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SETTING STRATEGIC PLAN FOR CROSS REGIONAL KNOWLEDGE TRIANGLE NETWORK

Review by

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INTRODUCTION

This review is an original compilation of[1–7] and aims to highlight key principles and actions to develop the knowledge triangle networks.

The contribution of higher education to jobs and growth, and its international attractiveness, can be enhanced through close, effective links between education, research, and innovation – the three sides of the '**knowledge triangle**' (KT) [3].

The knowledge triangle is a priority in the process of creation of globally innovational society on the basis of development and integration of the three elements of the knowledge triangle (education, research and innovation), as well as capital investment into human resources, development of professional capacities and support of scientific research, ensuring modernization of education systems, etc., so that they become more relevant for the needs of a knowledge-based global economy [7].

The recent shift towards open innovation has resulted in increased flows of knowledge and new types of cooperation between education institutions, research organisations and business [3].

The concept of the knowledge triangle relates to the need for improving the impact of investments in the three forms of activity – education, research and innovation – by systemic and continuous interaction. The knowledge triangle provides a way of understanding and promoting the role that the strong interaction between education, research and innovation can play for society and business as well as for higher education and research.

Interaction is the flow of knowledge between the concepts and the interaction between the actors which epitomises what is behind the knowledge triangle. It particularly highlights the non-linear nature of knowledge creation and the multiple input and feedback loops that exist between the actors in the knowledge triangle system. There are no poor relations in the knowledge triangle. As a model it is flexible and fluid with all sides of the triangle having a key role in the creation of new knowledge, ideas and innovation. From the perspective of European higher education

institutions creating knowledge, sharing knowledge, developing skills, curriculum development, embedding new ideas in markets and contributing to new relationships are some of the important aspects [1].

Currently, the four components (regulatory, organizational, human resources and financial frameworks) are often determined by systemic, institutional and bureaucratic barriers. The cross-connection of these barriers has a negative effect on the research potential. The outcomes of these barriers could contribute to an inadequate, inefficient and ineffective implementation of policy documents and development strategies in the field of research and innovation [7].

The **structural constraints** for the KT are follows [7]:

– Lack of human resources in the field of research and development. The number of persons employed in R&D decreased significantly due to "brain drain", while among the remaining researchers a certain ageing trend can be observed. At the same time, the R&D field is unattractive (from salary and existing infrastructure points of view) for young talents. The level of knowledge obtained in local universities does not meet market expectations, while attraction of foreign students or researchers is difficult due to unappealing conditions. All these factors, and not only, determine poor quality of scientific research;

– Insignificant investment in the KT development, especially from the private sector. All types of activities related to KT are under-funded and rather limited as a result of a low GDP. This is mostly due to a near lack of funding from the private sector. Moreover, it is difficult to identify clear and well defined scientific and technological priorities in the modest governmental funding;

– Poor interaction of KT stakeholders (universities, research centers, regulatory institutions, enterprises, etc.). These stakeholders are not integrated into an efficient and operational KT; each of them work rather separately: research centers yield mostly academic results, universities are oriented mostly towards education, while businesses focus on the market and products with low technological intensity (cheaper products);

– An inefficient KT management model. A Soviet-type management model hasn elevated level of centralization and a rather “academic” nature. The current system of organization of science and innovation lacks clear separation of authorities responsible for formulation, implementation, monitoring and evaluation of relevant policies;

– Lack of an adequate innovation infrastructure. The solution to this problem takes time; it involves additional effort and can be achieved by establishing a regional network of business incubators in all fields of scientific knowledge.

– The mechanism of evaluation and monitoring of law reforms and of their potential effects on national economy is uncertain and undefined. Also, **the lack of a set of indicators comparable with regional and international statistics** makes performance evaluation of KT even more difficult.

The priorities for action and associated challenges in developing education in the knowledge triangle [1]:

– Developing more coherence between policies in the field of education, research and innovation.

– Accelerating pedagogical reform.

– Partnership between universities and business and other relevant stakeholders.

– Measures to develop an innovation culture in universities.

– Creating incentives for universities to develop transferable knowledge.

– New approaches to quality assessment.

The set of challenges for the education sector in the knowledge triangle [1]**.**

– The need to **bridge the gap between education and research and innovation**, where Higher Education Institutions have a unique pivotal role. At present, however, even though most institutions interact with the other elements of the knowledge triangle, they often do so in a fragmented way – contacts with industry being undertaken by careers services, technology transfer offices of varying roles, by alumni services and fundraising functions and through individual professors

– A need for a **more innovative and entrepreneurial culture in the university sector** has been identified, covering all aspects from pedagogical methodologies to the encouragement of student business and spinouts from research activities, start-ups and incubators. This has implications for many dimensions of HEI activity and governance, and is the subject of a separate study.

– A need **to improve communication and mobility between teaching and research and business and the wider economy** has been identified so that knowledge flows can be optimised, with people as the vector of transmission. At present barriers of various natures exist to these types of mobility – both cultural and practical. They raise issues of career structures and accreditation, recognition of qualifications and asymmetric barriers to entry.

– A need for **further reform of governance and financing structures** for greater autonomy and accountability to facilitate more diversified revenue streams and more effective collaboration with the business world. This is needed to give universities the flexibility to operate within this linked and entrepreneurial environment. Barriers include legal frameworks – limiting the powers of universities in fields as diverse as Intellectual Property and staff contracts A further challenge, highlighted earlier, is the need for education to raise its profile within the debate on the knowledge triangle, which until now has been dominated by the research/innovation dimension.

The role of universities is crucial operating within their regional innovation ecosystems while being connected to global networks at the same time, and making the complex inter-linkages more understandable and visible. The quality and joy of research, learning and working will enhance remarkably, when the university activities are increasingly based on the real life & real case -approach building bridges to innovation and societal impact. The effectiveness and efficiency of the university community will grow, when its operations are based on the implementation of the Knowledge Triangle principles and practices [4].

1 THE KNOWLEDGE TRIANGLE
STAKEHOLDERS ITERACTION AND STRATEGIES

The implementation of the perfect concept of the knowledge triangle will strengthen the situation in the following sectors [7]:

– Education and business. Although there is currently no direct relation between the labor market and universities that prepare young specialists, the recent years' higher education graduates (Bachelor, Master) have the possibility to do their internships at any company, depending on their profile. Such internships increase graduates' competencies and give them the possibility of employment. So, one of key directions is to strengthen innovation connections between companies, universities and research institutes in order to achieve productive merger of competences and resources required for an innovative economy – financial, human and scientific capital. Their synergy will result in new products and services, or a niche eventually, capable to compete successfully on national and foreign markets. Given the fact that there is no "National Qualifications Framework, updated professional training and occupational standards nomenclature," professional training at all levels of education does not ensure the skills required by the labor market. In this respect the following solutions may to be implemented:

1) Introduction of elective courses in entrepreneurship and economics in secondary and high school education;

2) Development and implementation of education programs related to innovation in management and engineering departments: law and economics of intellectual property; innovation management; marketing of new products; evaluation and sale of intellectual property objects;

3) Increase of scholarships for undergraduate students, Master's students, PhD students in exact sciences, engineering and technology and increase of the number of undergraduate students, Master's students and PhD students in exact

sciences, engineering and technology due to redistribution of places for specialties that are unappealing for the labor market.

– **Education and research.** The education is one of the most significant factors for human resource development. Education has an essential role in ensuring economic growth, modernization of technological and intellectual components and increase of population's welfare. Only by acknowledging the fact that the quality of education is vital for the formation of the research potential a tighter relation between education and research can be achieved. In higher education institutions the research, development, innovation and creation activities are performed for the purpose of learning and professional training of highly qualified specialists. The European experience shows that the creation of cluster-type networks, where manufacturing enterprises, education institutions and public institutions interact, boosts the technological performance and productivity, contributing to companies' competitiveness, market extension and increase of visibility.

– **Research and business.** Business is a key component needed for the economic development of any country. Entrepreneurs who decide to engage in innovation activities need highly qualified researchers. But the absolute majority of companies do not conduct research and technological development due to the increased level of financial risk. So the state need to support companies that are committed to using their own resources for developing new promising technologies. In this context, the intellectual potential of researchers, inventors, engineers, patent service workers, etc. will be highly demanded by the business sector, which will lead to its rapid development and will make these professions attractive to youth.

The interaction between KT stakeholders is realized via three channels, each of them being double-directional [7]:

1. Relation/interaction between research and higher education. In this relation, the functions of the stakeholders involved in research activities consist in transfer of new knowledge and results of the research process to higher education, development and provision of scientific and methodological knowledge and new methods of its application, etc. Meanwhile, the role of the stakeholders involved in

education is to define qualifications for researchers, identify research areas for graduates and coordinate their research projects, etc.

2. Relation/interaction between research and innovation. This relation involves several stakeholders, with distinct functions each. For example, research and its stakeholders should provide to companies the newest inventions, know-how for using them, as well as provide services of expert examination and feasibility in various fields, etc. In their turn, companies determine and define directions for research, determine the economic parameters for application of research results, and apply the results that promise to be profitable, etc. On the other hand, the institutions promoting technology transfer perform the function of intermediary between research and real economy. At the same time, organizations that provide support to companies create and ensure the necessary conditions for the development of a healthy business environment and provide legal and economic advice to companies, especially newly created.

3. Relation/interaction between innovation and higher education. In this relation, the private sector (companies) formulate to the academic environment requests for the professional and social competences of future specialists and managers, while universities integrate them into university curricula and prepare professionals and managers according to the modern requirements of the labor market and of real economy. Also, universities contribute to the development of entrepreneurial culture, collaborate with the institutions that promote technology transfer and participate in the communication platform (cluster) between students, scientists and business representatives.

In this context, it is clear that the separate work of each of the KT elements cannot ensure its functionality or, subsequently, benefic effects in the process of establishment of knowledge-based economy at the national level.

The relationship between Higher Education Institutions and businesses is a very important catalyst of the knowledge triangle. There are following **types of university business cooperation** [1]

1. Collaboration in research and development (R&D).

2. Mobility of academics.

3. Mobility of students Commercialisation of R&D Findings.

5. Curriculum development and delivery.

6. Lifelong learning (LLL).

7. Entrepreneurship.

8. Governance An important finding of the study is that cooperation between Higher Education Institutions and business in Europe is still in the early stages of development.

Knowledge Triangle should be supported with following **education activities** [6]:

1. Embedding the entrepreneurial culture throughout the higher education institution.

2. Involving students as co-creators of knowledge and as part of the innovation system.

3. Creating rich learning environments for talent development.

4. Quality assurance and recognition of new skills development.

5. Taking an interdisciplinary approach.

6. Developing academic talent.

7. Internationalization as a way of improving institutional practice.

8. Implementation of flexible manageent models.

9. Transforming working environments – widening access.

10. Embedding evaluation and monitoring of the impact of activities related to the Knowledge Triangle in the university strategy.

11. Smart specialization as a focus for knowledge triangle activities.

12. Taking the longer-term vision for change at the institutional level.

13. Incentives and funding structures.

14. Engaging with the national policy environment across the areas of research, education, enterprise and innovation

Three Generic Strategies in the Knowledge Triangle [6]:

– a strategy of transmission, from one part to another, where universities broadcast knowledge in order to accelerate its use (e.g. through curricula and conferences),

– a strategy of translation, where universities mediate knowledge, adapting it to a specific use in a practical context (e.g. consultancy) and

– a strategy of transformation, where universities manipulate knowledge in order to shape a given practical or theoretical knowledge for new use.

Whichever the strategy, its formulation must include some information about the university, such as:

– Identity: competences, specificities, mission within the Knowledge Triangle.

– Localization: creating meeting places or hubs, adapting and putting the Knowledge Triangle into effect in the university environment.

– Learning: having a portfolio of projects (as they will not all succeed), creating new competencies.

– Structures: a network that is open to all stakeholders.

– Politics: finding the right alliances and operating in the right arenas.

The development of the knowledge triangle requires that involved organizations will contribute to [7]:

– **Restructuring and reorganization of existing institutional structures of universities and research institutions:** Such structural reforms would allow to increase the global competitiveness of universities, develop strong research environments, boost business ties and better ensure and support cohesion with the EU in the field of academic performance of universities;

– **Improving funding for universities:** The key factors for the success of research funding systems are a mix of appropriate framework conditions. Most European universities are publicly funded. It is also still the most important source of funding flow for Moldovan universities. However, the use of multiple sources of funding could lead to greater stability and greater autonomy for universities;

– **Promoting competitive funding models:** Funding is a key concern for universities worldwide. To get a better quality of research, it is necessary to develop clear concepts and selection mechanisms. In this context, the emphasis on performance and establishment of appropriate indicators are important for successful funding of research;

– **Supporting researchers throughout their careers, focusing on creation of good framework conditions:** Creating an attractive, open and sustainable labor market for researchers;

– **Ensuring better interaction between research, innovation and higher education:** In a knowledge-based society, research should not be isolated from neither innovation nor education. It is important to better integrate aspects of higher education, research and innovation in national strategies;

– **Removing deficiencies from the current regulatory framework:** A real obstacle to the conduct of research and innovation activities by all stakeholders and at all levels;

– **Developing and implementing coherent and comprehensive strategies and policies in the field of "brain circulation":** The required number of young scientists is very high because many researchers retire. Moldova should strengthen its ability to attract and train young people to become researchers and provide nationally and internationally competitive research careers. Also, attracting the best researchers from abroad;

– **Ensuring a closer interaction between universities and the non-academic sector:** Universities must start working with a wide range of private and public sector partners in order to increase the amount of private money invested in research. Major benefits could come from the knowledge transfer from research into new businesses, services and policies.

The requirements for the functionality of the knowledge triangle required to be implemented [7]:

1. Non-functional requirements for the system of education, research and development:

– Giving a broader meaning to the innovation concept and increasing the role of research and innovation in the country's general development process, referring both to the innovation based on research and research related to commercial models, planning, brand strategies and services that bring added value to users;

– Strengthening the education system through adjustment of education offers to market requirements. Creation and stimulation of business education programs for pupils and students, which would help in the transition from education to real economy;

– Strengthening the innovation potential by increasing the motivation of researchers and innovators, improving education by bringing curricula in line with international market demands, reconciling the education offer with business requirements;

– Encouraging cross-border cooperation among various stakeholders, which involves the use and exchange of knowledge and experience. Recently, it has become one of the more and more used ways to develop successful innovations.

2. Functional requirements for the system of education, research and development:

– Initiating state programs to facilitate interaction between the business community and universities through creation of innovation **Clusters** and **Voucher** initiatives – granting vouchers to Small and Medium Enterprises (SME) which would cover the cost of BDS (business development services) package. These BDS packages can be offered as consultancy, feasibility studies, training, marketing, information, technology transfer, etc. The BDS intention is to improve a company's performance and access to markets and to strengthen its competitive capacity. Moreover, the BDS package can be a mechanism for stimulating further demand for BDS, since the state (or specialized entities) is able to facilitate interaction between the business community and universities by referring potential BDS customers to universities or research centers.

– Involving all stakeholders in the innovation cycle: not only several high technology companies or big enterprises, but also SMEs from all sectors, including

from the public sector, social economy and even citizens (“social innovation”), each focusing on their own strengths (“intelligent specialization”), within a partnership. Thus, the development of innovative SMEs by ensuring favorable conditions for organization and development of their activities and decrease of start-up risks is a first step to creating new national innovation networks. Moreover, considering that a true competition and a good functioning of competitive markets are key elements for innovation, strict application of competition rules that ensure access on the market and opportunities for those who enter the market for the first time is a must;

– Creating a national innovation network (science and technology parks, innovation incubators, information technology transfer centers, business incubators, science and innovation clusters) and creating a mechanism for collaboration between science, education, innovation, production and funding;

– Developing an integrated evaluation system (a set of indicators) to assess the innovation capacity and performance of local companies as a mechanism of quality-based evaluation of innovation project results. There is no information on the level of innovation activities within companies and firms due to an imperfect record system of statistics and accounting on innovation activities and their costs;

– Clearly separating competences in the field, which could increase the reliability of the institutions involved in scientific research and innovation and contribute to increasing their efficiency and effectiveness.

3. Non-functional requirements for the improvement of access of research institutions and enterprises to funding:

– Eliminating shortcomings from the current regulatory framework. The regulatory framework must be adjusted to current requirements, which would protect both the national entrepreneurs that intend to develop their business through innovations and the foreign investors that would invest in new risky but promising businesses;

– Supporting researchers and young specialists in their entire career, focusing on the creation of good framework and financial conditions. Encouraging research specialists through attractive salaries;

– Promoting public-private partnerships focused on innovation;

– Further developing the infrastructure of knowledge triangle support.

4. Functional requirements for the improvement of access of research institutions and enterprises to funding:

– Eliminating discrimination in funding research activities and opening access to public funding for the private innovation sector;

– Creating a micro-crediting fund for innovative micro-enterprises, aiming at developing a network of incubators as business accelerators in creative industries;

– Expanding the area covered by the Credit History Bureau, focusing on micro-funding institutions, leasing companies and loan and savings associations;

– Strengthening the capacity of the Credit Guarantee Fund and the Deposit Guarantee Fund;

– Reviewing tax policies and the tax system to create a favorable framework for the implementation of various financial instruments;

– Modifying and improving banks' risk assessment procedures and methodologies;

– Creating a mixed fund (funding both from the state budget and private sources) to support new export-oriented innovation businesses (start-ups);

– Applying "venture" and "business angels" type instruments.

5. The requirements to future conditions of the knowledge triangle:

– Reconfiguration of the regulatory framework is required to optimize and make the governing in the fields of education, research and innovation more efficient. Correct reconfiguration will lead to expected medium- and long-term results;

– It is necessary to develop a mechanism for effective management of innovation and research assets, including modification of funding for innovation projects carried out by SMEs. To create appropriate conditions (at least supplying the necessary and new equipment) for business development within science and technology parks, innovation incubators, research centers/laboratories/facilities of training centers. It is necessary to adopt the law on venture funds. Therefore, these hedge funds will facilitate business development based on innovation;

– The development of a common strategic framework between the public sector (representatives of legislative power) and the private sector that will determine specific actions and, as a result, will influence the development of education, research and innovation. The modification of legislation and encouragement of private sector through financial incentives, “tax vacations” for start-up SMEs and other rewards can be a potential solution for the stimulation of public-private partnerships;

– It is mandatory to adequately allocate resources (financial, material and human) for all activities related to research and innovation – not only a decent salary to experienced specialists, but also to create conditions that will attract young specialists with innovative ideas, strengthen communication relations and interaction with national and international partners, etc.

2. REGIONAL INNOVATION SYSTEMS

The innovation system approach sees a high degree of division of labour and of non-linear exchange of knowledge among the various actors (enterprises, HE institutions, public institutions, etc.) as a main characteristic of innovation processes. Regional innovation is a kind of collective learning which results from the interplay of the various actors in a regional innovation system. This approach puts much more emphasis on a balanced view of the various actors involved in innovation

A **Regional Innovation System** (RIS) is composed of three subsystems, including the respective actors [2]:

– Generation and diffusion of knowledge, composed of the regional institutions of research and teaching, as well as technology transfer and human resource development;

– Application and (economic) utilisation of knowledge, includes the regional enterprises;

– Regional political and policy system and its supporting/promotion institutions.

Those subsystems are seen as embedded in a common regional socioeconomic and cultural context, and ideally interact in an intense net of flows of knowledge, human capital and resources.

The RIS-approach does not exclusively focus on the direct commercialisation of knowledge from higher education, but includes a much broader set of exchange mechanisms, e.g. consulting or commissioned research, as well as formal co-operations, networks or industry clusters.

Main results of empirical research in this approach are:

– The transfer and exchange of knowledge, which is not only dependent on the HE institutions, but depends on the contributions by the various actors and their interactions is a very important element in innovation.

– The demand for knowledge, and the potential of the regional economy to utilise the supply of knowledge (“absorption capacity”) are of equal importance as

the sufficient supply. The demand for knowledge depends on the regional economic structure; various trades and sectors differ significantly by their knowledge base or their learning and innovation practices.

– In traditional sectors that use a *synthetic knowledge base* innovations are driven by the "Doing-Using-Interacting (DUI)"-type of learning and innovation; experience, informal learning, application and recombination of existing knowledge, and cooperation with customers and suppliers are main sources of innovation.

– The (high-tech) sectors using an *analytic knowledge base* apply the "Science- Technology-Innovation (STI)"-type of learning and use innovation that is built on the scientific and technological knowledge as well as on interactions with universities and other research organisations.

– Thus, different sectors demand different kinds of knowledge.

The RIS approach emphasises the context dependency and situation specificity of the knowledge transfer and use, and points to the different types of learning and innovation (DUI and STI) which need different kinds of knowledge bases, and development, transfer, and circulation mechanisms. Thus a broader set of activities of knowledge exchange (mobility of workers, research cooperation, informal and noncommercial mechanisms) is considered, which do not so much privilege HE institutions as suppliers.

Political consequences are beneath the strengthening of the role of HE institutions in the regional innovation activities also to consider the roles and potentials of the other players in the system, and to strengthen the interactions including SMEs and the integration of HE institutions in broader regional structures (e.g., cluster development, and regional steering bodies; "Multi-Actor-Governance").

As an approach for the third mission of higher education the involvement of HEIs in the regional interactions and processes is the most important aspect, and besides HE the role of vocational education is an important asset in DUI Innovation.

A substantial further development and refinement of the RIS can be seen in the use of smart specialisation in the regional context. This approach tries to concentrate resources in areas where demand can be reasonably identified.

This concept has such barriers.

– The relationship between regional and wider processes beyond the regional context, and to a neglect of the creation and circulation of knowledge beyond the regional borders.

– Specific combinations of regional and trans-regional knowledge might be particularly supportive for innovation, as HE institutions as well as enterprises are embedded not only in regional, but also in wider relationships.

– How much universities in fact specifically contribute to their regional context as compared to wider spaces up to the global one has not much been systematically analysed so far in this approach.

Regional innovation policy initiatives are driven by the fundamental aim of bringing together key actors within a given region or district for joint innovation activities. The Triple Helix model has been widely adopted to help identify the key linkages and core functions between the public sector, academia and private companies. However, this and other traditional collaboration models and frameworks have evidently remained too generic and abstract, and consequently, produced only nominal results in guiding regional innovation processes. It is important to note that the true nature of regional innovation ecosystems (RIE) is necessarily much more complex than understood so far, and thus, needs to be addressed in a more comprehensive and systemic way to provide functional guidelines for the development of operative innovation platforms. The Triple Helix and other models need to be complemented with market aspects, demand factors, and increased participation of citizens as users and developers of innovation. The models need to be supplemented with smart orchestration practices bringing together key stakeholder interests, and extended to address the specific challenges related to the value system competition in global contexts [6].

There are policies required for RIS[2]:

– **Students involvement.** As the first mission of HEIs was always education – and it always will be. According to academics asked about the main beneficiaries of their cooperation with business, they mention the students. Since

students are at the heart of HEIs it seems obvious to involve them actively in KT processes, be it research-teaching-nexus approaches or innovation activities “using” students for bridging between sectors.

– **Long-term perspectives.** HEIs do not change over-night, nor do academic cultures. Implementation processes of the KT need time and a long-term perspective. The same applies for KT activities, especially the fact, that relational qualities are more valued than business qualities in facilitating cooperation shows, that KT activities need sustainable partnerships, within and outside the HEI.

– **Career development for academics.** Academia has its own procedures of adding to reputation and promoting researchers. To encourage academics to get more engaged with the KT, these activities need more visibility outside but especially within academia and have to be considered as another criterion besides research excellence for the evaluation and promotion of researchers.

– **Interdisciplinarity.** Innovative actions call for interdisciplinarity. But like bridges need solid riverbanks, interdisciplinarity needs excellent researchers from the respective disciplines. Disciplinary know-what and know-how are of great importance for innovative action. Thus, an atmosphere of partnership on equal foot across scientific boarders and with business partners seems to be crucial for realising interdisciplinary work.

– **Valuing of KT activities.** The initial implementation of KT activities is time and money consuming. While financial resources are an issue of funding and supply of resources, the aspect of time resources is also related to the career development issue. Further, this point relates to the accreditation of KT activities for students already.

– **Integrating the KT into HEIs’ strategies.** This is by far the most ambitious effort, but examples show the benefits of this approach, for the region, the students and the HEI. Last but not least, this integration leads to more responsiveness of HEIs to their regional environment at all vertices.

The following **guidelines** were defined **for immediate action** [6]:

– The focus must be on creating and implementing innovations on a practical level, based on values and mentality, in order to achieve concrete results for the well-being of citizens;

– Political decision makers should consistently demonstrate the courage needed to aim for the highest ambitions and bring forth something radically new;

– Regions and cities should create pioneer initiatives that are genuinely European by nature: multicultural, human-centered, focused on societal innovations and capabilities for creating better structures for the welfare society and laying the groundwork for the Digital Single Market development.

– Academia must be assessed for its overall scientific abilities (faculty structure, number of researchers, research output, number of centers of excellence etc.), its ability to create commercially interesting intellectual properties that create grounds for patenting or new business creation (start-ups and licensing), and its readiness to provide adequate services in R&D contract management and technology transfer.

– The private sector audit should include a comprehensive industry analysis to identify the potential anchor companies, the promising growth companies and the dynamic start-up ventures that can complement the ecosystem with the commercialization talent required for regional prosperity. These sector-specific assessments can be complemented with a related human resource (HR) audit, where the focus is on the regional talent pool, its development and training. During audits, it is important to identify the potential gaps within the ecosystem and plan for actions to attract and recruit “glocal” talent to the emerging value network roles.

The **stages for regional actions implementation**.

1. Public support.
2. Regional pre-conditions:
   – Potential of existing regional/international innovation system (= audits);
   – Willingness to utilise this potential (= active participation).
3. Creating the innovation hub:
   – Joint R&D;

– Joint innovation capacity;

– Joint commercialization;

– Joint platforms.

4. Orchestrating Regional Innovation Ecosystem (RIE):

– Mindset change;

– ImplementingKnowledge Triangle;

– Integrating innovation activities with research programs/

5. Development of National or Regional Innovation System.

If and when regional decision makers decide to upgrade their respective innovation ecosystems to be globally interconnected, the regional audits should be extended to analyze also the global role and targets of the ecosystem. The first notion is that to be globally competitive and interesting, the region must make sure the key results (quality, critical mass in numbers, relevance, degree of specialization etc.) of all of the above basic audits create an appropriate foundation for its global actions.

The coordination of parallel, partly even conflicting sectorial interests, and the orchestration of common collaborative interfaces have proven to be one of the most critical management issues for all innovation hub organizations. The public-sector actors focus on setting up the policy foundation and related regulatory framework to meet the broadest possible societal needs and actively promote innovation, cross-sectorial collaboration, while the private-sector actors plan to line up their in-house innovation processes for delivering the maximum commercial benefits. As neither party could accomplish their respective missions without the other, they are drawn to establish productive, mutually beneficial partnerships. However, they often lack the necessary understanding of the related key factors (including common terminology, need for sharing interests with third parties, facilitating work methods) that need to be aligned for truly fruitful outcomes. Hence, it is common that they look for interpreters, facilitators and coordinators to mediate the process, which usually means business for the hub organizations.

This key orchestration activity is called smart orchestration, which implies: active cross-sectorial communication to reduce overall ambiguity, coupling the

sector-specific needs and requirements for a unified ecosystem structure, leading the shared development of the pro-innovation culture and joint processes towards regional ecosystem excellence.

Smart orchestration facilitates ecosystem integrity and increases synergy, creating a unified code in bringing together the parallel innovation processes and distributing the best practices on all innovation related issues. The proposed management approach calls for an explicit shift of focus into managing the related, industry-specific interfaces for effective cross-sectorial processes, and a smart approach to addressing the associated hand-over of responsibilities, control and authority across domains.

It is natural to conclude that innovation hub actors could also play an important role in channeling and managing the ecosystem-level resource flows to support shared activities and collaborative processes. In most cases, ecosystems can benefit from a professional coordination function, which specializes in:

– core funding issues (e.g. options of public investment support, regulation and practice for public procurement, program funding for coordination)

– application procedures (domestic and multinational context), and

– channeling resources (both public and private) for effective combinations.

Self-evidently, accumulating expertise improves overall process efficiencies and facilitates practical coordination. Consequently, hub actors could play a key role in advising the other innovation actors in the planning and management of joint infra-structure projects, layer-by-layer development programs and related coordination of regional innovation creation processes. They can focus on securing and upgrading the required human resource pools for innovation, support regional project creation, and plan for an appropriate portfolio of the key science and technology and R&D infrastructure/service assets for all to share, while public officials, researchers and business (wo)men could focus on added value creation and optimized innovation processes.

3. THE PRINCIPLES OF KNOWLEDGE TRIANGLE NETWORK BUILDING

Networks are broadly understood to be a combination of persons (or organizations), usually dispersed over a number of geographically separate sites, with appropriate communications technology.

The term "**knowledge network**" is often used as a blanket description for a variety of collaboration models. However, there are a number of important distinctions between our emerging model of a formal knowledge network and other models of institutional collaboration. There are, of course, many hybrids of these basic models, and best management practices for one model can well serve to strengthen other collaborative approaches.

There are folowing **knowledge network models** [5].

– Internal knowledge management networks. These networks evolve through the thematic mapping of expertise within an organization, combined with the creation of appropriate environments for knowledge sharing. Their primary purpose is to maximize the application of individual knowledge to meet organizational objectives. These networks are largely internal, although they may cross national boundaries.

– Strategic alliances. In the private sector, these alliances are long-term purposeful arrangements among distinct but related organizations that allow those firms to gain or sustain competitive advantage vis-à-vis their competitors outside the network. A true adoption of the private sector model by civil society organizations would involve real value appropriation (money, time and influence) among the partners in the network. Each partner must ask itself how this alliance will further the partner's competitive advantage and strengthen its position in the marketplace of ideas. Partners do not necessarily need to have equal status in the relationship; alliances can function with a dominant partner or partners. Strategic alliances are usually built one partner at a time.

– Communities of practice. Two or more individuals can create a community of practice for conversation and information exchange, possibly even leading to the development of new ideas and processes. Participation is purely voluntary and will wax and wane with the level of interest of the participants. Communities of practice primarily build capacity. They attract individuals who are willing to share their expertise in exchange for gaining expertise from others. The principal driver is the desire to strengthen their own skills for their own objectives, more than a desire to work together on common objectives.

– Networks of experts. These networks bring together individuals rather than organizations; the invitation to join is based on expertise in a particular area.

– Information networks. These networks primarily provide access to information supplied by network members, occasionally with overlays of interpretative materials that organize content thematically. However, they are fundamentally passive in nature. Users must come to the network—physically or electronically— to benefit from the work of the network.

– Formal knowledge networks. Formal knowledge networks tend to be more focused and narrowlybased than information networks; more cross-sectoral and cross-regional than internal knowledge management networks; more outward-looking than communities of practice; and they involve more partners than some strategic alliances. A formal knowledge network’s strengths lie in its productivity and its impact on decision-makers. It is weak, however, in communicating research with broader audiences.

A formal knowledge network is a group expert institutions working together on a common concern, to strengthen each other's research and communications capacity, to share knowledge bases and develop solutions that meet the needs of target decision-makers at the national and international level. The key elements in this definition focus on purpose, expertise, capacity development and the recognition that the knowledge being shared and developed is not primarily for the network itself but for use by others, specifically decision-makers.

Operating principles for formal networks [5]:

1. Knowledge networks are **purpose driven**. We have observed that the narrower the focus, the more influential a network becomes. We recommend, therefore, that institutional collaboration take place around a single issue or problem rather than a broad spectrum of interests. Focus is essential. The network's research on the issue should be transdisciplinary, always keeping in mind the sustainable development framework of economics, environment and social considerations, as well as the governance implications of its work. The purpose of the network could be thematically based (e.g., trade, dams, ozone depletion) or regionally focused (e.g., environmental policy options in Central America).

2. Knowledge networks are **working networks**. One of the greatest challenges in setting up and running a network is moving the participants beyond sharing information to actually working together on solutions. In our view, knowledge networks are far more “work” than “net.” A working network is driven not just by research, but by implementation. As part of creating work plans for the network, the members should focus on how the results of the network's research will be used. The work plans should include strategies for the application of the research: How will the research be linked to the public policy process? How will the process or technology developed by the network be commercialized or put into practice by those outside the network?

3. Knowledge networks **require institutional commitment beyond the participation of individuals and experts**. While expert networks and consultative groups have their place, we have learned that a knowledge network requires the commitment of an institution for several reasons:

– Accountability: The participants in the network represent institutional mandates rather than personal research interests. The agenda is, therefore, more likely to be focused on implementation. Participants are also held accountable for their work not only by their colleagues in the network, but by the institutions they represent.

– Continuity: Networks can take up to a decade to thrive and have real impact. With institutional commitment, it is more likely that work will continue even

if there are staff changes. 20 Strategic Intentions: Managing knowledge networks for sustainable development

– Commitment of resources: The network activities will be endorsed as part of each institution's mandate, more easily justifying financial and in-kind support from participating institutions and ensuring their involvement in promoting the results of the network's research.

4. Knowledge networks are **built on expertise, not just interest**. The identification and selection of members is one of the most important tasks of the network. The reputation of the network, and the level of influence it will have, will be based on the expertise and credibility of the members. Institutional membership should be based on expertise and the capacity to undertake the research and implement work plans. Interest in an issue is not, in itself, reason enough to include an organization in a knowledge network. Membership in a formal network should be based on merit. This lends an aura of exclusivity to network activities, which makes development workers trained in consensus and public participation methodologies uncomfortable. Nevertheless, in order for a knowledge network to create new knowledge and to have real influence, that knowledge and influence must be grounded in expertise and reputation. If exclusivity is a concern of the network, then communications mechanisms can be employed to bring points of view from outside of the immediate network membership. These include workshops, electronic conferences, the nomination of associate members for specific activities and the formation of more open, dynamic “working groups” within the formal network.

5. Knowledge networks are **cross-sectoral and cross-regional**. Knowledge networks should result in a reduction of boundaries between sectors such as universities and industry, or governments and civil society. Sometimes, this can be accomplished through appointing representatives from different sectors to the network. In other cases, this is accomplished by including cross-sectoral interests in work plans and implementation strategies. International knowledge networks must include the experience of developing and transitional countries. This respect for

diversity— diverse values, interests and knowledge—is the basis for crafting creative solutions that are more likely to last.

6. Knowledge networks must **develop and strengthen capacity in all members**. Strengthening capacity is critical to the formal knowledge network model. Organizations create knowledge networks to learn from each other and build on each other's strengths. Capacity development occurs at all points in the work plan: in research management; in the substantive issues; in virtual teamwork; in communicating findings more broadly; and in influencing decision-making.

7. Knowledge networks are **communications networks**. This final principle underpins all the others. The knowledge created and aggregated by the network must be shared beyond the network members. This operating principle is part and parcel of a network being a purpose-driven, working network. Mechanisms must be put in place from the beginning to reach targeted decision-makers who will be the ones to put the research of the network into action. These engagement strategies include traditional communications approaches including distributing printed reports and placing the content on a network web site. But, the strategies must go beyond that and build relationships with decision-makers through regular, repeated contact, engaging them in discussions on the research and recommendations through workshops, electronic conferences, and other means. Broader audiences should also be informed about the network, through effective use of web communications technologies on a network web site, and through marketing and positioning on other web sites, including the individual sites of network members, portals and gateway sites.

The first two principles related to purpose and work lie at the heart of the network. The second group of principles addresses a variety of membership considerations including the composition of the network (expertise, cross-sectoral and regional experience) and the interaction of members (institutional commitments and capacity development). These serve to strengthen the reputation and effectiveness of the network, without which it would have no impact on decision-makers. The final principle, that the network is a communications network, emphasizes the *raison*

d'être of the network: the transfer of its work into implementation through the engagement of decisionmakers and communication with broader audiences.

The **universities need to take actions** [4]:

– Network-centric working culture focusing especially on desired attitude and mindset change

– Targeted orchestration of major transformation operations

– Creating new collaborative value creation methods, processes and models

– Planning and implementing the activities with strong mental, physical and virtual architectural dimensions to create innovation ecosystems

– Making strategic choices to start potential breakthrough mega-level initiatives focusing on joint-research topics to create new solutions.

CONCLUSIONS

To eastablish and develop the Knowledge Triangle it is needed to use following **recommendations** [1].

1. Embedding the entrepreneurial culture throughout the higher education institution. The entrepreneurial culture should be embedded throughout institutions, among staff, students and with partners/other stakeholders. This involves changing many of the ways in which a university tackles its teaching, research and other third mission activities, putting partnership at the heart of approach. In some cases this is a centralised approach, in other cases the approaches taken are decentralised. Both approaches can be powerful. This is an over-arching recommendation which can be implemented in many ways. The subsequent recommendations for universities should all, in part, lead to increasing the entrepreneurial culture.

2. Involving students as co creators of knowledge and as part of the innovation system. There is a fundamental shift in the position of students in many institutions from an end product or consumer to an integral part of the development of knowledge and opportunities. Students already look for all kinds of additional opportunities to enhance their academic achievements and they increasingly value opportunities for internships, project based activities, creating their own relationships with stakeholders and exposure to new learning environments. Universities and business alike can benefit from these relationships.

3. Creating rich learning environments for talent development. Many of the case studies are taking novel approaches to teaching and learning and embedding them across curricula. This is not just about entrepreneurship but talent development in general. The role of the student in being part of creating these environments is increasingly important, especially in action learning. These new learning environments are equally important in those universities which are now providing vocational education and lifelong learning opportunities for business and the wider public. Those outside of the formal education system often respond better to

collaborative learning environments and ideas development delivered through informal teaching and learning mechanisms. The rich learning environments also need diverse types of teachers. Institutions are engaging more industrial partners to deliver courses or course modules. In addition, researchers are given more teaching time in order to ensure transfer of knowledge from current research into the curricula. All of these elements together are crucial in developing the transversal competencies which graduates need for creating companies, gaining access to the labour market or working in research.

4. Quality assurance and recognition of new skills development. Students are both changing the relationships they have while at university, and also changing the way they learn. Therefore it is important to find new ways of recognising the wider variety of skills that are being accumulated in these rich knowledge triangle environments.

5. Taking an interdisciplinary approach. Universities with developed approaches to the knowledge triangle have a strong emphasis on interdisciplinarity and on breaking down traditional academic silos. The approaches take place at many levels, including interdisciplinary research centres, interdisciplinary courses and modules and it is also embedded in the management structure in some universities. Interdisciplinarity is mentioned in most of the case studies as being part of its success.

6. Developing academic talent. Academic staff are faced with a number of new roles and responsibilities as universities changing their vision and strategies to include more aspects of working across the knowledge triangle. As well as incentives to engage in new activities, academics also need to have professional development opportunities to further develop their own talent and to allow them access to new ideas for teaching, learning and business interaction. Academics are a key mechanism for ensuring joint working and sharing of good practice happens across faculties and structures.

7. Internationalisation as a way of improving institutional practice. There are many reasons for universities to have a strong internationalisation agenda. There

are also specific ways in which internationalisation can affect knowledge triangle related activities. In the global operating environment linkages between education, research and business extend beyond regional and national borders. Internationalisation provides two strong ways for improving the knowledge triangle, first through international partnerships with both universities and business, and secondly through using these partnerships to learn about other approaches and improve their own institutional capabilities and practices.

8. **Implementation of flexible management models.** Universities are changing the way in which they manage their assets (research, education, students, relationships). There is an emergence of matrix organisational models. These types of models help to combine more traditional education and research activities with cross disciplinary approaches.

9. **Transforming working environments - widening access.** Many of the institutions in the case studies have developed close long term relationships with local research and industry partners and work with them across the education and research agendas. The working environment also plays a key role in making these relationships work. In some cases, this is through co-location of stakeholders and in others universities have developed physical spaces outside of the university infrastructure to help facilitate the relationships. Well designed spaces and buildings for interaction and networking are a common feature in this collection of case studies.

10. **Embedding evaluation and monitoring of the impact of knowledge triangle related activities in the university strategy.** It is always difficult to understand the relationship between activity and impact if there are no measurements being made. Evaluation and monitoring of university business interaction is still quite scarce external to technology transfer.

11. **Smart specialisation as a focus for knowledge triangle activities.** In order to be successful, it is important to look at the assets of a university and surrounding area and exploit them fully. Smart specialisation implies concentrating resources on a few key priorities based on a region's economic potential rather than spreading efforts and investments too thinly. In the smart specialisation strategies

encouraged under the Structural Funds, universities are highlighted as a key critical asset of the regional innovation system. Universities can turn this around for their own benefit as by tapping into the resources and talent of a region and specialising their knowledge triangle activities there is more chance of having a significant impact.

12. Taking the longer term vision for change at the institutional level. Many of the case studies highlight how changes in the way the institution works in relation to the knowledge triangle are often incremental and take time. Although there are some cases of major institutional reform, the initiatives and activities often build on years of other experiences and activities, learning and adapting by doing. Universities can capitalise on the lessons learnt from existing activities and set about implementing incremental change towards a long-term vision of the knowledge triangle as a part of the institutional culture.

13. Incentives and funding structures. It is not possible to recommend particular incentives or funding structures, which encourage knowledge triangle, related activities. There are too many national, regional and local specificities. However if universities want to develop relationships and create transferable knowledge it is essential to have the right incentive and funding structures in place. It is especially important to consider incentives for academics that are too often bound by professional development incentives, which relate to their research agendas and ignore education, business relations and other third mission activities. Competitive research funds in particular might be encouraged to look at all three sides of the knowledge triangle and treat them more equally.

14. Engaging with the national policy environment across the areas of research, education, enterprise and innovation. Universities are working in a much wider environment when tackling education, research and business. In countries where universities are closely linked to their ministries, the new agendas often means that they need to be able to work with more than one Ministry if they are to be able to fulfil all of their missions to equal success. Cross ministerial contact can be complex

and a recommendation to policy makers would be to try and overcome this barrier by helping universities to have access to all the necessary policy support.

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