



# **Knowledge Economy**

## *Position Paper for ROMANIA*

BUCHAREST – 2002

# **Knowledge-based Economy Issues Paper for the 19-22 February 2002 World Bank Conference**

## **Introduction and Background**

This paper aims to provide a framework for discussion at The World Bank's 'Knowledge Economy Forum for EU Accession Countries' to be held in Paris on February 19 – 22, 2002. This international conference will review the achievements and challenges of the knowledge economy approach to date, as well as foster an exchange of views among governments, domestic stakeholders and their partners on how this approach could best impact on development.

During 2001, the World Bank launched the idea of a 'knowledge-based economy' strategy paper for Romania to be delivered at the 'Knowledge Economy Forum for EU Accession Countries' hosted by Paris in February 2002. The World Bank initiative brought together representatives the Romanian Government, the civil society and the academic community as well as of donors, into a Working Group. The Group met in several sessions and eventually agreed on this strategy paper.

The purpose of the paper is to provide a framework for debate at the conference on the priority issues raised by the numerous Knowledge-based Economy approach stakeholders. The paper is an open-minded survey of the Knowledge-based Economy to date.

Conference participants are invited to identify any other issue that may not be addressed herein.

## **Overall Perspective**

Knowledge is now recognized as the driving force behind productivity and economic growth, shifting the focus to information, technology and learning and their role in economic performance. The growing codification of knowledge and its transmission through communications and computer networks are shaping an '*information society*'.

The course to this emerging economy based on knowledge is determined by two major underlying and inter-related factors. The first is globalization. Increasingly, economic activities are undertaken with no regard to international borders. The second are communications, which means lower costs and a higher efficiency in information transmission, retrieval and analysis. Together, these factors create a global economy where knowledge is used pervasively as both input and output.

Defining the knowledge economy (or knowledge-based economy) is a fairly difficult task: all the more is this so as this is a compound name and each of its components are in turn difficult to define.

Such a definition implies several levels:

- production of knowledge by steady innovation;
- dissemination of knowledge to all members of society;
- intensive use of scientific knowledge in every area of life (in technology and organization more particularly);
- society training for this type of economy through an education and training system based on innovation and research;
- emergence of dynamic, internationalized markets<sup>1</sup>:

Knowledge production, knowledge distribution, employment and the science systems have to change and reflect the new '*knowledge-based economy*' paradigm. This term is an outcome of the recognition of the role of knowledge and technology in economic growth.

Science, technology and industry policies have to be formulated to maximize performance and well-being in a '*knowledge-based economy*', which is directly based on the production, distribution and use of knowledge and information.

There are many economies that make use of knowledge, but only few '*knowledge-based economies*'.

Knowledge and information are no scarce resources. Once the information is used, it is available to others to do likewise. What is, however, scarce is the capacity to use it in meaningful ways. A lot of information brought together may be more than just a sum-total, it may generate new ideas and knowledge. Some kind of knowledge can easily be reproduced and distributed, but some other (tacit knowledge) cannot be transferred from one organization to another or from individual to another. Knowledge can also spill over from one firm or industry to another, with new ideas being used repeatedly at little extra cost. Such spillovers can ease the constraints placed on growth by the scarcity of capital.

### **Achievements to Date**

This type of society is just emerging in Romania which has to address the challenge of a twofold transition: from a centrally planned to a market economy (common to all former socialist countries) and from the old society to the new one (along with all world countries, with the economically advanced ones in the first place – statistical data in attachment no.1)

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<sup>1</sup> This new type of markets is characterized by: supplying goods that are customized down to uniqueness, the consumption of which does not necessarily imply disappearance (the case of information), beyond the control of the laws of equivalent exchanges (the exchange of knowledge is non-equivalent and depends on the potential it holds for use and the receiver's creativity).

The new production factor offers Romania new opportunities such as:

- highly diversified possibilities of economic growth
- easier access to recent findings and innovations
- higher-quality goods
- lower costs
- adjustment to consumers' requirements
- better efficiency - social equity correlation

Negotiation packages for EU integration for integration education and research have been closed in 2000. Romania also follows closely the eEurope+ plan.

eEurope+ action plan aims to build an information society for all and the 'most competitive economy in the world' based on knowledge. The key objectives of eEurope are:

- Bringing every citizen, home and school, every business and administration entity into the digital age and online
- Creating a digitally literate Europe, supported by an entrepreneurial culture ready to finance and develop new ideas
- Ensuring that the whole process is socially inclusive, builds consumer trust and strengthens social cohesion

The eEurope+ action plan was built by and for accession countries and has the following main objectives:

1. European youth into the Digital Age
2. Cheaper Internet Access
3. Accelerating e-Commerce
4. Fast Internet for researchers and students
5. Smart cards for secure electronic access
6. Risk capital for high-tech SMEs
7. e-Participation for the disabled
8. Healthcare online
9. Intelligent transport
10. Government online

### **“The Romanian economy paradox”**

The development of a knowledge society seems to be Romania's only viable explanation of, and solution to, what Romanian economists call the “Romanian economy paradox”.

The paradox is that for the last 150 years (except the period after 1989), even though Romania's development pace was higher during the ascending phases of the centenary cycles – considered as a world and/or European cycle – and the contraction during the descending phases was smaller, the economic gap has widened steadily (under the influence of efficiency criteria), just like the productivity gap and the living standard gap, too.

A possible explanation of that paradox is that Romania's economy has always focused on less than state-of-the-art products. It happened in a framework that offered a temporary comparative advantage (in short run).

This vicious circle can be broken only by embarking on the path to the knowledge economy that is based, as shown above, on a new production factor, i.e. knowledge and transition to the "competitive advantages" as defined by M. Porter.

### **How useful is the knowledge economy perspective in understanding the challenges Romania faces and the opportunities that EU accession provides to Romania?**

The perspective for the development of a knowledge-based economy for Romania will ensure:

1. A strong and durable economic development and decrease of social and economic discrepancies
2. A better (and quicker) integration into the European Union and the world economy
3. Setting up of a national competitive system
4. Creation of a culture of communication and knowledge motivation
5. Creation of knowledge generating human resources
6. Setting up of knowledge generating structures
7. Turning knowledge into capital
8. Training regarding the use of knowledge
9. Promotion of continuous innovative system

### **What are the most difficult challenges Romania faces in building a knowledge-based economy in the context of EU accession and the overall economic and institutional reform efforts?**

The most significant challenges Romania faces are:

#### **A. Development of an enabling economic environment and institutional environment:**

1. Awareness of the need for knowledge:
  - at policymakers level
  - at businesses level
  - at civil society level
  - knowledge-oriented education and training
  - development of a knowledge culture and motivation
  - overcoming the "inertia" to changes
2. Appropriate prioritization of the actions to be taken:
  - assessment of benefits, risks and costs as well as effects
  - sectoral strategies and ranking them in terms of priority
3. Integration into the international knowledge flow
  - linking up to such flows
  - legislative and logistic compatibility

- identification of world and European trends in knowledge economy
  - narrowing down cultural, religious and social-economic discrepancies
  - information management
  - communication opportunities (seminars, conferences, mobility of students, teachers, researchers as well as entrepreneurs) and brain drain prevention
  - integration into the knowledge production and utilization environment (co-operation or competition)
4. Adequate knowledge management in connection with:
    - production of new knowledge
    - effective utilization of the existing knowledge
    - formation of knowledge-creating human resources:
      - education based on creative thinking
      - initial training as well as continuous, formal and informal training
    - management of the new knowledge flows and exchanges
    - creation of a legal framework to stimulate knowledge, information protection and intellectual property protection
    - establishment of knowledge-producing structures:
      - a strong academic environment
      - creation and stimulation of excellence centers
      - expansion and strengthening of research networks
    - digitalizing the existing knowledge (especially the internal, specific ones) and generalized digital learning
    - systematic and effective monitoring of the strategies adopted
  5. Completion and strengthening of the structural reform of the economy (for setting up a functional market economy) and public administration.
  6. Removal of all obstacles that prevent access of businesses (especially small and medium sized ones) to knowledge and resources.
  7. Steady growth of the “social capital”.

## **B. Measures to provide human resources for the knowledge society**

1. Development of education and knowledge society:
  - Education at all levels (adjusting the curricula to the new needs of a knowledge society as well as to labor market demand, promoting multimedia technologies in learning, digital literacy, extension of on-line education, virtual learning units creation, etc)
  - Continuing qualitative reform of the education and research system:
    - education effectiveness (in relation to societal needs, curriculum, teachers’ training, education management, evaluation and examination)
    - growing equitable access to education (and higher mobility within the system to allow for education to be furthered)
    - an updated infrastructure to meet the development needs of society (especially access to information technology, to Internet)
    - promotion of multimedia technology in teaching

- Continuing education (formal and informal)
  - Strengthening the public and school libraries systems
2. Integration into the world (particularly European) research and innovation system:
    - correlation of national research, development and innovation programs to those in the EU
    - development of the ability to absorb and disseminate the outcome of research across the economy (the technology transfer and innovation infrastructure - information and assistance centers, incubators, technology transfer centers, etc)
    - development of high level research centers in key areas of science and technology
    - integration of research units into European and world R&D networks
    - international training programs for young researchers
    - promotion of international cooperation in knowledge production and use
  3. Stronger links of education and research with the real economy (between the knowledge generation and utilization) and stronger public - private sector partnership
    - fostering creativeness
    - promoting knowledge demand
    - building and strengthening the national research and innovation network and innovation and technology transfer programs (scientific and technological parks)
  4. Training the trainers
  5. Narrowing down geographic, cultural, social, economic discrepancies

### **C. A coherent and enabling legal environment to foster a knowledge economy**

1. The creation of an adequate legal framework to stimulate knowledge, information protection and intellectual property protection;
2. Promotion of and support to open competitive markets and the liberalization of sectors.

The main fields where quick actions are required (with some already under way) to align the national legislation are:

- Intellectual property protection:
  - The copyright protection in the field of information
  - Liability and penalties for information fraud
- Regulation of personal data protection:
  - Individual protection against personal data processing and dissemination
  - Free information and communication, including by Internet, in accordance with the deontological and professional rules for data processing and transmission in the social environment;

- E-commerce regulation:
  - a) *Creation of a framework able to stimulate e-commerce in accordance with EU legislation:*
    - development of services using electronic documents and signature;
    - implementing an information system based on e-tax adopted legal framework
    - implementing an information system based on and e-procurement adopted legal framework
    - intellectual property protection
    - safety of transactions, data privacy
    - consumer protection
    - exclusive use of electronic means for public procurement
  - b) *Enabling environment through liberalization and regulation of telecommunications*
- Promoting SME's integration into the knowledge-based economy, information society and e-commerce utilization:
- Equal access to networks and information
- Improvement of the legislation on "incubators" and "spin-offs"
- Access to public information through electronic means

#### **D. Building an adequate (information) infrastructure**

1. Building and expanding modern communication infrastructure
2. Closing the geographic, social and cultural gaps in access to computer infrastructure
3. Cheap and quick access to Internet:
  - establishment of a competitive environment for cheap connection and utilization
  - high access speed
  - accessible equipment
4. The provision and promotion of e-content
5. Implementation of a high speed communication network:
  - building a metropolitan network
  - international interconnection
  - provision of an open competitive environment

#### **E. Building an efficient innovation system**

1. Building a research and innovation network
  - strengthening and aggregation of national networks
  - open research network for schools/high-schools/universities/research institutes
  - raising investment funds to develop and strengthen the research network and create laboratory networks

- promoting centers of excellence

**2. Innovation and technological transfer programs (scientific and technological parks)**

- creation of public-private partnerships for the development and use of specific technologies of a knowledge-based economy, mainly through the development of specific technologies for virtual centers of technological services and technology transfers (focused on advanced technologies and environment-friendly technologies)
- promotion of links between domestic and international research (also through technology transfers enabled by FDI)
- improving the legal framework to protect the outcome of research

**3. Developing the capacity of the economy to absorb R&D achievements**

- development of the technological transfer and innovation infrastructure (technology information and assistance centers, technology transfer centers, incubators, etc.);

**4. Incentives for the creation and development of innovative SME's**

- creation of zones where various incentives (other than fiscal ones) will be provided to firms (scientific and technological parks)

**Weaknesses and strengths. Romania in a global competitive knowledge economy**

(See also the STEEP and SWOT analysis in attachments 3 and 4)

**Strengths for knowledge-based development (at the beginning of the century)**

To address the above-mentioned challenges, Romania may claim several advantages that could amount to strengths for outlining a draft knowledge economy strategy. At the very least, the strengths include:

1. Political will to develop a knowledge economy:
  - government programs and strategies (mainly in the research, education and ICT field, for public administration etc.)
  - several national working programs
  - pilot projects of national interest: in 2001 alone, 20 projects were successfully implemented (to be extended or already being so)
  - establishment of the Parliamentary Commission on Advanced Technology, Communications and Information Technology, of the IT Promotion Group
2. Relatively well-educated population:
  - high literacy rate (97%)
  - high-school training – fairly good (as proved by the prizes won at the International Olympiads)
  - top-level higher education in certain fields (computer sciences, communication, mathematics, medicine, etc)
  - about 5000 ICT graduates a year

- 300,000 specialists trained in 116 universities with 36 computer and communications faculties
3. Ethnic, cultural, religious tolerance
  4. Young people eagerly acquiring knowledge and seeking promotion
  5. Women significantly involved in active life
  6. Political and societal will to join the EU (the higher share of EU accession supporters)
  7. A positive education reform
  8. A growing economy; (GDP growth was 1.6% in 2000 and 4.9% in 2001, with 4.5% forecast for 2002; see also attachment no. 1)
  9. Conditions for a public – private partnership are good
  10. High growth rate of the IT industry (Romania’s electronic industry accounts for just 0.5 percent of the manufacturing industry and employs 19,000, but was almost 100 percent privatized in 2001; together with the electrical equipment and appliance industry, it contributes 5 percent to the country’s industrial production, 5.1 percent to employment, 8 percent to exports and only 3 percent to foreign investment in Romania)
  11. Fast developing software industry (over 3500 companies that employed about 25,000 in 2001 as against 15,000 in 1999)
  12. Initiation of e-government (in four areas: G2C, government - citizen interaction; G2B, government - business interaction; G2E, government - civil servants interaction; G2G, government - governmental institutions interaction) and especially the adoption of e-administration strategy in September 2001
  13. Faster adoption of technologies based on mobile communications and cable TV (while the mobile telephony growth rate of 108 percent exceeds the 73 percent average for EEC, the share of mobile telephones in the number of conventional lines is 38 percent, similarly to EEC; Romania is sixth in Europe in terms of cable TV subscribers i.e. 71 percent of TV set owners, adding to whom are satellite aerial users that make up a further 9 percent )
  14. The ICT average growth rate of 15 percent in Romania as against 8 percent in the world

## **2002 main weaknesses in building a knowledge based society in Romania**

Along with the existing strengths, there are also constraints and obstacles, shortcomings that Romania has to overcome or address in developing a knowledge society. All must be carefully considered in any strategy. We identified, among other things:

- The high rate of the poor (33.8 percent in 2000; 28.2 percent urban and 40.5 percent rural) and the implicit risk of “elite” capture of the field (accessible only to the rich, highly trained, urban residents)
- Major urban-rural gaps, as well as social and regional disparities
- The propensity to migrate of the young and highly skilled
- Relatively low economic development level
- Incomplete legislative framework, inappropriate for the development of a market economy

- Poor computer science knowledge and internet access of Romanian high schools and universities (only 17.8 percent)
- Low investment in producing and using knowledge
- Inappropriate development infrastructure
- Poor communication (last mile) infrastructure requiring major investment (eg. the fixed telephony penetration rate is under 20 percent, compared with 27.5 percent in the EEC)
- Internet penetration rate of only 10 percent (as against 86 percent in the EEC) and number of users of 3.1 in 100 inhabitants (as against an average of 8.4)
- Low e-content
- Relatively high cost and relatively low speed of access to e- information
- Incomplete standards and lack of specific indicators
- Inefficient and poorly managed agriculture which employs about 38 percent of the working population
- Major geographic, social, economic gaps (imbalanced development), eg. 70 percent of ICT labor force is in Bucharest, even if employment in agriculture is around 40 percent of labor force the added value of agriculture is under 18 percent of GDP
- low level of IT expenses as a percentage of GDP (in 2000, the figures were 6.25 USD per capita and 0.56 percent of GDP)

### The national advantage in a knowledge-based economy

Porter's diamond will be used to analyze the national advantage, presented in the figure below:

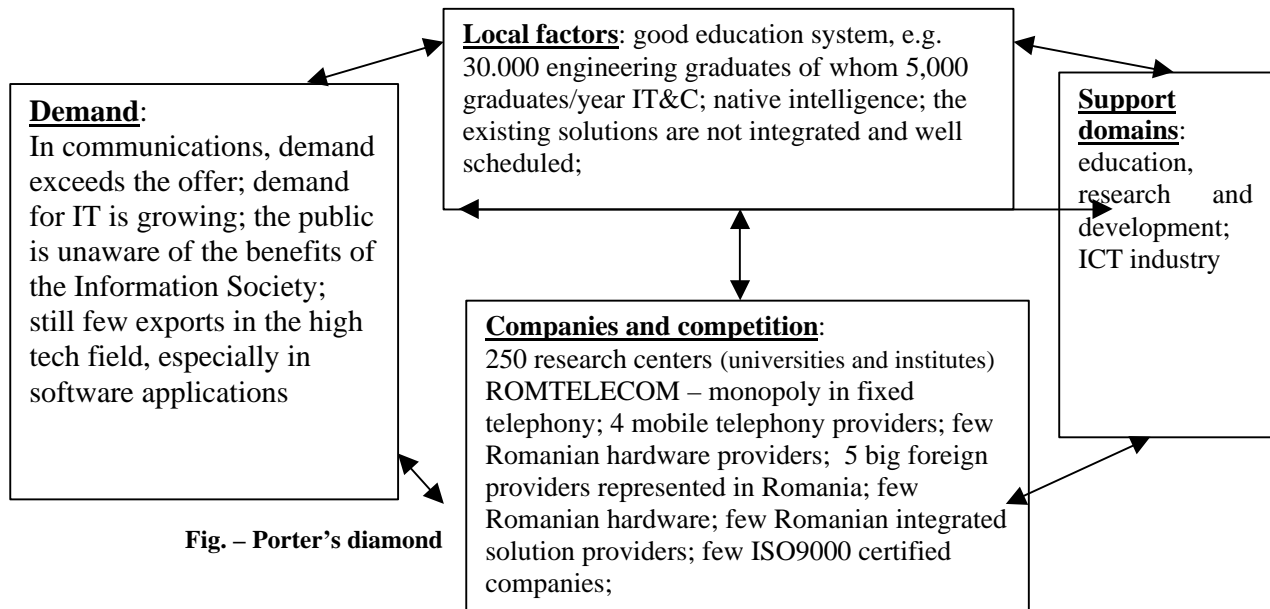
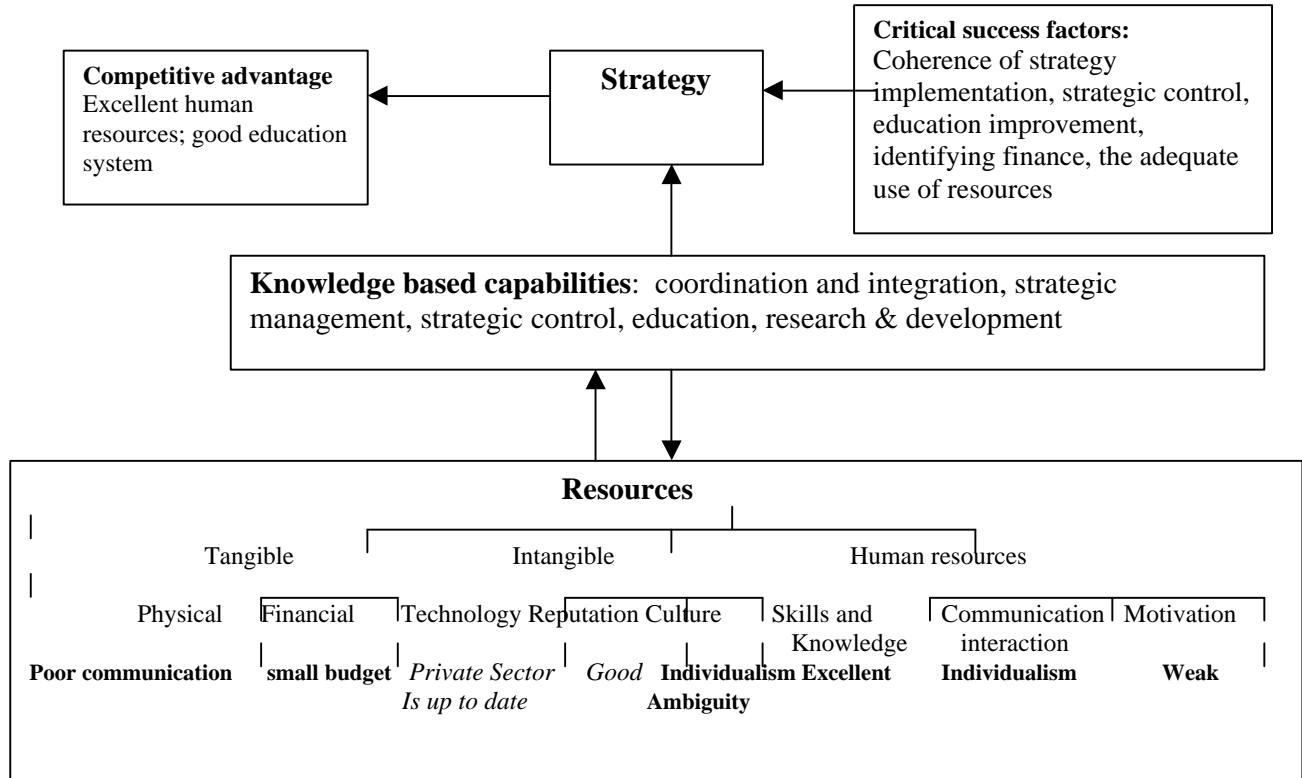


Fig. – Porter's diamond

**The Romanian competitive advantage in the production and the use of knowledge is dependent on Romania's resources and capabilities in this field.** The strategy for the development of a knowledge-based economy should be based on how best to use the existing resources and capabilities



Legend: **Bold** = weaknesses *Italic*=strengths

**Fig. – Grant – Resources, capabilities and competitive advantage**

As an investment, education is an end in itself, or an intermediate end with knowledge gained from education as the ultimate end. The proportion of education services used increases when per capita income is higher because of the declining marginal return on other marginal things. Therefore, higher education in a knowledge-based economy consists of the following three characteristics:

**a. Academic excellence**

There are a number of institutions that are qualified research universities capable of creating new knowledge and be major sources of technological progress, which is indispensable to modern economic growth

**b. Higher education public awareness campaign**

In a knowledge-based economy, higher education is no longer a luxury that only the rich can afford and is restricted to the elite of society. Higher education is required not only for the continuous growth of the economy, but also for reasons of equity

**c. Diversification of higher education**

## What are the implications of the ‘knowledge divide’ for Romania in terms of regional disparities, social exclusion and the urban –rural divide?

The main aspects regarding the knowledge divide (both as cause and effects) refer to the following aspects:

1. Social polarization
2. Social marginalization of persons with disabilities
3. Limited access to the culture of the population in rural and suburban areas
4. Economic discrepancies between and within the regions

Even if a bulk of population works in agriculture a small share of added value is given by this branch.

### Structure of employment and GDP

	Employment						Value added			
	Administrative data			LFS data			1991	1995	1997	1998
	1991	1995	1997	1996	1997	1998				
<b>Agriculture, forestry</b>	<b>29.7</b>	<b>34.4</b>	<b>37.5</b>	<b>38.0</b>	<b>39.0</b>	<b>40.0</b>	<b>20.1</b>	<b>21.4</b>	<b>19.8</b>	<b>17.7</b>
Industry	35.5	28.6	27.1	27.2	26.3	25.4	40.4	35.6	38.8	35.1
Construction	4.6	5.0	4.9	4.3	4.2	4.0	4.7	7.1	5.8	5.8
Services	30.6	32.0	30.5	30.5	30.5	30.6	34.8	35.8	35.7	41.4
Total	100	100	100	100	100	100	100	100	100	100

Note: Administrative data on employment (“employment balance”) indicate a lower than actual rate of employment for specific occupations, especially small farming

Source: Institute of Agricultural Economy, internal paper 2001 and Labor Market and Social Policies in Romania – Employment OECD 2000 p 36.

The distribution of employment is distorted.

### Distribution of employment, by occupational groups in 2000

Specification	Total	Urban	Rural
Total employment – thousand	10148	4930	5218
Executives and high-ranking public administrators and economic and social corporate officers %	2.4	4.3	0.6
<b>Intellectual and scientific professionals %</b>	<b>6.8</b>	<b>12.5</b>	<b>1.3</b>
Technicians, foremen and similar %	8.4	14.1	2.9
Administrative office workers %	4.0	6.6	1.6
Operators in services, trade and similar	7.0	0.8	3.5
Farmers and skilled workers in agriculture, forestry, fishery %	36.8	3.1	68.6
Craftsmen, tradesmen %	17.8	26.1	10
Other occupation classes %	16.8	22.5	11.5

Source: Household Labour Survey AMIGO, CNS, trim I, 2000 p.22

Out of the total employees in agriculture, 1.7% have graduated from a higher school, 6.5% from a secondary and post-secondary school, 50% from a middle or vocational school, 35.4% from a primary school and 6.4% have no formal schooling (according to the 1992 population and housing census).

In recent years, enrollments in agricultural secondary schools and vocational schools have dropped sharply from their 1989-1990 school year levels:

	1990	1999
	1991	2000
Agricultural secondary schools, – enrollments	125893	28636
Vocational schools– enrollments	32252	7252
Agricultural higher schools (including veterinary medicine) – enrollments	7075	18562

From “Lessons of Transition. Romanian Agriculture” by Marin Popescu, Ed. Expert 2001 (p. 226)

General school training in rural area has also declined (shorter school years, growing number of children who are not enrolled or do not attend school, poorly equipped school laboratories, libraries plus many teachers who lack proper qualification)<sup>2</sup>. Enrollments in agricultural higher schools are rising, but the experts who migrated from agriculture still outnumber the graduates who take employment in this sector. In 2000, the telephone penetration rate was 16.8% in rural areas as compared to 83.2% in the urban areas.

### **Which were some of the successes Romania experienced in moving forward towards a knowledge economy?**

Considering Romania’s effort to develop a functional and prosperous market economy based on knowledge, the following achievements are worth mentioning:

1. Passing of regulations and laws, consistent with those in the EU:
  - electronic signature
  - e-tax
  - e-procurement,
  - intellectual property rights
  - protection of private data
  - access to public information
2. Computerized education programs:
  - computer aided education
  - electronic management of the education system (electronic management of the high school and university entrance examination)
  - e-learning
3. Pilot programs of MCIT (first e-government) and of MER (see attachment no.X)
4. A significant growing position of the IT sector in the economy
5. Involvement in international research and development programs: Framework program V, Ecolinks, Eureka, Cost, GEANT, E-content
6. Initiation of the competitive funding of research and higher education
7. Electronic debt compensation program
8. Telecentre network

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<sup>2</sup> As education in the countryside declined, rural young people’s access to higher schools was constrained. According to the President of Romania, in the late nineties rural residents who took regular higher-school courses accounted for just one per cent of total enrollments in higher education.

9. ROEDUNET national education network
10. Danube Delta Institute
11. Public information centers
12. Development of communication systems: radio communications, mobile telecommunications, multimedia telecommunications
13. ORACLE, CYSCO, INFOSOC academic initiatives
14. Participation of Romania at the European Survey of the Information Society, within the European Commission project for Central and East European and Mediterranean Countries (ESIS)
15. In February 2001, an ICT Task Force known as GPTI (Group for Promotion of Information Technology), was established by Government Decision No. 271/2001. GPTI is chaired by the Prime Minister of Romania and comprises the heads of 'e-ministries' (those ministries which have an important stake in the implementation of e-government): Public Administration, Education and Research, Communication and Information Technology, Public Finance, Development and Prognosis, and the minister for the General Secretariat of the Government.
16. An economic and institutional environment that provides incentives for the efficient use of the existing and new knowledge and growing entrepreneurship
  - direct investment legislation (Emergency Ordinance 92/1997 as amended)
  - new direct investments complying with the provisions of Law 332/2001 may benefit from the following tax incentives
  - access to a special development fund set up by the Government in accordance with Emergency Ordinance 59/1997 as amended (GD 317/2001) from the proceeds of the sale of state-owned companies
  - incentives available to small and medium enterprises (SMEs) under the provisions of Law 133/1999 as amended
  - income tax legislation – tax exemption (Emergency Ordinance 94/2001) for analysts and programmers
  - Government Decision on the privatization strategy for companies under the Authority for Privatization and State Ownership Administration in which the State has a stake

#### **Priorities in main action plan**

1. Education and training in a knowledge based economy
2. Research, development and innovation
3. Culture in the Information Society
4. Public (civil society, policymakers, specialists in various fields) awareness raising in connection with the importance of the knowledge economy and information society development in Romania
5. Development of a new attitude: a new "culture" of communication and co-operation in the new knowledge based society
6. Knowledge based economy and information society infrastructure (development of the national internet)
7. The required legislation and institutional framework

8. Adjustment of public administration to knowledge based economy and development of other public services
  9. SME's development in the framework of a knowledge based economy
  10. Development of a strong ICT industry
  11. The role of the financial and banking system and e-commerce
- The actions envisaged for these priorities are detailed in attachment no. 9

### **Indicators for the knowledge-based economy**

At the heart of the knowledge-based economy, knowledge itself is particularly hard to quantify as well as price. While new knowledge will generally increase the potential output of the economy, the quantity and quality of its impact are not known in advance. There is no production function, no input-output formula that could approximate, however roughly, the effect that one unit of knowledge would have on economic performance. Knowledge, unlike conventional capital goods, has no fixed capacity.

The achievements in implementing eEurope+ are measured by a set of indicators:

1. percentage of population who regularly use the Internet
2. percentage of households with Internet access
3. Internet access costs
4. faster Internet for researchers and students
5. speed of interconnections and services available between and within national research and education networks (NRENs) within EU and world-wide
6. number of secure server per million people
7. percentage of Internet-using population that have experienced security problems
8. number of computers per 100 students in primary/secondary/tertiary education
9. number of computers connected to the Internet per 100 students in primary/secondary/tertiary education
10. number of computers with high speed connections to the Internet per 100 students in primary/secondary/tertiary education
11. percentage of teachers using the Internet for non-computer skills teaching on a regular basis
12. percentage of workforce with ( at least) basic IT training
13. number of places and graduates in ICT-related tertiary education
14. percentage of workforce using telework
15. number of Public Internet Points( PAP) per 1,000 inhabitants
16. percentage of central government websites conforming the WAI accessibility guidelines at A level
17. percentage of companies that buy and sell over the Internet
18. percentage of basic public services available on-line
19. public use of public procurement which can be performed on-line
20. percentage of health professionals with Internet access
21. use of different categories of web content by health professionals
22. percentage of EU web sites in the national top 50 visited
23. percentage of the motorway network equipped with (traffic) congestion information and management system

There are four principal reasons why knowledge indicators cannot approximate the systematic comprehensiveness of traditional economic indicators:

- There are no stable formulae or recipes for converting knowledge inputs into outputs
- Inputs into knowledge creation are hard to map because there are no knowledge accounts analogous to the traditional national accounts
- Knowledge lacks a systematic pricing system that would serve as a basis for aggregating pieces of knowledge that are essentially unique
- New knowledge creation is not necessarily a net addition to the stock of knowledge, and the obsolescence of units of stock knowledge is not documented

### **Measuring knowledge inputs**

1. R&D - standard practice for research and experimental development surveys (Frascati Manual 1993)
2. R&D – measurement of research and experimental development (Frascati Manual, 1993)
3. Technology balance of payments – Standard methods of compiling and interpreting technology balance of payments data (TBP Manual, 1990)
4. Innovation – guidelines for collecting and interpreting technological innovation data (Oslo Manual, 1992)
5. Patents – using patents data as science and technology indicators (Patent Manual, 1994)
6. Human resources – measurement of human resources devoted to S&T (Cambera Manual, 1995)

### **Measuring the amount and flow of knowledge**

1. Rate of return on R&D investment
2. R&D personnel
3. flow of knowledge = the amount of knowledge that flows into the economy during a specified period of time
  - a. embodied diffusion (embodied in tangible, corporeal assets; operating new machinery, equipment and components thereof as part of the production process)
  - b. disembodied diffusion (embodied in intangible, incorporeal assets; conveying knowledge, technical expertise or technology in the form of patents, licenses or know-how)

Information technology indicators are being developed that focus on the dissemination and use of information technology – computers, software, networks – by businesses and households. They measure the flow of technology and the factors that enable or obstruct it, such as pricing, which allows us to assess how fast the information society is growing.

### **Measuring knowledge outputs**

Rough indicators have been developed that convert specific knowledge inputs into knowledge outputs in order to analyze and compare the economic performance of

countries. These measures tend to categorize industrial sectors or parts of the workforce as being more R&D, knowledge or information-intensive or less so. The measures are based on the assumption that certain knowledge-intensive sectors play a key role in a country's performance in the long run by their spillover effects, by creating high-skill and high-paying jobs and generating a higher return on capital and labor. R&D intensity (R&D expenditure-to-gross output ratio)

### **Measuring knowledge networks**

Innovation surveys capture information on the factors affecting the propensity of firms to innovate and how knowledge and innovation spread in the economy. Based in part on these innovation surveys, efforts are just beginning to map out national innovation systems and the knowledge dissemination power of the economy by analyzing two main flows:

- The distribution of knowledge across universities, public research institutions and industry
- The distribution of knowledge in a market between suppliers and users ( Smith, 1995)
  1. acquired technology
  2. outsourcing of R&D to public R&D institutes
  3. outsourcing of R&D to private R&D institutes
  4. outsourcing of R&D to other companies
  5. informal contacts
  6. recruitment of qualified personnel

### **Measuring knowledge and learning**

To assess the social rate of return means to measure the impact of education expenditure and attainment levels in society at large on economic growth. Measures of private rates of return tend to look at changes in human skills and competencies at the individual or firm level and their impact on firm performance. More micro-level or firm-level indicators are needed to establish linkages between enterprise training, its impact on human capital and skill formation and the effects on firm performance. Human capital indicators, particularly those relating to education and employment, are central measures for the knowledge-based economy. Measuring the private and social rates of return on investments in education and training will help point to means of enhancing the learning capacity of individuals and firms. Micro-level firm indicators on human resource requirements, employment and occupational mobility will help better match supply and demand for skills in the labor market.

## Attachment 1 - Statistical data

Romania has a population of 22,435,205 (at July, 1, 2000), with 94,1 inhabitants/km<sup>2</sup>. Urban residents account for 54.6% of the total. By ethnicity, the composition is as follows: 89.5% Romanians, 7.1% Hungarians and 3.4% others. The capital is Bucharest with 2,009,200 inhabitants: first time recorded at 09.20.1459, its capital city status goes back to 1862.

Main statistics are:

	1996	1997	1998	1999	2000
<b>Basic data</b>	<b>thousand</b>				
Population (at 1 <sup>st</sup> of July)	22,608	22,546	22,503	22,458	22,435
	<b>km<sup>2</sup></b>				
Total area	238,391	238,391	238,391	238,391	238,391
<b>National accounts</b>	<b>thousand million Lei</b>				
Gross domestic product at current prices	108,920	252,926	371,194	539,357	796,534
	<b>thousand million ECU/euro</b>				
Gross domestic product at current prices	27.8	31.2	37.2	33.0	40.0
	<b>ECU/euro</b>				
Gross domestic product per capita <sup>3</sup> at current prices	1,200	1,400	1,700	1,500	1,800
	<b>% change over the previous year</b>				
Gross domestic product at constant prices (nat. currency)	3.9	-6.1	-4.8	-2.3	1.6
	<b>in Purchasing Power Standards</b>				
Gross domestic product per capita <sup>4</sup> at current prices	6,100	5,900	5,800	5,800	6,000
Structure of production	<b>% of Gross Value Added<sup>5</sup></b>				
- Agriculture	20.1	19.5	15.8	14.8	12.6
- Industry (excluding construction)	34.8	33.4	30.3	29.9	30.5
- Construction	6.8	5.7	5.5	5.4	5.3
- Services <sup>6</sup>	38.3	41.5	48.4	49.9	51.5
Structure of expenditure	<b>% of Gross Domestic Product</b>				
- Final consumption expenditure	82.6	86.4	90.2	87.2	86.4
- household and NPISH	69.5	74.2	76.0	74.4	73.9
- general government	13.1	12.3	14.2	12.7	12.5
- Gross fixed capital formation	23.0	21.2	18.3	18.0	18.5
- Stock variation <sup>7</sup>	2.9	-0.5	-0.4	-0.8	1.0
- Exports of goods and services	28.1	29.2	23.5	29.0	34.1
- Imports of goods and services	36.6	36.2	31.5	33.4	39.9
<b>Inflation rate</b>	<b>% change over the previous year</b>				
Consumer price index <sup>8</sup>	38.8	154.8	59.1	45.8	45.7
<b>Balance of payments</b>	<b>million ECU/euro</b>				

<sup>3</sup> Figures have been calculated using the population figures from National Accounts, which may differ from those used in demographic statistics.

<sup>4</sup> Figures have been calculated using the population figures from National Accounts, which may differ from those used in demographic statistics.

<sup>5</sup> Including FISIM.

<sup>6</sup> Figures include changes in inventories, acquisitions less disposals of valuables and the statistical discrepancy between the GDP and its expenditure components.

<sup>7</sup> Figures include changes in inventories, acquisitions less disposals of valuables and the statistical discrepancy between the GDP and its expenditure components.

<sup>8</sup> Changes in Methodology: PROXY HICP since 1996 (see methodological notes).

	1996	1997	1998	1999	2000
<b>-Current account</b>	-2,446	-1,895	-2,637	-1,382	-1,477
-Trade balance	-2,350	-1,756	-2,332	-1,183	-1,831
<i>Exports of goods</i>	7,693	7,475	7,376	7,986	11,268
<i>Imports of goods</i>	10,043	9,231	9,708	9,169	13,099
-Net services	-366	-367	-581	-402	-276
-Net income	-294	-285	-393	-387	-305
-Net current transfers	564	513	669	589	935
<i>-of which: government transfers</i>	45	57	46	54	76
- FDI (net) inflows	250	1,077	1,804	980	1,114
<b>Public finance</b>	<b>% of Gross Domestic Product</b>				
General government deficit/surplus	-3.5	-4.5	-4.4	-2.1	-3.8
General government debt	:	16.5	17.9	24.4	22.9
<b>Financial indicators</b>	<b>% of Gross Domestic Product</b>				
Gross foreign debt of the whole economy	21.5	24.1	19.8	25.2	22.4
	<b>% of exports</b>				
Gross foreign debt of the whole economy	76.4	82.6	84.2	86.8	65.8
Monetary aggregates	<b>thousand million ECU /euro</b>				
- M1	2.2	2.1	1.7	1.6	1.9
- M2	5.9	7.0	7.2	7.3	7.7
- M3	:	:	:	:	:
Total credit	6.3	5.7	6.8	6.0	4.9
Average short-term interest rates	<b>% per annum</b>				
- Day-to-day money rate	53.4	86.0	80.9	80.8	44.8
- Lending rate	55.3	72.5	55.4	65.6	53.8
- Deposit rate	38.1	55.7	37.3	45.8	32.9
ECU/EUR exchange rates	<b>(1ECU/euro=.. Leu)</b>				
- Average for period	3922	8112	9985	16345	19922
- End of period	5182	8859	12814	18345	24142
	<b>1991=100</b>				
- Effective exchange rate index	1.2	0.6	0.5	0.3	0.2
Reserve assets	<b>million ECU/euro</b>				
-Reserve assets (including gold)	1,259	2,780	1,981	2,455	3,637
-Reserve assets (excluding gold)	429	1,987	1,175	1,519	2,652
<b>External trade</b>	<b>million ECU/euro</b>				
Trade balance	-2,733	-2,596	-3,202	-1,979	-3,055
Exports	6,364	7,481	7,381	8,055	11,365
Imports	9,097	10,077	10,583	10,034	14,420
	<b>previous year = 100</b>				
Terms of trade	97.2	101.2	105.1	103.8	103.5
	<b>% of total</b>				
Exports with EU-15	56.5	56.6	64.5	65.5	63.8
Imports with EU-15	52.3	52.2	57.7	60.7	56.6
<b>Demographics</b>	<b>per thousand people</b>				
Natural growth rate	-2.5	-1.9	-1.5	-1.4	-0.9
Net migration rate (including corrections)	-0.9	-0.6	-0.3	-0.1	-0.2
	<b>per thousand live births</b>				
Infant mortality rate	22.3	22.0	20.5	18.6	18.6
Life expectancy :	<b>at birth</b>				
Males:	65.2	65.2	65.5	66.1	67.0
Females:	73.0	73.0	73.3	73.7	74.2

	1996	1997	1998	1999	2000
<b>Labor market (ILO methodology)</b>	<b>% of labour force</b>				
Economic activity rate	64.8	64.8	63.6	63.4	63.2 P
Unemployment rate, total	6.7	6.0	6.3	6.8	7.1 P
Unemployment rate, males	6.3	5.7	6.5	7.4	7.7 P
Unemployment rate, females	7.3	6.4	6.1	6.2	6.4 P
Unemployment rate of persons < 25 years	20.2	18.0	18.3	18.8	18.6 P
Unemployment rate of persons >= 25 years	4.2	3.8	4.2	4.9	5.3 P
	<b>% of all unemployed</b>				
Long-term unemployment	51.3	47.7	41.9	44.3	51.5 P
Average employment by NACE branches	<b>% of total</b>				
- Agriculture and forestry	38.0	39.0	40.0	41.7	42.8 P
- Industry (excluding construction)	27.2	26.3	25.4	23.9	22.4 P
- Construction	4.3	4.2	4.0	3.7	3.8 P
- Services	30.5	30.5	30.6	30.7	31.0 P
<b>Infrastructure</b>	<b>km per thousand km<sup>2</sup></b>				
Railway network	47.8	47.7	46.2	46.1	46.2
	<b>Km</b>				
Length of motorways	113	113	113	113	113
<b>Industry and agriculture</b>	<b>previous year = 100</b>				
Industrial production volume indices	106.3	92.8	86.2	97.8	108.2 P
Gross agricultural production volume indices	101.3	103.4	92.5	105.2	85.8 P
<b>Standard of living</b>	<b>per thousand inhabitants</b>				
Number of cars	106	116	125	133	139
Main telephone lines	139.8	151.9	161.2	168.3	173.8
Number of subscriptions to cellular mobile services	:	9.0	24.5	50.1	90
Number of Internet subscriptions	:	:	:	:	:

P=provisional figures

## Attachment 2 - The National Research Network and its activities in the transition period

### The Network of Romanian R&D units

The Ministry of Education and Research is an active promoter of new beginnings, in its efforts to modernize the country through advanced science and technology. At the beginning of the new millennium, the Romanian scientific research proves to be a real force which gives the strategy makers opportunities to stay abreast of the changes taking place at a global level. The interdependence and conduction of scientific knowledge and research results is the new philosophy of action, among both economic, political, social and cultural decision-makers and the executives of firms, companies, organizations and institutes. The organizations that are part of the Network of Romanian R&D units range from basic research, applied research, and technological development to the design and execution of prototypes and short series products. The Network of Romanian R&D units comprises 665 research bodies (universities, institutes, centers, SMEs, enterprises), regardless of their organizational structure: national R&D institutions subordinated to or coordinated by the Ministry of Education and Research, other central bodies, state-owned joint stock companies, national authorities and private companies.

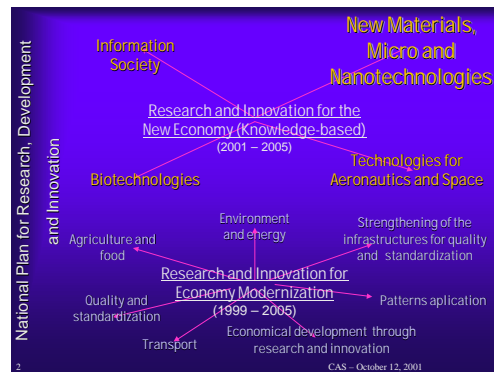
The units of the Romanian Research Network are grouped into the following categories:

- Entities of the Romanian Academy = 65
- Entities subordinated to and coordinated by the Ministry of Education and Research = 28 national institutes
- Entities subordinated to and coordinated by universities and other central institutions and independent entities = 557

In 2001, the Romanian Government launched the extension of the National Plan for Research, Development and Innovation (PNCDI), through programs for priority domains ( 10 new thematic programs). The Plan for 2001-2005 stipulates that 30% of the total budget of PNCDI should be allocated to "Cooperation and innovation in support of developing the new, knowledge-based economy".

Four programs with themes related to the priority domains defined for the Framework Program VI belong to this last category, namely:

new materials, micro- and nanotechnologies (MATNANTECH), information society (INFOSOC), biotechnologies (BIOTECH) and technologies for aeronautics and spatial activities.



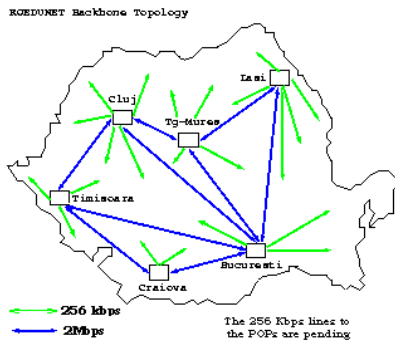
### The Romanian Education Network (RoEduNet)

Was created in July 1993, concomitantly with the establishment of the Polytechnic University of Bucharest (PUB). A Local Area Network was created and the P.U.B. Central Node got connectivity with the international data networks and services. From the very beginning RoEduNet was conceived as an open structure, offering free access to

the academic, scientific and cultural nonprofit institutions; once the first institution was connected - the University of Bucharest, August 1993 - the nucleus of the academic data communication infrastructure was created.

This process has continued and, today, the RoEduNet data communication infrastructure covers the national territory, connects and offers services to more than 150 institutions, offers international connectivity through two high speed channels - 1.5Mbps with TaideNet and 4Mbps with LoralOrion; the measured traffic figures shows a data exchange volume over the international channels of 0.8-1 Tbytes/month. The structure remains open to all universities as well as to non-profit scientific and cultural institutions.

### ***RoEduNet - Backbone***



The RoEduNet backbone consists of the links between the NSP (Network Service Provider) nodes in 6 major cities: Bucharest, Iasi, Tg. Mures, Cluj, Timisoara and Craiova. These nodes make up the "level-0" entity of our network, the infrastructure (backbone) providers. The blue (2Mbps) lines represent the existing links between the backbone nodes. The green (256Kbps) lines are the connections between RoEduNet NSP nodes

(backbone nodes) and RoEduNet POPs in each county capital city. These connections will bring a RoEduNet point of presence closer to educational institutions throughout the country, minimizing the cost of the network. All NSP nodes are/will be able to connect our users via dialup, leased asynchronous lines and leased digital (n\*64 kbps) lines. Also, based on local resources, users can be connected over Ethernets, cable (CATV), wireless or fiber optic. All NSP nodes are sufficiently equipped for operating a high-speed infrastructure based on this model, high performance routers being deployed in each node.

### **The Romanian National Research and Development Network (RNC)**

RNC is a national project coordinated and established by the Research Department of the Ministry of the Education and Research (formerly the National Agency for Science, Technology and Innovation) and focuses on the following main objectives:

- Setting up technical and organizational infrastructure meant to provide national and international services for the Romanian scientific research community;
- Providing a rapid and competitive tool for the exchange of information in the framework of R&D community;
- Using the scientific and technical data bases available in the country and offered by the national networks from other countries through international networks;
- Providing support for information, documentation and scientific and technical co-operation considering research teams and topics and R-D programs.

94 institutions connected through leased lines, over 250 research institutions connected by "dial-up";

about 8,000-10,000 users. Total international traffic 300 Gbytes/month and total international & national traffic 500 Gbytes/month;

RNC is a member of the following European organizations:

-TERENA (Trans European Research and Education Networking Association)

-CEENet (Central and Eastern European Networking Association)

International link:

Connection to LORAL ORION - USA (2M / 512k)

### **The Agricultural Research Network**

The post-1990 agricultural research network has not changed its structure significantly. It is made up of 39 central institutes and stations across the country and 74 field stations. Of them, 21 institutes and all stations are under ASAS (the Academy of Agricultural and Forestry Studies). The remaining 18 institutes and central stations have only their specialized activities coordinated by ASAS but otherwise do not report to it.

In 1998, the ASAS research unit network employed some 29,000, of which 2,800 were qualified researchers, with 300-350 of them being also involved in technology transfer activities. In 1998, those units operated about 100,000 hectares of farmland, and owned 16,000 cattle, 20,000 sheep, 260,000 pigs and 400,000 poultry. There were about 300 test and experimental plots where technology transfers were used.

About half of the ASAS-subordinated research units are commodity-oriented, with a few others being activity-oriented (marketing, soil science and agricultural chemistry, agrarian economy, food chemistry, irrigation and drainage engineering).

### Attachment 3 – Knowledge Economy related indicators

#### Education units – all levels

	1997/1998	1998/1999	1999/2000	2000/2001
Total	29084	29409	27633	24481
School enrollments (thousand)				
<b>Total</b>	4643	4631	4578	4565
<b>Preschool education</b>	623	625	616	611
- private sector	4	4	3	4
<b>Primary &amp; Middle</b>	2560	2557	2498	2412
<b>Secondary</b>	766	718	694	688
- private sector	13	10	7	7
<b>Post-secondary and foremen's</b>	86	96	95	82
- private sector	30	38	39	34
<b>Higher</b>	361	408	453	533
Private higher schools	111	130	130	151
School enrollment of the school-age population (%)				
Total	65.1	66.3	67.3	68.9
Male	65.0	65.4	66.3	67.7
Female	65.1	67.2	68.3	70.2
<b>Preschoolers, school children and higher-school students-to-teacher ratio</b>				
Preschoolers	17	17	17	18
School children	15	14	15	15
Higher-school students	15	16	17	19
<b>School children and students per 10, 000 people</b>				
School children	1623	1599	1563	1525
Higher school students	160	181	202	238

#### School Graduates (thousand)

	1997/1998	1998/1999	1999/2000	2000/2001
Middle school	232.6	275.6	283.7	...
Secondary school	183.6	182.8	174.1	...
Vocational and apprentice schools	81.9	78.4	70.3	...
Post-secondary and foremen's schools	29.8	35.0	39.2	...
Higher schools	67.8	63.6	67.9	...
Teaching staff (thousand)				
Total	309	312	301	295
Preschool	37	37	36	34
Primary and middle	173	173	166	163
Secondary	64	66	67	64
Vocational and apprentice	8	7	4	5
Post-secondary and foremen's	3	3	1	1
Higher	24	26	27	28

#### R&D Workers, by sector (thousand, full-time equivalent)

	1998	1999	2000
Total	52.5	44.1	33.9
- fully private sector	4.4	8.0	7.3
Business sector	36.2	32.0	22.5
Government sector	10.5	8.8	7.6
Higher education sector	5.8	3.3	3.8

#### Total R&D Expenditure, by sector (billion lei, current prices)

	1998	1999	2000
Total	1833.4	2195.8	2962.0
Fully private sector	208.0	300.0	710.6
Business sector	1406.7	1633.4	2056.1
Government sector	343.0	407.6	557.3
Higher education sector	83.7	154.8	348.6

## Newspapers, Magazines and Other Periodicals

	1997	1998	1999	2000
Titles– total	1855	1550	1986	1932
Number of libraries (end-of-year)				
Total	13849	13821	13785	13422
- <i>private sector</i>	267	545	562	517
Cinema (end-of-year)				
Number of cinema halls	468	313	321	279
Shows (thousand)	272	223	185	179
Spectators (million)	9	7	4	4
Entertainment institutions (end-of-year)				
Number of units	142	144	146	147
Performances (thousand)	16	16	16	16
Spectators (audience) (million)	4	4	5	5
Museums (end-of-year)				
Total	512	506	515	519
- <i>private sector</i>	38	54	48	50
Visitors (thousand)	9149	10926	8818	9594
Radio service subscriptions <sup>1)</sup> (thousand)	4082	3971	3591	3055
TV service subscriptions <sup>1)</sup> (thousand)	4018	3931	3710	3462
Radio programs <sup>1)</sup> (thousand hours per program)	89	90	92	96
- <i>private sector</i>	973	1382	1498	1789
TV programmes <sup>1)</sup> (hours per program)	14501	14670	14197	15296
- <i>private sector</i>	292013	437507	512514	512247

1) Public service

**Attachment 4 - The external environment acts through the STEEP factors (Social, Technological, Economics, Environmental and Political)**

**Table 1 –STEEP factors analysis, market and competition**

Competition	<p><b>The current state of IT&amp;C as support industry of knowledge based economy</b> (Mobile communications have experienced a boom in the past three years, the fixed ones have developed especially in the urban area; the rural area has an incomplete and obsolete network ; until 1<sup>st</sup> of January 2003  ROMTELECOM still has the monopoly over fixed communications; Information Technology started to be introduced in all fields; those of the State are incomplete and non-integrated  (e.g. Public Administration: Finance Ministry – Management Information System for Public Finance : doc. mgmt  Automatic processing of forms (functional~5,000 forms/month) beginning with General Revenue Taxation ); Gen Dir of Customs : ASICUDA - monitoring and control system for customs declarations (PHARE funds), 101 custom offices- phase 1, 12 regions, approx 120 custom offices, hundreds of custom commissioners, beneficiaries( export/import companies), traffic control); Web pages for : Presidency, Chamber of Deputies, Central Government, Ministries, Local Councils, City Halls  <b>National companies:</b> (TAROM , SNP, ROMTELECOM, CONEL , Romanian Post)  <b>Market:</b> current demand is high enough ; the future is estimated to be three times bigger, because of <i>software solutions , based on the Internet</i>, which extend and increase the international flow of information; buyer behavior : buyer prefer a low price, irrespective of quality; there were too few solutions that led to repetitive acquisition; ( eg.: mobile communications, Internet service providers); market segments: <i>people over 50 years</i> make limited use of both communications and the Internet; <i>students</i> use communications and the Internet extensively, <i>people aged 25 to 50</i> use the Internet mostly because of the nature of their work, on the job .  <b>Competition:</b> market shares: Romtelecom has a monopoly in fixed telephony until 1<sup>st</sup> of January 2003, rural areas not fully covered, (for mobile telephony there are 4 providers: Mobilrom, Mobifon, Cosmorom, Suntel); for postal services: the Romanian Post and other providers for rapid services ; for hardware there are foreign manufacturers (HP, IBM, Sun, Compaq, etc), but also local providers of brands; software providers are foreign (SAP,ORACLE,BAAN, PEOPLE SOFT, Computer Associates, Microsoft), but also local (small and medium companies); the IT market is shared : individuals( 1%), small companies( 9%), medium companies(25%), big companies(30%), very big companies 40%); new entrants: market entry is very difficult because of the very large initial investment needed.</p>
Political factors	<ol style="list-style-type: none"> <li>1. <b>Legislation:</b> avoidance of double taxation – agreed with some countries; treaties with EU countries for IT&amp;C workforce</li> <li>2. <b>Support for companies:</b> high taxation; rate lowered by SME law or incentives granted to start-up companies</li> <li>3. <b>EU Developments: entry to EU</b> implies implementation of the <b>acquis communautaire</b></li> <li>4. <b>Political changes in many markets:</b> developed countries are moving toward the knowledge-based economy;</li> <li>5. <b>Regional Trading Blocks :</b> Europe(EU), Americas(NAFTA), Asia(APEC, Japan, ASEAN), Africa, Middle East, etc</li> <li>6. There are many international funds and international programs for the implementation of the Information Society in the developing countries</li> </ol>
Economic factors	<ol style="list-style-type: none"> <li>1. <b>Interest rate</b> is high( approx 40 %);</li> <li>2. <b>Unemployment</b> is high in Romania; the highest rates are in Moldova (Vaslui, Botosani, Braila) and Oltenia (Craiova); unemployment will increase in mono-industrial areas (Galati, Brasov, Resita, etc).</li> <li>3. <b>Inflation:</b> 30.3% (official)</li> <li>4. <b>National currency lost</b> 30% of its value in 2001</li> <li>5. <b>Still high fees for communications</b></li> </ol>
Social factors	<ol style="list-style-type: none"> <li>1. Romania has about 5,000 CTI graduates each year; Education level in Romania in IT&amp;C is good, but decreasing</li> <li>2. 70% of the IT&amp;C workforce is in Bucharest;</li> <li>3. 25% of IT&amp;C workforce leaves Romania every year</li> <li>4. Public not informed about the benefits of Information Society</li> <li>5. People lack confidence in communications and information;</li> </ol>

	<ul style="list-style-type: none"> <li>6. Labor productivity is low</li> <li>7. The use of Information Technology disseminates information fast and helps implementing the latest innovations</li> <li>8. Workforce is cheap in Romania</li> </ul>
Technological factors	<ul style="list-style-type: none"> <li>1. Technology development in the world leads to its implementation in Romania</li> <li>2. The price of technology is high because of the small number of market players</li> <li>3. Lack of integrated solutions is behind the high operational costs of businesses</li> </ul>

## Attachment 5 - SWOT analysis for the Romanian use of knowledge

<p style="text-align: center;"><b>Strengths</b></p> <ul style="list-style-type: none"> <li>○ <b>Numerous and well educated human resources</b></li> <li>○ <b>Good education system( all levels)</b></li> <li>○ Convergence of Communications and Information Technology industries</li> <li>○ E-signature law, e-commerce law( draft), data protection law, unified emergency calls system</li> <li>○ <b>ICT community</b> started to have identity</li> <li>○ <b>Political situation is favorable to the development of knowledge based economy</b> ( MCTI, Parliamentary ICT Commission, ICT councilors at the Romanian Presidency)</li> <li>○ <b>Rapid adjustment to the latest technologies</b></li> <li>○ Solutions developed “from scratch”</li> <li>○ Rapid return on investment</li> <li>○ IT solutions enhance company value</li> </ul>	<p style="text-align: center;"><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>○ Communications infrastructure in rural areas; large investment requirements</li> <li>○ Average salary is low when compared to developed countries</li> <li>○ IT teams of central and local administration are not well prepared or motivated</li> <li>○ High ICT piracy level (67%)</li> <li>○ Not enough “externalization” of ICT services</li> <li>○ Not enough e-content</li> </ul>
<p style="text-align: center;"><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>○ A good education system</li> <li>○ World economy is moving towards a knowledge based economy and Information Society( distances become irrelevant, etc)</li> <li>○ Worldwide huge demand for ICT services and digital content;</li> <li>○ benefits for Romania: Romanian specialists use state-of-the-art technology, some of the people who emigrated turned into Romania’s good “ambassadors” <ul style="list-style-type: none"> <li>a. EU makes specific requirements (24 March 2000 Lisbon – EC – directives in order to join the EU: <ul style="list-style-type: none"> <li>i. Education, as a factor of progress</li> <li>ii. Cheap Internet access</li> <li>iii. Use of e-commerce</li> <li>iv. Interactive student-teacher communication</li> <li>v. Smart-cards use</li> <li>vi. ICT use by SMEs</li> <li>vii. On-line health services</li> <li>viii. Intelligent transportation</li> <li>ix. On-line governance)</li> </ul> </li> </ul> </li> <li>○ Substantial international funding to implement an Information Society in developing countries</li> </ul>	<p style="text-align: center;"><b>Threats</b></p> <ul style="list-style-type: none"> <li>○ There is a huge demand for ICT professionals in the developed countries (well-educated human resources working in Romania are getting fewer)</li> <li>○ If Romania does not develop a knowledge based economy, the economic gap between Romania and the developed countries will grow wider still</li> </ul>

A ‘knowledge based economy’ strategy should help Romania use the opportunities to address its weaknesses and make its strengths grow stronger.

## **Attachment 6 - EU accession related activities**

For the implementation of the eEurope+ action plan, the deadline of which is end-2003, several EU programs have been made available to the member states and the candidate states. The European programs in which Romania's involvement is sought by MCTI as they could support Romania in the process of building an Information Society are as follows:

### **1. The e-Content program**

It will unfold during 2001- 2005 and its main goals are the improvement of the Internet access and extension of the use of electronic information in the public sector, increased production of e-content in a multicultural and multi-linguistic environment, higher e- content market dynamism. On the basis of its contribution to this program, Romania may prepare proposals for projects which, pending approval, will be financed through the EU program. The projects a country works on are not limited to the contribution of that country.

### **2. Safer Internet Action Plan program**

It spans over 1999- 2002 and involves Romania's yearly contribution of Euro 78,000. The main objectives are to create a safer Internet environment, encourage Internet self-regulation and codes of conduct, promote cyber crime prevention and deterrence. The projects a country works on are not limited to the contribution of that country.

### **3. IDA II Program (Interchange Data Administration)**

It unfolds over the period 1998-2004 and its main objective is the interconnection of the administrations of the participating countries with the aim of best practice promotion, facilitating the exchange of digital information, stimulating the convergence as well as understanding of the problems the participant countries are faced with, and developing public services beyond a country's borders. Within this program, a common inter-operability framework will be developed, the benefits of employing electronic services will be identified, and the criteria of operating and interconnecting secure networks will be established. The projects a country works on are not limited to the contribution of that country.

### **4. IST Program - Information Society Program**

As the use of the Internet increases, more attention should be paid to social changes, to social integration and confidence-building, to the security and protection of privacy. Given the fact that Information Technology is a priority sector to the European Union, it launched a program to support research in this field. In order to promote the acceptance of innovation in every field of activity, Romania takes part in the EU's IST program.

The research development frame program (FP6) of the European Community was sent to the European Parliament in February 2001. IST consists of a priority of the frame program FP6. The 2002 budget estimate of the frame program is Euro 370 million, which accounts for some 37% of the IST program's annual budget in the last three years.

The frame program priority objectives are:

- Network administration, network interoperability and distributed systems;
- Information systems for health care, and for elderly and disabled people;

- Development of e-commerce activities, of distance working, security and personal data protection;
- Extension of education, training and cultural activities;
- Development and testing of GRID technologies.

Bearing in mind that the implementation of the eEurope+ action plan is being monitored on the basis of a set of indicators which have to be sent every year to the European Commission, MCTI has initiated a collaborative effort with the National Institute of Statistics and Economic Studies in order to define a thorough set of indicators for monitoring relevant developments.

The European Union intends to finance the measurement of certain indicators that national statistics offices do not collect data for, as well as some workshops on defining a set of indicators and measurement methods. The workshops will be attended by MCTI and the National Institute of Statistics and Economic Studies experts.

#### **5. Signing of a memorandum of understanding between some accession candidate states regarding communication**

On November 19 a memorandum of understanding for facilitating the information transfer and communication was signed in Bucharest by the Ministry of Transport and Communications, Skopje, the Federal Ministry of Transport and Telecommunications, Belgrade, the Ministry of Public Economy and Privatization, Tirana, the Ministry of Communications, Public Works and Transport, Nicosia, the Ministry of Communication and Information Technology, Bucharest, and the Ministry of Transport and Communications, Athens.

The objective of this interstate initiative as set forth in this MOU is to expedite and facilitate the communication between the parties and their participants (ministries, governments, agencies etc.). It is the will of the parties that all correspondence, document handling, information retrieval etc be accomplished via electronic means through secure networks and mechanisms (hereinafter referred to as “E-Governance Project”).

#### **6. Participation within the eEurope Action Plan**

During a meeting held on the first day of the conference, the ministers attending the event – around 30 – agreed on a Ministerial Declaration that reaffirms their commitment to fast e-government development as part of the eEurope Action Plan.

Future key challenges were also identified:

- To provide one face to customers through real integration within and across departments
- To examine integrated management processes and assess different funding models, including public/private partnerships
- To engage citizens in order to drive up usage – this can be achieved by taking a citizen’s point of view and thinking about how to make the citizen’s life easier
- To enable the identification and authentication of citizens; this is either not yet resolved or faces legislative hurdles
- To address security concerns, while remembering that security must be appropriate to the service

## **Attachment 7 – Ministry of Education and Research Projects**

### **Financed through bilateral agreements**

#### 1. Cooperation with Austria

Projects financed by KulturKontakt Austria and implemented in Romanian schools with consulting provided by the National Center for the Development of Professional and Technical Education (CNDIPT)

- a. The cooperation project “Developing and supporting the Romanian tourism schools”
- b. ECONET- “ Establishing a regional network for economic education” between the Ministry of Education and Research of Romania and KulturKontakt, Austria, financed by the Austrian Ministry of Foreign Affairs within the Stability Pact for South Eastern Europe.
- c. “ Improving education in depressed areas-piloting the Hauptshule and Berufshule models in schools in Romania ”, in vocational schools for the following professions:
  - farming and ecological management
  - masonry
  - workers in infrastructure and railway beds
  - workers in concrete casings and structures
- d. “Training for the occupation –Agri-tourism operator- based on the Austrian model”
- e. “Development of the instruments for regional and transborder cooperation in the field of tourism in South East Europe “

#### 2. Cooperation with The Netherlands

Matra – Quality assurance in higher education

#### 3. Projects in collaboration with the British Council

### **Financed by the World Bank**

Education Reform Project

Higher Education and Research Reform

School Rehabilitation

### **Financed through European programs**

1. Socrates II
2. Leonardo da Vinci II
3. FP 5
4. Phare HER (Universitas 2000) 8 million euro
5. Phare VET 25 million euro
6. TEMPUS
7. MATRA – a component for pre-university education
8. Other PHARE Projects
  1. Mutual recognition of qualifications for professional purposes
  2. Access to education for disadvantaged groups, with special focus on Roma
  3. Participation in Community programs and Agencies
    - Socrates
    - Leonardo da Vinci

4. Investments in economic and social cohesion-(Technical and Vocational Education and Training);
5. Institution building for economic and social cohesion-(Technical and Vocational Education and Training)
6. Phare end user support for the participants of the mobility schemes of the Socrates II Community program

## Attachment 8 – Action plan

### 1 Education and training within a knowledge-based economy

No.	Measure
1	Internet connection of all schools and high schools
2	Pilot projects for multimedia high schools
3	Multimedia equipment of high schools
4	Improved performance of the Ro-Edu-Net in order to set up remote education systems and support the connection of the education unit to this network
5	Development of educational software
6	Training specialists for pre-university education: teachers of other than computer science subjects – in the computer science field; computer science teachers – in the new technologies; network managers
7	Virtual universities / e-learning
8	Easier access of researchers and students to virtual counterpart European teams
9	Draft a computer skills list and correlate it to the European ones (adoption of a European List of professions and skills in the field of information science)
10	The creation of a framework that would provide incentives to private companies (and the specialists therein) to be involved in the equipment of education units

### 2. Research, development and innovation

No.	Measure
1	Programs for IS technologies
2	Romania's integration into the "European research and innovation area" (EU initiative) - participation in research networks, virtual laboratories/teams, virtual institutes.
3	Development of partnerships between the public and private sectors for the utilization of the IS technology
4	Improved performance of the national R&D network

### 3 Culture in the knowledge-based society

No.	Measure
1	Priority computerization of the institutions holding cultural heritage in stock (libraries, archives, museums) and broad access to them: - connecting university libraries to the high speed network and web sites for all libraries, museums, theatres and other cultural units - national internet connection of libraries and museums of towns - connection of other libraries and museums - connection of the theatre halls and other cultural units
2	Presenting the benefits provided by the IS technology

### 4 Public (civil society, policy makers, specialists in various fields) awareness campaign on the importance of knowledge economy and information society development in Romania

No.	Measures
1	Launching of a national program to raise public awareness of the importance of the knowledge economy and information society (in the context of the EU accession of our country – conferences, TV and radio programs, articles in the press)
2	Training courses for specialists in various fields on the importance and features of the KE society

### 5 The development of a new attitude: a new "culture" of communication and cooperation in the new knowledge-based society.

No.	Measures
1	Web sites for all ministries and agencies (supply of up-to-date and coherent data on the plans, programs, expenses, achievements and effects of such action - public procurement, auctions, etc.): web sites supplying public information (documents, actions of public interest, auctions, etc.), own servers for web sites
2	On-line publication on the Government's web site of the forms commonly used by people in their

No.	Measures
	relations with local and central authorities.
3	An infrastructure to secure the electronic documents so that companies and individuals may be able to fill in and send safely the electronic documents.
4	Internal programs worked out by all governmental bodies regarding their purposes and targets, action framework and steps to be taken for the implementation of the measures for the expansion and diversification of IT use by every ministry, agency, governmental body
5	Legal amendments to provide incentives for investment in IT
6	All applications used by public servants and citizens that are in “electronic” contact with public institutions will be in Romanian
7	Provisions for the compulsory use of Romanian diacritical marks by both producers and distributors of keyboards in Romania, and designers and producers of applications for public administration
8	Easier access of the disabled to IT
9	Electronic format of all financial reports of companies
10	Promotion of a new “organizational culture” based on computer skills essential for a successful activity in the new information society.
11	Courses for continuous computer skill training of civil servants

## 6 Knowledge-based economy infrastructure (development of the national internet)

No.	Measures
1	Development of digital transmission mains (optical fiber). Rational operation of the network and performance updating.
2	Safe transmission of data in the national data network
3	Access by optical fiber to regional mains for all Romanian towns (one internet node for each town)
4	Access of remote areas to information (pilot projects and dissemination of positive outcome)
5	Access of all information producers to the data transport infrastructure
6	Development of alternative communication networks: interconnection of the networks for data transmission; interconnection with the national internet
7	Lower data transmission costs
8	Liberalizing communications and selling by auction of licenses for zonal telephone services
9	IT resources for education, research and culture institutions consisting of hardware, software, service, connection to internet
10	Improved performance of the national R&D network
11	Improved performance of the national RoEduNet and RNC and their connection with the GEANT European Data Transmission Main
12	Expansion of communication infrastructure of education and research for multimedia applications: connection by optical fiber of some research institutes for multimedia applications for further link with GEANT, connection with GEANT
13	Campus networks able to ensure multimedia communication
14	The integration of a Romanian campus network into the European virtual campus
15	A high speed network for health care units (hospitals, polyclinics): connection of hospitals and university clinics, connection of the emergency health care services of cities, connection of other town hospitals and polyclinics
16	An information network to monitor the environment

## 7 The required legislation and institutional framework

No.	Measures
1	- The updating and implementation of the legislation for personal data protection: the individuals’ protection against the processing and transmission of personal data; the free information and communication including internet by observing the deontological and professional rules regarding the transmission and processing of data in the social environment.
2	A legal framework favoring e-commerce development in accordance with EU legislation
3	Appropriate application of the law on intellectual property protection in the information society
4	Legislation on information crimes: information security, the concept of information crime, electronic payment means

## 8. The adjustment of public administration to the knowledge-based society and the development of other public services.

No.	Measures
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No.	Measures
1	Implementation of a system of information stalls to provide public information concerning: legislation, local cultural events, environment conditions (in the area) - in all communities of over 20,000 people
2	The development of web sites to record the citizens reaction to legislative initiatives and performance of public administration – legislative initiatives to be available on the internet before being discussed
3	A high speed network for the interconnection of public administration units (prefect's offices, mayor's offices in towns and villages)
4	Connection of remote localities
5	Promotion of the smart card utilization in the following fields: health care, telephone, public transport and payment to civil servants
6	Computer aided health care services: standardization of the utilization of smart cards in activities concerning health care in accordance with the European solutions.

### **9. SME's development in the framework of a knowledge-based economy**

No.	Measures
1	Amendment to the tax legislation in order to create the business environment required by the knowledge based economy and information society (incentives for investment and technology transfer, access to internet, communication infrastructure, etc.)
2	Development of a legal framework that would stimulate SME's integration into an information society: Electronic document and signature, e-commerce, equal access to network and information, "Incubators" and SME "spin-offs", transaction security, privacy of some data, consumer's protection, exclusive use of electronic means for public procurement
3	The creation of an environment enabling involvement of Romanian companies in e-commerce and the globalization of their activity in accordance with EU standards, supporting companies to shift to e-commerce and e-business.
4	Multi-lingual "front-end" development on internet sites to lower or remove the trader's limited access to markets due to language barriers.
5	Raising users and consumers awareness of e-commerce benefits and inducing them to accept and use the new technologies.
6	Telework utilization
7	Development of integrated programs to ensure SME's connection to the networks.
8	Registers per field/service
9	Development of education, training and promotion programs for SME's
10	Creating the institutional framework for the development of the specific domestic market.

### **10. Development of a strong ICT industry**

No.	Measures
1	Improvement of the framework of enforcing the copyright law and law enforcement
2	Development of Cybercenters in the IS field (hardware and software)
3	Development of education software
4	The utilization of software in the Romanian language
5	Pilot projects in e-commerce and in scientific software applications
6	Improvement of the quality of the Romanian software ISO 9001/9002 certification
7	Development of a list of jobs in the field of CIT

### **11. The role of the financial and banking system and e-commerce**

No.	Measures
1	Smart-cards utilization in the financial and banking system
2	Easier e-commerce by means of the financial and banking system

## CONTENTS:

Introduction and Background .....	1
Overall Perspective .....	1
Achievements to Date .....	2
“The Romanian economy paradox” .....	3
How useful is the knowledge economy perspective in understanding the challenges Romania faces and the opportunities that EU accession provides to Romania? .....	4
What are the most difficult challenges Romania faces in building a knowledge- based economy in the context of EU accession and the overall economic and institutional reform efforts? .....	4
A. Development of an enabling economic environment and institutional environment: 4	
B. Measures to provide human resources for the knowledge society .....	5
C. A coherent and enabling legal environment to foster a knowledge economy .....	6
D. Building an adequate (information) infrastructure .....	7
E. Building an efficient innovation system .....	7
1. Building a research and innovation network .....	7
2. Innovation and technological transfer programs (scientific and technological parks) .....	8
3. Developing the capacity of the economy to absorb R&D achievements .....	8
4. Incentives for the creation and development of innovative SME’s .....	8
Weaknesses and strengths. Romania in a global competitive knowledge economy .....	8
Strengths for knowledge-based development (at the beginning of the century) .....	8
2002 main weaknesses in building a knowledge based society in Romania .....	9
The national advantage in a knowledge-based economy .....	10
What are the implications of the ‘knowledge divide’ for Romania in terms of regional disparities, social exclusion and the urban –rural divide? .....	12
Which were some of the successes Romania experienced in moving forward towards a knowledge economy? .....	13
Priorities in main action plan .....	14
Indicators for the knowledge-based economy .....	15
Measuring knowledge inputs .....	16
Measuring the amount and flow of knowledge .....	16
Measuring knowledge outputs .....	16
Measuring knowledge networks .....	17
Measuring knowledge and learning .....	17
Attachment 1 - Statistical data .....	18
Attachment 2 - The National Research Network and its activities in the transition period .....	21
The Network of Romanian R&D units .....	21
The Romanian Education Network (RoEduNet) .....	21
The Agricultural Research Network .....	23
Attachment 3 – K.E.- related indicators .....	24
Attachment 4 - The external environment acts through the STEEP factors (Social, Technological, Economics, Environmental and Political) .....	26

Attachment 5 - SWOT analysis for the Romanian use of knowledge.....	28
Attachment 6 - EU accession related activities.....	29
1. The e-Content program.....	29
2. Safer Internet Action Plan program.....	29
3. IDA II Program (Interchange Data Administration).....	29
4. IST Program - Information Society Program.....	29
5. Signing of a memorandum of understanding between some accession candidate states regarding communication.....	30
6. Participation within the eEurope Action Plan.....	30
Attachment 7 - MEC Projects.....	31
Financed through bilateral agreements.....	31
Financed by the World Bank.....	31
Financed through European programs.....	31
Attachment 8 – Action plan.....	33
1 Education and training within a knowledge-based economy.....	33
2. Research, development and innovation.....	33
3 Culture in the knowledge-based society.....	33
4 Public (civil society, policy makers, specialists in various fields) awareness campaign on the importance of knowledge economy and information society development in Romania.....	33
5 The development of a new attitude: a new “culture” of communication and.....	33
cooperation in the new knowledge-based society.....	33
6 Knowledge-based economy infrastructure (development of the national internet)...	34
7 The required legislation and institutional framework.....	34
8. The adjustment of public administration to the knowledge-based society and the development of other public services.....	34
9. SME’s development in the framework of a knowledge-based economy.....	35
10. Development of a strong ICT industry.....	35
11. The role of the financial and banking system and e-commerce.....	35