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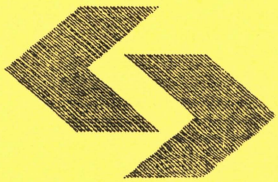

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THE COMING DIGITIZATION OF AGRICULTURAL SECTOR. ECONOMIC, SOCIAL, SYSTEMS AND TECHNOLOGICAL CONSIDERATIONS

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1. Introduction

It is now clear that the Polish agriculture and industry are 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 agriculture is due to many reasons, local, regional, national and supranational as global ones.

Nevertheless, the Polish agriculture is still at the point of no return – no return to old agriculture style of the so-called agriculture society as well as – no return to till "very modern" agriculture style of the so-called super-industrial society.

The ideas for the paper came out of series of research projects of Systems Research Institute of the Polish Academy of Sciences. SRI projects on modelling and analyzing economy in transition, new economy, new management and new technology started since 1989. One of projects was directly committed with the concept of reengineering of the Polish agriculture started as early as 1994. [25,26]

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. [19]

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 2010 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 agriculture and rural areas.

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 economy for the Information Society is a digital economy. In the old economy, information flow was physical: cash, checks, invoices, bills of landing, reports, face to face meeting, analog telephone calls or radio and television transmissions, blueprints, maps, photographs, musical scores, and direct mail advertisement. [1, 4, 5, 6, 7, 8, 10, 11, 12, 13, 16, 18, 20, 21, 22, 25, 26, 27, 29, 32, 33]

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. Many agricultural and industrial jobs are already knowledge workers and in American economy nine of ten new jobs are in information-intensive sectors of the economy.

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 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 from the old. [27]

RULE 1: KNOWLEDGE AND RESEARCH

- The new (digital) economy is a knowledge and R&D – intensive economy.

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

RULE 2: DIGITIZATION

- The 21st century economy is a digital economy

In the new economy, 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 can be 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, there are a lot of virtual matters:

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

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

RULE 4: SYSTEMS INTEGRATION / INTERNETWORKING

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

The C^4I^3 technology networks enable small companies to overcome the main advantages of big companies – economies of scale and access to resources. The Internetworked Enterprise will be a far-reaching extension of the virtual corporation and dot.com because there will be access to external business relationships and a dramatic increase in outsourcing. The Internetworked Enterprise 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 – suppliers, customers and competitors. Every economy needs a national C4I3 infrastructure. The new infrastructure will change economic 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.

RULE 6: PROSUMPTION / IMMEDIACY

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

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. [31]

4. The Rules for Agricultural sector of the new (digital) economy

The recent Westerneuropean agriculture disasters have shown that industrialized agriculture is not a solution for 21st century, for the new (digital) economy. To-day farms are operated with agricultural equipment brimming with chips, there are smart vehicles brimming with microprocessors that do a hundred new things every year. Information technology already penetrates the agricultural business and economy yet.

The speed with which the Internet transformed non-agriculture business during the last decade, the first of the twenty-first century, we may see an equally dramatic

transformation, driven not by computers and communications, but by genetic engineering. Farmers, doctors, pharmaceutical companies, chemical processors, computer and communications companies, energy companies and many other commercial enterprises will be drawn into the business of life science. Advances in genetic research are setting off an industrial convergence that will have profound implication for the global economy. To make the transition successfully, they'll have to change the way they think about their business. The next revolution – the life-science revolution – is coming and agriculture could become science-intensive sector soon; and the first rule of the new (digital) economy would become the first rule for the agriculture sector of the new (digital) economy. [9]

Moreover the new phases of digitization revolution are coming. Let us consider a ten top trends in technology and business on 2001 from the agricultural sector point of considerations. [30]

Trend number one: Distributed computing redefines computers networks, underpinning innovation, company formation and investment. In 2001 distributed computing will become one of the sure things. Signs of this are already evident, with venture capitalists investments. Distributed computing is going to change the way we think about technology and the Internet itself. On a practical level it will have far-reaching effects on how software is written and on how computer and networking gear is installed in business. The potential of distributed computing is huge, think about a scenario where there is unlimited computing power available to you, any place, any time. Right now the Internet is site- or destination-centric; you go to a site to get information, but in a distributed computing it is a model that fades dramatically, because instead of going to a specific destination, users can have a peer-to-peer contact that gathers desired information from multiple sources.

One of the biggest changes brought about by distributed computing will be a reconsideration of traditional network topologies and computing architectures. As the network infrastructure get broken down into smaller, application – specific parts. Software will become intelligent and tailored to specific task. This will allow companies, users to buy only the functionality they need.

Most import, though, distributed computing will help us realize much of the Internet's potential, transforming it from a document-based network of Web pages and e-mail into a dynamic, granular network where specific (for example agricultural) components of information can be located and shared efficiently. Finally, the network really is the huge computer with time-sharing data processing.

Trend number four: The rise of ECNs (Electronic Communications Networks) will push traditional exchanges to consolidate into a single electronic network (Public electronic markets). ECNs now carry 34 percent of NASDAQ's share volume, with Instinet carry 40 percent of ECN market share. European electronic equity market place is currently very fast growing. ECNs market places could be easy reachable for farmers.

Trend number five: Wireless new technology – Bluetooth nears, creating significant opportunities. Farmers could use the short-range wireless protocol with the flashy name for monitoring control and communication. According to Allied Business Intelligence, 2,2 million devices with 802.11, a wireless protocol developed by the Institute of Electrical and Electronic Engineers will ship this year. 802.11 transmits data about 100 times as far and 15 times as fast as Bluetooth. The speed and range of

802.11 make it useful for laptops on large farms; the power and cost saving of Bluetooth make it better for mobile phones and handheld computers. The technologies may prove to be complementary. Allied Business Intelligence, for instance, predicts manufacturers will ship 1.4 billion Bluetooth devices – and only 20.2 million 802.11 devices – in 2005. The to-day Bluetooth device can transmit data up to 30 meters at 720 kbps.

The technologies considered above could digitize almost all existing farms.

Trend number six: Communications caries shift from voice and data transmission to new high-bandwidth services. Many high-bandwidth services will be offered by carries in major metropolitan areas begging this year, but not for rural areas. Creating interactive applications by broadband services are also very promising for rural areas in long-term. Telecommunications companies will begin to offer new services that will stimulate demand for bandwidth. At first, these services will include interactive video-chat and videoconferencing for example – as well as interactive TV services, distance-learning and movies-on-demand. Later, these offerings might include e-commerce services from local on-line yellow pages, or the ability to rent software from application service providers (APSs).

From the above we could learn the new phases of digitization revolution are behind the door and will enter rural areas as well.

5. Systems Integrated Organized Technology for Twenty First Century Agriculture Production.

The interrelation between people's values, desires, lifestyles, institutions, economy, environment and technology have been crucial for agricultural development in the 19th and 20th centuries. In the 21st century "the wired world and the networked global society" as a whole, along with the set of networks of interrelated regions will be based on systems integrated organized technology (SIOT). The concept of the *systems integrated organized technology* was developed at IIASA by Dobrov, McManus and Straszak (1979). The SIOT is a three-dimensional construct, which includes hardware, software and orgware dimensions, or – technology hardware, technology intelligence and technology organizational ability dimensions. SIOT means technology integrated with users' intelligence. Agricultural development in the 21st century will need technology integrated into the agricultural development process, see Fig. 1.

During the 1984 SRI/IIASA workshop [24] the role of new technology for development was formulated as follows: "*New technology (highly automated, science intensive) will no doubt be one of the important issues which should be considered during the analysis of the strategic policy for any region within 30-40 years perspective. Any future technology will intensively use automated systems or artificial intelligence and shall be heavily supported by human intelligence, therefore it is strategically wise for any region to create or to expand the regional innovation centers and possess own research and development strategic policy. Integrated human- and artificial-intelligence-intensive technology will play more important role in the near future for drastic improvement of regional management.*"

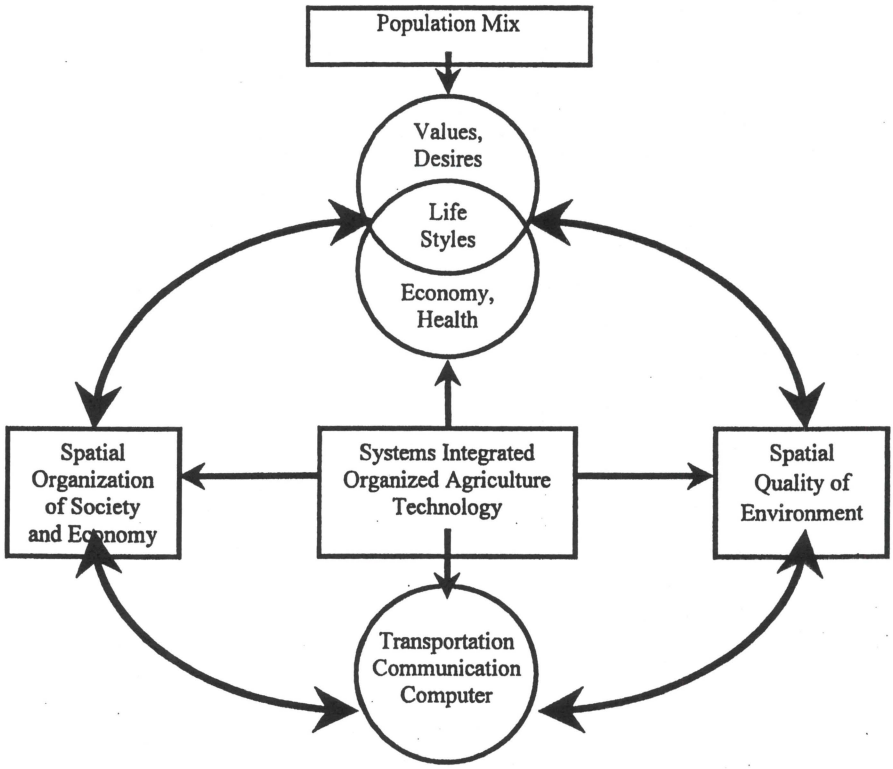

Fig. 1. Systems Integrated Organized Technology (SIOT) and Agriculture Development

The grand strategy for the majority of Polish regions and regional agriculture over the next 20 years should be based upon the intensive use of new technologies in the areas such as telecommunications, computers, high and very high speed intelligent transport, and new agglomeration technologies (*the widely networked agglomeration construct*).

The intensive use of new technologies should be supported by the lifelong education process. Does the future world of growing international interdependence and approaching new technology frontiers demand of all countries and regions within countries to behave so as to carry out their international responsibilities? It must namely be born in mind not only the national economic development features, but also the regional and national development pitfalls could produce substantial increase not just merely in the national, but also international instability.

If competitiveness becomes the key future regional and regional agriculture development issue within the national, as well as international, perspectives, then all the intra-country regions will need their own grand strategy for at least 20 years ahead. It is not a role for the knowledge sectors to try to design such grand strategies for any

given region, but rather to consider several cases and to prepare methodological guidelines based on generalization of international experience.

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