A New Dimension of Technology Assessment in Russian e-Society

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Abstract

Free information access and public discussion of controversial technological decisions put an end to the hegemony of technocracy, which had been fully backed by a totalitarian society. In the e-society, however, it is also not always easy to understand specialised scientific and technological information either, nor to differentiate between important and unimportant data, false and correct information. This is a wide field for the technocratic lobby's propaganda manipulation of public opinion through television, the Internet, etc. Independent international technology assessment is an appropriate countermeasure to this manipulation.

The main features of technocratic thinking

Totalitarian technocratic society operates under control and punishment-free conditions: any word of criticism of state-supported technological and economic projects uttered by a member of the general public or the press is treated as betrayal of a state secret and a direct move against national interests. Any centralised authoritarian state is motivated by the initial supposition that the majority of its citizens are unable to take responsibility for what they think and do, take care of themselves or make a useful contribution to society. This is why such a state forms a circle of managers (nomenclature) out of the privileged minority and entitles them to make decisions (also about the direction of technological development) for the rest of the society. The State, having taken the responsibility to patronise science and technology, inevitably begins to demand they should be used to multiply its economic and military power and does not provide free research to increase our knowledge for the welfare of the people. This forced technological and social progress was both inhumane and destructive for the environment. This is a precondition for the genesis of technocracy.

Beginning in the 1920s, the illusion emerged in Russia that a totalitarian social system would bring huge advantages, but the premise itself was wrong:

- The command-and-administrative system, instead of developing a free market, gave rise to a gigantic growth of bureaucracy, expanded ministries and departments, which dictated all economic and social decisions.
- The militarization of nearly all branches of industry and the economy in their entirety brought about a severe neglect of consumers' interests, a low quality or poor assortment of consumer goods, the underdevelopment of current technology against the background of outstanding achievements of technology in some strategically important sectors working for defence purposes, etc. This trend found its reflection in ideological slogans using military terminology, but calling for routine, normal work: 'the struggle for quality, for the plan', 'the battle for the harvest', etc.
- The build-up of an industrial espionage system (Forester 1989, 74–75) in place of purchasing patents and licenses doomed the country to drag behind the technological progress in most technological spheres, in computer technology in particular, just copying the models already developed in the West.
- This was also associated with the illusion that a new technology, if it could not be imitated, could be bought from industrially developed countries and built into a different social system without any changes in global or even local social structures. The history of technological development shows that there is a boundary, across which the transition to new technologies within the existing social structures is impossible without the transformation of these structures. The emergence of new degrees of freedom in society gave a new impetus to the development of technology, while conversely, new technologies created conditions for attaining new degrees of freedom in the society. However, in the early 20th century, another conviction became increasingly prominent, the conviction that the effective achievement of technological tasks required a decline in the degree of freedom in society and that the

concentration of resources in the most important areas of technolgical development required a more strictly centralised social system. In fact, this was one of the foundations for the justification of a totalitarian society (under the guise of different ideological slogans and excuses, but equivalent in essence).

– The creation of an atmosphere of secrecy (or rather of pseudo-secrecy) in so-called special design bureaus, convenient for the uncontrolled disposal of huge resources, resulted in the severance of ties with world science and between firms belonging to different departments. Thus instead of a concentration of efforts in the most important directions, the result was a repeated duplication and wasteful expenditure of huge resources for the development and implementation of gigantic, but often useless or ineffective projects. The main result of so-called 'restricted access to information', however, consisted in the impossibility of total computerisation, not so much due to the lack of computers, as to the impossibility or ineffectiveness of operating them under such conditions.

Free information access and public discussion of controversial technological decisions as a precondition for putting an end to the hegemony of technocracy

In the second half of the 20th century it became particularly obvious that possession of information gives people great strength. In the totalitarian societies it also gives power or a justification of power. If an individual comes up with criticism of the system, he can always be silenced on the grounds that he does not possess complete information. The strength of the bureaucrat lies in the fact that the higher he is on the bureaucratic ladder, the more information he has at his disposal. In a totalitarian society, instead of free circulation and dissemination of data, information moves through 'closed channels'. It is false information that moves through 'open' channels. False information from the top echelons is at first intended as disinformation for the peoples of other countries and for their own citizens, but later on this phenomenon penetrates all levels of the bureaucratic ladder, the top ones in particular. In such a situation, where crucial correct information is lacking, it becomes impossible to influence and control society, with or without computers. This was vividly demonstrated by a campaign for the automation of management of industries and individual enterprises, which was particularly vigorous in our country in the 1970s–1980s. All enterprises, institutes and ministries sought to introduce computers, but then did not know what to do with them. What is needed here is not just the design of separate hardware components and their adaptation for convenient handling, but the planning (or rather reorganisation) of human activities with subsequent integration of machine components. Only by the transition to the era of glasnost did the free movement of information in society create the necessary social prerequisites for the development in Russia of new information technologies and for passing on to a so-called new information society. These, however, were only *pre*requisites.

Attainment of this goal under conditions of total 'information' devastation, long lasting disruption of normal communications and a lack of realistic (not false) statistics requires great material expenditure, as these disadvantages must be overcome. Our history shows that the priority of ideology over economy, and often over mere common sense as well, is extremely costly. In the information sphere, this resulted in the lack of normal communication with the West, which is a must for a free exchange of information and transition to an information society. It also affected information exchange within the country.

Free access to information, including environmental information, is a necessary condition for the development of democracy and a social market economy. To take part in the process of making environmental decisions, the general public should have access to information. The old technocratic wave in the post-Soviet society choked itself under the conditions of the emerging market economy and the reign of democracy. Russian citizens who had been silent till then began to voice violent protests against, for instance, the re-routing of the Siberian rivers, contamination of water reserves, illegal and unsafe disposal of hazardous industrial waste. Free information access and public discussion of controversial technological decisions put an end to the hegemony of technocracy and expertocracy, which had been fully backed by a totalitarian society and in return had given a scientific substantiation of the communist leaders' plans and acts. We are now living in a quite different situation. The rates of scientific and technological progress are so accelerated that the environment can no longer cushion human impact and 'digest' man's industrial and domestic waste without external help. The understanding of the environment as a God given receptacle at man's disposal gradually transforms into an awareness of our unity with nature, the impossibility of existence without taking full account of the environment, its vulnerability and limitations, the dependence of its survival (as well as that of mankind) on a cautious human attitude to the environment. As we can see, the main contradiction of modern technological civilisation, noticed by cultural criticism of technology, is that modern technology, on the one hand, opens some unprecedented opportunities for humanity to satisfy and even make up their own requirements and on the other hand, makes it possible to destroy the very basis of human existence that seemed a mere sci-fi nightmare until recently. This situation creates a new quality of environmental thinking in our society. Russia has vast territories with the result that environmental problems do not seem to be so acute there, but this is an illusion: the problem of waste will have to be solved either by this generation of Russians or the generations to come. At the same time, total pollution of vast territories (untouched by economic activity) will have an effect not only on the citizens of Russia but also on the whole world since environmental problems are known to have no state borders. Moreover, to put the problem of waste utilisation onto the shoulders of coming generations is as immoral as to design unsafe and insufficiently dependable machinery for the present generation. In this point the problems of the humanisation and environmentalisation of technology touch directly on the philosophy of technology that is so very popular in the West and on ethical problems that are not being discussed enough in Russian society. Against this background the possibility arises for the re-emergence of technocratic thinking in Russia in the new situation, which is creating an e-society in Russia.

The new possibility of the re-emergence of technocratic thinking in the e-society

Russia is currently witnessing the revival of technocratic thinking in a new situation. The market economy is known to lead to more harmful effects on the environment and more impoverishment of the majority of the population if not suitably controlled by society and the government. Under such economic conditions democracy inevitably transforms into arbitrary rule and anarchy. This is followed by excessive natural resources exploitation and methodical destruction of the environmental conditions of society. Ecological and environmental protection organisations stand in the way of profitable economic and technological projects, while the exhausted and frequently exploited people are eager only to raise the level of their own standard of living to a bearable state and are more concerned about not having a share in public revenues than about environmental protection. Such conditions fertilise the revival of technocratic tendencies in society, especially if these technocratic illusions promise prompt enrichment to society and are backed by the technocratic lobby's propaganda. Today we can hear some notes of nostalgia of the time when one could utilise great resources to develop this or that direction of technology that was considered politically or strategically important from the point of view of the leaders, practically without control and care for environmental issues. The leaders' point of view was usually reinforced, substantiated and often imposed by lobby-groups of experts. This is the domination of expertocracy or 'system technocracy' (Lenk 1994, 17–34). The Cheliabinsk Region Public Educational Organisation For Nuclear Safety, a Russian independent environmental organisation, states in its report on 'Plutonium Economy: A Way-out or a Deadlock? Plutonium in the Environment':

> The establishment of a numerous technological bureaucracy that uses a deliberately dim terminology, protected by state secrets, protected from market competition, servicing the privileged political elite—this is the result of social and political choice of the 20th century—the century of weapons of mass destruction. Nuclear technologies force society to give up the principle of democracy providing the basis for a dangerous turn towards totalitarianism. (Plutonijevaja ekonomika 1998, II–6)

One of the characteristic features of technocratic thinking is to praise inhuman megaprojects, constructions and enterprises, whose implementation results in sacrifices of human lives, and whose economic benefit is highly doubtful. Another characteristic feature of this thinking is the priority of the so-called 'needs of society', but actually of the comfort of a bureaucratic establishment over the needs of the majority and the priority of the manufacturer over the consumer. False collectivism and the struggle against any individuality entail the levelling of the individual personality and encourage engineers and managers to take only partial responsibility for the results of their work, which leads in fact to irresponsibility. In short, technocracy is characterised by the domination of a 'pocket' expertocracy and the absence of public opinion, the priority of specialised knowledge over universal human moral and cultural values and finally the priority of a bureaucracy, which creates no values whatsoever.

Under conditions of the dominating totalitarian regime and the command-administrative economic system of that time, the very idea of any legal or moral responsibility could never arise. Any information of pollution, unauthorised discharge and even local catastrophes that were inevitably connected with that kind of new machinery development without taking care of effects on the health of the people on the planet and the biosphere of the Earth, was considered secret and never leaked to mass media. In all the countries of the world information on nuclear power systems was kept in completely non-transparent technocratic structures. If such information became available for journalists, it was removed by strict censorship before it was published. Today it is possible to publish this information, but the technocratic lobby's propaganda receives many new informational possibilities in the e-society to declare this information as scientifically or politically irrelevant through the mass media. It is very difficult for citizens to understand some scientific and technological details and to differentiate between the partially false and correct information about, for example, the utilisation of radioactive waste from nuclear power stations. The e-society creates not only new possibilities for a free access and distribution of important information but also for the fabrication and falsification of data.

The possibility and necessity for a campaign against technocratic tendencies with the institutionalisation of international and interdisciplinary independent technology assessment, humanisation and environmentalisation of technology

The responsibility of those concerned in devising new machinery and technology to both the present generation and the generations to come is evident for every thinking and educated person. Moreover the development of the means of space surveillance and highly sensitive sensors makes it impossible to conceal from the world community even minute cases of pollution at any spot on our planet. With the extraordinary growth of environmental awareness in economically developed western countries any negative human impact on the environment may cause and rather frequently causes economic sanctions not only on the part of the governments of these countries but also on the part of the general public that voluntarily refuses to buy products whose manufacture has negative environmental effects.

> The nature of technology and its global spreading hardly permit nationally limited solutions any more. Naturally, we must consider national characteristics, yet aware of the views of other states and cultural spaces. This is not only an ethical, but also an economic concern. (Kuhlmann 2001, 3)

Which is why Russian producers will sooner or later be forced to demonstrate at least to the world community that the areas around their plants and factories are environmentally safe. One of the most advanced Russian companies in this context is RAO GAZPROM (see, for example, the joint report together with Ruhrgas on the project of climate protection; besides this, GAZPROM is setting up a system of inter-company environmental monitoring that is also necessary to show the Western consumer of Russian gas that the plants and factories of the company in Russia are environmentally safe).[1]

The moral, legal and economic impunity of managers and certain workers of Russian industrial enterprises that pollute the environment might lead unscrupulous Western businessmen to try to sell them products and technologies that are environmentally unacceptable in Western countries. They might also try to 'present' them with outdated machinery marked in those countries as 'special waste', whose utilisation would cost a lot of money. Nature cannot recycle some of this waste, and there is no satisfactory scientific and engineering technology to help nature 'digest' this waste. In this case we face the attempt, having grown rich through primary processing and storing, to put the problem of utilisation onto the shoulders of the next Russian generations, including the children and grandchildren of those who make such decisions. It would be more sensible to refuse the short-term profit of introducing environmentally harmful technologies and concentrate the material and intellectual efforts of society on the development of environmentally friendly technology and the removal of the accumulated negative effects of outdated industries. New machinery and technology should take into consideration all these aspects at the stage of project application, bearing in mind the expenses for the future removal of its negative effects. Unfortunately, Russia does not have this mechanism of at least relatively independent social and environmental assessment of technological and economic projects.

> In a technology assessment exercise it must be clearly stated, what the idea of shaping shall be oriented on: on the *development of technology* according to societal goals and values, on the *development of societal strategies for adaptation*, or on a *combination* of both positions, which estimates the possibilities for influencing technology as well as the necessity for adaptation from one case to the next, and which provides orientation on this basis. (Grunwald 2002, 30)

It is as immoral as to sacrifice the present generation in the hope of a happier future for the generations to come, the idea that has been rammed into poor Soviet citizens by communist ideologists for decades. We can still witness the results of this policy. No reference to state, economic or technological expediency and supreme scientific interests can justify the moral and material damage to mankind and the environment. Public attitude changed after the Chernobyl catastrophe, as people became aware of the necessity of using independent and impartial experts to assess technological safety as well as of the narrow-mindedness of human knowledge and scientific prognosis. It makes no difference to the concept whether the present generation suffers to achieve happiness for their children and grandchildren, as the communist ideas promised, or on the contrary, whether the happiness of the present generation is achieved at the expense of the destroyed life space for all generations to come, if we speak about squandering of natural resources and contamination of the environment. Dostoyevsky's remark that it is immoral to build one's own happiness upon the unhappiness of others may be recalled here.

> The first and the main task that the theory of progress sets itself is to show that history has meaning and sense and that the historical process is not only evolution but progress as well. This task is too difficult for empirical science as it has a metaphysical character. (Bulgakov 1990, 284)

The humanisation of technology should be complemented today by the environmentalisation of technology, a task, which is becoming more and more urgent. The environmentalisation of technology implies taking account of the consequences of technological environmental impact and their future removal as well as the planning in advance of measures and expenses for the removal of outdated machinery and its waste, R&D of machinery that would use *non-renewable* energy resources more economically, R&D of machinery based on renewable resources and low-waste technologies, R&D of new machinery for the disposal, storage and conversion of waste into a form that nature can digest. However, to make this transformation possible we need to bring environmental consciousness to managers, engineers and scientists and change the present-day scientific and technological outlook. Such a change is becoming more and more evident in Germany where a lot of companies not only comply with the waste treatment standards fixed by society and the state, but also set themselves even stricter limits. They are elaborating their own inter-company organisational mechanisms that make technology and its output environmentally friendly (see, for example, environmental reports of such big companies as DaimlerChrysler and BMW).[2] It is natural that this state of affairs in industry is determined by the growth of environmental consciousness of all citizens in this advanced industrial state. It is also connected with the size of the country, where everyone personally feels the danger of choking with industrial and domestic waste. Moreover, the individual should pay for and sort his or her own waste. To change this we should totally re-orient not only technological thinking but also the conscience of society and every individual, starting in the kindergarten and school, towards a new understanding of scientific and technological progress and the development of environmental awareness. This is a '*societal learning process*'.

> It should involve collective learning instead of merely mediating or compromising to attain technology acceptance [...] It means that politicians learn from laypersons, laypersons from experts, experts from politicians and—very important—the other way round. (Grunwald 2000, 138)

This is also important for e-society.

> If we want to talk about shaping e-society in the full sense of the term [...] then the outcome of these learning processes must be kept open. And this, in its turn, implies that not every technical innovation will be successfully integrated into society. In a constructive understanding of shaping technology, the refusal to accept a technology, a product or a system can also be the result of a learning process. (Grunwald 2002, 40)

Discussions of information and communication technologies in Russia

Period I

(*1950s – 1960s*) after World War II to the first Russian satellite ('Sputnik')

Soviet orientation towards the development of information and communication technologies in the military sphere:

– technological progress in radar and radio technologies;[3]
– security of scientific and technical information and development of special purpose computer and communication technologies for military and astronautics programs;
– concept of the application of scientific-technological development as a political card in the competition of the different social systems;
– development of systems of scientific-technological education (engineering schools, technological universities, Academy of Sciences of the USSR).

Period II

(*1960s – 1980s*)—Khrushchev/Brezhnev eras

The USSR and the countries of the socialist block focused on transferring the results of the development of information and communication technologies from the military sphere to civil life:

– political theory of the peaceful coexistence and competition of the different social systems;[4]
– necessity of achieving cost-effectiveness[5] in military technologies and the development of scientific-technological cooperation between socialist countries (in the fields of information and communication technologies —production of large computers, e.g. ES EVM—and satellite communication), mainly between the USSR and GDR, Hungary, Czechoslovakia and Poland;[6]
– technological progress and shortcomings;[7]
– concept of applying scientific-technological results from the military sphere to civil life—plants and research institutions of the military-industrial complex and military technological R&D institutions were obliged to develop goods for mass production for the citizens;
– application of information and communication technologies in the national economy (first of all in the branches of industry of the military-industrial complex)—computerisation of the management in the different economic structures (plants, branches of industry, national economy as a whole): automated management systems; the important role of Gosplan (State Committee for Planning), the Academy of Sciences of the USSR and industrial research institutes in this development;[8]
– the development of information and communication technologies under strong state and ideological control as a contradiction to reality (for example, the idea of designing a video player with CD—at that time it was impossible to make a private copy and to distribute copies of films without access permit from the Security Service);
– development of dissenting counter-culture multimedia on the basis of new information and communication technologies (copying and distribution of books, songs, music etc. using copiers and tape-record-

ers; reception of ideologically alien foreign radio stations with the help of the new short-wave radio receivers, and, as a countermeasure, the design of telephone interception and jamming devices; impossibility of free communication with foreign countries);

- *discussions* about the development of the educational system, foundation of the new chairs for systems engineering,[9] cybernetics etc. in the technical high schools; translation of technical literature from English and German;
- *discussions* about the social consequences of computerisation in the society and of the computer revolution;[10]
- *discussions* about the methodological problems of the development of information and communication technologies: cybernetics debate, AI research, systems engineering, automation of human activity;[11] political and ideological persecution of scientists and their support from the military-industrial complex;
- *discussions* about informatics as a new discipline and its interdisciplinary approach (with the participation of engineers and experts in social psychology, ergonomics, engineering, computer linguistics, mathematics and philosophy).[12]

Period III

(*1980s – 1990s*)—Gorbachev/Yeltsin eras

Transition from planned economy to market economy in the sphere of information and communication technologies:

- elimination of telecommunication boundaries and dampers and other ideological and political limitations;
- development of the free market of information and communication technologies—production (assembly in Russia) and distribution of personal computers (for the private users) and as a result, the reduction of prices in this area;
- foundation of Russian Telecom for using satellite communication both in the economy and the private sphere as sine qua non for the devel-

opment of a free market on the large Russian territory;

- organisation of the Russian Foundation for Basic Research (RFBR) for state support for the development of information and communication technologies and the initiation of private capital investments in this sphere—communication and computer technologies are the most profitable and rapidly developing sectors of the national economy;[13]
- development and implementation of information and communication technologies for the ecological sphere—ecological monitoring, distant early warning and satellite environmental monitoring, especially after the Chernobyl disaster, international financial support;[14]
- *discussions* about the technological and economic development of information and communication technologies and about the socio-political impacts and processes connected with their distribution in order to emphasise their positive consequences (for example, the possibilities of free access to information etc.).

Period IV

(*1990s – until today*)

Distribution of information and communication technologies in all spheres of society and private use in Russia:

- distribution of communication technology—radiotelephone as an everyday instrument for communication via satellite (also from abroad);
- assembly in Russia makes personal computers and other business machines cheaper and accessible to all as important tools for individual activity and has made them a profitable business;
- development of local computer networks in firms, banks, universities and research institutions;[15]
- development of the job of programming as a profitable and prestigious profession, training, further education and postgraduate courses for economists and jurists, who are often highly interested in distributing information and communication technologies in society, as a profitable enterprise in the area of further education;

– extension of access to the Internet for all institutions, private persons and voluntary societies;[16]
– *discussions* about negative consequences of the use of information and communication technologies in modern society:
  - the problem of free access to information and information security;[17]
  - the problem of limited access to information due to financial difficulties (high operating costs—economic limits to free access to information);
  - the problem of reliability of information and communication technologies and hackers;[18]
  - the problem of informational dependence of the society and private users on the operation of information and communication technologies and latent risks of the application of information and communication technologies, for example in the military sphere, atomic energy industry etc. (failures, accidents, etc.);[19]
  - the political debate about the limited access to data, for example, in the ecological sphere.

Summary of the modern discussions about information and communication technologies

There is first of all a discussion of the following problems:

(1) informational and technological problems of the development and distribution of information and communication technologies;

(2) social and economic problems of information and communication technologies—financing of the use of information and communication technologies;

(3) social and political problems of the use of information and communication technologies (discussions about the attempt to re-introduce state control in the spheres of communications and multimedia).[20]

The difficulty arises from misapprehension of the necessity to create social and normative, legal and ethical conditions (‘human beings cannot morally deprive themselves of their power of decision and their accountability or cede their moral responsibility to computers and information systems' (Lenk & Maring 2001, 722)) for the use of information and communication technologies in modern Russian society as fast as possible.

> Technicians often have the impression that the projects they are working on in a way are 'law-independent'. This, by the way, was the reason for the idea proposed some time ago that the Internet should be considered as a 'law-free' space. Meanwhile the technical world has also learned that the contrary is true. (Herberger 2001, 559)

This can be a barrier for the accession of the Russian Federation to the economic, informational and political world community.

> It is necessary to note the importance of legal questions associated with the development of the Russian information infrastructure, such as:
>
> – Legal regulation of property rights, author's and adjoining rights in view of technically easy copying and duplicating of any information submitted in a digital manner;
>
> – Legal status of electronic editions and electronic publications;
>
> – Legal regulation of contents (harmful and illegal);
>
> – Legal status of providers and other suppliers of information services in telecommunication networks;
>
> – Financial and legal questions of distribution of information (especially urgent for state funded organisations) etc. (Syuntyurenko 2002, 285).

Technology assessment of information and communication technologies in the e-society as interdisciplinary research

Technology Assessment (TA) is interdisciplinary in the usual sense.

> In TA it is self-evident and has been exhaustively discussed that it is necessary to cross disciplinary borders, with all of the well-known methodological, communicative, and organisational problems this entails. Integrating disciplinary knowledge,

> defining interdisciplinary projects and talking across disciplinary borders are problems well-known in TA. [...] Integrative research is faced with large expectations concerning its problem-solving contributions. The results of TA are intended to influence social and, above all, political practice. (Decker & Grunwald 2001, 42–43)

In the e-society this interdisciplinarity of technology assessment of the new information and communication technologies is supported, in turn, by these technologies themselves. If a large number of specialists from various fields of science and engineering are engaged in developing a very complex system, such as a space project, a power generation system, and the like, which consists of diverse units, the coordination of scientific-technological work becomes a very difficult task. Technology assessment of such complex scientific-technological activities and large-scale technical systems is problem and project oriented.

> Technology assessment is oriented to the scope of social problems and challenges related to technology. Impacts and consequences of technology, political and societal ways of dealing with them, potentials for contributions to societal problem-solving and innovation policy and implementation conditions of technology are the classical fields of technology assessment. Technology assessment shall *provide knowledge as a basis for acting and decision-making concerning technology and its implementation in society*. (Grunwald 2002, 28)

Decision-making and acting, social shaping of technology is the kernel of project oriented TA (see Figure 1).

The 'horizontal' structure of scientific-technological work is concerned with the division of specialists' efforts by the type of components and the various aspects of the system. 'Horizontal' synthesis is the integration of the disciplinary knowledge (but also non-scientific, for example, regional knowledge or engineering requirements and limitations). The 'vertical' structure of scientific-technological work constitutes co-operation of specialists in research, invention, design, development, operation etc. The coordination is aimed at uniting different experts. The 'vertical' synthesis is the integration of procedural knowledge. Through integrating a complex collection of different types of knowledge and methods, and encountering a variety of disciplines, it uses them for handling specific problems that cannot be solved by any of these disciplines separately.

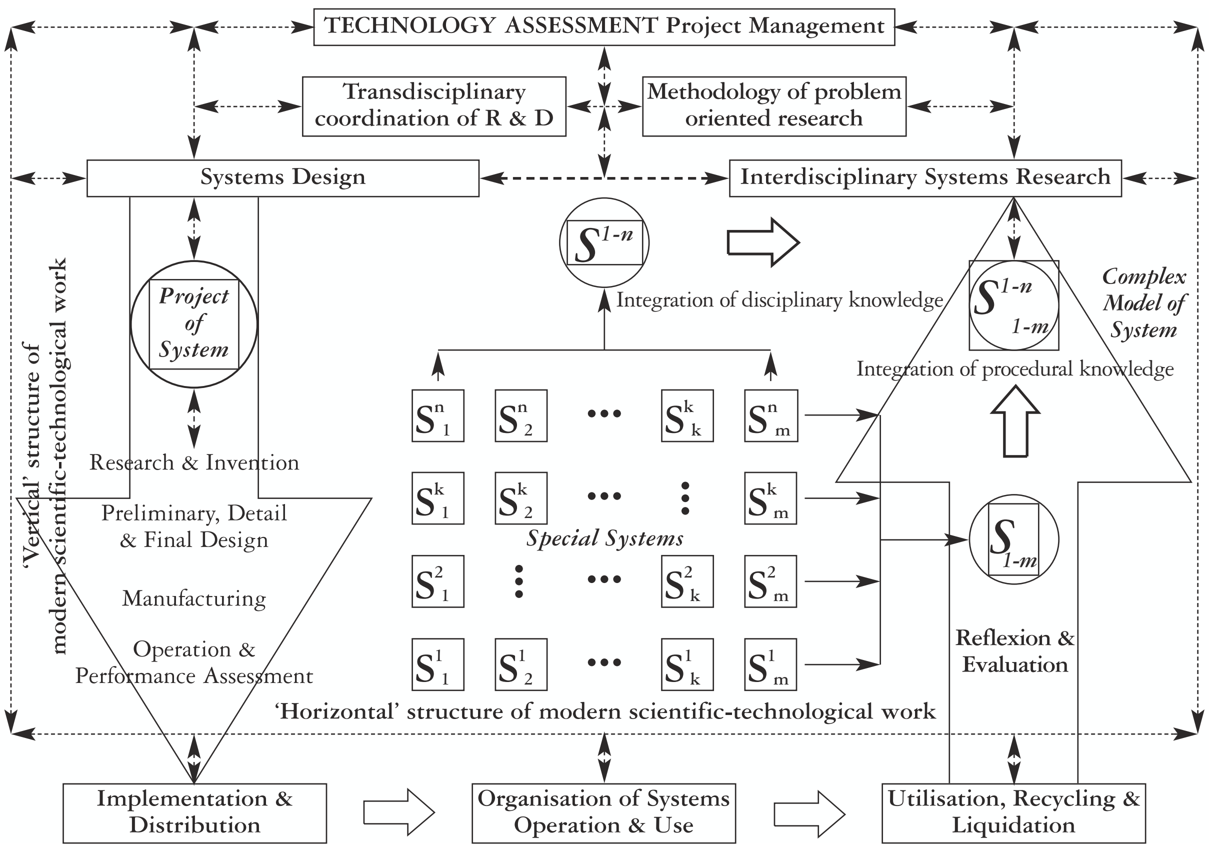

Figure 1. The organisation of project-oriented TA

Any disciplinary research standpoint is regarded as limited and one-sided in principle. This requires a certain methodology, to be a methodologist, to always undertake a methodological reflection on any 'syncretistic' activity. Systems analysis is the most adequate methodological basis for interdisciplinary research in TA .

A new style of scientific-technological thinking is now gradually emerging with the ever increasing effect of science and technology on social life and the need for a comprehensive solution of scientific and technological problems. Such changes have already begun to take place both in theory and practice. They involve the development of a wider systems approach to studies and design of complex objects, which requires diverse factors and consequences of scientific and engineering actions to be taken into account. The investigation of these consequences must be not only interdisciplinary, but also transdisciplinary.

> Transdisciplinarity therefore means nothing other than *problem-oriented research* [...] and refers to the non-scientific problem-orientation of its work—in other words, to the fact that research which crosses disciplinary boundaries is a means to an end, but no end in itself. At the same time, this interpretation allows us to establish criteria and standards for success or failure for this type of research: namely, to provide implementable solutions for a socially defined problem. As opposed to the concept of 'interdisciplinarity', that of transdisciplinarity has the advantage that it already includes its own reasons for pursuing cross-disciplinary research—namely, that it should contribute to mastering non-scientific problems by means of scientific methods. In this paper, the notion of 'interdisciplinarity' is maintained because the orientation of TA to extra-scientific problems seems to be evident. (Decker & Grunwald 2001: 35)

Notes

1 See: Optimierung des Gastransportes. Ein internationales Gemeinschaftsprojekt zum Klimaschutz - Ruhrgas AG/OAO Gasprom, 1999.

2 See: Umweltbericht 99, DaimlerChrysler 1999; Vereinfachte Umwelterklärungen der Werke 99, DaimlerChrysler 1999; Environmental Declaration 2000, DaimlerChrysler AG, Werk Sindelfingen, 2000; Umwelt, Wirtschaft, Soziales: Wege der Zukunftsfähigkeit. Sustainable Value Report 2001/2002. BMW Group, München: BMW AG, 2001.

3 The Research Institute for Radiolocation was established in the USSR in 1943. In 1944, the Council of Radiolocation of the State Defence Committee was founded, which in 1947 was reorganised into the Committee of Radiolocation. In 1945 the Council of Radiolocation established the Scientific-Technological Council for coordination of the scientific and engineering activities in this field. In 1946 an information centre and a publishing house were also founded (Gorokhov 2000, 351–352).

4 'After the war a new stage of technological modernisation began when whole factories were brought from defeated Germany. Huge investments were made in the development of new kinds of weaponry and the arms race began when military technologies were rapidly developed and an enormous military-industrial complex was established. All that was financed by keeping the people on the subsistence level.

Such a situation could not last long in the conditions of peaceful coexistence to which all nuclear powers were doomed. Peaceful coexistence presupposed competition, and Nikita Khrushchev and the Soviet leaders who followed him to raise the living standards and at the same time money to maintain the military machine. Natural resources were barbarically exploited for that purpose' (Gorshkov, Kondratyev, Danilov-Danilian & Losev 1994, 18).

5 The order of priorities in information processing at the computer centres can serve as an example. There are bureaucratic rather than economic priorities: information needed by a high level of the bureaucratic hierarchy will be processed with a higher priority than information yielding more profit. But a computer revolution, a transition to an information and communication society are impossible without the shaping of an information market.

6 Technology transfer 'could be managed legally by cooperation or manufacturing under license as well as illegally. During the Cold War period all forms of technology transfer between East and West had been common practice', especially in the sphere of computer technology. For example, in the 1960s and 1970s 'the USA tried to prevent the export for [...] computers to the Soviet area by strengthening the COCOM regulations and so the obtaining of modern computer technology became the job of the eastern secret services'. Know-how transfer between socialist countries existed independently of global technology transfer. 'At the end of the 1960s the USSR demanded the standardisation of computer technology available in the socialist countries. At that time 27 computer systems with about 600 different devices existed' in these countries. 'A few years later a unified computer came into series production. The hardware and software was very similar to the IBM 360, later to the 370 series.' Several socialist countries produced parts for these computers. 'Global communication was no longer determined by ideological barriers' (Dittmann 2002, 55).

7 In the 1970s, technology assessment of large-scale projects in the Soviet Union was defined as the task of the new Research Institute for Systems Investigations of the State Committee for Science and Technology. From 1979 this Institute published a yearbook *Systems Research. Methodological Problems* in the Publishing House 'Nauka' [Science]. The idea of scientific and informational support of decision makers in the formulation and implementation of a certain scientific and technological policy was an important foundation for this publication (see Gorokhov 2001, 33–35).

8 'Management information systems for specific enterprises and associations as well as for branches of the national economy and territorial objects (cities, regions, republics), are established. [...] all these systems will eventually be linked into the National Computerised System for the Collection and Processing of Information for Stocktaking, Planning and Management (OGAS). [...] The OGAS technical base is the National Network of Computing Centres (NNCC) linking all centres engaged in handling economic information' (Glushkov 1979, 179; see also Gorokhov, 1979).

9 'Seminars and conferences on Systems Engineering are held in Kiev, Leningrad, Moscow, Warsaw and elsewhere. Special courses in Systems Engineering are given in many higher educational institutes of the USA, USSR etc. In 1970 a Chair of Systems Engineering was set up at the Moscow Power Engineering Institute. The first All-Union Symposium on the Problems of Systems Engineering was held in Leningrad in 1970' (Gorokhov 1985, 183; see also Gorokhov 1982).

10 About the discussions of the social problems of informatics in the USSR at this time see Belkina & Gorokhov (1987, 30–39).

11 It was not enough for designing management information systems to operate solely with the knowledge afforded by technical and natural sciences. In the implementation of management information systems engineers are confronted with numerous socio-economic and socio-psychological problems that cannot be solved merely by the application of common sense and good judgement. They need a methodological support for their work. The development of these systems requires socio-economic, sociological, and socio-psychological studies. That is why Russian engineers discussed the methodological problems of modern engineering work at that time.

12 'Identification of the subject matter of computer science attracts both philosophers and professionals, and the literature currently includes a rather broad range of views. Some call computer science a fundamental natural science [...] others an integrated scientific-engineering discipline [...] Still others regard it as a new name for cybernetics [...] designed to separate 'the healthy scientific and technological core and to create a distance from the blahblah chaff' of computer work [...]' (Gorokhov 1995, 258; see also Gorokhov 1989, 20–22),

13 'The basic task of the programs of the Russian Foundation for Basic Research is the maintenance of the coordinated and balanced development of three basic components of an information infrastructure for science: telecommunication, information and computing resources.

The important and priority activity of RFBR is the support of interdisciplinary investigations and modern applications, such as: remote exploration of physical and biological objects (including telemedicine); systems of complex maintenance; virtual scientists groups; computer maintenance systems for monitoring large-scale natural and technical objects; electronic libraries and collections; systems of videoconferences; interoperable (open) systems; information safety' (Syuntyurenko 2002, 285–286).

14 'After the Chernobyl catastrophe the scientific view of the world changed. It is now understood that [...] is necessary to inform both the population and the political leadership about regular or extraordinary situations in nuclear power stations and their vicinity. This is very important for organising independent (i. e. independent of operators, designers and emergency organisations etc.) yet qualified environmental monitoring of the radiation situation near ecologically dangerous objects' (Gorokhov 2000, 150). It is important to collect ecological information about the radiation situation in and near dangerous objects. The main goal is to create a system for monitoring the environmental situation in regions in the vicinity of ecologically (including radiation) dangerous objects in an independent manner (i. e. independent of operators, energy producers and users, fire fighters, policemen, emergency and disaster clean-up operators etc.). This information will be sent to all interested authorities for the purpose of information dissemination of governmental and public organisations and the population not only in our country, but in the whole world. 'The transition period proves favourable to the environment. The economic slump reduced the load on nature. The status of nature protection agencies in-creased, and access to ecological information was ensured. Several non-governmental ecological organisations emerged and many ecological problems were enthusiastically discussed' (Gorshkov, Kondratyev, Danilov-Danilian & Losev 1994, 20). The National Environmental Action Plan of the Russian Federation for 1999–2001 states on the issue of environmental monitoring: 'None of the existing environmental observation and control systems have been focused on a complex assessment of the environmental state, informational support of complex environmental protection tasks. Some changes took place after adoption of the regulation for the establishment of the United System of State Environmental Monitoring (USSEM) according to the Governmental Decree of the RF N 1229 dated 24 November 1993. The USSEM has achieved essential positive results over the past few years, such as interdepartmental interaction at the federal level, elaboration of normative

regulations; 48 subjects of Russia have promoted activities aimed at setting up territorial sub-systems of USSEM, regional informationanalytical centres, which are well-equipped with modern computer technologies, including GIs for data processing, have been established in 20 regions. In the framework of the development of an interstate system of environmental monitoring for the CIS countries, members of the Interstate Environmental Council have approved the Agreement on Cooperation in the Field of Environmental Monitoring. [...] In order to implement the Governmental Decrees of the RF 'On the United State Automated System of Radiation Control on the Russian Federation Territory' N 600 dated 20 August 1992 and 'On the Federal Program for the Establishment of the United Radiation Control System on the Russian Federation Territory' N 1085 dated 2 November 1995, activities to improve radiation control are being fulfilled in compliance with existing requirements, the State authorities and population are provided with timely and reliable information on the radiation situation' (The National Environmental Action Plan 1999, 28). The destruction of the State Committee for Environmental Protection of the Russian Federation in 2000 unfortunately changed this situation.

15 'It is possible to identify five blocks of information processing problems of science and education in Russia at the state level [...]:

1. Data processing of information resources (in view of questions of interoperability of non-uniform collections) and implementation of modern telecommunication access for Russian scientists to information resources of the leading national centres—database generators (VINITI, INION etc.).

2. Creation of a uniform interface of access to resources and electronic catalogues of scientific libraries, and also creation of a system of digital libraries—first of all on the basis of information resources of leading Russian libraries, such as the Russian State Library, the Library of Natural Sciences of the Russian Academy of Sciences, the State Public Scientific and Technical Library etc.

3. Introduction of information methods in processes of scientific research: computer modelling, correlation analysis of a 'structure – property' type, statistical analysis etc.; implementation of telecommunication access to scientific data bases created in the scientific organisations of the country (about 20,000 databases in various subject domains: physics, chemistry, mathematics, biology, computer science etc.); integration of research and information activity by means of introduction of alternative information technology—the technology of computer auto-formalisation of professional knowledge. The scientists can generate new knowledge (scientific production) by experiments, theoretical considerations and generalisation of knowledge. To the present time—at least in a number of subjects (mathematics, geology, chemistry etc.)—a vast volume

of knowledge and information has been collected in Russian science. This knowledge must be generalised and systemised in order to make it usable by scientists and experts. In geology and geophysics, by some estimates, such large volumes of data have been stored that from the point of view of pragmatic productivity it would be expedient to refuse expenses for new research in these fields in the next 8–10 years and to concentrate efforts on ordering and processing the information already available.

4. Reconstruction of a new basis for information exchange between information centres of East European countries and former USSR republics.

5. Implementation: (a) of telecommunication access of Russian scientists to foreign databases with scientific and technical information; (b) of access of the global scientific community to the automated information resources of Russia' (Syuntyurenko 2002, 284–285).

16 'There is evident progress in Russia in using modern information technologies, in spite of financial and economic problems. Thousands of Russian web-servers have appeared on the Internet, providing scientific, educational, cultural and other non-commercial information. Thousands of original educational and distant learning programs are currently being created. Thousands of research and educational institutions, libraries, museums and archives are involved in the Internet, and 55% of their users have higher education, among them: 50% specialists, 18% students, 15% leaders of groups and institutions. It is expected that the number of personal computers will reach 14 million in 2004, and 2/3 of them will have access to the Internet' (Syuntyurenko 2002, 283).

17 'It is necessary to draw attention to the fact that Russia is only making first steps in the standardisation of link security, unlike industrial countries abroad which have substantial experience with this problem' (Syuntyurenko 2003).

18 "Hacking' means using a personal computer and modem to enter other people's computer systems over the telephone by finding the right password. […] Hackers […] have become increasingly controversial in recent years. Some see them as modern folk heroes, while others regard them as little better than as common criminals' (Forester 1989, 265). This problem is very important in Russia today.

19 'The *accuracy* of the information stored on databases such as those of the FBI has been frequently challenged. For example, in 1981 the Office of Technology Assessment (OTA) commissioned New York criminologist Dr. K.C. Laudon to make a study of the value of criminal history data contained in the FBI and state police agency files. He found that a high proportion of the information was incomplete, inaccurate and ambiguous. A great deal of it involved arrests and investigations that did *not* result in a conviction or were related to minor offences

in the dim and distant pass. Other studies have shown that employers are most unlikely to employ such people with a 'criminal record'. Four out of five states approached by the OTA admitted that they never checked the accuracy of the data in their files or conducted regular quality audits' (Forester 1989, 269–270).

20 'Mit dem Maß der Freiheit wächst das Maß der Verantwortung. Verantwortung ist die Antwort auf die Herausforderungen der Freiheit. Es ist interessant, dass gerade in der jetzigen Zeit, in der (Meinungs-)Freiheit boomt, der Determinismus wieder verstärkt auftritt und der Überwachungsstaat voranschreitet. Das technisch hoch entwickelte Spionage- und Überwachungssystem 'Echelon' scheint der diesbezügliche Spitzenreiter zu sein. Gegenwärtig gibt es zwei exzessive gegenläufige Tendenzen: den völligen Liberalismus und den kompletten Determinismus. Beide Entwicklungen bedingen offensichtlich einander. Homo compensator' (Kolb 2001, 564).

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