

Education and digitalization, the path to a more sustainable, resilient and secure society

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Abstract. *The world experience proves that the development of the innovational society is directly linked to the concept of human capital through the development of the sectors where the accumulation of human capital takes place and primarily in the sphere of education and science. This paper is an exploratory research based on the analysis of macroeconomic indicators on digital performance, highlighting the progress made in terms of digital competitiveness, as well as on the digital framework and systemic conditions for education. The educational system is in a continuous dynamic; to cope with changes, this system is forced to make intensive use of creative techniques at all levels of it. However, in this context, many teachers are concerned about standardised processes and tests, compared to creative ones. Creativity has been and is combined with science: art and technology turn people's ideas into facts. At the beginning of the twenty-first century, the importance of innovation for growth (especially economic growth) was recognized, but the question of non-technological innovation is also raised.*

To this end, consideration was given to the processing and systematisation of secondary data taken from official reports prepared and published by the European Commission. Thus, we refer to the reports of the Digital Economy and Society Index (DESI) and the Human Capital Index (HCI) with reference to Romania, in the time horizon 2018-2020. The DESI 2020 reports are based on 2019 data. The UK is still included in the DESI 2020 and the EU averages are calculated for 28 member states. The DESI has been recalculated for previous years to reflect changes in the choice of indicators and corrections to the data. Human capital is a key trigger for sustainable, inclusive economic growth, but investment in health and education has not received the well-deserved attention. The index establishes a direct link between improved outcomes in health and education, productivity and economic growth.

Keywords: human capital, intellectual capital, digitalization, education

Introduction

Digitalization "promotes the formation of new business models or the remodeling of existing ones and determines *digital entrepreneurship* defined as a process or as a result of business activity" (Satalkina L., Steiner G., 2020). It creates both opportunities for entrepreneurs and new challenges for entities that want to strengthen their position on the market. The digital economy is very important because it increases innovation, growth and development, employment and competitiveness. "The rapid development of internet infrastructures and the increased accessibility and speed of access in parallel with this development allow digital technologies to be more

involved in the production process. In this context, digital technologies and digital transformation tools have recently become the leading source of product and service innovations for the business world” (Moroz, 2017).

The pandemic has unprecedentedly influenced the educational system in Romania, along with the whole world. With March of 2020, schools began to close one by one and millions of students either went on forced vacation or in the so-called ”online school” - according to UNESCO, a number of 91.3% of students were affected by this closure.

Due to the pandemic, Romania's digital transformation has been accelerated by the rapid progress of new technologies (artificial intelligence, cloud computing and blockchain or robotics), Education can benefit from this transformation - access to digital technologies helps to bridge the gap in education. The digital transformation in education is inevitable. The impact of information technology is remarkable, having in principle positive effects, but, of course, also bringing side problems. New technologies use digitalization, but are we ready for digital?!

Studying the European Union Strategy 2020, we discover the main priorities are: research, development and innovation and improving the educational process. Europe is in a changing world, so society is open to inclusion, innovation and reflection. The school of the twenty-first century was marked by a changing world, a world in which global transformations manifested themselves rapidly, technological progress was accelerated, and the world became open to innovation and digitalization.

The education system in Romania is far from being a perfect system, it is a system with many difficulties of quality, equity and infrastructure. Perhaps this is where the limits related to Romania's capacity to build a modern, knowledge-based economy start. The main challenge of the Romanian education system is the lack of equity, reinforced by large differences in quality and high rates of early school leaving.

Digitalisation is a concern for all levels of education. Even if we have officially adopted better the digitization process starting with 2020, we still face a need to change the pedagogy. In addition to the involvement of pupils / students in the use of technology and resources, the need to make investments in equipment to facilitate learning and, indirectly, innovation is also signaled. The degree of digitalisation of education should also address the training of staff and their access to educational resources.

In the National Recovery and Resilience Plan, one of the objectives regarding Component 15 - Education is "Digitalization of the educational process, to allow integrated approaches, improvement of digital skills for both students and teachers".

Under the title "Educated Romania", Romania aims to develop a legislative package by September 2022 through which digitalization is one of the priority areas of action, namely: the development of digital skills of teachers and students, the development of a digital ecosystem of education and programs and education for data safety and cyber safety.

Literature review

Intellectual capital is a concept with a three-dimensional origin: the United States of America, Europe and Japan. Europe is represented by Swedes Brooking Annie, Van Buren and Karl-Erik Sveiby. The latter is known as one of the founders of knowledge management in 1991, when the concept of ”intellectual capital” used by Thomas Stewart in the magazine ”Fortune” - the article ”Brainpower” appears for the first time. In the work dedicated to the human dimension of intellectual capital, the author argues for ”knowledge that can be converted into value”. The United States is represented by David Teece, a researcher at the University of Berkeley, and Thomas A.

Stewart. They launched the theory that supports "intellectual capital is the sum of the knowledge of all workers of the company, which ensures its competitiveness". The Japanese, represented by Hiroyuki Itami, argue that the elements of intellectual capital are information-based resources (know-how, brand visibility, customer bases) and tangible assets (people, goods and money), the theoretical dogs of the concept of intellectual capital are found in two completely different directions of thought which are called: the strategic direction and the direction of diversification:

1. The former studied the creation and use of knowledge, as well as the relationship between knowledge and value creation.
2. The latter focused on the need to develop a new information system, measuring both non-financial and traditional financial data.

In Romania, professor-researcher Ion Petrescu, through his work "Human Capital Management", emphasizes that intellectual capital is at the core of human capital; human capital is a form of manifestation specific to the post-industrial situation of the era of the technical-scientific revolution. Ovidiu Nicolescu added that "intellectual capital in an economic sense means not only elements that have recognized value on the market, but also participation in products and services".

Analyzing the literature, it can be concluded that intellectual capital is an economic category at the macroeconomic level, but an economic resource at the microeconomic level. Considered an economic resource, intellectual capital is formed by combining and interacting with components such as knowledge, technologies, innovations, customer and supplier relationships. Intellectual capital is a set of knowledge united to each other that the organization has, with the aim of creating processes necessary in obtaining a long-lasting competitive advantage of the company.

Digitalisation, a new coordinate towards the future

Nowadays, in the context of the pandemic, we have all realized the importance of digitalization within an economy. Digital skills, the internet, artificial intelligence provide support to each country's economy and ensure continued work, monitoring the pandemic and identifying effective treatments. Thus, each Member State has tried to find the most appropriate measures to mitigate the impact of the virus, which is also presented in the report. Obviously, in this fight with the pandemic, an important role is played by digitalization.

The European Commission supervises the digital evolution of the Member States of the European Union through the digital economy and society index (DESI) reports. For the first time this report was produced in 2014. In the reports we find the country profiles of the analyzed states, thematic chapters as well as aspects related to telecommunications.

The DESI 2020 reports are based on 2019 data. The UK is still included in the DESI 2020 and the EU averages are calculated for 28 member states. The DESI has been recalculated for previous years to reflect changes in the choice of indicators and corrections to the data.

The DESI analysis report for 2020 includes the analysis of connectivity skills, internet literacy skills, digital skills, business digitisation, digitalisation of public services, and cybersecurity. According to desi 2020 Finland, Sweden, Denmark and the Netherlands have the most digitized economies within the European Union. These are followed by Malta, Ireland, Estonia and Bulgaria. Access to a fast and reliable broadband connection is crucial in the current context, where key online services are provided. A modern and robust digital infrastructure provides the necessary coverage for these services. During the crisis, networks have faced significantly increased demand, while at the same time having to provide broadband services. In

terms of connectivity, Denmark had the highest score, followed by Sweden, Luxembourg, Latvia and Spain. Greece, Cyprus and Bulgaria performed the worst for this size.

Connectivity Access to a fast and reliable broadband connection is crucial in the current context, where key online services are provided. A modern and robust digital infrastructure provides the necessary coverage for these services. During the crisis, networks have faced significantly increased demand, while at the same time having to provide broadband services. In terms of connectivity, Denmark had the highest score, followed by Sweden, Luxembourg, Latvia and Spain. Greece, Cyprus and Bulgaria performed the worst for this size.

Human Capital The current pandemic has shown how important digital assets have become to the economy and how basic and advanced digital skills support the economy and society. Although already 85% of citizens used the internet in 2019, before the pandemic, only 58% have at least basic digital skills. Therefore, having an internet connection is not enough; it must be associated with the right skills to take advantage of the digital society. Digital skills range from basics that allow people to participate in the digital society, consume digital goods and services, to advanced skills that empower the workforce to develop new digital goods and services.

Use of internet services Citizens with internet connection and digital skills can engage in a wide range of online activities. Although already 85% of citizens were using the internet in 2019, before the COVID-19 pandemic, the current crisis may have the positive impact of further increasing the number of internet users and their online interactions. This dimension of DESI measures how many people use the internet and what activities they do online. Activities include the consumption of online content (music, movies, TV, games, information in the media, online social interactions), using modern communication activities and transaction activities such as online shopping and banking services.

Digital technology integration Digital technologies enable companies to gain competitive advantages, improve their services and products, and expand their markets. The digital transformation of businesses opens up new opportunities and stimulates the development of new and reliable technologies. This dimension measures the digitalisation of businesses and e-commerce. The best performers are Ireland, Finland, Belgium, the Netherlands, Denmark and Sweden, with scores higher than 55 points (out of 100). At the other end of the scale, Bulgaria, Romania, Hungary, Poland, Greece and Latvia lag behind scores below 35 points, significantly below the EU average of 43 points.

Digital public services Digital technologies are placing more and more requirements and expectations in the public sector. Realizing the full potential of these technologies is a key challenge for government organizations. Effective e-government can provide a wide variety of benefits, including more efficiency and savings for both governments and businesses, can increase transparency and openness. The best performers are Estonia, Spain, Denmark, Finland and Latvia, all with scores higher than 85. On the other hand, Romania, Greece, Croatia, Slovakia and Hungary score less than 60 and significantly below the EU average of 72.2.

Research methodology

This paper is an exploratory research based on the analysis of macroeconomic indicators on digital performance, highlighting the progress made in terms of digital competitiveness, as well as on the digital framework and systemic conditions for education. To this end, consideration was given to the processing and systematization of secondary data taken from official reports prepared and published by the European Commission. Thus, we refer to the Reports of the *Digital Economy and Society Index (DESI)* and the *Human Capital Index (HCI)*.

The purpose of the present work is the analysis of the digitization process in the Romanian economy and, in particular, in the educational environment. To begin with, we have proposed the following **assumptions**:

1. Digitalization is a large-scale phenomenon that influences the educational environment.
2. DESI and HCI are important indicators for analyzing the Digital Economy.

Following this research, we set out to find answers to the following questions:

1. Does digitalization influence educational performance?
2. Is the Romanian educational system ready to adapt to new technologies?

The objectives to be achieved in the process of research elaboration are:

1. defining the digitization process
2. presentation of theoretical aspects regarding the interdependence between education, human capital and digitalization
3. analysis of the level of digitization of the Romanian economy and society
4. analysis of the human capital index in Romania
5. drawing conclusions from the analysis carried out

Romania holds the 11th place in the Connectivity dimension. As we see in Table 1, the values for the 4G *Coverage* indicator have improved in the 3 years analyzed, from 72% to 85%. At the same time, *the use of mobile broadband* has stagnated at the level of 2019 at the value of 86.

For *high-speed broadband coverage*, there was an increase to 82%, but still Romania is still below the EU average of 86%. *The overall fixed broadband usage rate* has kept the same value of 66% for a period of 3 years and is 12% lower than the EU average. Due to the infrastructure of urban areas, Romania is performing well on indicators such as the coverage of fixed very high capacity networks (VHCN) and the use of broadband services of at least 100 Mbps (68% and 49%).

Another positive aspect regarding Romania is the fact that it exceeds the EU average (26%), in *broadband use of at least 100 Mbps*, reaching 49%, which represents an increase of 4 points compared to the previous year. At the same time, Romania still has to improve its 4G coverage, as it is lagging behind, with a value of 85% compared to the EU average of 96%. As regards the indicator on the *Readiness for the use of 5G networks*, Romania has a score of 21%, similar to the EU average. Romania's broadband price index reached 92, well above the EU average of 64.

Table 1. Connectivity Dimension, Romania

No.	Indicators	Romania			EU DESI 2020
		DESI 2018	DESI 2019	DESI 2020	
		value	value	value	value
1a1	Overall fixed broadband usage rate % of households	67 %	66 %	66 %	78 %
1a2	Use of fixed broadband services of at least 100 Mbps % of households	44 %	45 %	49 %	26 %
1b1	High-speed broadband coverage (NGA) % of households	74 %	76%	82 %	86 %
1b2	Coverage of fixed very high capacity networks (VHCN) % of households	61 %	63 %	68 %	44 %
1c1	4G coverage % of households (average of operators)	72 %	77 %	85 %	96 %
1c2	Use of mobile broadband. Subscriptions to 100 people	82	86	86	100
1c3	Preparedness to use 5G networks. Assigned spectrum expressed in % of the total amortized 5G spectrum	-	0%	21 %	21%
1d1	Price index of retail services. Score (0-100)	-	-	92	64

Source: Digital Economy and Society Index, Romania 2020.

As we can see in Table 2, the level of *digital competences at least elementary* and *at least elementary skills in software* matters places Romania on the 27th place in the ranking of the 28 states analyzed. This is due to the fact that 31% of people aged 17-64 have at least primary digital skills, compared to the EU average of 58% of the EU average, and basic digital skills in software have only 35% compared to the EU average of 61%. Romania is also not good at *digital skills above the elementary level*, where it ranks last in the EU, with only 10% of users. Although there was an increase in ICT specialists, who were in a small proportion of 2.2% compared to the EU average of 3.9%. As for the employment of women IT specialists in the field of work, they represent a percentage of only 1.2%. However, there is a better situation regarding the graduates in the ICT field, where Romania is on the first place in the ranking, more precisely the 5th place, with 5.6% of the graduates.

Table 2. Dimension of Human Capital, Romania

No.	Indicators	Romania			EU 2020
		DESI 2018	DESI 2019	DESI 2020	
		value	value	value	value
2a1	At least basic digital skills % of persons	29 %	29 %	31 %	58 %
2a2	Digital skills above the elementary level % of persons	10 %	10 %	10 %	33 %
2a3	At least elementary skills in software material % of persons	32 %	32 %	35 %	61 %
2b1	ICT specialists % of all people still in employment	2,0 %	2,1 %	2,2 %	3,9 %
2b2	ICT specialists % of women in employment	1,2 %	1,3 %	1,2 %	1,4 %
2b3	ICT graduates % of absolvents	5,4 %	4,9 %	5,6 %	3,6 %

Source: Digital Economy and Society Index, Romania 2020.

Keeping the same position, Romania has the lowest level of use of internet services among the EU member countries, which is correlated with a low level of primary digital skills.

According to table 3, 18% of Romanian residents have never used internet services, while the EU average is only 9%. By contrast, at the opposite pole, Romania ranks among the top countries using social networks (82% compared to the EU average of 65%) and video calls (67% compared to the EU average of 60%). The lack of credibility and trust in digital technology has led to the use of internet banking services (11%), shopping (29%), online news tracking (55%), also videos, online games (63%) in a very small proportion, i.e. the lowest services among EU Member States.

Table 3. Dimension Use of Internet Services, Romania

No.	Indicators	Romania			EU 2020
		DESI 2018	DESI 2019	DESI 2020	
		value	value	value	value
3a1	People who did not use the Internet at any time % persons	27 %	21 %	18 %	9 %
3a2	Internet users % persons	61 %	68 %	72 %	85 %
3b1	News % internet users	69 %	69 %	55 %	72 %
3b2	Music, video crafts and games % internet users	67 %	63 %	63 %	81 %
3b3	Video on request % internet users	6 %	10 %	10 %	31 %
3b4	Video calls % internet users	53 %	51 %	67 %	60 %
3b5	Social networks % internet users	82 %	86 %	82 %	65 %
3b6	Taking an online course % internet users	5 %	5 %	4 %	11 %
3c1	Banking services % Internet users	11 %	10 %	11 %	66 %
3c2	Shopping % Internet users	23 %	26 %	29 %	71 %
3c3	Online sales % internet users	4 %	5 %	3 %	23 %

Source: Digital Economy and Society Index, Romania 2020.

Another dimension analyzed is the Integration of digital technology. The transformations or developments in the indicators analyzed were not observed. Thus, according to Table 4, only 23% of companies in Romania exchange information online, well below the EU average of 34%.

At the same time, only 8% of businesses use social media compared to 25% of the EU average. A gratifying aspect is the small increase in the share of SMEs that carry out E-Commerce, i.e. sales of products and services online. The value of the indicator has increased from 8% to 11%, while still below the EU average of 18%. 6% of SMEs sell their products online outside the country's borders, compared to the EU average of 8%.

Table 4. Digital Technology Integration Dimension, Romania

No.	Indicators	Romania			EU 2020
		DESI 2018	DESI 2019	DESI 2020	
		value	value	value	
4a1	Electronic exchange of information % enterprises	22 %	22 %	23 %	34 %
4a2	Social communication platform % enterprises	9 %	9 %	8 %	25 %
4a3	High volume of data % enterprises	11 %	11 %	11 %	12 %
4a4	Cloud Technology % enterprises	6 %	7 %	7 %	18 %
4b1	Online sales of SMEs % SMEs	8 %	8 %	11 %	18 %
4b2	Electronic sales business figures % SMEs business figures	5 %	5 %	5 %	11 %
4b3	Cross-border online sales % SMEs	2 %	2 %	6 %	8 %

Source: Digital Economy and Society Index, Romania 2020.

The last DESI dimension analyzed is Digital Public Services. According to table 5, Romania has occupied the last place in the member countries in the last three years analyzed:

Table 5. The evolution of Digital public services dimension, Romania

No.	Indicators	România			EU 2020
		DESI 2018	DESI 2019	DESI 2020	
		value	value	value	
5a1	Users of e-government solutions % of internet users who need to submit a form	80 %	82 %	82 %	67 %
5a2	Prefilled form Score (0-100)	12	10	10	59
5a3	Online services only Score (0-100)	62	67	70	90
5a4	Digital public services for businesses Score(0-100) - including national and cross-border level	51	53	53	88
5a5	Open data % of maxim point	-	-	57 %	66 %

Source: Digital Economy and Society Index, Romania 2020.

DISCUSSIONS AND RESULTS

Digitalisation is the phenomenon that extends its coverage every day, covering the entire economy and society as a whole. For the purpose of its analysis, the Digital Economy and Society Index was studied, especially the country reports of Romania and Poland. The overall comparative situation is presented in Table 6:

Table 6. Index summary table DESI 2020

	Romania	
	place	value
Connectivity	11	56,2
Human Capital	27	33,2
Use of internet services	28	35,9
Digital technology integration	27	24,9
Digital public services	28	48,4
DESI 2020	26	35,1

Source: author development.

The Human Capital Index (HCI) measures the human capital that a child born today can expect to attain by age 18, given the risks of poor health and poor education that prevail in the country where she lives. The HCI quantitatively illustrates the key stages in this trajectory and their consequences for the productivity of the next generation of workers, with three components: *Component 1: Survival*. This component of the index reflects the unfortunate reality that not all children born today will survive until the age when the process of human capital accumulation through formal education begins. *Component 2: School*. This component of the index combines information on the quantity and quality of education:

- The *quantity of education* is measured as the number of years of school a child can expect to obtain by age 18 given the prevailing pattern of enrollment rates
- The *quality of education* reflects work at the World Bank to harmonize test scores from major international student achievement testing programs into a measure of harmonized test scores.

Component 3: Health. There is no single broadly accepted, directly measured, and widely available summary measure of health that can be used in the same way that EYS is used as a standard measure of educational attainment. Instead, two proxies for the overall health environment are used:

- *Adult survival rate* is measured as the share of 15-year-olds who survive until age 60. This measure of mortality serves as a proxy for the range of nonfatal health outcomes that a child born today would experience as an adult if current conditions prevail into the future.
- *Healthy growth among children under age 5* is measured as the fraction of children who are not stunted, that is, as 1 minus the share of children under 5 whose height-for-age is more than two standard deviations below the World Health Organization Child Growth Standards' median.
- The overall HCI is constructed by multiplying the contributions of survival, school, and health to relative productivity, as follows:
- $HCI = Survival \times School \times Health$, with the three components defined as :
 - $Survival = \frac{1 - Under-5 \text{ Mortality Rate}}{1}$
 - $School = e^{\left(\text{Expected Years of School} \times \frac{Harmonized \text{ Test Score}}{625} - 14 \right)}$
 - $Health = e^{\left(\gamma_{ASR} \times (Adult \text{ Survival Rate} - 1) + \gamma_{Stunting} \times (Not \text{ Stunted Rate} - 1) \right) / 2}$

The components of the index are expressed here as contributions to productivity relative to the benchmark of complete high-quality education and full health. The parameter $\emptyset = 0.08$ measures the returns to an additional year of school. The parameters $\gamma_{ASR} = 0.65$ and $\gamma_{Stunting} =$

0.35 measure the improvements in productivity associated with an improvement in health, using adult survival and stunting as proxies for health. The benchmark of complete high-quality education corresponds to 14 years of school and a harmonized test score of 625. The benchmark of full health corresponds to 100 percent child and adult survival and a stunting rate of 0 percent.

Table 6. HCI Component Data in Romania

Economy	Components of „HCI 2020						HCI		
	Probability of survival to age 5	Expected years of school	Harmonized test scores	Learning-adjusted years of schooling	Adult survival rate	Fraction of children under 5 not stunted	HCI 2020	HCI 2018 back-calculated	HCI 2010
Romania	0.99	11.8	442	8.4	0.88	-	0.58	0.59	0.60

Source: author development, based on HCI dates HCI, 2020.

Table 7. Data sources forevery level of schooling for economies with a decrease in EYS between 2010 and 2020

Romania	Preprimary	12.7	78.8	2013	WB Staff (ANER)	11.8	83.9	2018	WB Staff (ANER)
	Primary		95.8	2010	UIS (TNER)		89.5	2018	WB Staff (TNER)
	Lower-secondary		91.7	2010	UIS (TNER)		84.9	2018	WB Staff (TNER)
	Upper-secondary		86.3	2010	UIS (TNER)		74.4	2017	WB Staff (TNER)

Sursa: author development.

Component data for the HCI 2020 update were subject to extensive World Bank- wide data review to ensure data quality. The review process was conducted between February and July 2020, and was split into two parts. The first part of the process (February to May 2020) focused on the enrollment data used to construct estimates of expected years of school and was conducted with World Bank Program Leaders for Human Development. The second part of the data review process (May to July 2020) focused on the other four index components – child mortality, harmonized test scores, stunting rates, and adult mortality. The enrollment data were validated separately because experience from the first edition of the HCI in 2018 suggested that those data required the most intensive review in terms of time and inputs needed from World Bank country teams, due to extensive gaps in the data as reported by UIS. All component data were reviewed for timeliness and completeness, with gaps filled and revisions made as needed. (HCI, World Bank, 2022)

Of the 48 countries in Europe and Central Asia included in the 2020 Human Capital Index (ICU), 33 are among the upper third of countries in the world, and almost half are in the upper half. However, there are significant variations within the region. Among the emerging and developing economies of the region, a child born in Poland can learn to reach 75% of the productivity of an adult with complete education and optimal health.

In the field of education, the World Bank supports the strengthening of both basic education (including capacity building for digital education during COVID-19). as well as higher education.

Conclusions

Intellectual capital is a resource designed to help a company grow, even more so in the age of technology and knowledge. It can be considered a pillar of success in the organization, a factor in improving the image of the company in the market. If in accounting the term intangible assets is specific, in management, intellectual capital is the term used most often and can be assimilated to intellectual property.

The society in which we live is a society of knowledge, and intellectual capital derives from human capital, along with relational or strategic capital.

Investments in education, in the formation of human capital both individually and at the level of society are depreciated if knowledge, skills, qualifications are not used regularly and properly. Different studies have revealed the importance of investing in education as well as the various non-economic benefits that can be associated with this investment.

While in economically developed countries primary and secondary education are generalized (only children with particular mental or physical health problems, children of emigrants or delinquents do not attend school) in Romania the percentage of school participation only at primary level is close to 100% while at secondary level it is just over 60%. One of the most important motivations of individuals to invest in education is related to the accumulation of a stock of human capital – materialized in knowledge and skills, which leads as a tendency to an increase in productivity and implicitly of the potential gains that the individual hopes to obtain – expressed in both monetary and non-monetary terms.

In order for the effects of education on the development of human and economic capital to be maximum, certain conditions must be observed:

- the quantity and quality of education measured in the number of years of study, percentage of GDP allocated to education, school participation rate, results, school performances to be high and the educational offer to correspond to the current and prospective requirements of the labor market;
- the existence of a stable socio-economic and political environment and an accelerated economic growth rate;

The main factors that allow Romania to become innovative take into account:

- consistent investments in order of magnitude in education in general and in higher level education in particular;
- quality informational and technological basis;
- high levels of government expenditures related to research and development;
- effective laws for the protection of intellectual property to support the research and development activity.

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