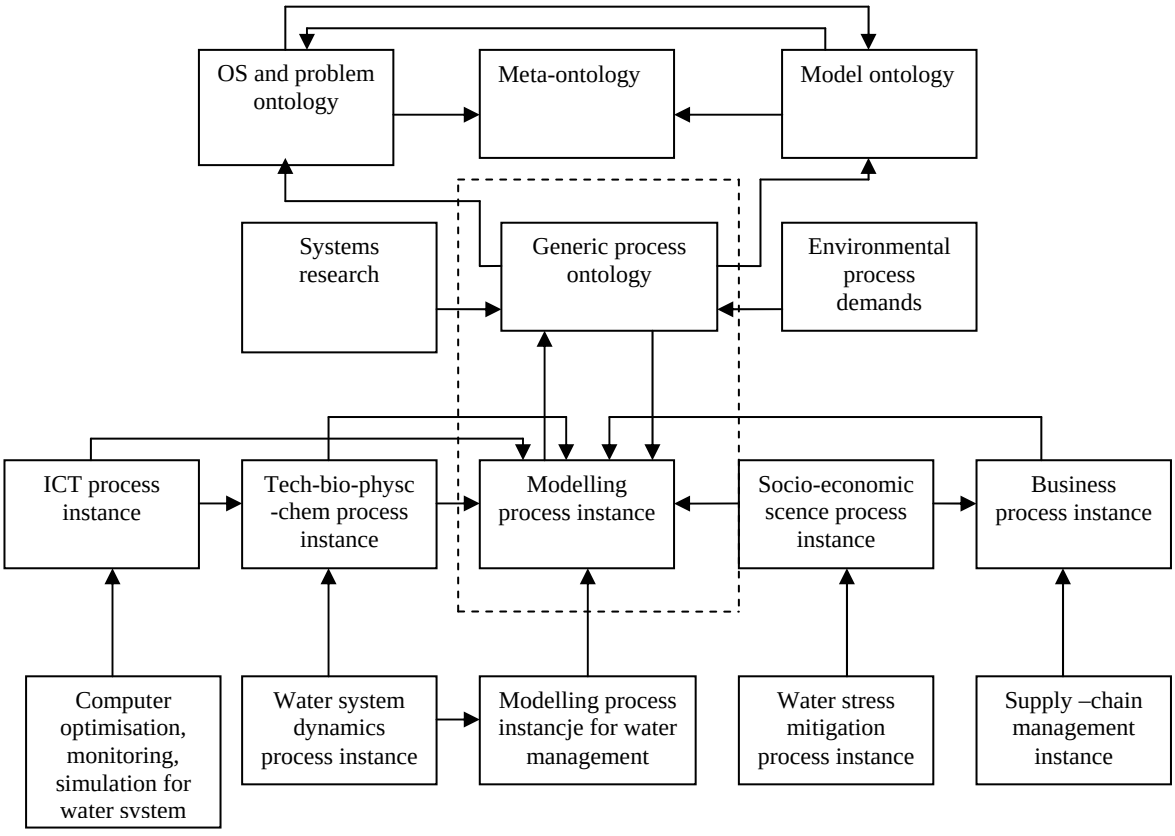

Fig.3.Vision of intensive knowledge structure of ontological support for multidisciplinary model-based problem solving for water system and management

Source: extended version using partly process ontology for model based suport system from Adrie J.M. Beulens and Hubb Scholten (2005).

5. EDUINFO INFRASTRUCTURE

Poland during last 15 years witnessed the biggest expansion of higher-education student numbers in history. Poland is currently conducting the world's biggest experiments in the 'massification' of higher education. The number of people attending universities has increase over four times during last 15 years from 0,5 m to 2 m. The price of this has been a decline in overall quality. Poland big advantage is a more recent development: a booming private colleges and universities. The best private colleges are doing admirable work, responding to demand for managerial, accounting as well as IT education, often in highly creative ways. The expansion at the doctoral level is increasing in 1989-2004 nearly 3 times as many doctors were awarded. In Poland, private universities and colleges have grown from almost account for more than two-thirds of all higher-education institutions and 30 percent of all students. Due to professor's enterpreneurship several "knowledge village as well as small cities" has been established in Poland. The Knowledge Civilization will need in future up to 70 percent of workers with college and universities diplomas. The Polish education sector infrastructure is ready to do that on demand in such future. Unfortunately the Polish EduInfo Infrastructure is progressing very slowly and is not ready on demand for knowledge organizations and knowledge workers yet and in the near future [7].

Current, so-called "New educational reform" in Poland according to the systems analysis point of view is still old-fashioned one as it will not produce high talent personnel for digital economics and knowledge societies in Poland and Europe. The new educational systemic revolution in Poland is needed now, based on full digitization of whole educational sector ready for mass production of high talent personnel by systems integrated and collaborative networks of state and private schools and universities. The fundamental rethinking and radical redesign of educational process to bring about improvements in performance at all schools and universities is necessary – the reengineering revolution within Polish sector of education is needed. Owing to the long-term historical processes the diversity of education quality patterns in Poland is enormous. Thus, in particular, even the region of Warsaw, along with the areas adjacent to it, are far below the satisfactory level of education quality. The on-going transition of the Polish economy and society, taking place since 1989, aiming at association with the global advanced market economy and at full membership of the global democratic society circle, induces the necessity of fast reengineering of the education within most if not all of the Polish regions.

In the long term, that is – a few decades away, we are going to live in the world which will be practically entirely globalized, meaning a currently unimagined degree of interconnection in physical, economic and financial domains, but first and foremost in the domain of information. The information flows taking place due to the advance and use of information, computer and communication technologies will offer an unprecedented scope of opportunities for interactive information exchange, virtual conduct of activities, and simple communication between almost any interested individual.

The progressing globalization (MacDonald, 1998, The 21st Century Economy, 1998) and virtuality of operations , coupled with the rapidly increasing connexity will have an enormous impact on the development of all education sector of the regions. In particular, it will offer an unprecedented opportunity of exchange among managers, teachers, professionals and scientists, thereby fostering creativity and collaboration. Along with this, globalization and virtuality, as well as connexity, will have an impact on the development of infrastructure, so that a new global, ultramodern infrastructure will be established. Very high speed and highly interactive multimedia will produce the distance invariant, richly equipped cyberspace. Very high speed global multimodal transport systems will provide connection among all the nodes of creativity and entrepreneurship within the ultra modern settlement system networks.[7]

The society of the 21st century will therefore be to a large extent *time* and *information* based (Ando, 1973). The doubly networked global-and-virtual, society will emerge with all the important firms , institutions, schools and regions potentially interacting on a global scale and in real time over virtual activities. The socio-economic and institutional transition in Poland will therefore not be an isolated process, but concurrent with other socio-economic and institutional transition in many countries, as well as the global transformation in world economy, transportation, and telecommunication, based upon the spread of high-technology – the global transformation from the industrial to the information era. Access to the global information, knowledge and intelligence resources will be available to most if not all countries and societies. These resources will become the most strategic ones, more valuable than land and than many other resources.
Reengineering is also not "restructuring" usually an euphemism for moving boxes around on educational

chart. Reengineering in centered on how education is done, not how schools and universities are structured. Fig. 4 shows a typical virtual education system. Fig. 5 shows EPR vs. ISD vs. Workflow Management.

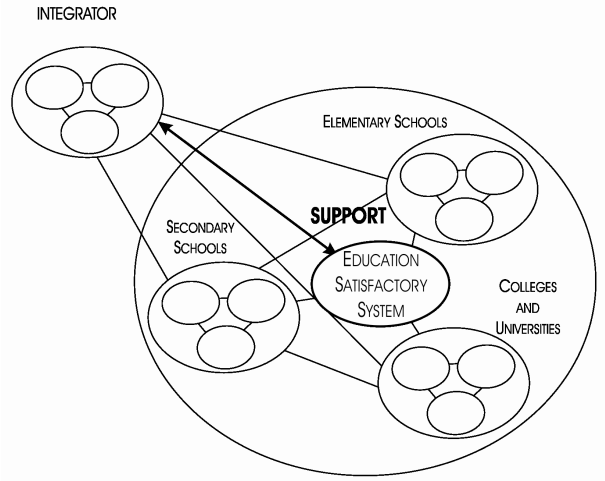

Fig.4. A national virtual education system.

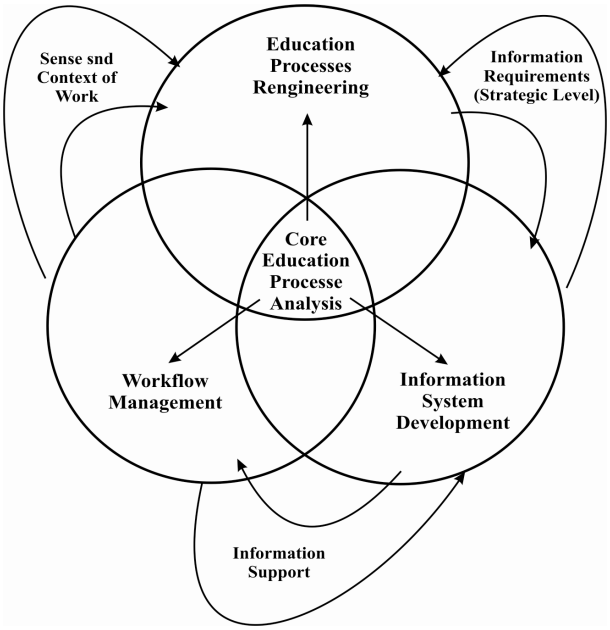

Fig.5. EBPR vs. ISD vs. Workflow Management

6. R&D-INFO INFRASTRUCTURE

The knowledge-based wealth creation dominates now over the methods associated with industrialization. Knowledge can reduce the extent to which such traditional production factors as raw materials, energy, land, labor, time, space, and capital, are needed. The digital economy of the 21st century will be based on knowledge and wisdom. Merely people and very advanced computers that can generate knowledge today, but only people can possess wisdom.

Thus, knowledge is thought to be the primary source of impact and power in today's markets and societies, it is the ultimate substitute for the traditional factors of production. Yet, unlike other factors of production, knowledge is unlimited and inexhaustible, and can be used to create even more of knowledge and wisdom. The value of successful firms and regions does not reside in stocks and inventory, but in their capacity of acquiring, generating, distributing, and applying knowledge.

The distribution of knowledge nodes within the global, continental, and country-wide knowledge networks is unfavourable for the Polish regions. Knowledge nodes make up a part of the R&D infrastructure of a country, but are located within specific regions. They may be defined as a special concentration of scientific and technological units for both the public and private sector (science cities or parks, innovation centers, technology transfer poles, and information centers). Knowledge nodes based on the high-technology spin-off from the governmental R&D laboratories and the major research universities are the most important ones.

The spin-off process has been studied for many years by Professor M. Eto from Tsukuba University, who recently advised to carry out the case. studies of formation of the spin-off companies resulting from (1) the governmental R&D laboratories in New Mexico, and (2) the governmental R&D laboratory in Tsukuba Science City and two universities in Tokyo. Few years ago, during his visit at the Systems Research Institute Warsaw, Poland, Professor Eto advocated for the conduct of such studies in Poland, but the drastic cut of R&D funding by the government and the private sector made such study unfeasible. The knowledge-based economies and societies should spend at least 3% of the GDP annually for the R&D purposes now, but this level will have to go up in the 21st century. For comparison, Polish government have used only 0.34% of the GDP for R&D 2003, while 1 % of GDP spent on R&D is considered the minimum for any country since 1980. In Poland in 1973 it was proposed 4 percent of GDP for R&D as a target in long term planning (1975-1990).

It is necessary that efforts aimed at financing of the R&D sector be made by the government and the private sector not only from the point of view of national development, but also the regional one as well.

Technopolises are widespread in the U.S., in Western Europe, and in Japan. Almost none exist as yet in Poland. Currently, several of the essential factors for the establishment of technopolises are available in Poland in a too short supply, namely:

(i) the R&D funding by the government and the private sector,
(ii) young research scholars,
(iii) modern laboratories.

These are just examples. The list could indeed go on. And yet, technopolis could constitute an important, long-term instrument for all regions development in Poland in the 21st century.

The 20th century management was independently created by Taylor, Fayol and Adamiecki some 100 years ago. It was based upon the experiences from the heavy industry, and was later on developed by P.Drucker, H. Simon and hundreds of high-class specialists all over the world. It will, however, only partly be used in the cybernetic world of the 21st century. Digital economy is the "zero-distance" economy, where local competitiveness and profitability are at the same time the global ones. Hence, the regional competitive advantage has been, is, and will reside in people themselves, rather than in the traditional factors, under the condition, of course, that the nodes of the two global Nets (C&T) are located within the region.

The keys to the global as well as rural region competitiveness in digital economy are the following ones:

- Knowledge constitutes the basic factor of production..
- High-level knowledge-based skills, including the managerial ones, are becoming more and more vital.
- Constant creation of the multidimensional innovations (including the managerial ones) is the prerequisite for survival in all industries and regions.
- Huge volumes of information have to be processed by industrial as well as regional organizations, creating the need for the more effective forms of systems integration, along with the large scale investments in the firms' and regions' information technology infrastructure.
- The rules governing successful companies in the future will be fundamentally different from those governing successful organizations today.
- Organizations will become much more complex and unpredictable places to work at.
- The role of the manager will become more lateral, with much more of the focus on people - staff members and customers, and processes.
- The future manager's profile: be an expert, be a net-worker, be self reliant, be resilient.
- The future company profile: responsiveness to global expectations coming from the potential customers, fast to-market, fast-to-produce, fast-to deliver, fast-to-serve.
- The value of successful companies in the future will not be based on such tangible assets as buildings, machines, stocks and inventory, but on their capacity for acquiring, generating, distributing and applying knowledge, both in the strategic and in tactical manner. The strategic planning and information systems will be inherently embedded in the structure of effective organizations.

Despite the dotcom boom and bust, the computer and telecommunications revolution has barely begun. Oven the next decade the internet and related technology really will profound transform UE society.

How rapidly such new technology is introduced will depend on a number of factors – mainly due to the state of the economy, the supply of investment capital, the behaviors of consumers and governments. But whatever happens the speed of computing and communications looks set to continue to grow, and its price to fall, at a steady rate for the next few decades. In the internet and high speed transport era distance is dying, but geography, it seems, is still alive and kicking, today closed UE regions are up to 1000 km, no far away, no any more [*Geography and the net., The Economist. Jan. 25th 2003*].

The global marketplace of the 21st century will reward firms, corporations that value entrepreneurial risk – taking, invest heavily in developing their Intellectual, Knowledge, Research and Development Capital promote individual knowledge and research workers as well as teams of knowledge and research workers.

Rand is a more than fifty years old a California corporation, independent and nonprofit consisting of about 1600 persons. It purpose is research, production, knowledge and accumulation of intellectual capital – only that, on matters affecting the public interest – questions of. U.S. strategic policy, for example; of the design, development, procurement, deployment, maintenance and support of military forces; of urban development policies, and those involving education, health, housing, energy, and so on. Rand was idea place where idea of internet was born.

Rand exists because it does one thing well. Not invariable well, because it is in the nature of research to run the risk of being wrong. But Rand has built a reputation for quality research of a kind that serve the people. And the need is more actual today, in the beginning of the 21st century than in was when Rand was founded and incorporated in May 1948, with funding from The Ford Foundation, after a two – year gestation period as Project RAND – a special and experimental contract between the Army, Air Force Project RAND contract was transferred to The Rand corporation in that year, and has been renewed without interruption to the present day. [www.rand.org].

Much of the Rand work of the past more than half – century was successful – some of it singularly so – Rand is a first prototyping construct of the 21st century "knowledge corporations", needed for public as well as for commercial purposes. To-day Rand is considered as a U.S. national knowledge resource. Rand's research staff is trained in a wide variety of disciplines.

Rand is based on high quality and trust on knowledge creation, mediation and application, on non linear model of knowledge management processes and on non linear quality doctrine. Today the system of business company or corporation or non – profit knowledge corporation research potentials are more complicated based on local and virtual research potentials [6].

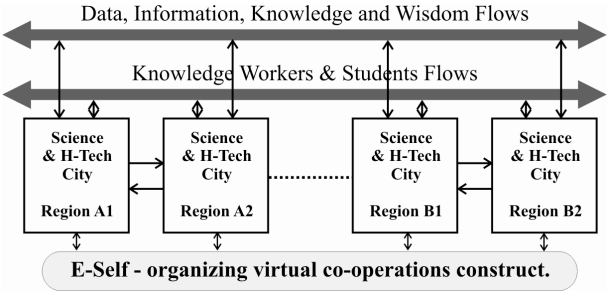

Fig. 6. Virtual knowledge organizations Cooperation Regions Belonging to the Immediate Neighborhood Countries to Favour Synergetic Development.

7. CONCLUSION

In 2001 the RAND Pardee Center for Longer Range Global Policy and the Future Human Condition was established. In 2002 Pardee Center published the book on Shipping the Next One Hundred Years with multiple visions of the future. The three general classes of scenarios were considered and labeled "Conventional Worlds", "Barbarization" and "Great Transition". Due to new roles of Systems Sciences in a Knowledge Society and in a vision of Knowledge Civilization the only acceptable scenarios on the label "Great Transition" for all countries have to be chosen for systemic consideration.

"Conventional Worlds" based on almost three hundred years experiences approach to its end and has not future. "Barbarization" scenarios are feasible but not welcome. "The management of global development" is becoming an increasing important issue of today and necessary issue of tomorrow. This is mainly due to the fact that the modern world has seen rapid technological growth or it is surely a technological phenomenon but all others dimensions of growth are insufficient over the last sixty years. But, it is also due to the fact that the future economic growth of the world will be much more difficult, more uncertain, more risky and more complex than in the past [6].

Unfortunately, the accumulation of knowledge in the field of "global management and controllability of global development" is still rather limited.

REFERENCES

[1] Beulens A.J.M., Scholten H. (2005) *Towards a Process Ontology for a Model Based Support System for Problem Solving: the Ontology Bootstrap Problem.* CSM/KSS-IIASA Workshop. Laxenburg, Austria.

[2] Bogdan L., Kaczmarska D., Studzinski J. (2005) *Computerization of waterworks in Poland – current state and perspectives*. In: Studzinski J., Drelichowski L., Hryniewicz O. (Eds.) Applications of Informatics in Environment Engineering and Medicine. PAN IBS Warszawa.

[3] Kacprzyk J., Nahorski Z. and Wagner D. (Eds.) (2005) *Systems Research Applications in Science, Technology and Economy*. Exit, Warsaw.

[4] Kulikowski R., Findeisen W., Nałecz M., Seidler J., Straszak A., Wegrzyn S. (1972) *Role of Cybernetics Sciences in Development of the Nation*. Polish Academy of Sciences, Warsaw.

[5] Pillman W. (2005) *The integration of Environmental Knowledge*. EnviroInfo 2005.

[6] Straszak (2003) *D&PSS in the uncertainty of the internal society*. In: Tung B., Sroka H. (Eds.) DSS in the Uncertainty of the Internet Age. Katowice.

[7] Straszak A. (2002) *Education needs for knowledge based society*. In: Owsinski J.W., Straszak A (Eds.) Information Society and Operation Research & Management (in Polish). EXIT Warsaw.

[8] Wierzbicki A., Nakamori Y. (2005) *Models of Knowledge Creation Processes.* CSM/KSS-IIASA Workshop, Laxemburg, Austria.