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THE GLOBAL CAMPUS—ICT AND THE FUTURE OF UNIVERSITIES

Roumen Nikolov

Abstract. This paper analyses the changes which the ICT causes on a global scale. The globalization of higher education triggered by e-Learning, the emergence of e-infrastructure for e-science, the Open Educational Resources movement, e-libraries and the tendency of building global educational alliances are analysed as well. Special emphasis is put on several well-known university models, e.g. Research University, Open University and Entrepreneurial University, as well as on some emerging university models for the Knowledge Society, such as: Global University and Innovation University. The paper puts in focus the influence of the ICTs and the new organizational and business models they bring, such as *Virtual University*, *eCampus, Enterprise 2.0, University 2.0*. A new university model is defined—the *Global Campus Model*. Some arguments that the ultimate result of the ICTs driven transformations could turn the whole world into a Global Campus in the next few decades.

1. Towards a Knowledge Society. The recent fast developments of ICTs and their deep penetration into the society caused a dramatic change in the

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way people live, learn and work, and this process is accompanied by social, industrial, and organizational reconstructions and innovations. The economist Fritz Machlup is considered as the pioneer who developed the concept of '*information society*' and also discovered the so-called '*information economics'* [40]. Machlup considers university, being the centre of knowledge production and teaching, as a '*knowledge factory*', equated to an industry [39]. Kerr laid out his views that **a large modern university had to operate as a part of society**, no longer as an ivory tower apart from it [37]. Since then the terms '*information society'* and '*knowledge society'* have been a matter of interest and analysis for many researchers, politicians, technologists, educators and other stakeholders in the process of global change. Knowledge has been at the heart of economic growth and the gradual rise in levels of social well-being since time immemorial [20]. Since the beginning of the 20$^{\text{th}}$ century we have seen a new characteristic of economic growth in the form of greater **intangible capital** as compared to tangible capital [1]. The economies of developed countries are increasingly based on knowledge and information. The problem is that access to knowledge-based economies is still very restricted and there are big disparities between different countries and different social strata. However, "*in the new kind of knowledge economy, the attitude to knowledge is different from what it was earlier. Knowledge is capital, which need not and must not be saved. Knowledge is like joy: it increases when it is shared and is replenished only when squandered*" [42]. It is becoming a common understanding that the most effective modern economies will be those that produce the most information and knowledge [66]. The opportunities for rapid progress are well illustrated by countries like Finland, Korea, Ireland, Chile, etc. Finland, for instance, is a country that has successfully transformed itself into a knowledge economy in a short time [18, 77].

2. European Universities in the Knowledge Society. EC very clearly recognized the role of the universities in building Europe of Knowledge [26]. All European universities are facing very serious challenges, such as:

- **increased demand for higher education.** Despite of the low birth rate in Europe an increased demand for higher education is observed and it is expected to continue in the next years;
- **internationalization of education and research.** European universities are attracting fewer students and in particular fewer researchers from other countries than their American counterparts;
- **need of developing effective and close cooperation between universities and industry**. The cooperation between universities and industry needs to be intensified by gearing it more effectively towards innovation,

new business start-ups and the transfer and dissemination of knowledge;

- **proliferation of places where knowledge is produced**. The increasing tendency of the business sector to subcontract research activities to the best universities means that **universities have to operate in an increasingly competitive environment**;
- **reorganization of knowledge**. The universities should urgently adapt to the **interdisciplinary character** of most advanced research and development areas. However, the university activities still tend to remain organized within the traditional disciplinary framework;
- **emergence of new expectations**. Universities must cater for new needs in education and training which stem from knowledge-based economy and society. These include an **increasing need for scientific and technical education, horizontal skills, and opportunities for lifelong learning**, which require stronger relations between the education and training systems.

The EU policy in education has three main objectives [60]:

- **improving quality and effectiveness** of education and training systems;
- **facilitating access of all** to education and training systems;
- **opening up education and training systems** to the wider world.

The EC aims at **increasing universities' excellence in research and teaching** [33]. European universities have to identify the areas in which different universities have attained excellence essential for Europe and to concentrate funding on them to support academic research. The commission supports not only intra-European academic mobility, but also mobility between universities and industry, thus opening up new career opportunities for young researchers. The number of young technological (spin-off) companies created by universities has been on the rise in Europe. Their average density nevertheless is far smaller than it is around the American campuses. A major obstacle to better application of university research results is the way intellectual property issues are handled in Europe. In addition, **European universities do not have well-developed structures for managing research results**.

Another important measure is to open up universities to the outside world and increase their international attractiveness and thus prepare them to a **broader international competition**, especially with the American universities which attract the best talents from all over the world. The regions of the EU are supposed to play a very important role through the **development of technology centres, science parks, and other cooperation structures between the business sector and the universities**, i.e. to catalyse devel-

opment of regional university development strategies and regional networking of universities.

3. Main Challenges to Universities in the 21st Century. Operating in a very complicated world, universities and other higher education institutions have to adjust themselves to handle concurrently contrasting trends and they do not normally have the privilege of choosing either one or the other, but rather have to find a delicate and subtle balance between opposing policies [32]. Seven pairs of contrasting trends in higher education were identified:

- **Globalization versus national needs.** Globalization has become one of the defining features of higher education in the 21st century. However, while globalization trends facilitate networking, collaboration, and flexibility between systems, they also threaten the stability, security and identity of universities in some national settings;
- **Government steering versus institutional autonomy.** During the last decade there has been a growing trend of providing more autonomy for higher education institutions in order to let them become more entrepreneurial, together with a strong demand for increased accountability on the universities' performance and quality assurance;
- **Harmonization versus diversity.** The Bologna Process aims at establishing a harmonized joint Higher Education Area of Europe by 2010 and making higher education systems more flexible. However, EC aims at preserving institutional diversity and heterogeneity of academic cultures;
- **Public versus private sectors.** The public and private higher education institutions typically have different academic cultures. In some countries, there is almost no private sector in the higher education system. The US, on the other hand, has a very strong component of private higher education institutions and the US private research universities have established themselves as leading world class universities. Many countries, e.g. Japan, China, India, Finland and Germany, try to build world class universities comparable to the American ones;
- **Basic versus applied research.** Research is a key ingredient in the institutional identity of universities and an indispensable prerequisite for a successful programme of teaching and public service but it costs money [76]. In order to mobilize large amounts of resources for research which requires expensive infrastructure, much attention is paid nowadays to applied research;
- **Competition versus collaboration.** It is inevitable that universities compete for scarce resources, e.g. research funding, good faculty or good

students. At the same time, successful collaborative university ventures hold great potential for generating additional resources and recruiting new students;

- **Intellectual property versus intellectual philanthropy.** These two contrasting trends have been enhanced by the emergence of ICTs. More open access to sources of scholarly information, libraries, and software codes would tremendously benefit especially teaching and research in those countries that suffer from severe shortages in adequate academic manpower and research facilities.

The EC considers **universities motors of the new, knowledge-based paradigm** but clearly states that *"they are not in a position to deliver their full potential contribution to the re-launched Lisbon Strategy"* [25]. The main conclusion is that *"Europe must strengthen the three poles of its knowledge triangle: education, research and innovation. Universities are essential in all three. Investing more and better in the modernization and quality of universities is a direct investment in the future of Europe and Europeans."* Universities are also required to take part in **strategies for economic development and social inclusion** at regional, national and international level where ICTs and innovations also play an important role, e.g. towards integration of formal and informal learning into lifelong learning projects and initiatives for different target groups [33]. In terms of primary "*change drivers*" affecting education and training two major forces could be recognized [33]:

- A push towards **de-institutionalization and "marketization"** of education and training. The increased **autonomy of learners** to choose and buy among a large number of learning opportunities is still not well supported by the traditional education and training organizations. E-learning is considered an area for fast market development and it attracts more and more investors and the increased supply of education and training is **gradually breaking the monopoly of public education**;
- The **process of innovation** penetrates education and training, e.g. the lifelong learning, integration between different subsystems of education and training, the autonomy of learners and the **shift from teacher oriented education to a learner-centred one**, ICT as an instrument for flexibility and better quality, increased engagement to changes and needs of economy and society, etc.

In addition, there exists **strong inertia** and **resistance to change** of education and training systems, which have very frequently absorbed some technological innovations without substantially changing their way of working and

thus inhibit both previously mentioned driving forces of change [33]. There are identified three extreme scenarios:

- The **classic universities are likely to resist to innovation** for a considerable number of years and defend their market position through their ability to deliver official titles and their direct access to public funding at national or regional level;
- Higher education institutions that provide continuing education are more likely to introduce innovative approaches to learning provision: focus on autonomous learners, high quality contents and services, building communities of practice, etc. Creation of a **stimulating learning context** becomes a more strategic asset for universities than the availability of attractive contents;
- The risk of "*consumerization*" is relatively lower in higher education than in other sectors of the education and training markets;
- There is expected a **strong differentiation** and possibly a polarization of higher education institutions—only few (around 10%) would be capable to compete globally and to join relevant international alliances. The others would play a national and regional role with modest international cooperation;
- A widely expressed opinion is that **e-learning would provide better quality of learning** comparable to that of conventional university courses. However, the dominant forms of e-learning still consist of simple on-line versions of textbook and lecture notes;
- The **US presence in European higher education is expected to increase** in the next 10 years to about 15% of the market and this would put strong competitive pressure and would stimulate innovation in European universities.

4. Building Knowledge Society and the Role of Universities in Finland. The Finnish experience of the 1990s represents one of the few examples of **how knowledge can become the driving force** of economic growth and transformation. During that decade, the country became the most ICT-specialized economy in the world and thus completed its move from resource-driven to knowledge- and innovation-driven development. **Education is considered the key element** of a knowledge-based, innovation-driven economy. It affects both the supply of and the demand for innovation. Human capital and skilled labour complement technological advances. Finland's innovation system successfully converted R&D and educational capacity into industrial strengths in close coordination between the public and private sectors. Markkula

states: "*Networking, orchestration and shared leadership form the basis for the ongoing paradigm shift. The basic values that support innovativeness in creating the desired knowledge society are the basic values linked to effective knowledge management: openness, trust, collaboration and knowledge sharing*" [42].

The **creative labour** is a major factor for an economy based on knowledge-intensive enterprises and science and technology parks. The Finnish model relies on **high-level basic education and a strong commitment of all citizens to lifelong learning**. In contrast with the cases for building knowledge society ecosystems in the USA, in Finland the state acts "*as a promoter of technological and social innovations, as a public venture capitalist and producer of knowledge labour, thus creating the conditions under which Finnish business could restructure itself and compete globally*" [42]. Every process has to be oriented towards capacity building and competence development for individuals or organizations. The success of every organization mostly depends on its **intellectual capital** and ability to utilize it. The intellectual capital consists of: **human capital** including education, competences and attitudes; **structural capital** including values, culture, processes, documented information, etc; **relations capital**, e.g. customer relationships, trust, image and brand.

A key element of Finland's success has been the **capacity of policy makers to pursue reform** [66]. An example of such capacity is the development of a **new university** in Finland as a merger of three existing universities: the Helsinki University of Technology, the Helsinki School of Economics and the University of Art and Design Helsinki with start-up funding of 700 Million Euros coming from the government and industry [41]. The vision is that the new (innovation) university has to be among the **top 5** European actors in the field of **continuing education and development services provided for working life** by 2013. The main aim is to create a link between the business community and the university and give a forum for **knowledge sharing**. The emergence of the new university concept in Finland **challenges the traditional role of universities**, addressing all the three missions of universities [41]. It aims to "*secure the nation's competitiveness in a situation where globalization on the one hand and ageing of the large age cohorts on the other are jeopardizing the current structures*". These fundamental factors in the university reform are related to multidisciplinarity, creativity and abilities to **increase intangible capital** both inside the universities and through them in society. However, this requires universities to commit to become **experts and change agents** especially in e-learning, lifelong learning and competence development, work-based learning, learning by developing and learning by research, networking and knowledge management.

5. Current and Emerging University Models. The university, as a centre of teaching and research, is a genuinely European invention and, with a few exceptions, the existence of the university was inspired by and confined to European cultural, economic, and political dominance for a long period of time [72]. Through the centuries European universities have changed considerably and they have also remained the central European institutions of reason, knowledge, criticism and learning [75]. Higher education must increasingly confront the issues of the access to, and the quality of, the educational services they offer [23]. The massification of higher education, the expansion of private-sector and foreign participation in this field, the application of ICT in education, and the emergence of the knowledge economy open up **new challenges and opportunities for higher education institutions**. Higher education systems all over the world are challenged nowadays by the new ICTs and these technologies have had a huge impact on the world economy, corporate management and globalization trends, and they bear a tremendous potential **to reshape the nature of study environments everywhere**, of both conventional and distance teaching institutions [32]. E-learning will catalyse the growth of both academic trade and academic philanthropy. Many universities and new for-profit companies **export academic and professional programmes as a commodity**, more often to third-world countries. American universities generally prefer **campus-based integration of digital technologies**. Thus, for students to select a career and for countries to choose an economic development path that will lead to a prosperous, secure lifestyle is much more complex now than in prior generations because the division of labour and the location of work are both rapidly shifting [22].

5.1. Research University. A distinguished characteristic of a Research University is that it puts great importance on the creation of new knowledge, applies new knowledge to solving important societal problems, and contributes to improving the quality of life. According to the Carnegie Classification of Institutions of Higher Education definitions for a **research university** they are doctoral degree granting institutions that award "*at least 10 doctoral degrees per year across at least 3 disciplines, or at least 20 doctoral degrees overall*" (`http://www.carnegiefoundation.org/`). While most European research universities try to integrate education, research and innovation on the MSc and PhD level, many of the American research universities target the BSc level as well [11]. The research universities can offer a **learning environment** which is not typical for the small colleges and non-research universities. The bachelor's candidate who studies in such environment develops his or her own research capabilities. Such universities could be both **student-centred and research-**

centred through *a "synergistic system in which faculty and students are learners and researchers, whose interactions make for a healthy and flourishing intellectual atmosphere"* [11].

America's research universities typically have an **international orientation**—they attract students, particularly on the graduate level, from many parts of the world, thereby adding valued dimensions of diversity to the community. International graduate students often become teaching assistants, so their presence becomes a part of the undergraduate experience. And many research universities offer an array of **interdisciplinary programmes** seldom available in smaller institutions. The graduates of these programmes make the names of the American research universities recognized and respected throughout the world. The concept of integrated education at a research university requires **restructuring both the pedagogical and the management aspects of the university**. Because research universities create technological innovations, their students should have the best opportunities to learn state-of-the-art practices — and learn to ask questions that stretch the uses of the technology. International organizations, such as UNESCO, OECD and World Bank, emphasize on the importance of research for the quality of higher education as well and the **importance of developing and sustain research capacity** [57, 76, 77].

5.2. Entrepreneurial University. The framework of Entrepreneurial University was defined by Clark [14]. "*Entrepreneurial*" is considered as a characteristic of the whole university systems, i.e. the entire universities and their internal departments, research centres, faculties, and schools. The concept is derived from '*enterprise*' and puts attention on the willingness to take risks when initiating new practices whose outcome is not certain. An entrepreneurial university actively seeks to innovate in how it goes about its business. It seeks substantial shift in its organizational character in order to better perform in the future. Capitalization of research findings is one of the primary features of an entrepreneurial university [14]. The main characteristic of such university is that it '*understands the commercial value of knowledge*'. Clark identifies five elements that constitute the irreducible minimum of entrepreneurial actions for an entrepreneurial university. The degree of implementation of each of these actions provides good indicators for the successful transformation of a university towards the framework of an entrepreneurial university. These actions are:

- **Strengthening the steering core**. Traditional European universities have demonstrated weak capacity to steer themselves. They have to combine new managerial values with traditional academic ones;
- **Expanding the developmental periphery**. Enterprising universities,

compared to traditional universities, have more units that build links with outside organizations and groups. They bring into the university the project orientation of outsiders who are attempting to solve practical problems critical in economic and social development;

- **Diversifying the funding base**. Entrepreneurial universities invest efforts to raise money from a second stream (apart from government) by more **actively competing for grants and contracts** from industrial firms, local governments, and philanthropic foundations, royalty income from intellectual property, earned income from campus services, student fees, and alumni fundraising;
- **Stimulating the academic heartland**. For change to take hold, gradually one department and faculty after another needs to become an entrepreneurial unit, reaching more strongly to the outside with new programmes and relationships and promoting third stream income;
- **Integrating the entrepreneurial culture**. An entrepreneurial university, much as firms in the high-tech industry, develop a work culture that embraces change.

Clark describes several case studies of universities which have managed to become entrepreneurial [13, 14]. Most of them have established specialized units and structures, such as: science parks, incubators, technology transfer offices, liaison groups, strategy committees, R&D outreach office (marketing, spin-offs), alumni networks, fund-rising initiatives, flexible load structure (education, research, industry), etc. There are many other cases described in the literature, including some in new member states of EU, e.g. in Romania [2], Hungary [6], Bulgaria [54], etc. The **Science Park** and **Knowledge Park** models are used by entrepreneurial universities as instruments for establishing better **links between universities and industry** and for **brain-gain**, i.e. for attracting back the talented specialists to the countries of origin [35]. They originate in the model of the early fifties when the Stanford Research Park (1951) and the Cornell Business and Technology Park (1952) were established. Today, the Stanford Research Park has 140 companies in electronics, software, biotechnology and other fields and employs 23,000 people.

The innovation university in Finland is a typical representative of the Entrepreneurial University model [41]. The overall aim of this university is to become a world-class actor in promoting academic entrepreneurship and a key player in producing services for growth entrepreneurship through the combination of three competencies (representing business, technology and the creative sector). The operations focus on entrepreneurial learning, on incubation development

along the Start Up Centre and on further development of the existing services to form a Virtual Service Platform for companies.

5.3. Electronic University. In order to become "*enterprise-like organizations*" universities tend to adopt ICT not only for e-learning, but also for management and administrative purposes. The most critical challenges that the campus information technology leaders in US are facing in 2008 are security and Enterprise Resource Planning (ERP) systems along with change management and e-learning [27]. An emerging issue was recognized, namely '*cyberinfrastructure*'—hardware and software systems, distributed computing, data, communications technology and tools for collaborating of the research communities.

There exist some European higher education projects aiming at integrating ICT into all university activities. For example the Technical University in Munich is developing a Digital University project [9]. The university realigns its ICT strategically in co-operation with the Leibniz Supercomputing Centre. This re-alignment follows an overall university strategy by means of closely interconnected projects in the areas of organization, campus management, e-learning and ICT infrastructure. In 2004 the University of Edinburgh started a "*change project which would include the implementation of a new student system, as well as fundamentally reviewing the way processes were carried out to identify shared solutions*" (`http://www.euclid.ed.ac.uk/`). The primary objective of the project is to develop a "*streamlined, modern approach to interacting with enquirers, applicants and students which reflects our international standing and the calibre of our teaching and research*". In 2002 the author initiated a pilot e-university project at Sofia University which evolved into an *eCampus* model [50, 53].

5.4. Virtual University. A **virtual university** (**virtual campus**) can be seen as "*a metaphor for the electronic, teaching, learning and research environment created by the convergence of several relatively new technologies including, but not restricted to, the Internet, World Wide Web, computer mediated communication*" [74]. The notion of "*campus*" reflects the American traditions in higher education. Turner states: "*As a kind of city in microcosm, it (the campus) has been shaped by the desire to create an ideal community, and has often been a vehicle for expressing the utopian social vision of the American imagination. Above all, the campus reveals the power that a physical environment can possess as the embodiment of an institution's character*" [71]. However, although many universities are not "*campus universities*", all of them might afford building a virtual campus, i.e. it would be more appropriate to use the term "*virtual campus*".

The state of higher education systems worldwide has often been described

as being in crisis—there are a number of change factors that influence the system [19]:

- **new demography**—an increasing world population, growing urbanization, international migration, ageing societies and new and old diseases all constitute challenges to the education system;
- **globalization** with digitalized knowledge and the process of removal of educational boundaries—technology, economic exchange, political integration and culture require education systems to reduce inequalities and marginalization and prevent widening technology and knowledge gaps between countries, among other challenges;
- **knowledge growth and its growing economic value**—information technology and development are inherently linked, but development must be defined in terms of knowledge and the humane uses to which it can be put: a society's wealth and welfare are determined by its capacity to train and educate its people to share in generating and applying knowledge in all spheres of life;
- **access to internet**, which results in globalization of information and increased access, but at the same time in increasing the **digital divide** due to differing access capacity;
- **government funding decreases**, leading to an increase of the needed competition;
- the need for **lifelong learning**, which demands new approaches.

In this context, universities face with some serious challenges, such as: improving **quality**, increasing **access** and reducing **costs**; modularizing **education** so that it can be **used and re-used**; **changing the role of faculty**; developing **e-learning competencies**; **changing institutional leadership styles** to become more adaptable and flexible.

Borderless education refers to educational provision that crosses the boundaries of time, space and geography [43]. The Bologna process and the Lisbon Strategy, through the European Area of Higher Education and the European Research Area, put an emphasis on establishment of borderless higher education in Europe. Many universities in Europe, especially in the UK, provide borderless education in many other parts of the world. The virtual campus model provides new dimensions of realizing borderless education. A study based upon ten case studies from different geographic regions identifies four different institutional models [46]: a **newly created institution** operating as a virtual university; **evolution of an existing institution**, with a unit or arm offering virtual education; a **consortium of partners** constituted to develop and/or

offer virtual education; a **commercial enterprise** offering online education.

Apart of competition between universities, a clear **need for cooperation** between them is of crucial importance. Many universities use the partnership as a means of entry into the global e-learning market and for penetrating less economically advanced countries [7]. The partner institutions from the less economically developed country bring adaptation to local culture, language benefits, local or national accreditation, sharing of costs and risks, and access to neighbouring markets or markets with similar language and culture. These are all considerable benefits for the partner from the more developed country. Many countries have announced national virtual university initiatives of various kinds [19, 78]. Some of these initiatives are intended to extend and enhance local provision while others are targeted at international markets. Learndirect, which started as a national initiative "*University for Industry*" in the UK, is funded by government and private investment and acts as a broker between learners and companies and providers, giving access to courses and learning packages through electronically equipped learning centres in a range of convenient locations [46]. A nationwide guidance service helps to put learners in touch with appropriate provision.

In some countries, such as China, the US or the UK, national media organizations have long been involved in the delivery of education [46]. In China, the main providers of distance education in the public sector are the 44 government-supported provincial radio and TV universities with almost 1,800 study centres. It is estimated that the Provincial Radio and TV Universities have around 1.5 million students enrolled in higher education programmes mainly at undergraduate level, representing about 25 per cent of all students in higher education. The types of development of virtual borderless education that are emerging from publicly-funded higher education include: regional and international consortia, forms of transnational education, national virtual university initiatives [46]. The category of providers from the private sector include: corporate universities, private and for-profit providers, media and publishing businesses, educational services and brokers. Among the market leaders with origins in the USA are the University of Phoenix (now with more than 100,000 registered students studying 'virtually' or at centres in the USA, Canada, Puerto Rico and Germany).

5.5. Emerging Global Model. The OECD *Global Student Mobility 2025* Report foresees that the demand for international education will increase from 1.8 million international students in 2000 to 7.2 million international students in 2025 which presents enormous opportunities and new challenges for all universities [59]. In nowadays' knowledge-intensive society, research universities, which are key institutions for social and economic development, are becoming

more international in focus [48]. While research universities represent only a small proportion of higher education, other institutions often look to them as models, so their influence is greater than their numbers would suggest. A subset of research universities reflects a new phenomenon, defined as the **Emerging Global Model (EGM) of the 21st century research university**. The emphasis here is on the international nature of a small group of institutions that represent the leading edge of higher education's embrace of the forces of globalization. EGM universities are characterized by an intensity of research that far exceeds past experience. They are engaged in **worldwide competition** for students, faculty, staff, and funding and they operate in an environment in which traditional political, linguistic, and access boundaries are increasingly losing their traditional roles. These top universities look beyond the boundaries of the countries in which they are located to define their scope as transnational in nature and their peers span the globe. The EGM emphasize that investment in human capital is of crucial importance and nations can harness a rational process of knowledge production through public investment in the research university. Thus higher education, and especially the EGM institution, becomes a key ingredient of the recipe for managed social and economic progress funded by the nation-state. Some call the EGM a "*super research university*" to emphasize the worldwide perspective and the high scholarly output of this subset of research universities [5]. Such universities exist mostly in the US, where they continue to expand, but are now increasingly a model aspired to by many research universities throughout the world.

There were identified eight common characteristics of the EGM universities, although not all of them demonstrate these characteristics in the same way and to the same extent [48]. The EGM universities:

- **see their mission as transcending the boundaries of the nation-state**, educating for global perspective and advancing the frontiers of knowledge worldwide;
- are **increasingly more research intensive** and use scientific methods in disciplines outside the sciences;
- have **faculty members who, as producers of new knowledge**, are assuming new roles, shifting from traditional independent patterns of inquiry to becoming members of **team-oriented, cross-disciplinary, and international partnerships**, with **research directed more often than before toward real-world problems**;
- are **going beyond government support and student contributions** to diversify their financial base with funding from corporations and private

donors, competitive grants for technology innovation, and creation of for-profit businesses as spin-offs of research enterprises;

- **create new relationships** with other universities, governments, and corporations to advance economic development and to produce knowledge for the social good;
- are a**dopting worldwide recruitment strategies** for students, faculty, and administrators;
- **require greater internal complexity** directed toward research, such as interdisciplinary centres, integration of research elements in student training programmes, and greater technological infrastructure for discovery;
- **cooperate with international non-governmental organizations and multi-governmental organizations** in support of collaborative research, student and faculty mobility, and validation of international stature.

As could be seen, EGM universities **integrate also the characteristics of an entrepreneurial university**. They measure their global reach in several ways, e.g. **the number and percentage of foreign students provide evidence of internationalization**. EGM universities give **special attention to international PhD students**, seeking the best minds worldwide to contribute to the research agenda as part of their doctoral studies. In addition, EGM universities are **developing partnerships**, often in research rather than degree programmes, with top institutions abroad, one way of expanding their influence and intellectual capital **without building campuses in other countries** [48]. Top institutions in Europe and North America **create international opportunities for their own students**, using the percentage of the student body with formal coursework in other countries as a measure of internationalization. Universities in economically developed nations encourage students to participate in short-term study abroad programmes, e.g. the **European mobility programmes** through the Bologna Process are seeking to **create a sense of transnational Europeanness** [75], which is probably the most extensive international mobility of students. Many developing countries send students and faculty to leading institutions to gain the most up-to-date learning to contribute to their home countries' national growth. Establishment of formal agreements with universities and research institutes in other countries is another indicator of an institution's international scope. The heart of the EGM is an expansion of the older functions of teaching, research, and service into an organization that can best be described as a **knowledge conglomerate** [31]. The professors in an EGM university have multiple responsibilities—they are not only expected to conduct publishable research but also to teach graduate and undergraduate

students, to provide service to their universities, and to use their knowledge for the benefit of local and national communities. New relationship ("*triple-helix*") among higher education, industry, and government tend to be established and the third mission of the universities has been defined—to serve society [28]. Governments support research universities to collaborate with businesses to develop the economy.

Accreditation of cross-border education is among the biggest issues in the globalization of education, e.g. **how one can ensure that institutions will receive equal treatment** from the various accrediting bodies. There has been identified a certain **risk of commercialization** of quality assurance practices on an international scale. Some valuable **guidelines for quality assurance of trans-border education** are provided by OECD and UNESCO [59, 72].

5.6. Global Alliances. A clear tendency in the global educational movement is building alliances. There are a variety of reasons for forming partnerships or consortia of universities [43]: sharing resources, costs and infrastructure to deliver e-learning; competing with international providers; reducing duplication among existing universities. One of the first global university networks is Universitas 21 (established in 1997) which includes 21 leading research-intensive universities in thirteen countries (`http://www.universitas21.com`). Collectively, its members enrol over 650,000 students, employ over 130,000 staff and have over 2 million alumni. Their collective budgets amount to over US$13bn and have an annual research grant income of over US$3bn. The network's purpose is to facilitate collaboration and cooperation between the member universities and to create opportunities for them on a scale that none of them would be able to achieve operating independently or through traditional bilateral alliances. All Universitas 21 member institutions are **research-led**, comprehensive universities providing a **strong quality assurance framework to the network's activities**. They offer opportunities for global education, research, projects and services. Another convincing example of the emerging trend in the International Alliance of Research Universities, which includes ten of the world's leading research universities (`http://www.iaruni.org/`). These universities share a similar vision and have a commitment to "*educating future leaders*".

Publishing companies are also active in alliances with universities, colleges and other educational service providers [46]. Several years ago Pearsons initiated partnerships with some traditional universities in the UK and the USA in order to extend their ability to offer a wider range of learning services. For example, in partnership with America Online, Pearsons has commenced its "*Learning Network*" with the University of Phoenix which got the rights to provide customized

electronic content based on Pearsons' textbooks. In 2000 Thompson invested in Universitas 21. The publishers could use their core skills in marketing, distribution, content and electronic delivery systems in alliance with those who provide learning, assessment and accreditation services to offer new products and services to existing and new markets.

5.7. Open Educational Resources. The global education movement gave rise to another one, namely Open Educational Resources (OER), which demonstrates great potential to overcome demographic, economic, and geographic educational boundaries and to promote life-long learning and personalized learning. The term Open Educational Resources (OER) was adopted at a UNESCO meeting in 2002 to refer to the open provision of educational resources, enabled by ICT, for consultation, use and adaptation by a community of users for non-commercial purposes [19]. A definition of OER is "*digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research*" [58]. According to OECD, there are more than 3000 open access courses (opencourseware) currently available from over 300 universities worldwide. For instance:

- **MIT OpenCourseWare** (`http://ocw.mit.edu`) is the most popular example of institutional OER model—they published on the Web about 1,800 courses which are made available to educators and learners worldwide at no cost. Any OER course offers lecture notes, problem sets, syllabi, reading lists, tools and simulations as well as video and audio lectures and users can use the materials for their own teaching and learning and as a model for their own open content initiatives. MIT OCW materials have been **translated into at least 10 languages**, including Spanish, Portuguese, Chinese, Thai, French, German, Vietnamese, and Ukrainian.
- **OpenLearn initiative** (`http://openlearn.open.ac.uk/`) launched by the UK Open University to make a selection of their materials available for free use by anyone and to build communities of learners and educators around the content using a range of tools and strategies.
- **OpenCourseWare Consortium** (`http://www.ocwconsortium.org/`)—a collaboration of more than 100 higher education institutions and associated organizations from around the world creating open educational content using a shared model. The model encourages institutions to be involved in some kind of established co-operation for sharing resources with others and to develop a common evaluation framework for all consortium members.

Some evaluation of the MIT OCW showed that the web site was visited more than 8.5 million times in 2005, a 56% annual increase from 2004 [78].

The data show that 61% of OCW traffic is non-US, 49% of the visitors identify themselves as self-learners, 32% as students and 16% as educators.

A special case of OER are the **open textbooks** [29]. The cost of textbooks in higher education is usually paid directly by the students and their parents, and it is now a substantial part of the total and rapidly increasing cost of higher education. At the same time the cost of textbooks has risen, their usefulness in the teaching and learning process in higher education is declining as more material is available for free on the Internet and neither the pedagogical approach nor the learning assessment process is well tied to them. A model of e-book is based on the new technologies: dynamic, interactive, regularly updated (including by users), localized, customized, remixed, etc. Open courses available on the web can also be the **centre of communities of students and teachers.** These books and communities could be employed for teachers' professional development in ways not possible or not as easily attainable with static texts. Open textbooks, as well as the all OER movement, are very important instruments for approaching the educational gap in developing countries. Recent OER developments are related to building open repository of research publications and other research outputs, e.g. Dspace at MIT (`http://dspace.mit.edu/`), DSpace of the TENCompetence project (`http://www.tencompetence.org`), Open Research Online of the UK Open University (`http://oro.open.ac.uk/`), TeLearn (`http://telearn.noe-kaleidoscope.org/`), etc. The Dspace at MIT Thesis collection, for instance, contains more than 20 000 items.

5.8. E-Infrastructure for E-Science. The **e-infrastructure** (cyberinfrastructure) is a **combination of hardware, software, services, personnel and organization** which provides a wide range of services for the global research communities, such as [4]: high performance computation services; data, information and knowledge management services; observation, management and fabrication services; interfaces and visualization services; collaboration service. The service layer is built upon base technology for computation, storage, and communication. Cyberinfrastructure should enable research communities and projects to rely on effective application-specific, but interoperable, knowledge environments for research and education. Interoperability is important for facilitating multidisciplinary projects as the evolution of discovery dictates. New types of scientific organizations and supporting environments are emerging, e.g. "*laboratories without walls*": **colaboratory**, **grid community**, **e-science community**, and **virtual community**. It is needed to "*enable, encourage, and accelerate this grass-roots revolution in ways that maximize common benefits, minimize redundant and ineffective investments, and avoid increasing barriers to*

interdisciplinary research" [4].

The term e-infrastructure refers to a new research environment in which all researchers – whether working in the context of their home institutions or in national or multinational scientific initiatives – have shared access to unique or distributed scientific facilities (including data, instruments, computing and communications), regardless of their type and location in the world [16]. Increasingly, new types of scientific organizations and supporting environments for science based on research communities are emerging; they can serve individuals, teams and organizations in ways that revolutionize the research practice. The industry could be an important partner in development and deployment of e-infrastructure, but it could also benefit from it. The e-infrastructure could be a platform for co-investments building new partnerships by universities and industry and thus catalyse new organizational forms for knowledge creation and education in the digital age [4].

There are many examples of implementation of e-infrastructure projects, such as:

- The **Enabling Grids for E-sciencE**—The EGEE (`http://www.eu-egee.org/`) project is funded by the EC and aims to build on recent advances in grid technology and develop a service grid infrastructure which is available to scientists 24 hours a day. EGEE is the **largest multi-disciplinary grid infrastructure in the world**, which brings together more than 140 institutions to produce a reliable and scalable computing resource available to the European and global research community. At present, it consists of approximately 300 sites in 50 countries and gives its 10,000 users access to 80,000 CPU cores around the clock;
- **nanoHUB.org** was created by the NSF-funded Network for Computational Nanotechnology—NCN (`http://nanohub.org`). NCN is a **network of universities** with a vision to pioneer the development of nanotechnology from science to manufacturing through innovative theory, exploratory simulation, and novel cyberinfrastructure. Many students, staff, and faculty are developing the nanoHUB science gateway while making use of it in their own research and education. nanoHUB.org is designed to be **a resource to the entire nanotechnology discovery and learning community**. Computation and software is a cross-cutting theme that connects computer scientists and applied mathematicians to problem-driven scientists and engineers, to address large-scale problems and develop community codes for nanotechnology.

E-infrastructure and virtual organizations are enabling a new form of

learning: **learning through interactive visualizations and simulations** [56]. In order to realize these radical changes in the processes of learning and discovery, **cyber-services also demand a new level of technical competence from the workforce and citizens** [56]:

- **Future generations of research scientists and engineers**. The new tools and functionality of cyberinfrastructure are transforming the nature of scientific inquiry and scholarship. New methods to observe and to acquire data, to manipulate it, and to represent it challenge the traditional discipline-based graduate curricula. Increasingly the tools of e-infrastructure must be incorporated within the context of disciplinary research;
- **Teachers and faculty**. To employ effectively the capabilities of learning environments enabled by e-infrastructure, teachers and faculty must also have continued professional development opportunities. Also, undergraduate curricula must be reinvented to exploit emerging e-infrastructure capabilities and the students should be able to do e-infrastructure-enabled scientific inquiry and learning;
- **E-infrastructure career professionals**.Ongoing attention must be paid to the education of the professionals who will support, deploy, develop, and design current and emerging e-infrastructure. For example, the increased emphasis on data-rich scientific inquiry has revealed serious needs for digital data management or data curation professionals. Such careers may involve the development of **new, hybrid degree programmes** combining library science with a scientific discipline;
- **Business and industry workforce**. The e-infrastucture will impact the portfolio of skills and knowledge that business people and professionals should strive to achieve through professional certification training continual workplace learning;
- **Citizens at large**. E-infrastructure extends the impact of science to citizens at large by enhancing communication about scientific inquiry and outcomes to the lay public. E-infrastructure enables lifelong learning opportunities as it supports the direct involvement by citizens in distributed scientific inquiry such as contributing to the digital sky survey.

5.9. Global Research Library. The model of **Global Research Library** (GRL) is also emerging (`www.grl2020.net`). The fast development of the Web 2.0 technologies and the OER and e-infrastructure are triggering changes in the library model as well. Several best-practice cases are reported, e.g. in the area of Nanotechnology, Earth Sciences, High Energy Physics. Some of the key challenges are:

- The growing expectations of faculties and students, now and in the future;
- The role of global research libraries in the future in supporting a transforming university mission in a technology enabled world;
- The need of investments and focus in the face of limited resources, conflicting priorities, proliferating user groups and often competing clientele.

The GRL of the future should be: multi-ethnic, multi-cultural and multilingual; a collaborative and global environment, which emphasizes the ethical issues surrounding data; purposefully inclusive, attending to different cultures. Building pan-European electronic libraries is among the main priorities of the EC. A typical example of such libraries is Europeana (`http://www.europeana.eu`).

6. The Global Campus Model. The ultimate model which will be used as a Framework for further research on the characteristics of the Global Campus Model (GCM) is the Emerging Global Model (EGM) of the 21st century research university [48]. The GCM is based on advanced ICTs and incorporates the main characteristics of the Research, Entrepreneurial, Electronic and Virtual University models.

6.1. Transcending the Boundaries of the National State. Similar to the EGM universities, **t**he GCM universities see their mission as transcending the boundaries of the nation-state, educating for global perspective and advancing the frontiers of knowledge worldwide [50, 51]. The GCM is intrinsically global since the ICTs provide natural means to cross borders. The GCM fits most one of the following models of virtual universities, identified by Middlehurst [46], namely "*an evolution of an existing institution, with a unit or arm offering virtual education*", or "*a consortium of partners constituted to develop and/or offer virtual education*". The cases of "*a newly created institution operating as a virtual university*" and "*a commercial enterprise offering online education*" could match the case of an alliance of universities and other strategic partners.

The GCM adopts the assumption that the "*current educational reform is driven by three major factors—asynchronous space and time, responsive environments, and virtual reconstruction*" [4]] and, instead of having "*a unit or arm offering virtual education",* the GCM follows the model of *Virtual Campus* as a **virtual reconstruction** of the existing campuses and "*bricks and mortar"* buildings, i.e. to "*redesign and reconfigure the human experience of existing physical spaces without having to make physical, structural changes in buildings".* Thus, virtual spaces would complement the physical spaces when designing an effective, student-centred learning environment. A virtual campus will be a virtual learning environment that integrates not only a variety of software tools

but also all the physical tools that can be found in physical campus [24]. We adopt also that the concept of *learning spaces* as one of the main features of the future learning [63] and the place-making is a very appropriate metaphor for designing cyberspace because *"the virtual places will include socio-cultural and perceptual qualities, enriching them to the point where they may approach – perhaps even surpass – comparable physical settings*" [34]. In such way even non-campus universities could build their virtual campuses and make campus education not only a good American tradition [71] but rather a **world standard for global higher education**. Referring to this tradition, the *"Educating by Design"* principle [68] could be applied by transforming it to the **virtual campus design** issues. Strange and Banning provide a comprehensive model for creating student-friendly and learning-supportive campus environments and discuss **four conditions for successful learning**: promoting safety and inclusion, encouraging participation and involvement, building a community of learners and designing for education with campus assessment [68]. They focus on the many complexities of campus settings and how they contribute to student success and the quality of learning experiences. The institutional virtual campus could evolve into a **global virtual campus comprising all university branches and partner institutions**. A (global) virtual campus should be enormously opened towards the other stakeholders and the users and provide *virtual places* where they could meet, cooperate, communicate, share information and knowledge. In order to meet this challenge, a GCM university should transform towards an Enterprise 2.0 (University 2.0) model [52] and incorporate the OER strategy, and use new tools for authoring, reading and collaborating on the emerging e-Books platforms [38]. The university could also benefit from the movement of creation of **e-libraries,** e.g. global research libraries and the recently opened European portal Europeana (`http://www.europeana.eu`).

As virtual organizations they will also incorporate a new form of learning: **learning through interactive visualizations and simulations** [55] and use global serious gaming environments. The GCM universities are developing partnerships and they would have an opportunity to jointly build a (global) virtual campus and e-infrastructure in order to do e-science. We adopt the **four main scenarios** for ICTs in higher education proposed by Collis and Moonen [15, 62]: Back to Basics; The Global Campus; Stretching-the-mould; The New Economy. Boezerooij emphasized that higher education institutions that prefer a world campus strategy considerably enhance the flexibility in delivery of education by using e-learning [10].

One of the measures for global reach of a university is the percentage of

foreign students, PhDs and postdocs. In relation to the Bologna Process and Lisbon Strategy and the targeted Europenness [75] the GCM might serve probably the most extensive international migration of students. The GCM university could promote virtual mobility schemes, e.g. by following the Virtual Erasmus model, which complements the existing Erasmus exchange programmes [61]. The virtual Erasmus can be used to prepare and follow-up the physical mobility or/and take courses at the home university while staying abroad. In addition, it embeds "*networked e-learning (in transnational collaboration of teachers and students) as an integrated part in mainstream higher education, aiming at transferability, scalability and sustainability: joint programme and course development, joint learning activities as virtual integrated elements of blended learning, 'following' (e.g. elective) courses abroad in a virtual mode*" [61]. Similar combined virtual/physical mobility models could be applied for mobility of researchers and for "*cross-sector*" (academia–industry) mobility schemes. These models could be further extended towards a combined Virtual/Physical Recruitment Model since the EGM (respectively GCM) universities are "*adopting worldwide recruitment strategies for students, faculty, and administrators*" [48]. The model of virtual mobility would be very useful for developing countries in their efforts to reduce the **brain-drain and turn it into a brain-gain** status and thus contribute to their home countries' national growth and help to reduce the rising "*knowledge gap*" between them and the developed countries. In order to fulfil this mission, the GCM universities should closely cooperate with international non-governmental and multi-governmental organizations.

6.2. A Research and Knowledge-Intensive University. The GCM universities should be **increasingly more research-intensive** and apply scientific methods in disciplines outside the sciences in order to fulfil their third mission, viz., solve problems of global importance to society as well as have **a strong orientation towards regional development and innovation, especially SMEs**. We adopt the framework of actions for strengthening and extending the university research provided by Weiler [76], which is powered by the new GCM e-infrastructure.

Similarly to the EGM, the GCM is "*an expansion of the older functions of teaching, research, and service into an organization that can best be described as a knowledge conglomerate*" [50], which puts the highest priority on the production of new knowledge and the training of expert personnel to carry on this production into the future. Being a kind of 'knowledge intensive enterprise', a GCM university needs an **effective knowledge management strategy and this becomes one of its main characteristics**. Knowledge management (KM)

emerged as a result of the development of ICTs and the changes in the organizations' structure, functions and management practices all over the world. The globalization of educational markets and the global competition put the focus on effective management of intangible assets as a way for universities to achieve competitive advantages since knowledge is their essential asset. We adopt the framework "*The KM Spectrum*" as a classification scheme of the KM activities [8]: Transactional KM, Analytical KM, Asset Management KM, Process-based KM, Developmental KM, Innovation/creation KM. A GCM university should apply KM tools: for generation of knowledge; storing, codification and representation of knowledge; knowledge transformation and knowledge use; transfer, sharing, retrieval, access and searching of knowledge. Such a university should also implement a knowledge-management strategy based on a distributed (Web 2.0) KMS with a distributed architecture [3, 50, 52].

6.3. Changes in the Academic Profession. The professors in a GCM university will face fast increasing global competition, especially with the development of the mixed virtual/physical mode of mobility and recruitment. In addition, they will have multiple responsibilities, i.e. not only to conduct publishable research but also to teach graduate and undergraduate students, to provide service to their universities, and to use their knowledge for the benefit of global, local and national communities. The use of ICTs demands new skills and additional time for effective use. The GCM universities will need **future generations of research scientists and engineers** [50, 55] which are able to use tools and services of the e-infrastructure and apply new methods to observe and to acquire data, to manipulate it, and to penetrate into new interdisciplinary areas of research reflecting the complex nature of modern science and engineering problems. The faculties must be provided with opportunities for continued professional development. They should be able also to renew the curricula and apply new methods of learner-centred education based on the emerging e-infrastructure, such as learning through interactive visualizations and simulations [56]. Ongoing attention must be paid to the education of the professionals who will support, deploy, develop, and design current and emerging e-infrastructure which will lead to the development of new, hybrid degree programmes, e.g. one combining library science with a scientific discipline or graphical arts with a science or engineering discipline. An appropriate internal measure would be to establish a **new reward system** in order to stimulate the active and successful GCM professors by combining the traditional research university values, such as to conduct publishable research and teach graduate and undergraduate students, with providing service to their universities, and using their knowledge for the benefit of global, local and national communities.

6.4. Becoming a More Entrepreneurial University. "*Entrepreneurial*" is considered as a characteristic of the whole GCM university systems, i.e. the entire universities and their internal departments, research centres, faculties, and schools. This means that a GCM university should actively seek *"to innovate in how it goes about its business"* and a *"substantial shift in organizational character in order to better perform in the future*". Such university should also "*understand the commercial value of knowledge*" and make capitalization of research findings one of its primary features [14].

Establishment of science parks, incubators and growing innovative businesses could be considered as another good American tradition which started with Stanford Research Park (1951) and the Cornell Business and Technology Park (1952). However, the GCM universities could use the power of the e-infrastructure and go towards **building virtual organizations** of such type as well [55]. A GCM university could adopt most of the characteristics of the Innovation University Model, e.g. become a leading actor in the field of **continuing education and development services provided for working life** and **increase intangible capital both inside the universities and through them in society** [41]. All this will **shift relationships among universities and government, business, and society. Successful organizations (universities or enterprises) within the future e-learning market will adopt a learner (customer) oriented paradigm.** It is necessary to underlie the commercial values by shifting the critical keys for success from technology and from what can be produced to the needs of the learner and the method of learning preferred by the customer [47, 50, 64].

6.5. Managing the Increased Complexity of University Organization. As was emphasized before, in order to become an "*enterprise-like*" organization the universities tend to adopt ICT not only for e-learning, but also for management and administrative purposes and ERP systems along with change management and e-learning [27]. However the fast developments of the Web 2.0 technologies and socials software networks are causing dramatic change in society (`http://oreilly.com/`). Gardner states: "*Although Web 2.0 is now entering the Trough of Disillusionment, it will emerge within two years to have transformational impact, as companies steadily gain more experience and success with both the technologies and the cultural implications*" [30]. The Web 2.0 technologies influence the business world and the notion *Enterprise 2.0* has been introduced [44]. McAfee gave the most cited definition: "*Enterprise 2.0 is the use of emergent social software platforms within companies, or between companies and their partners or customers.*" The Enterprise 2.0 model provides opportunities for com-

pany improvements in the area of innovation, collaboration, knowledge sharing, using collective intelligence and searching and discovering. This model is gradually adopted not only by many small companies, but also by a large number of big ones, such as IBM, Oracle and McKinsey. From the business perspective of Oracle "*Enterprise 2.0 is the creation of competitive advantage through interactive, collaborative business models*" and this leads to "*... an integrative business strategy that combines multiple disciplines, technologies, and experiences. Businesses can no longer wonder if they will have an Enterprise 2.0 strategy; they must determine how to have such a strategy*" [12].

In addition, the industrial economy's knowledge monopolies are breaking down and innovation is becoming more collaborative, distributed and open [69]. The Web 2.0 technologies give rise to company's business and innovation webs. Even the largest companies can no more afford to invest in all research activities that give birth to new products on the market. Tapscott states that "*in most industries, innovation increasingly depends on dense networks of public and private actors and large pools of intellectual property that routinely combine to create end products*". Tapscott and Williams put in the focus the opportunities for the new mass collaboration model to change "*how companies and societies harness knowledge and capability to innovate and create value*" [70]. The four principles of *Wikinomics*, namely: **openness**, **peering**, **sharing**, and **acting globally**, define the new features of the companies that wish to be competitive, which differ a lot from the ones of a "*traditional*" company. The so-called "*ideagoras*" emerged, i.e. Web 2.0 based environments where researchers and developers can collaboratively develop innovations. Companies are *innovation seekers* when they face difficult problems, and they could globally challenge the experts—the *innovation providers* [49]. The companies could also provide solutions and look for appropriate problems to solve. An example of such "*ideagora*" is InnoCentive (`http://www.innocentive.com/`)—a portal which provides a marketplace for innovations based on a community of companies and researchers. Such platform could also enhance the organizational innovation processes and thus contribute to better exploitation and use of the organizational knowledge management portals by improving the innovation and knowledge management processes within an organization [3, 50].

The so-called "*cloud computing*" concept emerged which stands for [36]: open information content, software and services; service orientation and delivery; service and storage virtualization; standardization of computing across. As it was stated above, the **Web 2.0 technologies and tools provide new avenues for cooperation between university and industry** both in the area of training

and in research and innovation, which is a solid ground for joint ICT professional competency development. On the way to knowledge society in a dynamic ICT environment the universities should catalyse a process of **deep institutional change**. One of the major challenges facing the universities in the next decade is to **reinvent themselves as information organizations**. It is emphasized that the "*universities are, at their core, organizations that cultivate knowledge, seeking both to create knowledge and to preserve and convey knowledge, but they are remarkably inefficient and therefore ineffective in the way that they leverage their own information resources to advance that core activity*" [73]. The **model of University 2.0** naturally emerged as a framework for universities to adapt to the social computing phenomena and to the networked information economy. We define University 2.0 as *a "research and entrepreneurial university which integrates Web 2.0 technologies and applications in all university activities, including ones with all knowledge intensive stakeholders, and implements the features of the Enterprise 2.0"* [50, 52]. The Web 2.0 based virtual learning environments provide opportunities for students, professors, companies and other stakeholders to cooperate in a 24/7 fashion. The virtual space of a University 2.0 is a natural place, where the **two worlds**, the academic and the corporate ones, **could establish solid bridges and naturally integrate**, especially if both adopt the principles of the Enterprise 2.0 model.

The GCM university organizational structure will follow the University 2.0 characteristics and will resemble the vision for "*Cloudy Academy*" [36]. A GCM university should also become a *virtual organization*. Virtual organizations (VOs) are a fast-growing phenomenon in all work settings. A VO is "*a group of individuals whose members and resources may be dispersed geographically and institutionally, yet who function as a coherent unit through the use of e-infrastructure*" [17, 55]. A VO is typically enabled by, and provides shared and often real-time access to, centralized or distributed resources, such as community specific tools, applications, data, and sensors, and experimental operations. Quite often, these resources use high-performance computing as a core capability. Such VOs are for instance EGEE (`http://www.eu-egee.org/`) and nanoHUB.org (`http://nanohub.org`). The term VO can encompass, at least in part, systems known by other names such as collaboratories, e-Science or e-Research, distributed workgroups or virtual teams, virtual environments, and online communities. VOs include a broad range of operational options, e.g. they can be formal or informal, planned or unplanned, transient or long lived. They share several common characteristics [17, 55]:

- **Distributed across space,** with participants spanning locales and institutions;

- **Distributed across time**, with asynchronous as well as synchronous interactions;
- **Dynamic structures and processes** at every stage of their lifecycle, from initiation to termination;
- **Computationally enabled**, via collaboration support systems including e-mail, teleconferencing, telepresence, awareness, social computing, and group information management tools; and,
- **Computationally enhanced** with simulations, databases, and analytic services that interact with human participants and are integral to the operation of the organization.

7. Conclusions. The technologies are ever changing and the new generations of Web are on the horizon – Web 3.0, Web 4.0, etc. They are related to increasing the intelligence of the Web. Davis describes these trends: *"The semantic wave embraces four stages of internet growth. The first stage, Web 1.0, was about connecting information and getting on the net. Web 2.0 is about connecting people — putting the "I" in user interface, and the "we" into Webs of social participation. The next stage, Web 3.0, is starting now. It is about representing meanings, connecting knowledge, and putting these to work in ways that make our experience of internet more relevant, useful, and enjoyable. Web 4.0 will come later. It is about connecting intelligences in a ubiquitous Web where both people and things reason and communicate together"* [21]. An emerging trend is the integration of the Web technologies with the global e-infrastructure in the academic world [65]. Having in mind the life-long learning need and the trend of integration of all existing forms of education, we might expect the ultimate result might be that **the whole world would become a Global Campus** in the next few decades.

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Roumen Nikolov
St. Kl. Ohridski University of Sofia
Centre of Information Society Technologies
125, Tsarigradsko Shosse Blvd, Bl. 2
1113 Sofia, Bulgaria
e-mail: roumen@fmi.uni-sofia.bg

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