TRANSDISCIPLINARY DANUBE UNIVERSITIES, RESEARCH, AND INNOVATION STRUCTURES

Tamara Mitić[1], Marcel H. B. Van de Voorde[2], H.-J. Fecht[3], Vojislav Mitić[4]

ABSTRACT

The Danube Region (DR) covers parts of 14 European countries, connecting over 100 million people it should be a good starting point for any education and scientific program. Refinement should follow the Danube Strategy naming the items: *Inland waterways, surface and air transport; Energy; Culture and tourism; Water quality; Environmental risks; Biodiversity; Knowledge society and information technologies; Competitiveness and cluster development; Investments in people and skills; Institutional capacity; Security,* as 11 priority areas of further intensive research. A recent study of Science and Technology Options Assessment (STOA) describes knowledge transfer mechanisms from eminent European universities and institutes to industry, thus focusing on the role of the Industrial Liaison, Technology, and Technology Transfer.

Twelve wise people from all over Europe made an analysis of possibilities and from among these possibilities offered to the Council of Education Ministers in Bologna a well-known Bologna Declaration. The main items are, uniformity of degrees and learning plans at the universities; student mobility through the Erasmus programme, and ranking of university excellences;

Keywords: Danube Integration and Strategy Development, Transdisciplinary, University Education, Research, Innovation, Nanodiamonds and Fractals

[1] Educons University, Novi Sad, Serbia

[2] Delft University of Technology, Delft, the Netherlands

[3] Ulm University, Germany

[4] European Academy of Sciences and Arts, vmitic.d2480@gmail.com

INTRODUCTION

The Danube Rectors' Conference (DRC) constitutes a network of 56 Universities in the DR with the aim to improve higher education in teaching and research in this region, having the City of Ulm as a pilot project centre. The "Ulm follow-up" is a program included in *Joint Declaration of DR Ministers for Research* (Ulm, 8-9 July 2012), to enhance cooperation in Research and Innovation. Also, *First Nano-Danube Workshop –DR*, was held in Ulm in July 2013, under the auspices of BMBF and the EASA. The cooperation should build on already existing structures, such as, for example, the annual *Danube Academies Conference* organized by the EASA every year with the 6th conference being held in Ulm in 2015.

Integration of DR in advanced scientific programs of the *European Research Area* (ERA). It is the eighth of *the Framework Programs for Research and Technological Development*, funding research, technological development, and innovation, with the focus on innovation, delivering economic growth faster and delivering solutions to end users that are often governmental agencies. Many new technologies and methods, developed in the last 50 years are more than welcome in the researches: Microbiology, Clean and Renewable Energy Sources, Ceramics and Composite Materials, Dynamics of Chaos, Fractals, Nanotechnology, etc.

The Horizon 2020/2025 has three important aims: centers of excellence (COEs), SME to generate new workplaces, and shortening the innovations and new products way to markets. The EU and non-EU countries potentials integrated through universities, scientific-investigation centres, institutes and companies' RND centres are the only chance for education, science, innovations, and services from the non-EU countries to have access to worldwide companies through the DR sub-integration.

Towards a strategy for the innovation and technology development of the Danube Region in the next decade and beyond.

1. A BRIDGE BETWEEN EU AND NON-EU COUNTRIES

The Danube is the longest river in Europe and the most international one in the world. It rises in the Black Forest of Germany and then flows for 2,872 km southeast, passing through several Central European capitals before emptying into the Black Sea via the Danube Delta. Once a long-standing frontier of the Roman Empire, the Danube Region covers parts of nine EU countries (Germany, Austria, Hungary, Czech Republic, Slovakia Republic, Slovenia, Croatia, Bulgaria, and Romania) and five non-EU countries (Serbia, Bosnia and Herzegovina, Montenegro, Ukraine, and Moldova). With over 100 million people, and one fifth of the surface of the EU, the region hosts the world's most international river as a major transport axis, a vital interconnected hydrological basin, and a world-renowned ecological corridor. As such, the area has always been vital to Europe and, moreover, it holds a strategic position, opening the EU to its neighbours, the Black Sea region, the South Caucasus, and Central Asia [1].

Today, 25 years after the collapse of the "Iron Curtain", the Danube Region has been particularly affected by turbulent events, with many conflicts, migrations, and undemocratic regimes. The Danube Region is facing several challenges, such as environmental threats, insufficient energy and transport connectivity, uneven socioeconomic development, as well as shortcomings in safety and security. The world's most international river basin is now largely a European Union (EU) space. A better coordination and cooperation between the countries and key players is needed to address these challenges. In order to build and capitalise on potential synergies, a European Strategy for the Danube Region has become necessary.

By building on considerable research and innovation perspectives, the Region can be at the forefront of EU trade and enterprise. Disparities in education and employment should be overcome. It can be made a safe and secure area, where conflicts, marginalisation, and crime are properly addressed. By 2020, all citizens of the Region should enjoy better prospects of higher education, employment, and prosperity. The Strategy should make this a truly 21st century region, secure and confident, and one of the most attractive ones in Europe. To achieve this goal, the Danube Strategy is organised in 11 functional Priority Areas bringing

together expertise and responsibility: (1) Inland waterways and rail, road, and air transport; (2) Energy; (3) Culture and tourism; (4) Water quality; (5) Environmental risks; (6) Biodiversity; (7) Knowledge society and information technologies; (8) Competitiveness and cluster development; (9) Investments in people and skills; (10) Institutional capacity; and (11) Security.

The Joint Research Centre JRC has launched an initiative for the thematic Priority Area 7 to provide scientific support to the Strategy, in cooperation with key scientific partners from the region [2]. The work was started on setting up a Danube-wide reference data and service infrastructure on common challenges such as environment protection, navigability, irrigation and agricultural development, and energy production. A special focus on the Smart Specialisation Strategies supports countries and regions in setting up regional innovation strategies.

1.1 The Danube River Protection Convention Objectives

1. Ensuring sustainable and equitable water management;
2. Ensuring the conservation, improvement, and rational use of the surface and underground water;
3. Controlling the discharge of waste water, input of nutrients and hazardous substances from point and non-point sources of emission;
4. Controlling floods and ice hazards;
5. Controlling hazards originating from accidents (warning and preventive measures);
6. Reducing pollution loads of the Black Sea from sources in the Danube catchment area.

2. THE RÉSUMÉ OF THE PRESENTLY LAUNCHED INITIATIVES

The most recent study of Science and Technology Options Assessment (STOA) describes knowledge transfer mechanisms from the European universities and institutes to the industry, thus focusing on the role of the Industrial Liaison /

Technology / Technology Transfer. The City of Ulm can, in this regard, serve as a pilot project for similar developments in other European countries and in the Danube Region [4].

A number of activities of the city and the region of Ulm related to the Danube Strategy have already been initiated and executed in the last few years. Some of the examples are:

2.1 The Council of the Danube Cities and Regions chaired by Mr. I. Gönner, the Mayor of Ulm. Details can be found, for example, in the Declaration of Vienna 2012 with an emphasis on mobilizing the economy, society, media, and people of the Danube Region.

2.2 The Danube Rectors' Conference (DRC) constitutes a network of 56 Universities in the Danube Region with the aim of improving higher education in regard to teaching and research in this region (Prof. K. Ebeling, President of the University of Ulm). The main focus is the advancement of the member universities by establishing and facilitating bilateral and multilateral contacts.

2.3 The Joint Declaration of Danube Region Ministers for Research in the Conference of the Ministers of the Danube Countries, Ulm, 8-9 July 2012, to enhance cooperation in Research and Innovation. This program is now also known as "Ulm follow-up".

2.4 The International Pan-European Union and Paneuropa-Union Deutschland.

2.5 The First Nano-Danube Workshop – Nanotechnology actions in the Danube Region, in Ulm, chaired by Prof. H.-J. Fecht (University of Ulm) and Prof. M. Zehetbauer (University of Vienna) 11 July 2013, under the auspices of BMBF and the European Academy of Sciences and Arts.

2.6 The Ulm-Belgrade-Niš Connection is one success story that serves as the confirmation of actual cooperation. Common projects with Hans-Jürgen Fecht, Director of the Institute of Micro and Nanomaterials at the University of Ulm, Germany include the topics of energy issue-related nanostructures, the application of fractal geometry, and the analysis of ceramics materials' micro and nanostructure, diamond films of micro and nanothickness, fractal self-similarity, and so on.

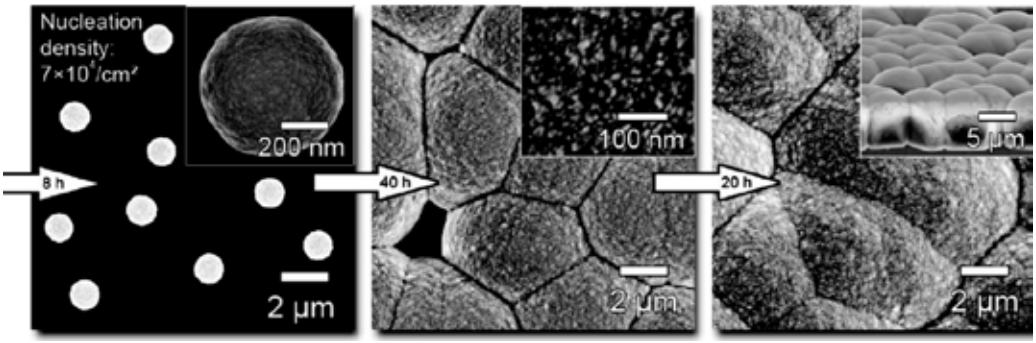
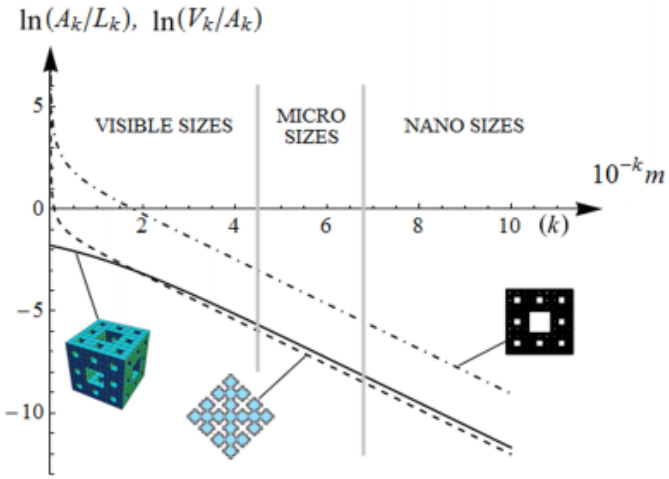


Figure 1 - Nanocrystalline diamond nucleation and early-stage growth on an untreated silicon substrate, microcrystalline diamond (MCD) film, >>100 nm, nanocrystalline diamond (NCD) film, 5-100 nm, ultra-nanocrystalline diamond (UNCD) film, 3-5 nm [6].



The ratios area vs. length for Sierpinski quadratic curve (Fig. 2) and Sierpinski carpet (as well as the ratio volume vs. area for Menger sponge (Fig. 4) in logarithmic scale.

Vojislav V. Mitić, Hans-Jörg Fecht, Ljubiša M. Kocić, *Materials Science And Energy Fractal Nature New Frontiers*, Contemporary Materials (Renewable energy sources), VI, 2 (2015) Page 190 of 203. UDK 620.91:514.12 doi: 10.7251/COMEN1502193M;

Figure 2 - The ratios area vs. length for Sierpinski quadratic curve and Sierpinski carpet as well as the ratio volume vs. area for Menger sponge in logarithmic scale. [6]

Figure 3 - Scientific cooperation in triangle Belgrade-Niš-Ulm as a model of integration of non-EU countries in the EU through the Danube Strategy [5].

2.7 The European Economic Interest Grouping (EEIG) DANUBIS Network for funding science was founded in October 2013 in Ulm under the auspices of Mr. G. Öttinger, commissioner for energy, to promote an R&D network along the Danube River. By linking such independently run activities and events with existing bilateral agreements on different levels, these activities can be improved and intensified through multilateral coordination and cooperation which could be either driven by geographic proximity or by fields of excellence. Cooperation should build on already existing structures, such as, for example, the Danube Academies Conference (DAC) organized by the European Academy of Sciences and Arts (Prof. F. Unger, Salzburg) every year with the 6th conference being held in Ulm in 2015.

3. COOPERATION RESULTS AND PERSPECTIVES

3.1 The Knowledge Society

A society's ability to create and exploit knowledge is the key factor for cultural and economic progress and growth. A society based on knowledge needs competitive research and education infrastructure, innovation supporting and facilitating institutions, as well as high-performance information and communication technologies. These framework conditions differ remarkably throughout the Danube Region but remain, overall, below the level of EU27. Given the polarisation within the Danube Region concerning innovation and ICT indicators, diffusion mechanisms as well as targeted support for research infrastructure have to be promoted. To stimulate excellence in research and development, cooperation between knowledge providers, companies and the public sector should be enhanced and incentives for stronger cooperation developed. A better coordination of national and regional funds is needed to stimulate research and development in the Region in order to fully benefit from the European Research Area. Existing bilateral agreements should be used and improved through multilateral coordination. Such cooperation could either be driven by geographic proximity or by fields of excellence. Cooperation should build on already existing structures, such as, for example, the Danube Academies Conferences organized by the European Academy of Sciences and Arts.

Some of the top-performing regions in Europe can be found in this macro-region, but others considerably lag behind. The leading regions exhibit strong and well-established innovation support systems, while, in other regions, institutions and framework conditions are absent or still not sufficiently developed. Long-term, transnational cooperation networks between innovation and business supporting institutions need to be developed for the different sectors, also utilising the opportunities within the framework of the European Research Area (ERA). The development of clusters and centres of excellence should be fostered and cluster

cooperation across borders and across sectors should be facilitated. To improve the conditions for enterprises, especially SMEs, the institutional capacities of business support agencies and industry associations should be strengthened throughout the region. As an example, Fig. 5 exhibits the locations of the European companies

manufacturing products or delivering services utilising nanotechnology. These have mostly been developed based on funding for nanotechnology, publications and patents through FP7. This is a clear indication of the need for the integration of the Danube Region in these European programs, in particular HORIZON 2020/2025.

3.2 Business Innovation and Growth from Exploitation of Academic Research (BIGEAR)

The Thematic Network BIGEAR [3], established in 2001, aimed to understand and disseminate best practice in the effective exploitation of academic research to stimulate business growth regionally, nationally and transnationally. BIGEAR supported by the European Commission's Directorate-General for Enterprise as part of the Innovation and SMEs programme is a member of the Innovating Regions in Europe (IRE) Network. This aims to facilitate the exchange of experience between regions developing regional innovation policies, strategies and schemes, and to improve their access to best practice.

Universities and other public research institutions as the key players in academic research can have a pivotal role in transforming invention into products and services. However, universities' principal role is to develop knowledge and the education of the next generation with the current body of knowledge. The current organisation of Universities is not well-suited to directly facilitate innovation in business or in the community. One of the reasons for this is the grant aided nature of many research projects which are simply terminated once the grant comes to an end. There might be a successful research outcome, but this happens at a premature stage of innovation. There is, thus, a mismatch between the potential for exploitation of academic research and what is often achieved.

Since the approach adopted to exploitation varies widely between universities and between countries, European innovation strategies would benefit from an understanding of current best practice in the exploitation of academic research. Effective exploitation requires intermediaries between universities and businesses who are familiar with academic research and with the needs of businesses. Such intermediaries may be: Business Innovation Centres, University Industry Liaison

offices, or companies who thrive on innovation. The BIGEAR network brought together representatives from all these stakeholders. An initial membership drawn from the UK (London Business Innovation Centre (BIC), UCL London), Germany (Deutsche Bank, University of Ulm, and Science Park Ulm), Italy (CESVIT-Firenze) and Poland (Academy of Sciences), has been extended to encompass Business Innovation Centres and other Institutions in Austria (Danube, Vienna), Bulgaria (Sofia University), Czech Republic (Brno University Tech), Hungary (Innostart, Budapest), and Slovenia (Ljubljana). BIGEAR has brought together some of the movers and shakers of innovation at regional, national, and European level in order to establish new conduits and best practice for successful exploitation of academic research. Innovation may be in technology, creating new products and services, or in business, requiring knowledge of markets, access to finance, and business support.

- an online forum and website as a first step towards establishing a more innovation friendly environment in which the results of academic research, whether these are new technologies or novel processes, can de diffused more rapidly into small, medium, or large businesses and regional communities;
- a wider business access to inventive steps in processes or technology;
- an increase in the value extracted from academic research;
- stimulation of new economic activity adding to the competitiveness of local regions.
- links to LIFT (Linking Innovation Finance and Technology) and FIT (Financing Innovation Technology).
- input into discussions between Member States on innovation policies and promotion of innovation.
- input into the understanding of cultural, social and organisational aspects of innovation.
- input into the "Innovating Regions in Europe" global network.

Public Research Organisations (PROs) play a significant role in innovation systems beyond simply providing new technologies to individual businesses. They provide access to skilled personnel, assist businesses with short-term problem

solving, support the development of research and innovation capabilities through collaborative working, and provide access to new ideas and concepts. In this sense, they are engaging in **knowledge transfer** and (not solely) **technology transfer**. In this wider notion, a range of different knowledge transfer mechanisms are used to transfer and exchange knowledge between PROs and industry including publications, consultancy, contract and collaborative R&D, and informal interactions as well as exploiting formal intellectual property generated by PRO research. Studies demonstrate that businesses make use of and value all such mechanisms. Individual companies tend to make use of several mechanisms with the pattern of use dependent upon the type of knowledge they wish to access, the focus of their particular innovation activities, and their industrial sector.

In this regard and while structural funds are already focused on innovation, DG Regio could be encouraged to place a much greater emphasis on the development of knowledge exchange capabilities and capacities within the regional PROs and to ensure that regional innovation strategies avoid the technology transfer paradigm. This support should also ensure that policy-makers and PROs in lagging countries are able to maximize opportunities to learn from experienced countries.

4. EXAMPLES OF BEST PRACTICE

4.1 The Cooperation Between Developed and Non-Developed Regions

The **European Economic Interest Grouping** (EEIG) **DANUBIS Network** for funding science was founded in October 2013 in Ulm under the auspices of Mr. G. Öttinger, commissioner for energy, to promote an R&D network along the Danube. By linking such independently run activities and events with existing bilateral agreements on different levels, these activities can be improved and intensified through multilateral coordination and cooperation which could be either driven by geographic proximity or by the fields of excellence. Cooperation should build on already existing structures, such as, for example, **the Danube Academies Conferences** organized by the European academy of Sciences and Arts (Prof. F. Unger, Salzburg) every year with the 6th conference being held in Ulm in 2015.

Figure 4 – The location of European companies manufacturing products or delivering services utilizing nanotechnology – courtesy M. Morrison IoN, Scientific cooperation in the triangle of Belgrade-Niš-Ulm as a model of integration of non-EU countries in the EU, over the Danube strategy [5].

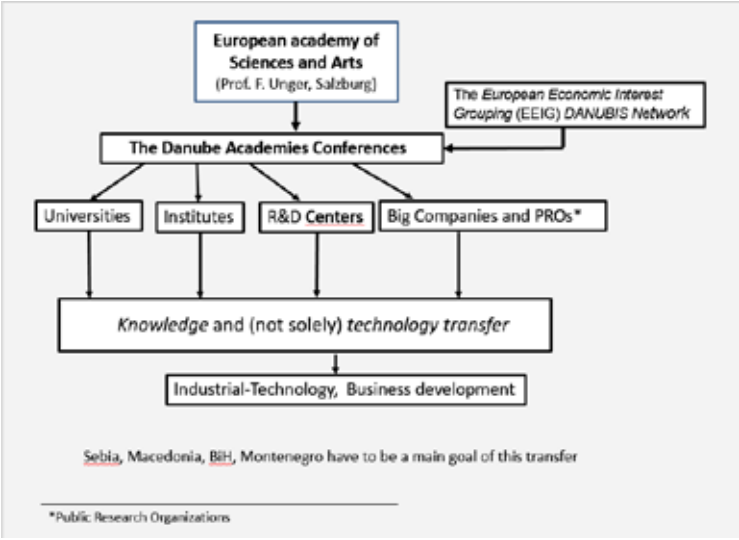


Figure 5 – The symbiotic relationship between the Danube Region academic and business sectors in regard to the transfer of technologies and the transfer of knowledge.

4.2 Business Innovation

Business Innovation should rely on Growth from Exploitation of Academic Research which is short for BIGEAR and projected as *Thematic Network*, established in 2001 and aimed at understanding and disseminating best practice in the effective exploitation of academic research to stimulate business growth regionally, nationally, and transnationally. BIGEAR, supported by the European Commission's Directorate-General for Enterprise, as part of the Innovation and SMEs programme, is a member of the Innovating Regions in Europe (IRE) Network. This aims to facilitate the exchange of experience between regions developing regional innovation.

Serbia, Montenegro, and Bosnia-Herzegovina must be the main goal of these strategies.

Different nations, states, religious, cultures, civilizations, etc.

The goals:

- Implementing of Danube agenda;
- Optimizing exploitation of natural resources;
- Optimizing transportation to markets;
- Opening new working places;
- Introducing modern technology in homes;
- Improving the quality of life and medical care.

4.3 Science City Ulm as a role model for the development in the Danube Region

The City of Ulm blossomed already during the 15th and 16th centuries, mostly due to the trade along the Danube River, the export of high-quality textile, and the establishment of trading posts and related banking institutions. In the mid-19th century, this position has been strengthened and Ulm became an important center of industrialization in southern Germany and experienced substantial growth in the decades following the World War II, with the establishment of new industrial zones.

In 1967, the University of Ulm was founded, which has proved to be of great importance for the development of the city and now is considered to be the best University in Germany founded in the last fifty years [5]. The university research fields are focused on natural sciences and engineering, medicine, and economics. The establishment also helped support the transition to high-tech industry, especially after the crisis of classical industries in the 1980s. Particularly since the 1980s, the transition from classical industry towards the high-tech sector has accelerated, with, for example, the establishment of research centers of companies and a number of applied research institutes and start-ups near the university campus in the Ulm Science Park – Science City Ulm with considerable financial investments of internationally active industries.

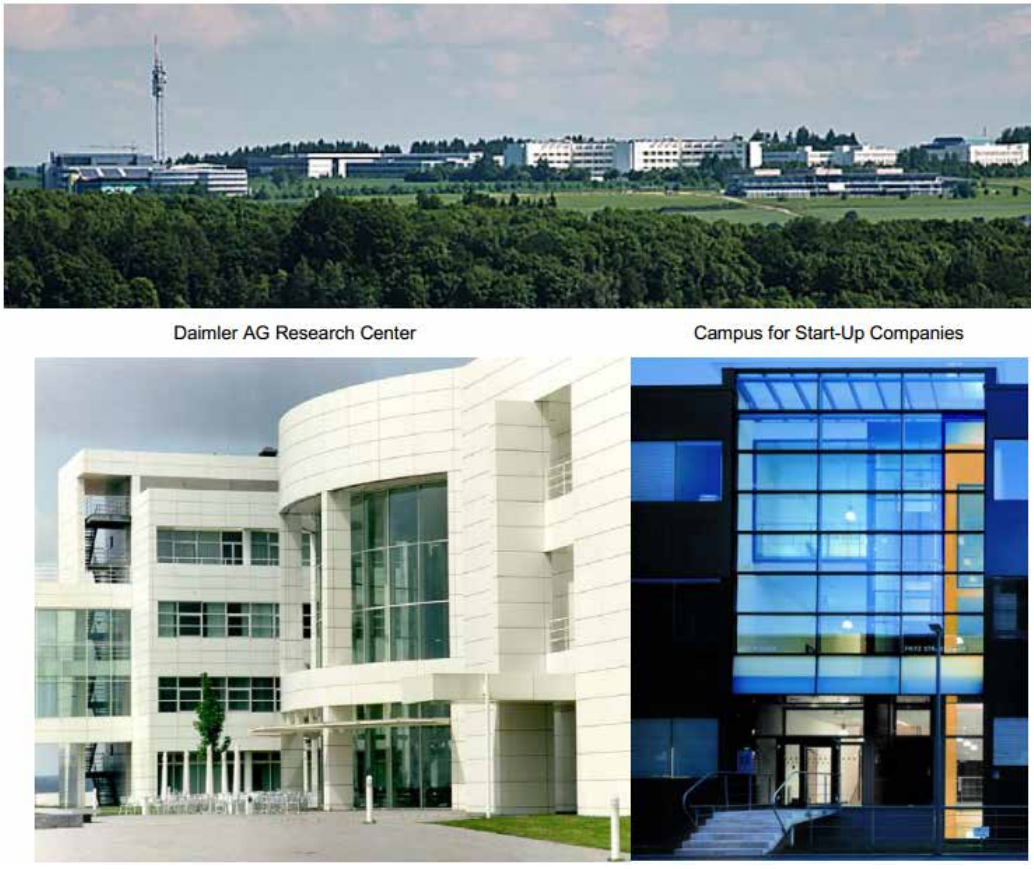


Figure 6 – Science City, the University of Ulm.

5. NEW TRENDS AND PERSPECTIVES

5.1 Converging Technologies (NBIC)

In the early decades of the 21st century, we stand at the threshold of a new renaissance in science and technology, based on a comprehensive understanding of the structure and behaviour of matter from the nanoscale up to the most complex systems [5]. Unification of science based on unity in nature and its holistic investigation will lead to technological convergence and a more efficient societal structure for reaching human goals as predicted by R. Feynam already in the 1950s in his famous speech at the California Institute of Technology "There is plenty of room at the bottom". Now concentrated efforts can bring together nanotechnology, biotechnology, information technology, and new technologies based on cognitive science. With proper attention to ethical issues and societal needs, the result can be a tremendous improvement in human abilities, new industries and products, societal outcomes, and the quality of life.

The phrase "convergent technologies" refers to the synergistic combination of four major "NBIC" (nano-bio-info-cogno) areas of science and technology, each of which is currently progressing at a rapid pace: (a) nanoscience and nanotechnology; (b) biotechnology and biomedicine, including genetic engineering; (c) information technology, including advanced computing and communications; and (d) cognitive science, including cognitive neuroscience.

Rapid advances in convergent technologies have the potential to enhance both human performance and the productivity of nations worldwide. Examples of payoffs will include, for example, fundamentally new manufacturing processes and improved products, improving both individual and group efficiency, highly effective communication techniques, perfecting human-machine interfaces including neuromorphic engineering for industrial and personal use, and achieving sustainable development. Nanotechnology, biotechnology, and information technology are moving closer together, following an accelerated path of unparalleled breakthroughs. Their focus on human dimensions is still emerging but promises to dominate the next decades in different fields – as evident from the examples given below – and will have a remarkable impact on the Danube Region as well.

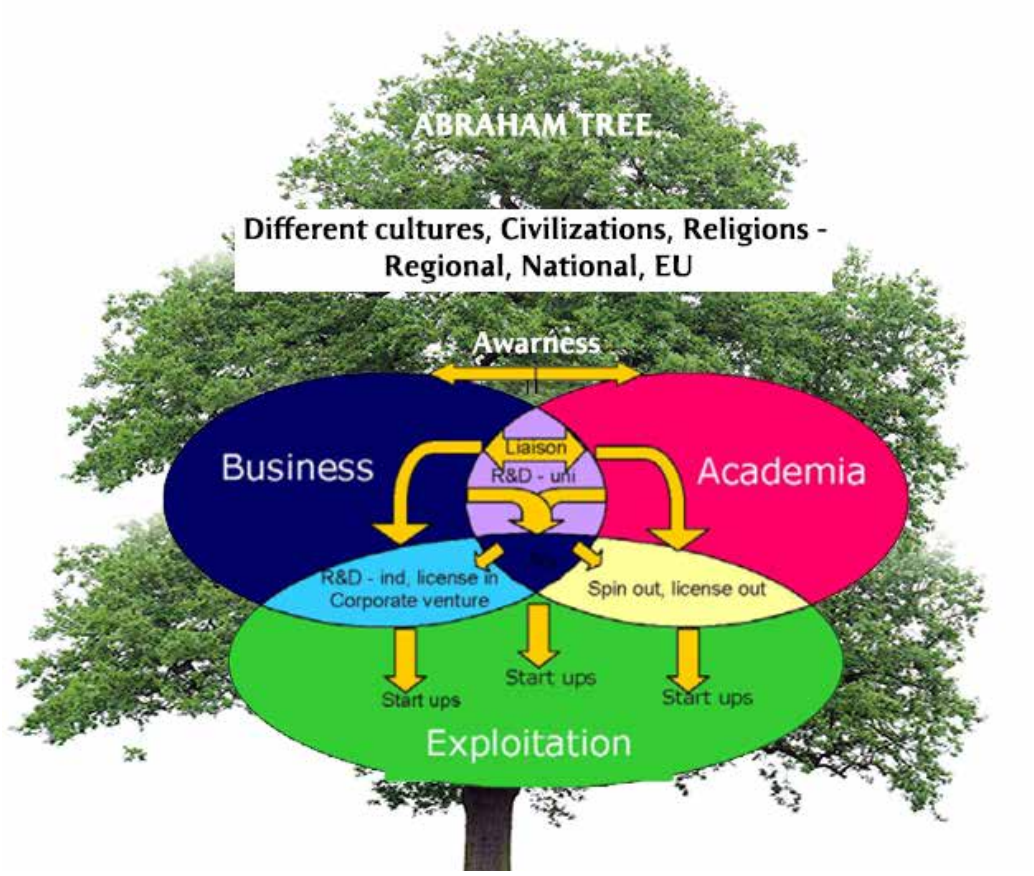


Figure 7 - Interrelation of actors in the BIGEAR network
leading to exploitation and economic growth.

5.1 Ten Priorities for Human Development:

1. Making the human development concerns country-specific;
2. Preparing a human development profile;
3. Improving human development statistics;
4. Setting human development goals and targets (water, health, food, etc.);
5. Costing the attainment of human development targets;
6. Identifying possible policy options;
7. Mobilizing financial resources and opportunities;
8. Formulating country-based strategies for human development;
9. Agreeing on a global compact on human development;
10. Encouraging public demand for human development;

5.2 Communication and Education

People will be able to acquire a radically different instinctive understanding of the world as a hierarchy of complex systems rooted in the nanoscale. Advances in cognitive science will enable nanoscience education, by identifying the best ways for students to conceptualize nanostructures and processes at increasingly advanced stages of their learning. Education at all levels will exploit augmented reality, in which multimedia information displays are seamlessly integrated into the physical world. The strategies for hierarchical, architectural, and global analysis and the design of complex systems will help integrate the curriculum of schools and inform management decisions across a diverse range of fields. Neuromorphic engineering may allow the transmission of thoughts and biosensory output from the human body to devices for signal processing. Wearable computers with the power similar to that of the human brain will act as personal assistants or brokers, providing the valuable information of every kind in forms optimized for a specific user.

Disparities in education and employment should be overcome. It can be made a safe and secure area, where conflict, marginalisation and crime are properly addressed. By 2020, all citizens of the Region should enjoy better prospects of higher education, employment, and prosperity. The Strategy should make this a truly 21st century region, secure and confident, and one of the most attractive ones in Europe.

Marcel van de Voorde points out the remarkable contribution of the Bologna process in regard to the standardisation of university education and ranking as well as the improved mobility of students.

6. THE FUTURE FRONTIERS

6.1 Actions to be Taken

In order to build and capitalize on potential synergies, the strategy for the Danube Region on Innovation and Technology shall be further developed in order to achieve the long-term objectives of the EU, namely, smart, sustainable, and inclusive growth by strengthening the scientific cooperation in the Danube

Region. According to the action plan of the EU Strategy by 2020, the Danube Region should become one of the most attractive regions in Europe.

This will be achieved by enhancing [2]

• Education; • Science; • Innovation and Technology; • Economic Development.

To achieve this challenging goal, the important socio-economic disparities across the different countries of the region have to be reduced. In the field of innovation and technology, the Danube Region counts a few countries - like Germany and Austria - whose performance indicators in the field of R&D intensity and participation in the Seventh Framework Programme (FP7) are amongst the highest in Europe while many of the other countries of the region rank amongst the lowest performing countries in this regard. As recommended by the EUSDR, to overcome such disparities and to stimulate excellence in research and development, cooperation between scientific actors should be enhanced and incentives for stronger cooperation should be developed in order to build prosperity in the Danube Region [2] by

• the generation of environmentally friendly energy; • a clean Danube River; and
• job creation and social integration based on new and innovative technologies.

6.2 Joint Declaration of Danube Region Ministers for Research Conference of the Ministers of the Danube Countries

To establish the Danube Region Research and Innovation Fund (DRRIF) on the basis of a feasibility study as foreseen in the roadmap of Priority Area 7 of the Strategy for the Danube Region, these efforts can build on existing European network projects, such as the INCO.NET project for the Western Balkan countries (WBC-INCO.NET). The dialogue initiated in this network should be continued in the near future with the EU project “INCO-NET Danube Region”.

Key objectives are:

- the implementation of a joint Danube research programme and network of all members and associated members of the EEIG;
- the support for sustainable development in the Danube Region through the provision of scientific outputs facilitating implementation of a strategy of smart specialization and with the focus on smart cities;

- the European and world-wide exchange of experience, the organization of and participation in dedicated conferences and symposia, workshops and similar, as well as participation in exhibitions, and, in general, the co-operation with European and international public and non-government institutions and organisations.

6.3 Roadmap for the innovation and the technology strategy HORIZON 2020/2025 / DG Region

In accordance with the recommendations made by the High-Level Group (HLG) on Key Enabling Technologies (KETs), "Leadership in enabling and industrial technologies" will allow treating KETs as the key priority of Horizon 2020/2025, highlighting their importance for growth and jobs. This includes a dedicated budget of 6,663 million euros for the KETs of photonics, micro- and nanoelectronics, nanotechnologies, advanced materials, biotechnology, and advanced manufacturing and processing [5]. As part of this integrated approach to KETs, dedicated support will be provided for the activities exploiting the accumulated benefits of combining a number of KETs, in particular, through support for larger-scale pilot line and demonstrator projects. International cooperation with third countries is necessary to address effectively many specific objectives defined in Horizon 2020/2025. This is the case in particular with all the societal challenges addressed by Horizon 2020/2025, which need to be tackled on a global level. In Horizon 2020/2025, there will be a greater use of general opening with focus on significant challenges, such as the Danube Strategy.

The milestones of the Roadmap can be summarized as follows:

Milestone No. 1: Identify hot topics in Research, Innovation, and Technology (NBIC);

Milestone No. 2: Entrepreneurship, SMEs, and human resources;

Milestone No. 3: Education and youth;

Milestone No. 4: Transfer the concepts of best practice like BIGEAR and STOA to the Danube Region;

Milestone No. 5: Identify national, regional and EU funds for Innovation and Technology.

As such, and in order to further develop the Danube strategy 2030 on Innovation and Technology together with a dedicated action plan and, thus, to build an industrial and social Danube Region, a basic structure of institutions and personnel / positions / responsibilities / decision and policymaking, it is necessary to act in accordance with the guidance of a Danube Conference and a task force.

7. CONCLUSION

The key objectives are:

- a bridge between EU and non-EU countries;
- the implementation of a joint Danube research programme and network of all members and associate members of the EEIG;
- the support for sustainable development in the Danube Region through the provision of scientific outputs facilitating the implementation of a smart specialization strategy and with the focus on smart cities;
- the European and worldwide exchange of experience, the organization of and participation in dedicated conferences and symposia, workshops and similar, as well as participation in exhibitions, and, in general, the co-operation with European and international public and non-government institutions and organisations;
- Towards a strategy for the innovation and technology development of the Danube Region in the next decade and beyond DANUBIS INNOVATION and TECHNOLOGY DIT 2030.

The idea of a Science City Ulm dates back for almost 30 years. In 1986, the innovative cooperation of the University of Ulm, the University of Applied Science Ulm, the (then) Mercedes Benz (now Daimler) research center Ulm and several “spin-off-companies”, research institutes in medical research, materials science, laser technology, and solar/hydrogen technology was pioneering and very successful endeavor. The interaction between basic research and technology allows direct exchange of know-how and ideas, and technology transfer in the economy. The marketing is in the hands of a newly founded society for project

development. As such, the Science Park Ulm provides a direct interface between basic R&D and industry. Today, after the transition from a classic industry site to the Science City Ulm, the Ulm region ranks among the top 10 economic regions in Germany and top 30 regions in Europe and has a high employment rate. A scenic impression of the Science Park Ulm is shown in Fig. 7 above. The main industrial sectors in the Science Park comprise Automotive, Energy, Materials, Medical, Microelectronics, Nanotechnology, and Telecommunication – all sectors of the highest priority for the Danube Region. The economic and cultural development of the City of Ulm over the last two decades has made a remarkable impact in the region and can serve as a prototype and a role model for other cities and regions in the Danube Region.

In addition to the recommendations made by the High-Level Group on Key Enabling Technologies (KETs), "Leadership in enabling and industrial technologies" will certainly make KETs the highest priority of Horizon 2020/2025 in order to further economic development and improve employment. This includes a dedicated budget of 6,663 million euros for the KETs of photonics, micro- and nanoelectronics, nanotechnologies, advanced materials, biotechnology, and advanced manufacturing and processing [5]. As part of this integrated approach to KETs, an additional emphasis will be put on activities exploiting the accumulated benefits from combining a number of KETs, in particular through supporting larger-scale pilot line and demonstrator projects.

The international cooperation with third countries is necessary to address effectively many specific objectives defined in Horizon 2020/2025. This is the case in particular for all the societal challenges addressed by Horizon 2020/2025, which need to be handled globally. This is why the Danube Strategy will pose the greatest challenge for Horizon 2020/2025 and, thus, needs to be tackled one step at a time in accordance with the Roadmap milestones.

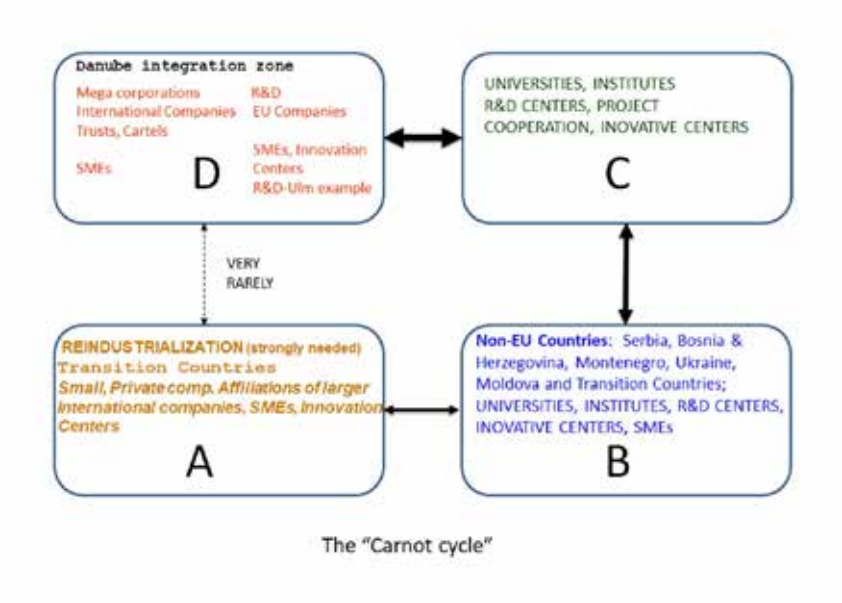


Figure 8 - The Carnot Cycle for Innovations [10].

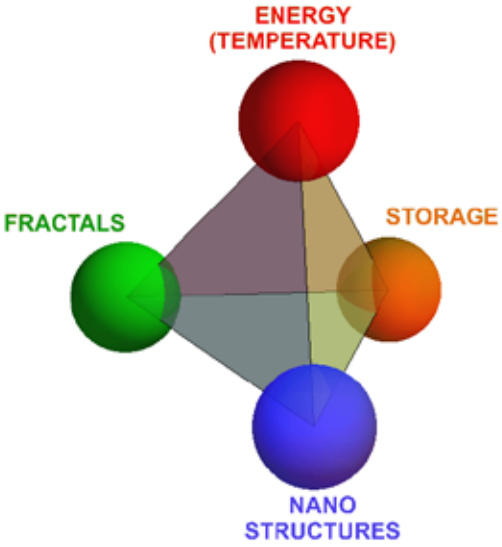


Figure 9 – The tetrahedral diagram shows the interconnection between the four key components contributing to the energy-nanoscale relation, which is one of the most important future goals [6].

What is the message and the goal of this paper?

There is no real development without the innovation which meets life, research, industrial development, and especially reindustrialization in transition economies. There will be no use of innovation if we don't have large companies and academia working together. SMEs and innovation centers, as independent actors in the market, are not enough for development without large and successful companies.

We can expect that the next Danube Academies Conference (DAC) 2018, Stuttgart will continue to develop and emphasize the DR integrations especially by supporting development programs in the fields of science, technology, research, and business in non-EU countries in order to accelerate their full integration in the European Union. It is very important to underline the only possible success story for related academies of non-EU countries (universities, institutes, research centers, labs, etc.), that is, the innovation through EU countries and academia in order to open doors to the implementation of innovations in the market-proven international companies.

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