Raport Badawczy
Research Report

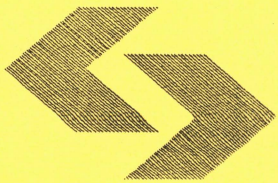
RB/76/2001

Educational process reengineering for polish information society

Andrzej Straszak

Instytut Badań Systemowych
Polska Akademia Nauk

Systems Research Institute
Polish Academy of Sciences



POLSKA AKADEMIA NAUK

Instytut Badań Systemowych

ul. Newelska 6

01-447 Warszawa

tel.: (+48) (22) 8373578

fax: (+48) (22) 8372772

Pracę zgłosił: prof. dr hab. A.Straszak

Warszawa 2001

Educational Process Reengineering for Polish Information Society.

Andrzej Straszak.

System Research Institute. Polish Academy of Sciences

Applied Informatics and Management University. Warsaw.

Andrzej.Straszak@ibspan.waw.pl

Abstract

The long-term perspectives on mankind's economic past, present and future were, are and will be based on education. The first the agricultural revolution was based on handwriting and dispersional systems of schools, the second the industrial revolution was based on industrial printing and hierarchical systems of schools and universities as well as mass production of educated personnel for industry and state, the third the information revolution will be based on the new educational revolution – the coming digitization of National Educational Sectors.

It's now clear that the Polish education sector is in greater trouble than was generally realized when the current Polish transition started in 1989.

The catastrophic situation of the Polish education is due to many reasons, local, regional and national ones.

Nevertheless, the Polish education sector is still at the point of no return – no return to old but well established industrial education style of the so-called industrial society.

Current, so-called "New educational reform" in Poland is from the systems analysis point of view still old-fashioned one because will not produce high talent personnel for digital economics and information 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.

There are four key words in the reengineering concept. Let's start near the end, with the concept of "dramatic" improvement. Reengineering is not about making marginal improvements to education. It is not about making education performance 5 percent or 10 percent better. It is about making quantum leaps in performance, achieving breakthroughs.

The second key word is "radical". Radical means going to the roots of educational process. Reengineering is not about improving what already exists. Rather, it is about throwing it away and starting over. Some may find this notion extreme, even dangerous.

The third key word is the definition of "educational process". By a process, we mean a group of related tasks that together create educational value for a person.

The fourth key word in the definition is "redesign". Reengineering is about the design of how education is done. Reengineering is based on the premise that the design of process how education is done – is of essential importance.

What reengineering is not? There are many widespread misconceptions about the nature of reengineering. Reengineering is not downsizing. Downsizing means getting rid of people and jobs to improve short-term financial results. Reengineering is about rethinking education from the ground up in order to eliminate education that is not necessary and to find better ways of doing education that is. Reengineering eliminates bad education, not jobs or people.

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.

1.Introduction

It is now clear that the Polish education sector is in greater trouble than was generally realized when the current Polish economical, political and social transition started in 1989. The catastrophic situation of the Polish education is due to many reasons, local, regional, national and supranational as global ones.

Nevertheless, the Polish education is still at the point of no return – no return to old education style of the so-called industrial society .

Current, so-called "New educational reform" in Poland is from the systems analysis point of view still old-fashioned one because will not produce high talent personnel for digital economics and information (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.

2. The New Great Transition

A long-term perspective on mankind's economic and social past, present and future includes three great transitions. The first was the agricultural revolution transition that occurred some ten thousand years ago and essentially created civic culture. Man ceased to be a wandering nomad and created communities tied to a particular area of land. The agricultural revolution transition took eight thousand years to spread around the world

The second great transition began two hundred years ago and was based on Energy and Industrial Revolution and after one hundred years also Managerial Revolution. Two hundred years was too short to spread the second great transition around the world. Even in some European countries like Poland the second transition was not completed yet, especially in such sector of economy like agriculture.

The third great transition began, in 1989, when Tim Burners-Lee invented the World

Wide Web technology. He put forward a "global hypertext project" to allow people to share their work around the world. Work could be now widespread over the globe instantly. Today about ten

percent of human population use already this first literally and technologically global system. By 2020 the WWW technology could be reachable for more than fifty percent of global human population. The WWW is the first but not least global technology, however we could consider now that Information Revolution occurred at the last moment of the 20th century and that 21st century belongs fully to New Third Great Transition. It is true for all sectors of economy and society, including of course education.

3. A Few Rules for Any Sector of Economy within Information Society.

The collapse of the old Economies, societies and technologies (agricultural and industrial ones) results that new global situation is turning the world economy upside down, the education for the Information society is a digital education.

In the new economy for the Information Society, information in all forms becomes digital. The new economy is also knowledge and research economy based on the application of human knowledge and research results to everything we produce and how we produce it. In the new economy, more and more of the economy's added value will be produced by knowledge workers, researchers and manager's brain.

In the new economy, adding ideas to products and turning new ideas into new products is what the future is all about. Whether people as consumers or producers, adding ideas will be central to wealth creation in the new economy. The Information Society is based on the Networked Intelligence, silicon microprocessors and roads of glass fiber are enabling humans across the hall, across the region and across the planet to apply their know-how, knowledge and wisdom to every aspect of production and economic as well as social life. This is an age of networking not only of technology but humans, organizations and societies, creating world wide web of human and artificial intelligence.

In the digital economy, competition doesn't come from competitors only – it comes from everywhere; and collaboration doesn't come from aliens only – it could come from competitors too. The new enterprise is a network of distributed teams based on the application of C^4I^3 technology – command, control, communications, computing / information, intelligence and intellect technologies. [19] A few overlapping rules are emerging that differentiate the new (digital) economy and education from the old.

RULE 1: KNOWLEDGE AND RESEARCH

• The new (digital) economy and education are a knowledge and R&D – intensive economy and education.

Information, intelligence and intellect technology (I^3T) enables an economy and education based on knowledge, intellect and wisdom. The new era of smart products including machines, robots, houses, factories and so on as well as very, very well (digital) educated peoples will revolutionize every aspect of economy and society.

RULE 2: DIGITIZATION

- The 21st century economy and education is a digital economy and education.

In the new economy and education, information, intelligence and intellect are in digital form: bits. When information, intelligence and intellect become digitized and communicated through digital networks as well as stored in bits, a new world of possibilities unfolds. New digital appliances are already created very soon that fit in your pocket and can have access to world wide vast information and knowledge bases wide.

RULE 3: VIRTUALIZATION / MOLECULARIZATION

In the new (digital) economy and education, there are a lot of virtual matters:

- Virtual corporation
- Virtual agency
- Virtual market
- Virtual education chain
- Virtual university
- Virtual teams and so on

The new (digital) economy and education are a molecular as well as virtual economy and education. The large corporation and education system are being disaggregated, replaced by molecules and others entities that form the dynamic basis of economic and education activity.

RULE 4: SYSTEMS INTEGRATION / INTERNETWORKING

- The new (digital) economy and education are is a networking economy and education, systems integrating molecules into new clusters that network with others for the creation of wealth.

The C^4I^3 technology networks enable small companies and schools to overcome the main advantages of big companies and schools– economies of scale and access to resources. The Internetworked Enterprise and Education System will be a far-reaching extension of the virtual corporation and dot.com because there will be access to external business and education relationships and a dramatic increase in outsourcing. The Internetworked Enterprise and Education System will behave like Internet, where everyone can participate and based on systems synergy, where the total effort is greater than the sum of the parts. Networks of networks along the Internet model are beginning to break down walls among companies and education units– suppliers, customers and competitors. Every economy and schools needs a national C4I3 infrastructure. The new infrastructure will change economic and education activity as thousand folds or more, as did electrification.

RULE 5: DISINTERMEDIATION / CONVERGENCE

The new national C^4I^3 infrastructure will change dramatically the role of middleman functions in new (digital) economy, partly eliminating them, partly offering them a new role.

The C^4I^3 technology it is a convergence technology itself and will stimulate other convergence trends in new (digital) economy. Convergence is becoming the basis of all sectors of new (digital) economy as well as education.

RULE 6: PROSUMPTION / IMMEDIACY

In the new (digital) economy and education mass production and mass education are replaced by mass customization, producers and providers must create specific products that reflect the requirements and tastes of individual consumers. In the new digital economy and education, consumers and student become involved in the actual production and education process. The new (digital) enterprise and school are a real time enterprise and school , which are continuously and immediately adjusting to changing business or education conditions through information immediacy. The recent RAND concept of "velocity management" will contribute to the new (digital) economy and education.

RULE 7: GLOBALIZATION

In the new (digital) economy is a global economy from the very, very beginning. Contrary to popular wisdom, companies from the fringes of the world economy can become global players. What they need is organizational confidence, a clear strategy, a passion for learning and the leadership to bring these factors together.

Is there a New Economy? Will the New Economy survive both the collapse of New Economy stocks and the cyclical downturn? Is a New Economy, a new (digital) economy described above?

A New Economy it was a name for 1995-2000 dot-com companies subeconomy. In the past year NASDAQ prices of the dot-com companies have fallen with astonishing speed, wiping out more than half of the previous five years gaining. Never has so much wealth created or destroyed so fast. However, financial markets are not a reliable indicator of the economic benefits of great technological revolution. Many economists continue to believe, that improvements in information technology have already increased the efficiency and productivity of the U.S. economy, with additional benefits to come as both old and new companies adapt their operation to make the most of the new technologies.

4. Educational Process Reengineering with Breakpoints.

The paper addresses the general issue of the *long-term* education *development* in a transition country, i.e. Poland. The socioeconomic systemic and institution in Poland will not be an isolated process, but concurrent with the global transformation in the world economy, telecommunication,

information technology, and transportation, based upon the spread of high technology-the global transformation from the industrial to the information and knowledge era. The long-term education development issue is considered within the framework of the *systemic integration approach* applied to the concept of *reengineering.* The precepts for such a methodology and their illustrations are shown.

Owing to the long-term historical processes the diversity of education quqlity 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 circle of the global democratic society, induces the necessity of fast reengineering of the education within most if not all of the Polish regions. Over the past few years the term "reengineering" has been used to denote the fundamental rethinking and *radical redesign* of the business, meant to bring about dramatic improvements in performance (Espejo et al., 1996, Hammer and Stanton, 1995).

There are *four keywords* to this approach. Let us start with the concept of "dramatic" improvement. Reengineering is not about making marginal improvements , like 5% or 10% better than before. It is about making of breakthrough in performance. The second key term is "radical". This means that reengineering is not about improving how to work. The third key term is "process". By a process, reengineering understands a group of related tasks that together create value for a result. The fourth key notion is "redesign". Reengineering is namely about the design of how the work is being done. The starting point for the organizational success is constituted by the well-designed processes, Hammer and Stanton (1995).

The art and practice of learning organization, based on the so-called "fifth discipline" is , likewise, not only the title or the book (Senge, 1990A,B), but , again, a result of use of a really revolutionary management thinking for Education Process Reengineering.

There are five keywords to this new approach. First – systemic thinking, second – widespread personal masterly work, third – mind's models, fourth – joint vision, fifth – collaborative learning.

In the long term, that is – a few decades away, we are going to live in the world which will be practically entirely globalised, 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 globalisation (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 serrlement system networks.

These two kinds of networks (NETS) will form the infrastructural basis of tomorrow. The first of these NETS will be reachable for almost all of the regions, the second NET, though, will be accessible for the regions located within the global transportation corridors and close to them. Thus, location of a region may become much more important than its size or other characteristics. It will namely be much easier to establish a new university or w virtual research centre in a medium-sized city within the reach of the NET, than to modify the global transportation corridor due to the wish or demand for inclusion of an even much bigger city, with an old famous university.

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.

5. The Education Process Reengineering and the new multiple change engines of the 21st century.

The worldwide communication industry is moving fast ahead. Wireless technology is all over the place, ranging from the globe-spanning satellite systems to the local area networks. The Internet, and above all the world-wide-web , race ahead exponentially and generate the hunger for the even faster public multimedia networks.

The spectacular growth of the wireless communication technology, in particular that of the cellular telephone , can be regarded as a kind of communication revolution.

Last years the biggest makers of the cellular equipment in Europe and Japan – put their brains together in order to build the next generation of cellular phones.

The medium of Internet constituted the breakthrough in terms of accessing, transmitting data and software, carrying out electronic commerce, and sharing computational results, as well as for exploiting the unused far-off computing resources needed for the large-scale computational tasks. When Internet is used for technical computations, a balance is needed between local and remote computing. Most of the mathematical computing work is best done locally, on a compact equipment. Thus , in particular, the large and complex graphic representations require excessive internet capacities, and transmitting them among remote sites might jam the connections.

Since the Internet is best used for communicating data and technical documents, the prevalent model for the internet computing will be constituted by the so called web-enabled products. This model often provides the best balance between internet communication and local computational efficiency.

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

Thus, knowledge is said 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 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 unfavorable 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 significance of the spin-off phenomenon as a means of technology transfer, leading to job and wealth creation is illustrated by the case of the MIT (Massachusetts Institute if Technology). An analysis carried out by the Bank of Boston (1997) identified 4,000 spin-off instances, employing 1.1 million people, and featuring worldwide sales of 232 billion USD. During the 1990s some 150 high-technology companies have been spinning-off the MIT each year. MIT is, of course, highly

exceptional among the American research universities in terms of its very high rate of spin-off, but other schools have also played the key role in helping to establish the technopolises (technology or science cities) through the spin-off process: Stanford University in Nothern California's Silicon Valley, the University of Texas in Austin, Cambridge University, which created the center of Cambridge, or the Tokyo Institute of Technology impacting on the surrounding area of Tokyo (Carayannis, Rogers, Kurihara, Albritton, 1998).

It is necessary that efforts aimed at financing of the R&D sector be made the government and the private sector not only from the point of view of national development, but also the regional one as well (Straszak, 1998).

The geographical location of knowledge centers or nodes has in recent years become an issue of an important body of scientific research. It is especially worth noting that various very large European cities are losing their share of contribution to the regional innovation potential and restructuring of the industrial sector to the advantage of the medium-sized cities (Nijkamp and Mouwen, 1985). The question therefore arises of identification of the urban centers, large and medium-sized ones, constituting promising locations for the knowledge nodes which would serve to provide the necessary R&D infrastructure of global, continental, country, or regional nature, inducing technological change in a definite area.

The latter question can only be answered if more insight is available into the geographical orientation of the global firms with respect to the external R&D facilities (including, notably, knowledge nodes).

Tsukuba Science City is one of the world`s few planned technology cities. The Japanese government decided in the early 1960s to create a technopolis. Today, 88 national R&D laboratories are in Tsukuba, along with two universities. In the past decade, 160 R&D laboratories are in Tsukuba. The cocept of technopolis has been accepted by practice, but it must be noted that there are cases which defy the rules of the thumb devised for such undertakings. And so, in the case of New Mexico two essential factors for creating a technopolis are in short supply: (i) risk capital for the start-up of the technology-based ventures, and (ii) entrepreneurs (Carayannis, Rogers, Kurihara and Albritton, 1998).

Technopolises are widespread in the U.S., in Western Europe, and in Japan. None exists as yet in Poland.

Linked to the information revolution there is another revolution – the intelligent systems` revolution. The manifestations of this revolution are not as obvious as those of the information revolution, because they involve, for the most part, not entirely new products, but an enhanced MIQ (Machine IQ), see Straszak (1998) and Zadeh (1998).

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.

There are four key words in the reengineering concept. Let's start near the end, with the concept of "dramatic" improvement. Reengineering is not about making marginal improvements to education. It is not about making education performance 5 percent or 10 percent better. It is about making quantum leaps in performance, achieving breakthroughs.

The second key word is "radical". Radical means going to the roots of educational process. Reengineering is not about improving what already exists. Rather, it is about throwing it away and starting over. Some may find this notion extreme, even dangerous.

The third key word is the definition of "educational process". By a process, we mean a group of related tasks that together create educational value for a person.

The fourth key word in the definition is "redesign". Reengineering is about the design of how education is done. Reengineering is based on the premise that the design of process how education is done – is of essential importance.

What reengineering is not? There are many widespread misconceptions about the nature of reengineering. Reengineering is not downsizing. Downsizing means getting rid of people and jobs to improve short-term financial results. Reengineering is about rethinking education from the ground up in order to eliminate education that is not necessary and to find better ways of doing education that is. Reengineering eliminates bad education, not jobs or people.

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.

Education Process Reengineering (EPR)

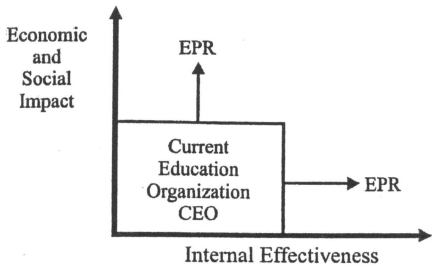


Fig 1. shows effectiveness of current education organization.

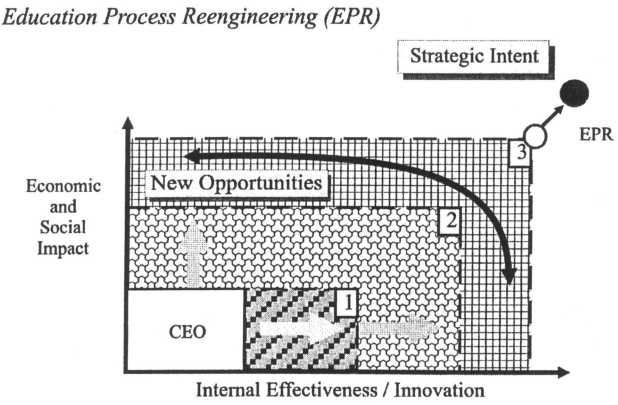


Fig 2. shows opportunities arising from improved education-chain elements.

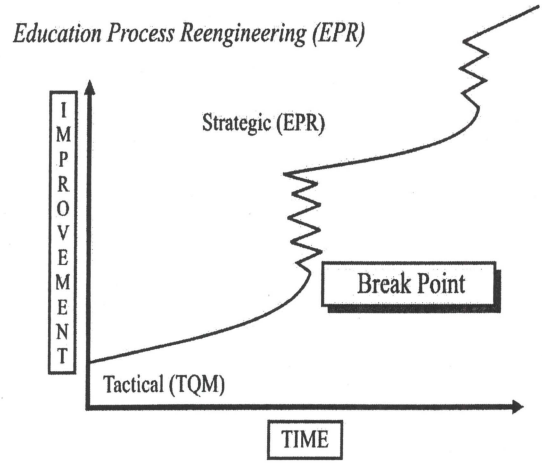


Fig 3 shows a education system journey to process – oriented improvement.

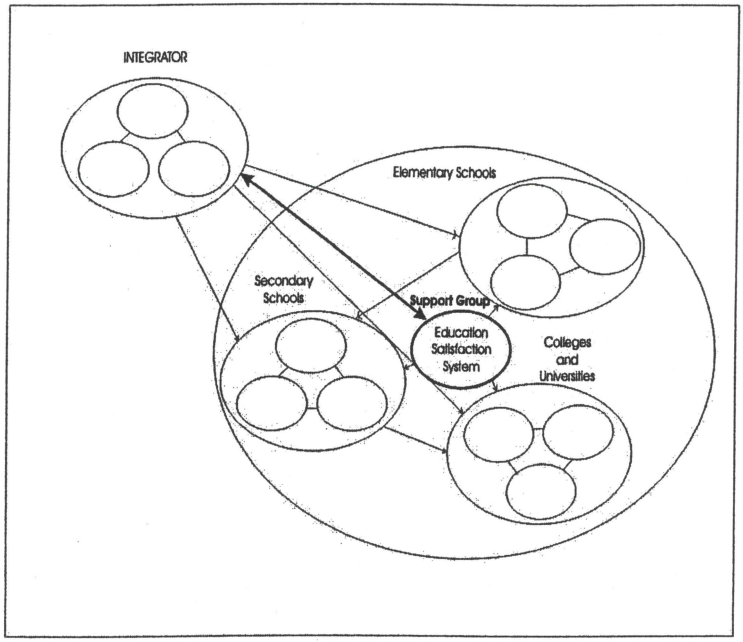


Fig. 4 shows a typical virtual education system.

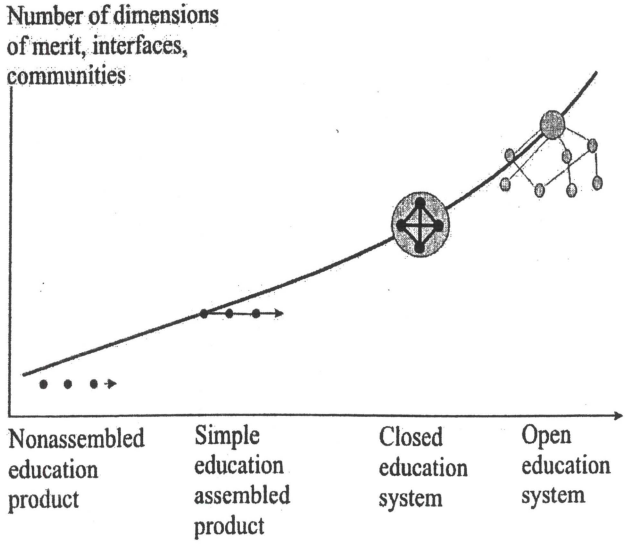


Fig .5. shows education technology as system.

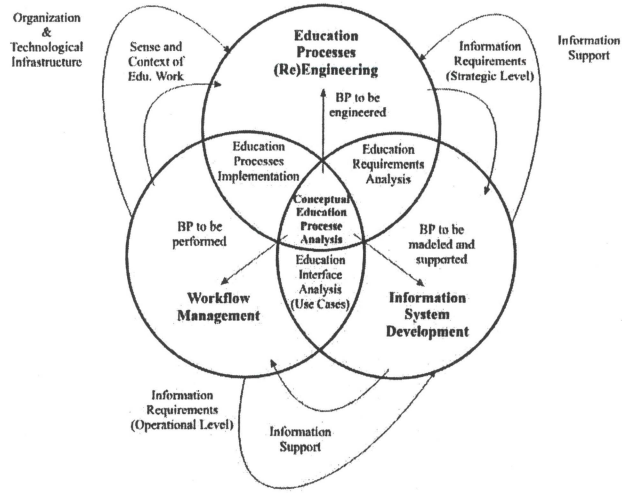


Fig 6 shows EPR vs ISD vs Workflow Management.

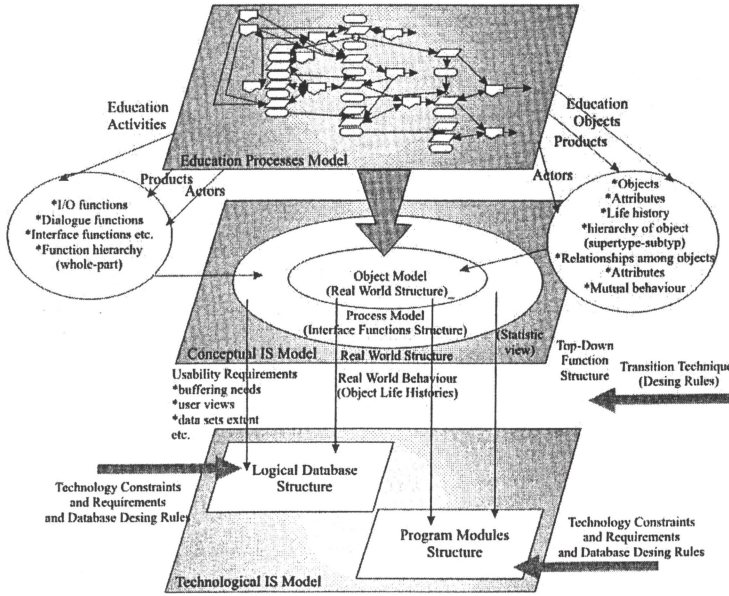


Fig. 7 shows Education Process Model and Information System Models.

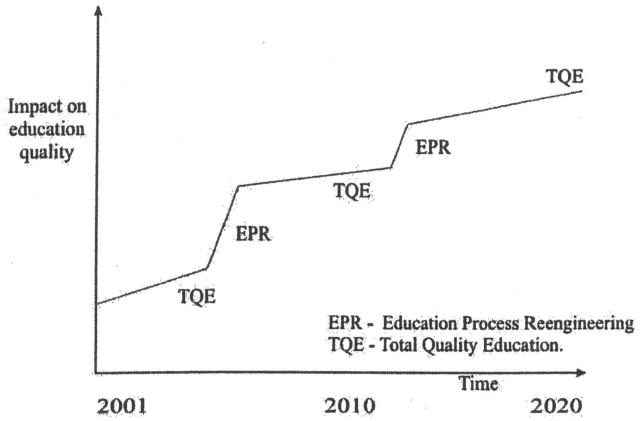


Fig. 8. shows total quality education and education process reengineering synergy.

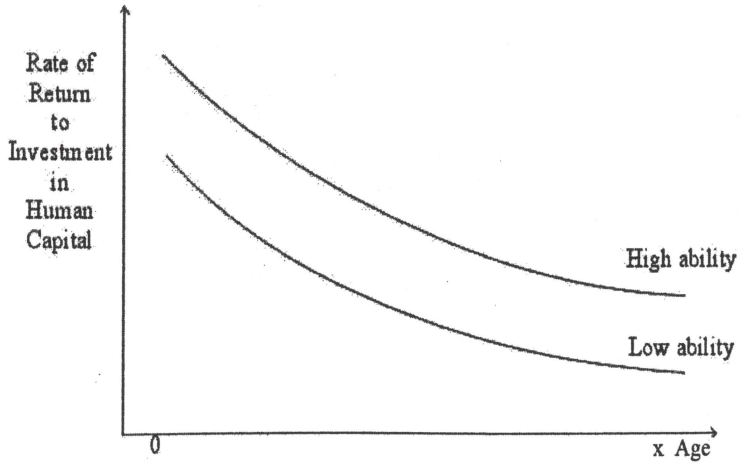


Fig. 9. shows rate of return to investment in human capital.

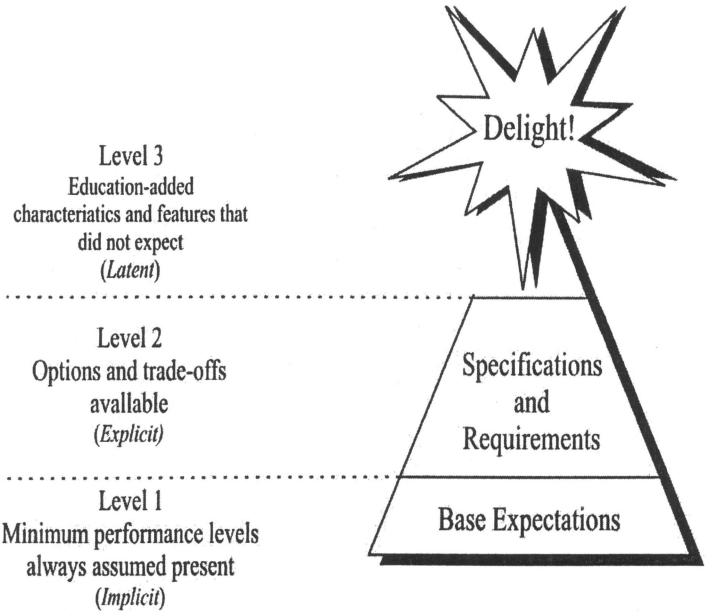


Fig. 10 shows levels of education expectation.

6. Conclusions.

To ensure the required adaptability of an education system as a whole under the conditions of a turbulent word, we must exploit radical education change, creating sudden radical changes in education conditions that take the form of education discontinuities or breakpoints.

With respect to breakpoints, there are creating breakpoints due to intensive use of IT and Internet technologies.

7. References .

1. Ando K. (1973) The Japanese Society. Data/Kontor 73. Stockholm.
2. Bartlett Ch. And Ghoshal S. (2000) Going Global: Lesson from Late Movers.Harvard Busin. Rev. March-April pp132-145.
3. Bradley S., J. Hausman, R. Nolon (1993) *Globalisation, Technology and Competition.* Harvard Business School Press. Boston.

4. Coleman D. (1997) Introduction to Electronic Collaboration. Online Cooperation Tutorial. Berlin.
5. Davidov W., M.Malone (1992) *The Virtual Corporation: Structuring and Revitalizing the Corporation for the 21st Century.* Harper Business, New York.
6. Davis S., B. Davidson (1991) *2020 Vision :Transform Your Business Today to Succeed in Tomorrow`s Economy.* Simon &Schuster, New York.
7. Doborov G., M. McManus, A . Straszak (1979) Management of Technological Innovations Toward Systems – Integrated Organized Technology. CP-7906. IIASA, Laxenburg, Austria.
8. Goldberg R. (2000) Transforming Life, Transforming Business: The Life – Science Revolution . Harv. Bus. Rev. March-April pp 94-106.
9. Espejo R., W. Schhman, M. Schwainger and V. Bileo (1996) *Organizational Transformation and Learning . A Cybernetic Approach to Management* . J. Wiley and Sons , Chichester.
10. Goliński M. (1993) Globalization of the world economy (in Polish) . *Company and market,* 2,7.
11. Gore Al. (1993) *Creating a government that Works Better and Costs Less: Reengineering Through Information Ttechnology.* Plume Books, Washington.
12. Gray P., M. Igbara (1996) the Virtual Society. *ORMS,* 23,6.
13. Hammer M., J.Champy (1993) *Reengineering the Corporation.* Haper Collins, New York.
14. Hammer M.,S.A. Stanton (1995) *Reengineering revolution. A handbook.* Haper Business, New York.
15. Hanan A. And J.A.Jahannessen (1993) Organizational cybernetics. In : F.Stowell, D.West, J.Howell (eds.) *Systems Science: Addressing Global Issues.*Plenum Press, New York.
16. Heracleous L. (1998) Better than the rest: making Europe the Leader in the next wave of innovation and performance. *Long Range Planning,* 31,1,154-158.
17. Hiltrom J.M. (1998) Preparing people for the future . *European management journal,* 16,1.
18. Johansson H.J, McHugh P, Pendlebury J., Wheeler W. (1993) Business Process Reengineering. Wiley & Sons Chichaster.
19. Kahn H. (1983) The Coming Boom. Hutchinson . London.
20. Martin C. (1999) *Net future.* McGraw-Hill, New York.
21. MacDonald G.J.(1998) *Science for Global Insight vision for the 21st Century.*IIASA, Lasenburg, Austria.
22. Repa V. Business Process Based Information System Development.
23. Senge P.M.(1990A) *The Fifth Discipline .Tthe Art. And Practice of Learning Organization.* Doubleday publishing Inc.
24. Straszak A. Ed.(1980) The Shinkansen Program: Transportation, Railway, Environment, Regional and National Development Issues. CP-81-82. IIASA, Laxenburg, Austria.
25. Straszak A. And J.W.Owsiński, eds 91985) *Strategic Regional policy.* SRI PAS, Warsaw.

26. Straszak A. (1998) Management by Cyberspace (in Polish) *Comapany and Market,* 2,7,
27. Straszak A. (1998) The Long Term Regional Development in Poland under The Inpact of the New Global Management, Infrastructure and Technology. In: Owsiński J. Ed. *Modeling and Analysing the Econimies in Transition . II Warsaw.*
28. Strebel P.(1992) *Breakpoints. How Managers Exploit Radical Business Change.* Harvard Business School Pres, Boston, Massechusetts.
29. Tapscott D.(1996) *The Digital Economy: Promise and Peril in the Age of Networked Intelligence.* McGraw-Hill, New York.
30. Tapscott D., Lowy A., Ticoll D.: (Eds.):*Blueprint to the digital economy, McGraw-Hill, New York 1998.*
31. Technology 1998 (1998) Technology 1998: Analysis and Forecast Issue. IEEE Spectrum, 38.
32. The 21st Century economy (1998) *Busines Week.*Special Issue, August 1998.
33. Top Ten trends 2001 (2000) Red Herring December.
34. Tyson L. (2001) Why The New Economy is Here to Stay. Business Week / April 30. European edition.
35. Wilson E.J. (1998) Inventing the global information future. *Futures,* 30,1.
36. Zadeh L.A.(1998) Some reflections on soft computing, granular computing , and their roles in the conception, desing and utilization of information/inteligent systems. *Soft Computing,* 2, 23-25.