PRIVATE SECTOR DEVELOPMENT

Policy Handbook

TRIPLE HELIX PARTNERSHIPS FOR INNOVATION
in Bosnia and Herzegovina

OECD

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POLICY HANDBOOK

Triple Helix Partnerships for Innovation in Bosnia and Herzegovina

MAY 2013

Foreword

Between 2000 and 2008 the Western Balkan economies experienced rapid growth, modest inflation, and increased macro-economic stability. The onset of the global economic crisis, however, saw a sharp drop in external trade and industrial production across the region. The crisis underscored the fact that buoyant growth prior to 2008 relied to a large extent on external financial flows, particularly FDI flows and international capital transfers that offset large and unsustainable trade and current account deficits.

The economic crisis is prompting governments in the region to make policy choices that will have implications for their long-term competitiveness. To assist Western Balkan counterparts in the design and implementation of those policies, the OECD Investment Compact for South East Europe (OECD IC) implemented a three year, EU financed, project called the Regional Competitiveness Initiative (RCI). More specifically, the RCI's goal is to assist with the design of sustainable economic policies on innovation and human capital development. Between 2010 and 2013, the RCI led pilot projects in seven Western Balkan economies: Albania, Bosnia and Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Kosovo1, Montenegro, and Serbia.

As part of its RCI pilot project, Bosnia and Herzegovina requested assistance with the implementation of Triple Helix Partnerships. The decision to seek OECD support on this topic came as a result of a roundtable meeting on 21 October 2010 in Sarajevo bringing together members of the business community, researchers, government officials and the OECD IC. This Handbook summarises the results of this RCI project.

[1] This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence. Hereafter referred as Kosovo.

Acknowledgements

The preparation of this Handbook has involved many experts, representatives of various institutions and government officials. The lead authors for this paper were Alan Paić and Almedina Musić from the OECD Investment Compact for South East Europe. The analysis presented in this study were closely reviewed and enriched by contributions from Anthony O'Sullivan, Milan Konopek, Elena Miteva, Slavo Radosević, Vanessa Vallée and Ania Thiemann. The paper was prepared for publication by Liz Zachary and Alexandra Chevalier.

The project has benefitted from excellent co-operation with officials from different levels of government in Bosnia and Herzegovina. In particular, we wish to thank the Ministry of Civil Affairs which has taken the lead in the design and throughout the execution of the project. In this respect we wish to acknowledge the contribution of Alma Hasanović, as project manager, as well as Assistant Minister Biljana Čamur who represented the ministry at several events, and Jelena Džomba who assisted in their organisation. The Ministry of Foreign Trade and External Relations also actively participated in the project, represented by Mirza Hujić and with high level support by Secretary General Hamdo Tinjak. Further contribution was provided by the Ministry of Science and Technology of Republic of Srpska represented by Assistant Minister Gordan Vukelić, as well as the Federal Ministry of Education and Science, represented by Damir Ravlić. We would like to thank them for their active participation and their support throughout the process.

In the scope of this project, three Triple Helix partnership proposals received support for implementation. We would like to thank all involved partners from academia, business and government.

Omega-3 Project: prof. Mirsad Veladžić from the University of Bihać; Marko Damjanović, entrepreneur; Food Safety Agency of Bosnia and Herzegovina represented by Emir Đedović and Admir Pljevljak; and Matjaž Červek from the EMONA Nutrition Research and Development Department in Slovenia as well as representatives from the Consumer Association in Bosnia and Herzegovina.

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Organic disinfection Project: Krsto Stojanović, entrepreneur; prof. Abdulah Gagić from the University of Sarajevo, representatives from the Ministry of Health as well as Domagoj Račić, consultant at KnowledgeNetwork.

We wish to thank the European Commission for the financial support, without which this project would not have been possible. Additional assistance was provided by the Flemish Government, including financial support, the provision of expertise and the organisation of a study trip to Flanders for Bosnia and Herzegovina officials in April 2011. The Flemish government critical contribution to the successful completion of the project was much appreciated.

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Acronyms and abbreviations

BiH	Bosnia and Herzegovina
CATI	Computer-aided telephone interface
CTT	Technology Transfer Centre
FDI	Foreign direct investment
GERD	Gross expenditure on research and development
FOD	Federal Public Health Authority
ICT	Information and communications technology
IPA	Instrument for Pre-Accession Assistance
IWT	Flemish Agency for Innovation by Science and Technology
LTU	Technical University of Lodz
PPS	Purchasing power standards
R&D	Research and development
RARS	Republika Srpska Agency for Development of Small and Medium-Sized Enterprises
RCI	Regional Competitiveness Initiative
SME	Small and medium-sized enterprises
WBC	Western Balkan countries

EXECUTIVE SUMMARY

The competitiveness of middle income economies increasingly depends on their ability to innovate. Enhancing innovation capacity and efforts to evolve toward a knowledge-based economy provide opportunities for more and higher value-added employment, and ultimately greater productivity and economic growth.

Triple Helix Partnerships can support countries in boosting innovation by facilitating co-operation between academia, business and local government. The Triple Helix model advocates the notion that value creation in innovation is accelerated when the actions of these three stakeholders are coordinated. This acceleration of value creation comes from synergies arising between the three stakeholders: businesses have first hand access to new technologies, scientists receive feedback from entrepreneurs about the commercial viability of their research, and governments obtain insights into the types of policy interventions that spur industry-research cooperation.

The main challenge in implementing Triple Helix partnerships is to ensure effective communication between the three stakeholders, in light of their different priorities, environment and mindsets. Therefore, Triple Helix partnerships have to be carefully structured and implemented to overcome those barriers, and initiate a virtuous cycle of communication and co-operation, combining the market knowledge of entrepreneurs with the technology from academia and policy frameworks of government.

Applying the Triple Helix model to Bosnia and Herzegovina

Economic competitiveness in Bosnia and Herzegovina (BiH) is low and its innovation system is underdeveloped: R&D spending is among the lowest in the Western Balkans region, business sophistication in research is low and universities have little capacity and resources to conduct research.

The positive results of applying the Triple Helix partnership model in Bosnia and Herzegovina's agri-food sector indicate that a systematic and consultative approach involving the key stakeholders from academia, business and government can indeed foster innovation. It also suggests that this model could be successfully transferred to other similar middle income settings.

Success factors

Triple Helix partnerships have to be skillfully facilitated to initiate an effective cycle of communication and co-operation, leading to tangible results and establish trust in this method.

Applying the Triple Helix model to three agri-food pilot projects highlighted a number of factors critical for project success:

- Open and inclusive communication between stakeholders. The development of a formal network involving academia, business and government - by means of a series of events - serves as a platform for exchanging ideas on potential innovations and helps overcome the inherent stakeholder challenges.

- Agreement on objectives. In order to address the different interpretations of innovation by stakeholders, a set of guidelines needs to define a common understanding of the objectives sought by concrete projects.

- *Clear roles and incentives.* In order to ensure the quality of the final result, each partner needs to pursue a clear objective in line with its skills and incentives.

- *Competition between participants based on transparent criteria.* Competition for the best project creates additional motivation among participants, but only if based on transparent criteria defined upfront.

- *Market focus of projects.* Participants need to justify their ideas from the customer's viewpoint.

- *Support for project implementation.* Such support should include: (i) a critical assessment of the proposed innovation and action plan; and (ii) a feasibility study to determine the concept's economic and technical viability. The study should determine the process that could achieve the needed functionalities under specific cost, quality and timeliness constraints.

- *Flexibility.* If a certain business model proves unfeasible, other scenarii need to be explored until a viable alternative is found.

An eight-step implementation process

The following structured implementation process can guide countries in implementing Triple Helix projects:

1. **Set project objectives:** The project has to be geared towards concrete project outcomes in order to mobilise and motivate the relevant stakeholders.

2. **Define project scope:** In order to keep discussions focused and create a sense of common purpose, there has to be a focus on the project scope. The focus could be on a sector, a region or a technology.

3. **Understand the business innovation behaviour:** A survey can help understand the existing innovation behaviour and the predisposition of businesses towards co-operation within the Triple Helix.

4. **Identify and motivate the stakeholders:** Relevant stakeholders from academia, business and local government institutions have to be identified, and a clear value proposition has to be communicated, to justify the time and effort that will be required from them in the project.

5. **Transfer international good practice:** Good practice transfer motivates participants as it demonstrates that the concept can give results in other settings. It needs to be clearly communicated, focusing on lessons learnt and how they can be applied to the local setting.

6. **Establish an efficient process to generate high quality proposals:** Clear guidelines need to be provided to participants. The selection criteria have to be transparent and clear in order to create a climate of trust and meritocracy.

7. **Assist with implementation:** Once a project proposal has been selected, it receives a reward in the form of technical assistance for implementation.

8. **Share learning and best practices:** It is useful to present the difficulties encountered, the achievements and the next steps for implementation at the end of the implementation phase. This will serve as useful feedback to all stakeholders, and will create additional opportunities for feedback and learning.

Results and future outlook for Triple Helix Partnerships

The implementation of the Triple Helix model in Bosnia and Herzegovina yielded three main outcomes:

All three pilot projects produced concrete results. One partnership resulted in the launch of an innovative food product for the local market, a second partnership modified its initial business model and shifted to higher value-added in the domain of functional food, and a third one involving a disinfectant product for farms is broadening its initial target customers to enhance its market potential and overall impact.

New partnerships led to the creation of an agri-food network. The Triple Helix project contributed to create a network of professionals in the agri-food sector, which continues to develop new initiatives beyond its original scope.

Government capacity was strengthened: Finally, the project contributed to capacity building. Government officials are better prepared to identify and support new Triple Helix partnerships in other sectors, independently of OECD involvement.

In order to ensure sustainability, future developments could build on the results of this project provided that a minimum financial amount is committed by the government. As a first step, similar projects could be implemented in the same or other relevant sectors of the economy of Bosnia and Herzegovina in co-operation with officials in the Ministry of Civil Affairs who have gained valuable experience in managing such projects. At a later stage, the approach can be broadened to the whole economy and institutionalised in order to boost market-oriented innovations. Further developments could include policy measures, such as innovation vouchers and grants targeted at industry-research collaboration.

Chapter 1

Triple Helix Partnerships: definitions and international good practice

The OECD defines innovation as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (OECD, 2002). This definition encompasses four types of innovations.

- *Product innovation:* goods or services that are new or significantly improved. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.

- *Process innovation:* new or significantly improved production or delivery methods. This includes significant changes in techniques, equipment and/or software.

- *Marketing innovation:* new marketing methods involving significant changes in product design or packaging, product placement, product promotion or pricing.

- *Organisational innovation:* introducing new organisational methods in the firm’s business practices, workplace organisation or external relations.

The Oslo Manual (OECD, 2005) identifies four factors that influence the effectiveness of the innovation process: (i) framework conditions, (ii) science and technology institutions, (iii) transfer mechanisms, and (iv) firm-specific innovative drives. General framework conditions such as the macroeconomic environment, the fiscal system and access to finance shape the activities of companies and their ability to conduct innovative activities. The efficiency of science and technology institutions drives the accumulation of knowledge. Transfer mechanisms enhance flows of information and skills between the various stakeholders in the innovation system and are crucial to ensuring that innovative ideas are actually brought to the market and contribute to economic growth. Finally, firms themselves need to seek, identify and exploit the potential for innovations to reinforce the innovation process. These four factors correspond to specific areas of policy interventions. Governments need to design measures to address potential barriers in each of these four domains and, most importantly, decide on the priorities that need to be set.

Linkages are important for the innovation system

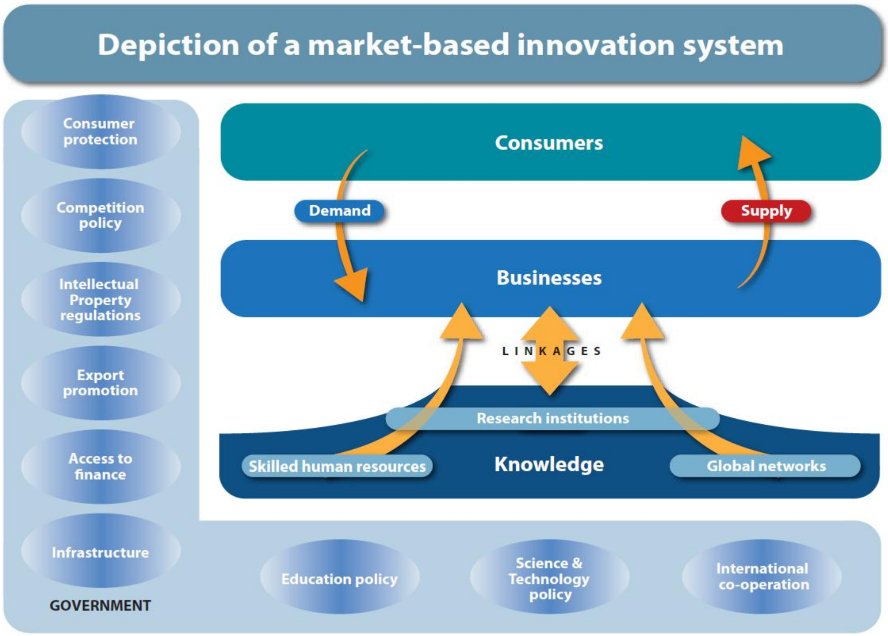
The inter-connectedness between the innovation actors, referred to as transfer factors in the Oslo Manual (OECD, 2005) is one of the main determinants of the performance of innovation systems (see Figure 1).

In the traditional linear model, knowledge is created within universities and research institutions, starting with fundamental research which gives rise to scientific publications, followed by applied research which can be published either as a publication, or a patent. The resulting knowledge is then taken over by businesses for commercialisation, where it follows a path of development to create new products, services or processes which will then benefit consumers and the society as a whole (Gomory, 1989). Such a "push" model, however, has major shortcomings since very few ideas actually enter the market, and the process from idea to market entry is very slow. Based on a study of 76 major U.S. firms, Edwin Mansfield shows that 90% of industrial innovations could have been developed without using recent academic research, suggesting the low transmission achieved by the linear model **Invalid source specified.**.

Transfer factors, on the other hand, ensure that innovation developed in a specific research institution benefits the economy as a whole and also that all the various stakeholders – both large enterprises and SMEs, public research centres, universities and policy makers – participate in the innovation process. It is important that businesses are well connected to the market, interpreting signals and identifying potential unmet needs. They can then seek both technical and non-technical knowledge from various sources: (i) from the existing body of internationally available knowledge (including non-technical knowledge about design, marketing or communications), (ii) through hiring skilled people, and (iii) from domestic research institutions.

This channel from markets through businesses is based on consumer demand that "pulls" relevant knowledge to introduce innovation. In addition to this, an informed "push" mode may be necessary for some breakthrough innovations which have their roots in fundamental science. The efficient harnessing of ideas originating from basic science can occur only through intense interaction with businesses which have intimate knowledge of customer needs. The role of government, as depicted in Figure 1, is to act with targeted policies on different parts of the system.

Figure 1. **Depiction of a market-based innovation system**



Source: Investment Compact for South East Europe

Overall, both government and the private sector increasingly acknowledge the benefits of co-operation. Public authorities have the long-term vision needed to conduct the fundamental research that fuels the innovation process. Public research institutions also represent a pool of diverse skills that can be used to develop a multi-disciplinary approach, an increasingly important factor in the innovation process. On the other hand, private companies have the resources to fund capital-intensive research and their intrinsic market orientation helps ensure its relevance. As a result, new forms of public-private linkages have emerged, relating to operational partnerships as well as the overall governance of the national innovation system.

The OECD Innovation Strategy (OECD, 2010a) has identified a number of areas that are essential for the design of successful policies to help develop linkages between the various stakeholders and improve their access to the right forms of finance (see Box 1). Lessons can be drawn from initiatives led by some OECD countries to further develop networks supporting innovation. In the Western Balkans, where policy support for innovation is still being developed, these lessons can contribute to the establishment of an institutional and economic framework that would be more conducive to innovation.

Box 1. **OECD Innovation Strategy (OECD, 2010a)**

The *OECD Innovation Strategy* is built around five priorities for government action:

1. Empowering people to innovate

- Education and training systems should equip people with the foundation to learn and develop the broad range of skills needed for innovation in all of its forms, and with the flexibility to upgrade skills and adapt to changing market conditions. To foster an innovative workplace, ensure that employment policies facilitate efficient organisational change.
- Enable consumers to actively participate in the innovation process.
- Foster an entrepreneurial culture by instilling the skills and attitudes needed for creative enterprise.

2. Unleashing innovations

- Ensure that framework conditions are sound and supportive of competition, conducive to innovation and are mutually reinforcing.
- Mobilise private funding for innovation by fostering well-functioning financial markets and easing access to finance for new firms, in particular for the early stages of innovation. Encourage the diffusion of best practice in the reporting of intangible investments and develop market-friendly approaches to support innovation.
- Foster open markets, a competitive and dynamic business sector and a culture of healthy risk taking and creative activity. Foster innovation in small and medium-sized firms, in particular new and young ones.

3. Creating and applying knowledge

- Provide sufficient investment in an effective public research system and improve the governance of research institutions. Ensure coherence between multi-level sources of funding for R&D.
- Ensure that a modern and reliable knowledge infrastructure that supports innovation is in place, accompanied by the regulatory frameworks which support open access to networks and competition in the market. Create a suitable policy and regulatory environment that allows for the responsible development of technologies and their convergence.
- Facilitate efficient knowledge flows and foster development of networks and markets to enable the creation, circulation and diffusion of knowledge, and an effective system of intellectual property rights.
- Foster innovation in the public sector at all levels of government to enhance the delivery of public services, improve efficiency, coverage and equity, and create positive externalities in the rest of the economy.

Box 1. **OECD Innovation Strategy (OECD, 2010a)** *(cont.)*

4. Applying innovation to address global and social challenges

- Improve international scientific and technological co-operation and technology transfer, including through the development of international mechanisms to finance innovation and share costs.
- Provide a predictable policy regime which provides flexibility and incentives to address global challenges through innovation in developed and developing countries, and encourages invention and the adoption of cost-effective technologies.
- To spur innovation as a tool for development, strengthen the foundations for innovation in low income countries, including affordable access to modern technologies. Foster entrepreneurship throughout the economy, and enable entrepreneurs to experiment, invest and expand creative economic activities, particularly around agriculture.

5. Improving the governance and measurement of policies for innovation

- Ensure policy coherence by treating innovation as a central component of government policy, with strong leadership at the highest political levels. Enable regional and local actors to foster innovation, while ensuring co-ordination across regions and with national efforts. Foster evidence-based decision making and policy accountability by recognising measurement as central to the innovation agenda.

The OECD Innovation Strategy recognises that countries' policy challenges differ, depending on their economic structure, level of development, culture and institutions. Its message is that a mobilising vision – and the ambition to achieve it through policy coherence and effective co-ordination – can help governments around the world to use innovation as a tool to improve economic performance, address societal challenges and enhance welfare. This requires both horizontal and vertical policy co-ordination. With the right set of policies in place, innovation will result in greater well-being at both the national and global levels.

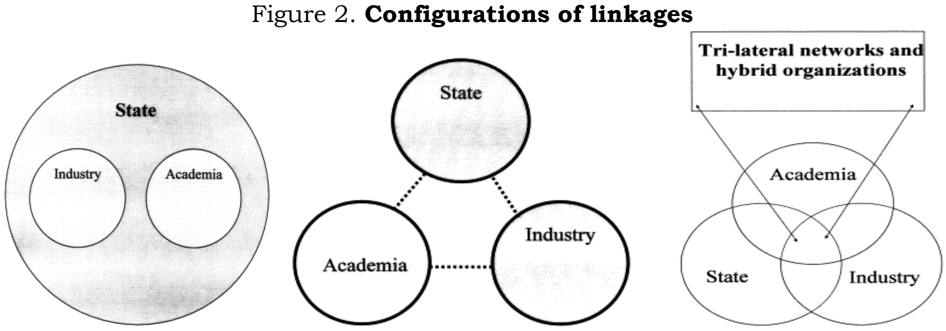
The Triple Helix model optimises co-operation and fosters innovation

In a knowledge-based economy, the creation of the knowledge base depends on the synergies created between the three main actors of the economy: academia, business and government. Each actor can be linked to a specific element of the economy: the universities are responsible for the creation of novelty, businesses generate wealth, and the government is responsible for the governance of interactions among the actors and is the keeper of societal rules (Leydesdorff, 2006).

The configuration of linkages is not always optimal

Etzkowitz (2002a) differentiates two extreme models for the configuration of linkages: the statist model and the laissez-faire model.

Figure 2. **Configurations of linkages**



(1) A statist model (2) A *laissez-faire* model (3) A Triple Helix interactive model

Source: Etzkowitz and Leydesdorff (2000)

In the statist model the government is the dominant institutional sphere that controls academia and industry. According to Etzkowitz (2002a), this model was in place in the former Soviet Union, France and many Latin American countries during most of the 20th century. In this model, the government takes the lead role in establishing partnerships as the other two spheres are seen as relatively weak. For instance, the government sets up regional public research institutions or stimulates R&D through public venture capital.

In the laissez-faire model, which was prevalent in the United States during most of the 20th century, the institutional spheres operate independently and with clear boundaries. In this model, the role of government is limited to the correction of market failures. Only limited interaction between partners is expected as each has its own proper identified role, with academia dealing with knowledge production, industry in charge of knowledge absorption (i.e. transformation into value-added products and services), and government taking care of regulation. Furthermore, any interaction between institutional spheres often occurs through intermediaries. For example, in the US, the Research Corporation was for many years responsible for the interaction between universities and companies. It identified research that could be patented and linked it with relevant companies (Etzkowitz, 2008, p. 17).

However, past experiences show that the relation between the actors and the policy-making process is not always static as described above. In both models, there is a pull to increase independence of university and industry from the government and increase interdependence among the three partners. To better describe these dynamic partnerships, Etzkowitz (2002a) proposes an alternative model: the *Triple Helix* interactive model.

The Triple Helix is a model of dynamic partnerships

In the Triple Helix model, universities, industries and government constitute interdependent and relatively equal institutional spheres. The model encompasses trilateral relationships among industry, government and universities in the process of knowledge capitalisation (Etzkowitz, 2002a). In the *Triple Helix* model, the roles of the three actors can overlap – for example universities can become more entrepreneurial through the creation of spin-offs, firms can become more involved in research and evolve closer to academia, and the government can intervene in knowledge creation (through government-sponsored research programmes) and knowledge absorption (for example through voucher schemes[2]). This movement between roles is typically illustrated as the Triple Helix strands of DNA – hence where the concept derives its name.

The development of Triple Helix relations involves both, bottom up and top down approach

According to this model, innovation takes shape through Triple Helix relations. Their development can occur from the bottom up, through the interactions of individuals and organisations from different institutional spheres, or from the top down, when promoted by policy measures (Etzkowitz, 2002a).

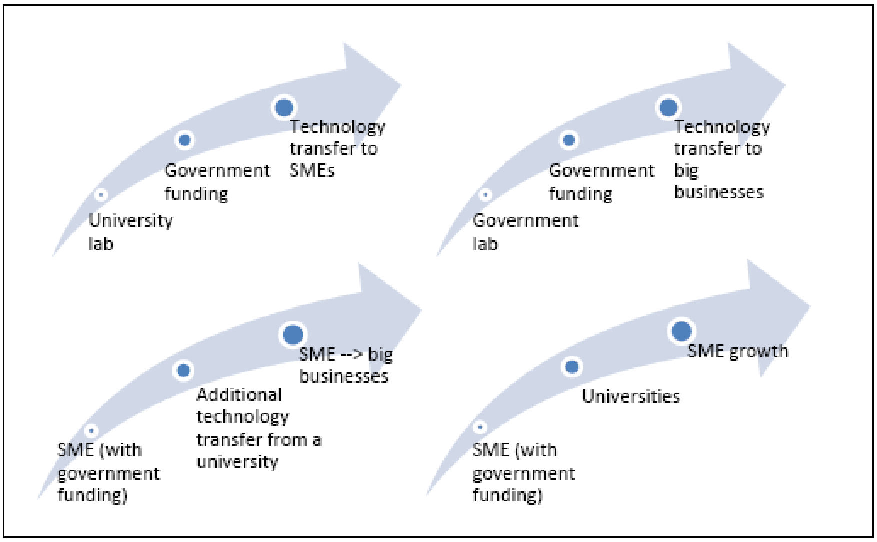
In a bottom-up process, pre-existing relationships can be further exploited and strengthened. The establishment of innovation consortia, however, will not affect the national research structure because projects are often small with no systematic constitution.

In the top-down mechanism, government policy determines priority areas and themes. This can affect the national research structure, since the implementation of these priorities will stimulate the search for new co-operation. These types of programmes, however, often have difficulties finding committed actors in industry and university (Hayashi, 2002).

The top-down process is more often found in societies with a more statist model, while the bottom-up process is dominant in laissez-faire models. In general, however, both processes tend to go hand in hand and complement each other. The specific partnerships can take multiple shapes and paths. Some examples are shown in Figure 3 below.

[2] Voucher schemes are generally aimed at small and medium-sized enterprises to start new, or accelerate innovative activities and enhance their competitiveness in collaboration with R&D institutions or other service providers.

Figure 3. **Examples of Triple Helix Partnerships**



Source: Causevic, 2010

Chapter 2

Innovation profile of transition economies: the case of Bosnia and Herzegovina

Transition countries, as Bosnia and Herzegovina (BiH), have developed few Triple Helix partnerships for innovation. In the past, the state controlled both academia and business with little emphasis on linkages between those actors. Academia has faced severe cuts in research funding leaving universities primarily with an educational role. The business sector has likewise reduced its R&D effort with the disappearance of large state-owned enterprises with in-house R&D departments. This transition reduced company spending on R&D and did little to increase linkages between the relevant stakeholders.

In this chapter, after analysing the economic environment as well as existing innovation policy in Bosnia and Herzegovina, the results of a survey on the innovation behaviour of BiH's agri-food sector will be presented briefly.

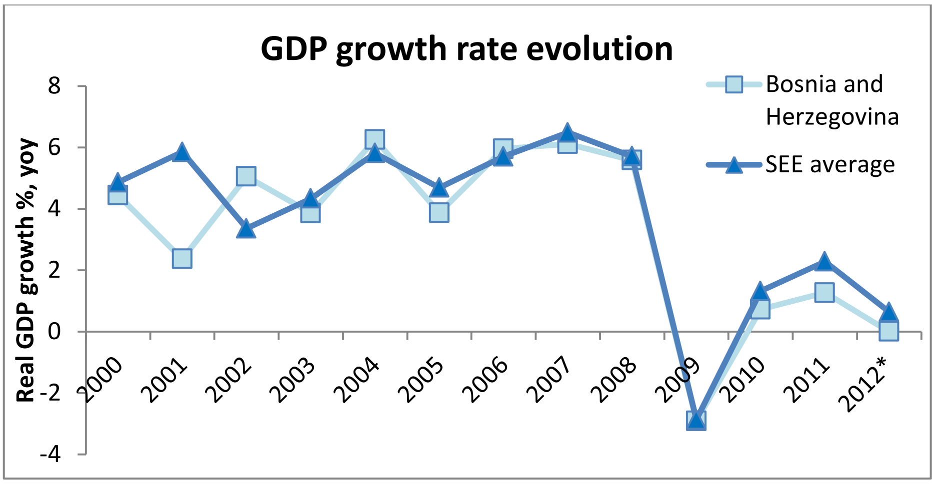
The economic environment in Bosnia and Herzegovina: lagging competitiveness

Bosnia and Herzegovina (BiH) has progressed over recent years from a post-war recovery state to potential EU accession candidate. The country's constitution was drawn up as part of the internationally agreed 1995 Dayton Peace Agreement. It established a complex political structure that provides for governments at the state level, for both entities (the Federation of Bosnia and Herzegovina and the Republika Srpska) and at district levels.

BiH's economic performance was quite encouraging until the onset of the global crisis. Overall, BiH's average growth rate is in line with that of the region in the 2000-2008 period (respectively 5.4% compared to 5.3%). The period between 1997 and 2007 witnessed an important level of industrial restructuring in terms of reconstruction and modernisation of the pre-war industrial base, based on wood processing, metalworking, textile and motor-car industries (World Bank, 2010).

After the recession in 2009, when real GDP fell by 2.9%, the country moderately recovered in 2010. However, the recovery was weaker than average in the SEE region, and the country barely avoided double-dip recession in 2012. Per capita income, measured in purchasing power standards (PPS), was 30% of the EU-27 average in 2010, unchanged from a year earlier.

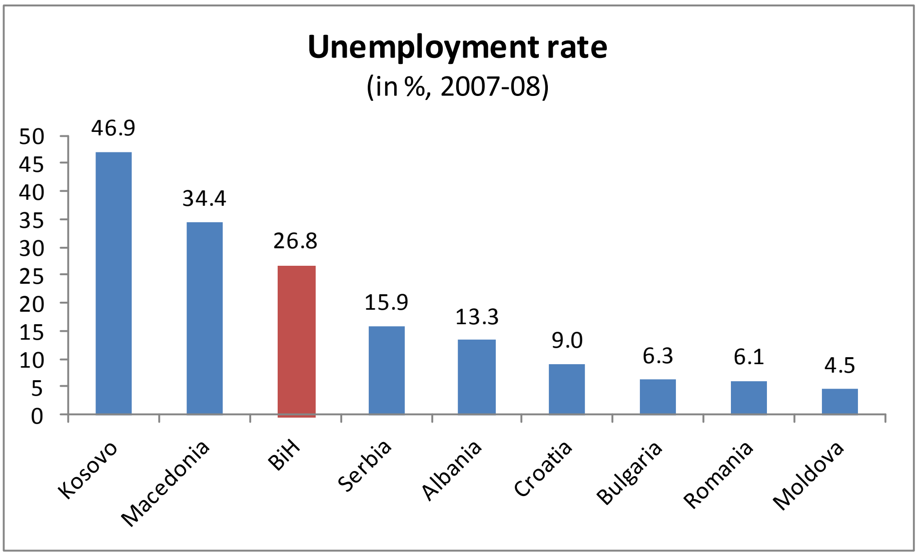
Figure 4. **Real GDP growth rate evolution in Bosnia and Herzegovina**



Source: IMF, 2012

The crisis revealed the lack of sustainability of the growth model based on credit expansion and consumption growth. High taxes, inefficient government administration and widespread corruption discourage entrepreneurial activity. According to the EBRD data, less than 6% of Bosnia and Herzegovina’s population managed to start up their business between 1989 and 2010. At the same time, the informal economy remains quite large (EC, 2011). The average official unemployment rate in 2010 was very high at 27.2%, among the highest in the region.

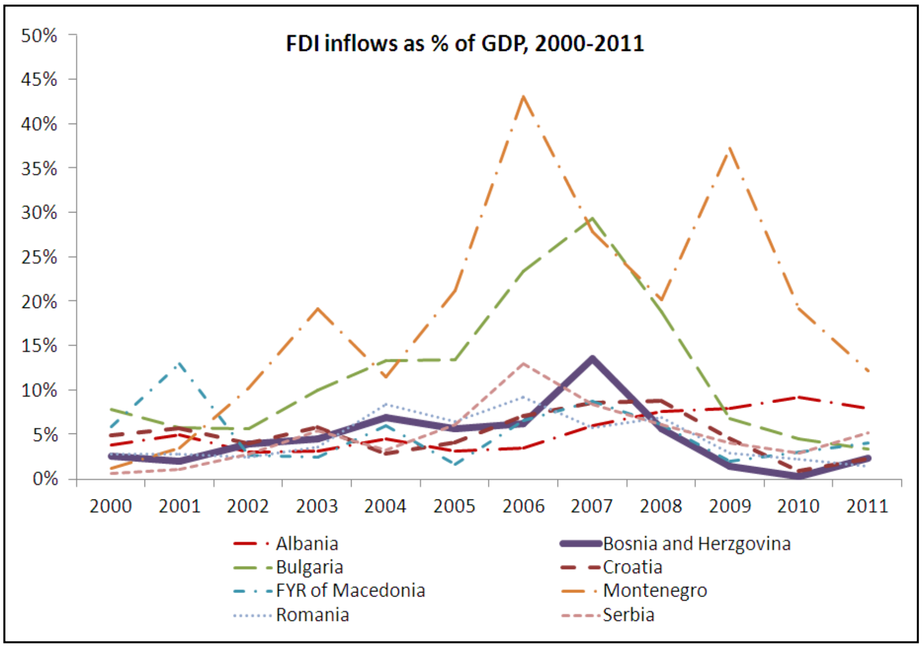
Figure 5. **Unemployment rate in SEE region (2007-08)**



Source: World databank (World Development Indicators), 2012, no data available for Montenegro

Net foreign direct investment (FDI) flows dropped dramatically, falling from a high of over 13.6% of GDP in 2007 to 0.4% of GDP in 2010. This makes Bosnia and Herzegovina one of the hardest-hit economies in South East Europe, highlighting the need to improve the country's low economic competitiveness. A regional overview for FDI Inflows between 2000 to 2011 is illustrated in Figure 6.

Figure 6. **FDI inflows as % of GDP in Bosnia-Herzegovina and SEE economies**



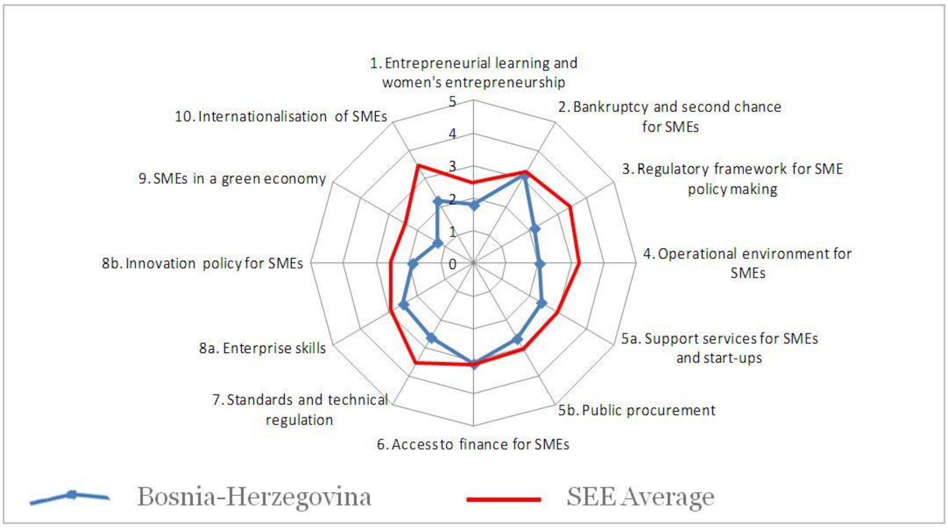
Source: UNCTAD and World Bank, 2012

The ranking of the Bosnia and Herzegovina business environment remains consistently low. The OECD's Investment Reform Index (OECD, 2010b) measures the advancement of reforms in favour of the investment climate in the nine economies of South East Europe3. The assessment points to the gap between the country's legislation and the average of South East Europe in most areas of policy making covered. The greatest gaps appear in human capital development, regulation, and trade policy.

A specific assessment of SME policies is also performed by the OECD, based on the Small Business Act for Europe. The 2012 assessment concludes that "the quality of the business environment in Bosnia and Herzegovina remains highly problematic and it continues to lag behind other economies in South East Europe; [...] No notable progress has been made in the field of institutional and policy co-ordination at the state level since the previous reports" (OECD, 2012). In this assessment, the largest gaps for Bosnia-Herzegovina appear in the areas of regulatory framework for SME policy making, in operational environment for SMEs, as well as internationalisation of SMEs (Figure 7).

[3] Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Kosovo*, FYR of Macedonia, Montenegro, Romania, Serbia

Figure 7. **Comparative assessment of SME Policy along the dimensions of the Small Business Act for Europe**



Source: SME Policy Index 2012 (OECD, 2012)

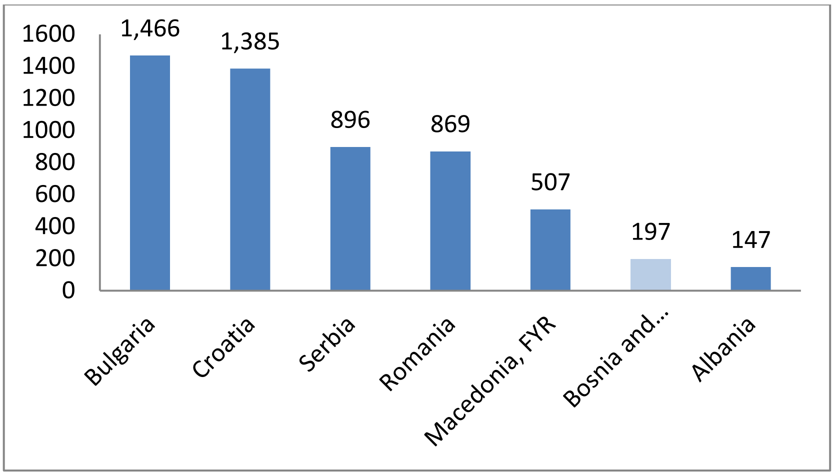
Similarly, the World Bank's Doing Business report ranks Bosnia and Herzegovina 126th out of 185 economies in 2012, making it the lowest ranked SEE economy (FYR Macedonia as the best-ranked SEE economy ranks 23rd, and other SEE economies rank between rank 51 and 98). The most problematic areas are "Starting a business", "Dealing with Construction permits", and "Getting electricity", where BiH ranks below 150.

According to an OECD survey of 80 high growth companies, corruption is the number one barrier to growth, closely followed by the informal economy. Corruption is seen as ubiquitous in the court system and also when obtaining licences. Informal companies are seen as disloyal competition since they do not pay contributions and taxes, and can thus unfairly compete on prices. Regulations are another domain of concern, since companies complain about obtaining licences. Inefficient court systems make it impossible to collect outstanding debt.

Innovation performance in Bosnia and Herzegovina

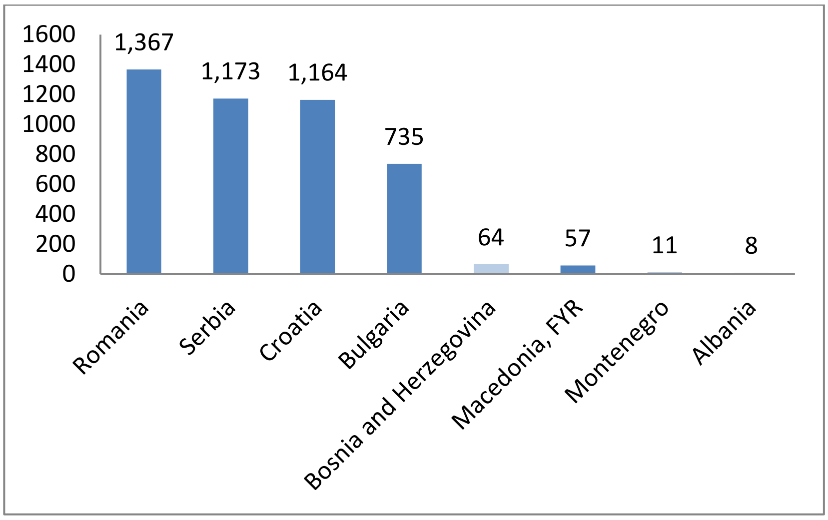
Investment in R&D is very low in Bosnia and Herzegovina, and no reliable statistics exist. Estimates are usually quoted in the range of 0.1 – 0.14% of GDP **Invalid source specified.**. This is less than one third of the regional average for South East Europe of about 0.46% **Invalid source specified.**, and less than a tenth of the average for EU-27 of 1.8%. Most of the existing spending is public spending, while spending by businesses is estimated at only 10% of the total **Invalid source specified.**. Not surprisingly, this low level of funding leads to a very low number of researchers per million population (Figure 8). The scientific output is likewise much lower than the regional average (Figure 9).

Figure 8. **Number of researchers per million population, 2007.**



Source: World Development Indicators, World Bank, 2012

Figure 9. **Number of scientific publications per million population, 2009.**



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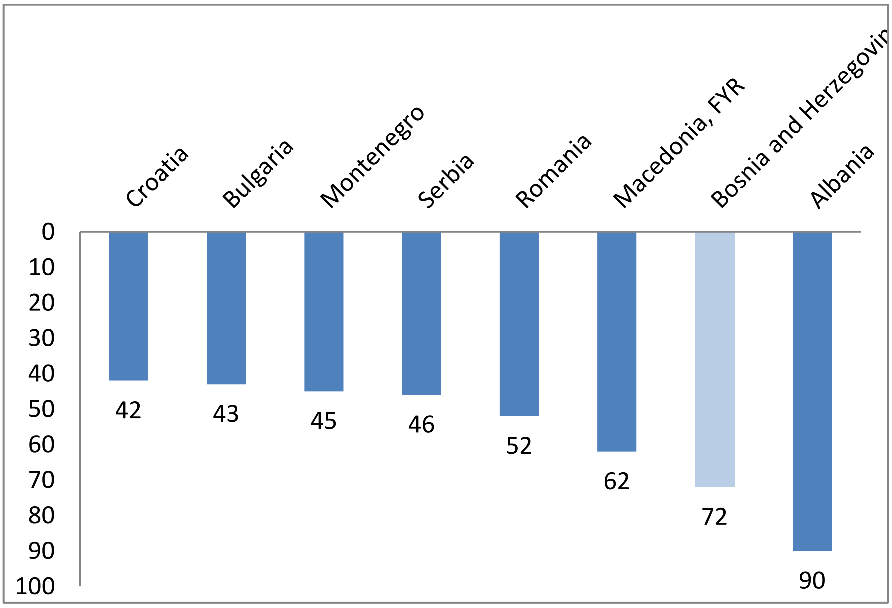
Source: World Development Indicators, World Bank. 2012

It is worth noting that this low level of spending is a strong decrease from the levels which existed prior to transition, since the level of spending in 1990 amounted to 1% of GDP **Invalid source specified.**. At that period, not only was the State spending more on research than today, but also strong industrial institutes existed in the aeronautics, energy, metalworking, machine tool, automotive, steel, defense, electronics and agri-food industries. Most of the industrial research and development (R&D) activity has disappeared since the beginning of the transition from a planned to a free market economy through the dismantling and privatisation of large state-owned enterprises. Public research has also been weakened by very low levels of government spending on R&D, and most university staff is almost entirely dedicated to teaching. The participation of Bosnia and Herzegovinian researchers in European projects has been limited.

According to the global comparison by INSEAD's Global Innovation Index (GII), Bosnia and Herzegovina is ranked 72nd out of 141 countries **Invalid source specified.**. Relative strengths according to GII include business sophistication, in which BiH is ranked 45th, human capital and research where it ranks 52nd, and market sophistication at rank 58. Areas of relative weakness are in infrastructure (both traditional and ICT), and creative outputs, both ranking 90th out of 141. Similar trends are confirmed by our company survey discussed below, which shows significant innovation behaviour in spite of very low business R&D spending.

Figure 10. **Global Innovation Index ranking of South East European economies.**



Source: INSEAD, 2012

Innovation behaviour of BiH companies in the agri-food sector

A business survey of 150 enterprises from the agri-food sector of Bosnia and Herzegovina was conducted in March 2011. The survey examined different aspects of firms' approaches to innovation, and co-operation in the agri-food sector of Bosnia and Herzegovina. A detailed summary of the results can be found in the Annex.

Overall, the survey results show encouraging innovation patterns in the agri-food industry, with significant innovation activity in the companies themselves, albeit with very limited R&D spending. At the same time, they point to significant opportunities for partnerships, providing two major issues are addressed: networking with scientists and financing of joint innovation projects.

Key outcomes of the survey can be summarised as follows:

- The survey shows very significant innovation activity among firms in the sector, with an overwhelming majority of respondents (86%) reporting innovation of at least one type. Even allowing for selection bias[4], in absolute numbers this means that 129 companies in the Bosnia and Herzegovina agri-food sector do innovate in at least one way. Larger firms consistently innovate more than smaller ones, but even micro firms report significant innovation behaviour.

- Nearly all (97%) of the interviewed companies who had introduced innovations in recent years indicated that the innovations had a positive impact on turnover and profit. Two-thirds (67%) of the companies indicated an increase of between 6-30% on average. Medium-sized companies appear to have had the greatest positive impact, with 70% of respondents reporting an increase of 11% or more on turnover, and 50% reporting an increase of 11% or more on profit. In the case of large companies, these percentages are respectively 40% and 27%.

- Despite firms reporting a positive impact from their innovations, there is still potential for improvement, as two-thirds of the firms identified at least one opportunity to innovate which they were unable to seize, overwhelmingly due to lack of financial resources. At the same time, 79% of firms have received no subsidies for their innovation activities. International funds supporting innovation and research activities are not fully exploited in Bosnia and Herzegovina.

- Although many firms rely mainly on external resources for R&D, and most have co-operated with researchers and rated them highly, only 21% of firms quote research institutions as being the primary source of external

[4] Non-innovative firms were more likely to refuse participation in the survey, thus some results can be over-estimated by the study.

know-how used for innovation. This is far behind the dominant source of know-how which is consulting, with 58% of respondents.

- When asked what would make them more willing to co-operate, firms indicated that they needed better knowledge of the science community and assistance in establishing direct contact with the scientists.

The case for Triple Helix partnerships in Bosnia and Herzegovina

Bosnia and Herzegovina has not yet established a legal and institutional framework for stimulating innovation. The adoption of the Strategy for the Development of Science in BiH 2010-2015 on the state level is a significant step for the country. Nine priority areas are explicitly detailed as urgent, short-term activity lines, namely:

- Strengthening the Science Department in the Ministry of Civil Affairs
- Stronger co-operation with the EU with the aim of using the Instrument for Pre-Accession (IPA) funds for strengthening scientific research activities
- Participation in the activities of the 7th Framework Programme (FP7) of the EU as well as in other international programmes
- Allocating funds from the Ministry of Civil Affairs for co-financing of international projects;
- Establishing a mechanism of collecting statistical data and monitoring scientific activities;
- More intensive co-operation on exchange of information between the ministries responsible for science and education;
- Establishment of the Science Council;
- Tax incentives for companies that invest in research activities; and
- Possibility of access to scientific information (scientific journals, data bases, etc.) via the Internet and various electronic systems.

The Strategy calls for support for innovation in general, and particularly technology transfer and commercialisation of science. In practice, there were few initiatives that encouraged linkages between business and science.

In Chapter 1 the advantages of Triple Helix partnerships were discussed. Transition countries in general, and Bosnia and Herzegovina in particular, have experienced a transition period where the previous statist model has been quickly and somewhat brutally transferred to a laissez faire model, with a drastic reduction of R&D spending both from public and, even more prominently, private sources. This is due to the swift transition to liberal market economy, which implied privatisation, restructuring, and rationalisation of all activities which cannot demonstrably contribute to short term profit. Due to the risky nature of R&D, the function was very often considered insufficiently profitable, and was sacrificed in the transition process. It is now quite evident that this process has cut the potential for long term competitiveness of the economy, and that policy intervention is needed to encourage increased focus on innovation.

The concept of “commercialisation of science” inherently supposes the classical linear model whereby knowledge is created in academia, in order to be taken over, or “commercialised” by business. However, in an economy with limited resources in academia, such a model is even less likely to produce results, since there is insufficient critical mass of public research, and even less research which could potentially be commercialised. In order to build up a critical mass of research, the government would have to substantially increase the resources for public R&D over a number of years, and results would only emerge in the medium to long term as capacity is built.

On the other hand, bottom-up initiatives fostering greater interaction between business and academia are a very cost-effective way of achieving concrete results in the short to medium term. Since the main channel for innovation at this stage is technology absorption, rather than breakthrough innovation based on original research, academia can play a role in this through its international networks, provided that the triple helix brings the market knowledge from the business partners, and the policy issues from government. In this way, Triple Helix can act as a catalyser, and focus the efforts of scarce R&D resources where their impact will create highest impact at lowest cost. Triple Helix initiatives can be implemented with limited financial resources. Examples of such initiatives are:

- consulting engagements of scientists by industry, paid for by industry, for which demand exists as shown in the survey of the agri-food industry;

- industrial Master’s or PhD’s where an industrial player finances a student who will do research directly relevant to its own product or process development;

- joint project submission for European project such as FP7/Horizon or others.

Other projects may need public subsidies such as innovation voucher schemes, or matching grants for R&D. Such programmes usually have very high multiplicative factors and are thus not a burden to the government budget, quite to the contrary, since increased business revenues generate additional tax revenue for the State budget. The Flemish agency for Innovation by Science and Technology (IWT) only accepts projects with the potential to increase sales by 25 times the amount of the subsidy. With a VAT rate of 20%, the proceeds from tax alone would return five times the value of the subsidy granted, without even taking into account all the revenue from company taxes, personal income tax, and so on. A recent evaluation found that their rule is not just wishful thinking, since its successful projects, which represent 87% of all subsidised projects, actually increase sales by more than 60 times the subsidy (Fiers et al., 2012).

In February 2011, a review[5] of existing co-operation between academia, industry and local government confirmed that experience of such Triple Helix co-operation is limited, although it does exist. One example is the Business Innovation Centre in Tuzla, which succeeded in starting up around 40 companies in the information and communications technology (ICT) sector and benefits from excellent co-operation with the faculty of electrical engineering located nearby, as well as strong support from the Tuzla municipality who provided the infrastructure. The University Entrepreneurship Centre in Banja Luka has attempted to promote similar co-operation, but faces financial, cultural and organisational challenges. In the furniture sector a successful co-operation was established between the wood industry and the Academy of Fine Arts, which provided furniture designs. Finally, in the agri-food industry, co-operation was established between the oil producer BIMAL, rapeseed growers and the Agricultural Institute of the Republika Srpska to explore the possibilities of expanding oilseed rape production in BiH in order to avoid importing this raw material.

In this setting the decision was brought to attempt the implementation of a Triple Helix project in order to demonstrate the potential of achieving tangible innovation results in a limited timeframe and with limited resources.

[5] See Annex.

Chapter 3

Developing Triple Helix partnerships in Bosnia and Herzegovina

Applying the Triple Helix model in the agri-food sector in Bosnia and Herzegovina was an endeavour to demonstrate that a pragmatic, bottom-up approach can foster innovative activities with concrete results in a country that under invests in research and development and where business sophistication in research is low.

A specific method of eight steps was developed for the implementation of the Triple Helix partnerships model. The eight steps are: (i) Set the project objectives; (ii) Defining the project scope; (iii) Understanding the business innovation behaviour; (iv) Identifying and motivating the stakeholders; (v) Transferring good practice; (vi) Set up of an efficient process to generate high quality proposals; (vii) Assistance in implementation; and (viii) Share learning. In this chapter, the implementation of these guidelines is illustrated on the basis of the Triple Helix pilot project in Bosnia and Herzegovina.

Step 1: Set the project objectives

The overall objective of the project was to create the foundation for a sustained investment in innovation in one strategic sector for the BiH economy, safeguarding the competitive position and employment in existing or newly created BiH enterprises.

The specific objectives were to establish a platform to bring together partners from public research institutions, private sector and government in one strategic sector of the BiH economy, as well as to establish three concrete partnerships between research, business and government around partnership projects.

The mobilisation of the stakeholders and ultimately the success of the project strongly depend on clear objectives that are attractive to all participants. As the project involves a significant investment of time and travel expenses, the perceived benefit has to be in the shape of tangible results. Therefore the project has to be geared towards concrete Triple Helix outcomes, such as:

- a consulting arrangement that will enable an academic to solve a problem for a business
- an outsourced R&D project
- shared use of R&D equipment
- a jointly developed product or service (in the most ambitious case)

Step 2: Define the project scope

In order to keep discussions focused and create a sense of common purpose, there has to be a focus on the project scope. A nationwide project covering all industry sectors and all technologies would not be an attractive proposition as participants would not be able to identify with each other.

The focus should be on a sector, a region or a technology.

A **regional focus** brings together actors located close to each other, which facilitates face to face contact and lasting relationships. This is especially true in situations where regions already show industry specialisation, and can lead to the emergence of formal or informal industry clusters. However, if the region has a very diverse industry base, combining both manufacturing and services, a regional focus may not be the best choice.

A **sectoral focus** ensures that all the business participants feel involved in most discussions, as they all pertain to their business sector. In addition, as was evidenced in the Bosnia-Herzegovina project, meeting colleagues from the same industry leads to networking, which can result in new business relationships that are not directly linked to the Triple Helix project itself. This is a valuable contribution to the creation of a national industry network[6]. The difficulty with a sectoral focus is the geographical distance of the various actors, which sometimes discourages them from participating in all events due to a lack of time and financial means to travel. However, this constraint also self-selects the participants who have the strongest motivation to participate, and is thus not detrimental to the success of the project.

A **technology focus** would be justified if a certain technology is particularly strong and can be applied to several industry sectors. However, this is usually not the case for middle-income countries.

[6] We intentionally avoid using the term “cluster”, as clusters are usually co-located within the same geographical region.

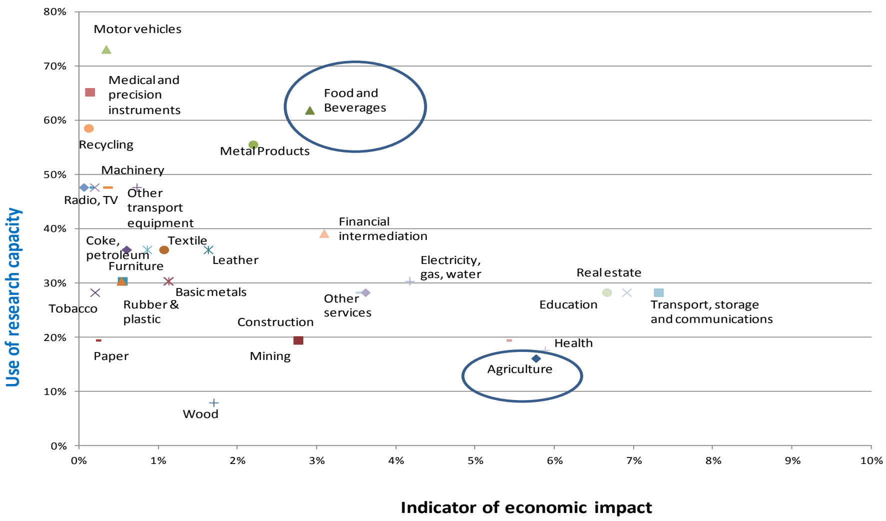
Selection of the sector for the pilot

The selection of the sector in which the Triple Helix partnerships were to be implemented is based on both research capacity and economic impact.

In Bosnia and Herzegovina, a method was designed to rank sectors according to their research capacity and economic impact. The scarcity of data measuring the research capacity was a challenge, and therefore a composite of different indicators for the entities was used: (i) number of doctoral students in the Federation in 2008, and (ii) number of research personnel engaged in R&D in the Republika Srpska in 2008. For economic impact a composite indicator was used combining: (i) gross value added per sector and (ii) employment per sector. The results are shown in Figure 11 below. Several sectors showed strong economic impact, and many have research capacities, although the absolute level of research capacity remains low.

The sectors which were chosen by the project team were agriculture and food industry. The food industry benefits from the greatest research capacities, and has significant, if not leading economic impact, while agriculture has leading economic impact and also benefits from some research support (Figure 8). Since both sectors belong to the same value chain, selecting the agri-food industry combined the strong research capacity and high economic impact. The sector is mostly composed of SMEs, which was another strong motivation in its favour, since SMEs generally do not perform in-house R&D and would therefore benefit strongly from Triple Helix co-operation.

Figure 11. **Sector selection according to research capacity and economic impact**



Source: OECD Investment Compact for South East Europe, analysis based on statistical data (2011)

Step 3: Understand the business innovation behaviour

In order to prepare an efficient Triple Helix process, it is necessary to understand the starting point for businesses: their current innovation behaviour, their needs and expectations, as well as their perceptions of the academic sector.

A survey on 150 firms from the agri-food sector was conducted. A detailed account of the survey is provided in Annex A. The survey showed that even though innovation was widespread within the agri-food industry, only a small percentage of firms collaborated with academia. The encouraging result was that those who did collaborate usually had a positive assessment of that collaboration. In addition, firms were keen to expand their co-operation with academia if given the opportunity, and potentially some financing.

Step 4: Identify and motivate the relevant stakeholders

Identifying the relevant stakeholders is a challenge in countries where similar projects have not been previously organised. To identify relevant stakeholders from academia, business and local government institutions, the best efforts have to be deployed. The project team consisted of officials from the Bosnia and Herzegovina state-level government, officials of both entities' ministries of Science and Technology, representatives of Chambers of Commerce, a team of OECD analysts as well as independent consultants hired for specific tasks during the project.

Next, a comprehensive effort was deployed to identify stakeholders from:

- Academia: Rectors of all universities and Deans of the faculties dealing not only with scientific disciplines, but also with management, marketing, organisation and design, as well as directors of public research organisations.
- Business: since very few businesses have an R&D function, contacts were usually established with the CEO, and in some cases with the Operations manager.
- Government: all levels of government were targeted: local, entity and State level.

Step 5: Transfer of international good practice

Good practice transfer motivates participants as it demonstrates that the concept can give results in similar settings. Therefore, it is important to choose the examples carefully, taking into consideration the context. A balance of examples from cutting edge practice has to be combined with examples from countries at similar levels of development. In the Bosnia and Herzegovina project, good practice from Germany and Belgium was used, as well as examples from transition countries such as Slovenia and Poland. Best practice has to be clearly communicated, insisting on the lessons learnt and how they can be applicable to the local setting.

Best practice is best communicated first hand, by stakeholders who actually experienced it and can answer questions from the auditorium. In some cases, unsuccessful examples can be used if they provide learning about what not to do.

Box 2: **Good practice example 1: Theory from academia translated into practice by meat industry in Slovenia**

The R&D department of a Slovenian manufacturer of animal feed partnered with the Animal Science Department of the Faculty of Agriculture in Zagreb (Croatia) and a large agro-industry firm in Croatia to produce omega-3 enriched meat. The purpose of the joint project was to research the impact of animal nutrition on the quality of meat from the animals. Researchers wanted to explore the possibility of producing leaner pork meat with a higher percentage of unsaturated fatty acids and a lower percentage of saturated fatty acids in order to achieve benefits to human health.

Each research partner had very clearly defined tasks and areas of research, which complemented each other well. The public R&D unit had a good theoretical base as well as knowledge of scientific developments internationally, while the industrial R&D unit had a better understanding of the practical dimension, which was critical for the successful transfer of knowledge into the production process.

The project started in 2003 and was completed in 2006. Financial support for the project (EUR 1.45 million) was provided by the Slovenian and Croatian governments under the EUREKA[7] umbrella. In contrast with other national instruments, EUREKA has the advantage of being focused on business-relevant R&D projects rather than the scientific excellence, and it encourages research to support market outcomes.

Among the difficulties encountered was a liquidity problem for the main business partner, the agro-industry firm, which delayed the investment in production, and a lack of commercial skills among researchers which slowed down the patenting and branding of research findings. Furthermore, the project did not invest enough in the public promotion of the improved feed and its end products, meat and meat products. There was no proper public support mechanism for this stage of the innovation process, due to a lack of understanding of R&D and the marketing phase.

In spite of these difficulties, omega-3 enriched meat (pork and poultry products) are being produced and marketed, and the Slovenian partner has successfully engaged in other projects of a similar nature. A new support scheme was introduced in Slovenia to help with the investment in new products and processes. An innovation voucher scheme was introduced to help with the costs of patenting.

[7] EUREKA is an intergovernmental network that supports market-oriented R&D and innovation projects by industry, research centres and universities across all technological sectors. Umbrellas are thematic networks within the EUREKA framework which focus on a specific technology area or business sector. The main goal of an umbrella is to facilitate the generation of EUREKA projects in its own target area.

Box 2: **Good practice example 1: Theory from academia translated into practice by meat industry in Slovenia** *(cont.)*

This project shows that even sectors such as agri-food, which are traditionally less R&D intensive, can benefit from co-operation in a Triple Helix relationship. However, due to a lack of specialised bridging instruments such as dedicated grants for Triple Helix projects, co-operation often depends on personal contacts and the experience level of actors. Governments should approach co-operation between science and industry in a systematic and integral manner and provide appropriate support from the first contact through to entering the market.

Source: (Bučar, 2011)

During seminars organised in Bosnia and Herzegovina, participants were presented with international good practice examples of successful Triple Helix projects. The examples provided several lessons for the implementation of the Triple Helix project in Bosnia and Herzegovina. The first is the importance of finding the right balance between scientific excellence and marketing skills. As the Slovenian example showed (see Box 2), a good product is not enough if marketing skills are not sufficient and the project is not actively supported by the public sector. The need to protect intellectual property is also important and patents can constitute an important in-kind contribution to spin-off companies.

The second good practice example from Ghent University demonstrates the importance of sharing trust among the relevant stakeholders. A protective attitude and the perception of other participants as competitors can be detrimental to the results as was shown in the Belgian example (see Box 3). Food2know is a centre of excellence at Ghent University whose primary mission is to strengthen the links between research and industry and help identify projects that are beneficial for both academia and business.

Box 3: **Good practice example 2: Academia helps business at Ghent University**

Ghent University has recognised the importance of building an institution to respond to market needs through Food2Know, an interfaculty centre of excellence for food science, nutrition and health. Over 30 laboratories and research units are part of this network, the National Institute for Agricultural & Fishery Research (ILVO) and the University Colleges. It brings together top expertise along the total health chain, comprising animal feed, human nutrition and general health issues. It covers both fundamental and applied research, and focuses on the specific needs of partners in industry, resulting in direct competitive advantages. It is regionally and nationally active, but also open to international partnerships.

Box 3: **Good practice example 2: Academia helps business at Ghent University** *(cont.)*

Partnership projects originate by combining industry needs and social needs with academic findings. This gives rise to basic research projects, financed partly by the industrial partners or through the budgets of the academic institutions. When the basic research achieves results, they are then protected by patent and the development phase can start, leading to a commercially viable product or service.

The various activities of Food2Know provide valuable support to the Flemish food industry and contribute to its competitiveness. Direct interaction between researchers and firms allows researchers to focus on research areas that are most relevant to the creation of value for businesses. The financial support of the government makes it possible to engage in research which would otherwise not be conducted by the private sector. On the other hand, the co-financing of projects by industry ensures that research outcomes eventually contribute to the business sector.

The main constraints observed by researchers when working with companies are companies not dedicating enough time to the collaboration and their desire to retain information as "protected knowledge". A more open attitude by the companies would improve the results even further.

Source: (Rajković, 2011)

These international good practice examples illustrate the considerable potential of Triple Helix partnerships for creating innovation and value by combining the talents of scientists with the business acumen of companies and accompanied by adequate policy support.

After sharing these and other good practices with participants, they were invited to submit proposals for concrete and innovative Triple Helix partnership projects. Interestingly, the term "innovation" seemed daunting to some participants, and it needed to be explained that innovations did not need to be very advanced, and that incremental innovations in products, processes or marketing were also welcome.

Step 6: Set up an efficient process to generate high quality proposals

Once good practice from foreign countries is transferred, the local participants should be ready to generate project proposals from local participants. The application and selection process needs to ensure the motivation of the participants to draft proposals and guidance throughout the process in order to ensure that good quality proposals are generated.

Clear guidelines should be provided in order to clarify the expectations as to the content and format of the proposals. The selection criteria also should be transparent and clear in order to create a climate of trust and meritocracy. A jury composed of neutral international experts, with no stakes in the country, is the most effective in selecting the best proposals that will benefit from the technical assistance.

A typical process involves three steps:

1. An initial invitation to participants to submit ideas for potential Triple Helix projects. At this stage ideas can be quite general, and the participant does not necessarily need to have identified partners from all three stakeholders, but can express the idea and define a search for a potential partner. The ideas are then presented at a meeting, and discussed. The audience helps the participant identify the strengths and weaknesses of the proposal, as well as potential partners to recruit. Very often partnerships can be started among the participants present in the room.
2. A call for proposals is published, complete with guidelines and a detailed template to be filled in (see Annex for an example used in the Bosnia-Herzegovina project). At this stage projects should have the following components:

   – A clearly identified need that the innovation should satisfy (this need can be a client need in the case of a product/service or a marketing innovation, but it can also be an internal need such as cost reduction if it is a process or organisational innovation.)

   – A description of the innovation, of its features and functionalities, as well as the process or technology to be used.

   – Clearly identified partners from all three domains: academia, business and local government, with a definition of their roles in the project.

   – An action plan: how is the innovation process going forward until market launch? The main phases of development have to be described, together with an assessment of the financial investment needed.

   – An assessment of the attractiveness of the innovation, to the business itself, its export potential, as well as its potential broader significance to societal challenges such as the environment and public health.

   – An assessment of the feasibility of the innovation and the potential risks to be faced.
3. The proposals are then graded by objective experts. Evaluation criteria need to be transparent and clearly communicated upfront. In this case they included: quality of partnership, coherence of project, quality of action plan, attractiveness of project, feasibility of project.

Selection involves two stages: an initial short-list is based on the written proposals, and shortlisted participants are invited to present their projects in order to decide on the final selection.

In Bosnia and Herzegovina, the project received 23 full proposals for consideration, many of them of good quality. During a conference held in June 2011 in Sarajevo, the proposals were graded by a team of four experts specialised in agri-food and innovation. A broad range of innovations was proposed, some of them very specific new products, others addressing processes, and some covering a broad range of potential new products (such as the omega product). Partnerships were not always evenly balanced, especially when the project leader was from a scientific institution. Local government partners showed a seemingly low level of interest at the project outset. The ten short listed projects are listed in Table 1.

A final selection round involved oral presentations of the ten shortlisted projects, which were then further prioritised, and only the top three proposals were awarded implementation support.

Table 1. **Top ten project proposals for Triple Helix partnerships in the BiH agri-food sector**

Project	Proponents
Use of field peas for the production of ethanol, protein concentrate and pellets	Project leader: University entrepreneurship centre, Banja Luka Partners: Branko Reljanović (entrepreneur), HPK (corn processing plant), farmers' co-operatives, SME Agency of Republic of Srpska
Omega products – production of food enriched with omega-3 fats	Project leader: Biotechnical Faculty from Bihać Partners: Teleoptic d.o.o. (dairy and poultry production), Posavina Koka d.o.o. (egg and poultry producer), Una-Sana canton Ministry of Agriculture
Organic disinfection agent for egg incubation and poultry farms	Project leader: KIKO d.o.o. (producer of hatching eggs) Partners: IRADIA (producer of hatching eggs), Veterinary faculty of Sarajevo University, Ministry of Science and technology of the Republic of Srpska
Vacuum-drying process for fruit and medicinal herbs	Project leader: Semberka (producer of dried vegetables, medicinal and culinary herbs, spices and soups) Partners: Technological Faculty, University of East Sarajevo; Municipality of Bijeljina
Production of organic fertiliser from chicken manure	Project leader: Posavina Koka (egg and poultry producer) Partners: Federal Department for Agropedology in Sarajevo, Veterinary faculty Sarajevo, Agricultural Ministry of Posavina County

Table 1. **Top ten project proposals for Triple Helix partnerships in the BiH agri-food sector** *(cont.)*

Project	Proponents
Development of a new dairy product based on cream cheese with fruit flavour	Project leader: PPM Tuzla (dairy producer) Partners: University of Tuzla, Technology Faculty, Ministry of Education, Science, Culture and Sports of the Tuzla canton
Herzegovinian sweet "ćupter" from grape juice	Project leader: Faculty for Agronomy and Food Technology in Mostar Partners: Federal Ministry of Environment and Tourism, Tourist Association of Hercegovina-Neretva county
Standardisation of the production process of Herzegovinian cheese	Project leader: Pramenka, an association of producers and processors of indigenous sheep cheese and meat in co-operation with the Food and Agricultural Faculty at the University of Mostar.
Enhancing food security in small farms	Project leader: Veterinary Institute of the Republic of Srpska Partners: Marché de Banja Luka, Food inspection agency of Banja Luka, "Blue Sphere" consumer association
Researching health properties of honey	Project leader: Federal department for agriculture Sarajevo

Step 7: Assist with implementation

Once a project proposal has been selected, it receives assistance for implementation, based on the timeframe in the action plan. This assistance usually has at least two out of three possible components:

1. technical assistance on product/service development which can include technology transfer, laboratory tests, field tests or other R&D actions;

2. market research to determine the market potential of the innovation, including surveys, focus groups or individual interviews with prospective clients;

3. analysis of the regulatory environment in order to recommend potential regulatory measures to support the innovation. This can include an analysis of regulatory environment, best practice sharing, expert consultation, and other activities.

An initial analysis should prioritise these three areas and determine where the focus should be. The trade-off has to be done on a case by case basis, based on the information contained in the project proposal, and in dialogue with the project consortium. One dimension that is often under-estimated is market research. Entrepreneurs often build market expectations based on anecdotal evidence and are usually unable to give accurate estimates of potential market size, taking into account not only the number of potential clients, but also their level of interest in the innovation, as well as their willingness and ability to pay a fair price for it. With the regulatory dimension the importance of sufficiently protecting innovation is not always realised. In the omega egg example it was identified that the creation of a new food label would be needed to protect the innovation.

The implementation phase often involves the engagement of one or more international or local expert(s) in the required field(s). For specialised technical subjects, experts can be found through personal contacts or desk research. For instance, a bibliographical search on a technical subject can very quickly show authors who are publishing in the area of interest. Such experts are usually very open to participation in a Triple Helix project, especially in a middle-income setting, as it may provide a new experience for them to apply their expertise.

Once a short list of experts is identified, detailed terms of reference have to be drafted. This has to be done in a collaborative way, taking into account the methodological suggestions of the experts, but also the needs of the project stakeholders. Ideally, two to three project proposals should be developed and submitted to the project team for prioritisation. As soon as the terms of reference are agreed upon by both the expert and the project team, the technical assistance can start.

It is important to continue monitoring the work of the expert, and make sure that both timeliness and the quality of output are at a satisfactory level. For a transparent and inclusive process, regular project updates need to be sent to project partners. It is also useful to organise regular meetings every two to three weeks in which the direction of the project can be discussed. For a fruitful discussion, it is necessary that all partners i.e. from academia, business and local government authority be present at meetings.

Active project management has to be adopted in this process as the process of innovation is not always predictable and sometimes swift changes in direction have to be decided. For example, if a proposed business model proves unprofitable, variations need to be explored in co-operation with project partners until an alternative model is identified, similarly, if a laboratory or field test does not give satisfactory results, the technical solution may need to be swiftly re-oriented

Step 8: Share learning

Exchanging information on difficulties encountered, the achievements and the next steps for implementation at the end of the implementation phase is the final step in the process. This serves as useful feedback to all stakeholders, and provides an opportunity to create additional opportunities for feedback and learning. It also demonstrates both the results and potential imitations of the method, and will gradually build trust, increasing the willingness of stakeholders to continue participating in Triple Helix projects.

In the case of the Bosnia-Herzegovina project, this was done by informing the network of 250 stakeholders about the outcomes of the project, and organising a final "InnoBiH" conference where the project leaders were able to present the progress they made on their projects.

Application of Triple Helix partnership projects in Bosnia and Herzegovina

The functioning of the explained steps is best illustrated by the three selected pilot project partnerships that were selected in the framework of the RCI project.

The three best-ranked proposals received support for implementation in the framework of the pilot project. Due to the limited time frame of the project, assistance for implementation could only be provided during a six-month period, which is a relatively short time to achieve any significant outcomes. The aim was thus to adapt the short-term support provided to help the project partners to make incremental progress and have a clear roadmap for future implementation. This section presents the activities on the three selected projects, the progress achieved and the lessons learned.

Project 1: Introduction of omega-3 enriched eggs to the market

This partnership was proposed by Professor Mirsad Veladžić from the Biotechnical Faculty at the University of Bihać. In order to improve the accessibility of healthy food and reduce cardiovascular diseases, Prof. Veladžić suggested introducing omega-3 enriched products such as meat, cheese, milk or eggs to the market in Bosnia and Herzegovina.

Context: Innovation needed to help solve a public health problem

The idea originated from a public health problem: the deficit of omega-3 fatty acids compared to omega-6 acids in the diet of the population is one of the key causes of cardiovascular disease, which is the cause of 53% of mortality in Bosnia and Herzegovina. Research in the area of improved fatty acid composition of food, especially dairy products, eggs and different varieties of meat, has been intensified in recent years. Studies of the Greenland Inuit tribe showed that their diet, which consists of large amounts of fat from fish, resulted in the near absence of cardiovascular disease (Bjerregaard et al., 1997). Today it is understood that the ideal ratio of omega-6 to omega-3 fat intake is 1:1, while in Bosnia and Herzegovina it is typically closer to 20:1 in favour of omega-6 acids. The reason for this is that omega-3 acids are predominantly found in fish, seafood and flaxseed, nutrients which are under-represented in the national diet.

In addition to the scientific context, the economic context was taken into account. Bosnia and Herzegovina has a large agri-food sector, with production capacities for milk, meat, poultry and eggs, all of which contain predominantly omega-6 fatty acids which could potentially be enriched with omega-3 fatty acids.

The innovation: Omega-3 enriched food to be introduced to the Bosnia-Herzegovina market

Prof. Veladžić proposed the introduction of omega-3 enriched products to the domestic market. Instead of adding omega-3 fatty acids to the final product, he proposed to investigate the potential of naturally producing food products with a more balanced fatty acid composition. The idea was to alter animal feed to change the balance of the final food products' composition in favour of omega-3 fatty acids.

The product development: Knowledge transfer from Slovenia

Having originated from a scientific institution, the idea needed a business partner. Prof. Veladžić found one large dairy and poultry producer, Teleoptic from Velika Kladuša, who was interested in the partnership. Within the network of participants in the Triple Helix project, there was another interested farm, Posavina Koka from Orašje, in the north of Bosnia and Herzegovina. Next, the team sought a best practice example which could be applied in Bosnia and Herzegovina. Dr. Matjaž Červek, an expert from Emona research institute in Slovenia, was hired for the project. Dr. Červek had previous successful experience with the introduction of omega products in Slovenia. According to Dr. Červek, the production of omega-3 enriched milk was challenging as the chemistry of cow digestion tends to transform the omega-3 acids it feeds on, and only a marginal effect could thus be obtained in milk production. On the other hand, he confirmed that egg and poultry production was much more feasible, and given the short time span of the pilot project, a pilot production of omega-3 enriched eggs ("Omega eggs") was selected as the project focus.

Next, a field test protocol was established whereby the two producers, Teleoptic and Posavina Koka, communicated their feed mix to Dr. Červek who then defined the new feed mix for the trial, including flaxseed to enhance the omega-3 content in eggs. The feed was then prepared according to the new recipe, and fed to a sample of 30 hens for a period of two weeks. Eggs laid before and after the two-week period were chemically analysed in Ljubljana, at the Emona Research laboratory. The field test was finalised when the results showed the expected the omega 3 content.

The market study: Good prospects for the introduction of omega-3 enriched eggs and chickens

In order to study the feasibility of launching Omega eggs, a market study was conducted. The main topics of the survey concerned questions on the perceptions of the influence of food on health, and the purchasing behaviour of customers. In order to study both the domestic market and an export market, the study was performed in both Bosnia and Herzegovina and Croatia.

The results of the study showed a very high level of awareness: 75% of the BiH population said that food very significantly influences health, and 79% said that they “always” or “frequently” paid attention to a healthy diet. In addition, 45% of the population is aware that omega-3 fatty acids reduce the risk of cardiovascular disease, and 80% are convinced that omega-3 acids are needed by the human body. Most (56%) of the population finds the availability of omega-enriched foods to be lacking. Finally, 50% of consumers affirm that the offer of Omega eggs would increase their consumption, and when confronted with a choice between standard eggs and more expensive Omega eggs, 68% would opt for the Omega eggs. The results in Croatia were similar, although the percentages tended to be slightly lower than in BiH. The survey also covered chicken meat, with the consumers also broadly agreeing they would buy omega-3 enriched chickens at higher prices.

The results of this market study showed that omega-3 enriched products would have market success if introduced. Even though the production, and therefore consumer, costs for “Omega eggs” are higher, consumers are willing to pay this price, thus confirming the economic feasibility of the product.

The role of government: Protecting the interests of consumers and innovative producers

The project also showed the importance of the third strand of the Triple Helix, the government. At the outset of the project, the government role was essentially to facilitate and finance the development and market study for the product. However, due to a lack of government resources, this task was taken over by the donor in this pilot project.

As the project unfolded successfully and the market launch became more imminent, the regulatory aspect of the project became more important. It became evident that a regulatory body would be necessary to protect the “Omega” label and regulate it on the basis of the exact content of omega-3 fatty acids in eggs and thus avoid “false” omega-3 products. Best practice from Slovenia showed that the “Omega” label was best protected under the label of “food of higher quality”, i.e. food that has special health benefits. The Food Safety Agency of Bosnia and Herzegovina then proposed specific legislation to introduce similar protection in Bosnia and Herzegovina. The legislation is now pending approval by the government.

Representatives from the Consumer Association were also involved in the discussions as representatives of the civil society, challenging the Food Safety Agency to effectively implement the protection of the “Omega” label.

Sustainability A solid business case ensures long term market prospects

The technical and economic feasibility having been demonstrated, Posavina Koka decided to launch “Omega eggs” on the market. As a concrete result of this Triple Helix partnership, omega-3 enriched eggs are available in supermarkets in Bosnia and Herzegovina since May 2012. If the results of the market research are confirmed in practice, production should be expanded and may be adopted by other producers, with the effect of improving the nutrition of the general population.

Prof. Veladžić continues to explore other food products which could be enriched by omega-3 acids: chicken, fish and other products. Provided that the University of Bihać has access to the required equipment, such chemical analysis could be conducted in Bosnia and Herzegovina in the future.

Project 2: Processing field peas into ethanol, animal feed and proteins

This partnership was proposed by Ms. Milena Ljubičić, a project manager at the Entrepreneurship Centre at the University of Banja Luka. The business partner was Mr. Branko Reljanović, an entrepreneur from Sweden. The director of the SME Development Agency of Republika Srpska, Mr. Slobodan Marković, was the main government partner. This partnership was ranked first among all the Triple Helix project ideas that applied. All three partners had clear interests and the project offered multiple opportunities for applied research and innovation with significant commercial potential.

The context: Seeking market applications for peas

Pea culture can bring positive effects when used in crop rotation with other cereals as it reduces the quantity of fertiliser needed. This motivated the Development Agency of the Republic of Srpska to seek potential markets for the peas.

Two of the three products that could be obtained from processing field peas – ethanol and proteins – are currently being imported to Bosnia and Herzegovina. Regulations dealing with the protection of the environment require the reduction of greenhouse gas emissions from vehicles. One strategy for achieving this goal is the inclusion of ethanol in fuel, in varying percentages ranging from 3 to 100%. In most developed countries, because of the shortages of this product, legal provisions require a minimum of 5% ethanol (with aims to increase that percentage); the EU plans to increase this share to 10% by 2013. In this context, the production of ethanol will have to be increased in the future.

Currently, it is mainly corn and soybeans that are used to produce ethanol. Using field peas as a raw material is an innovative idea with multiple advantages, not least the conservation of soil quality given that artificial fertilisers are not required. A Swedish company “Chematur Engineering AB” has developed a design for the production of ethanol from peas, which is in fact a redesign of an already existing plant. The size of the plant is significantly smaller than the industry standard and requires a significantly smaller amount of raw materials for processing. According to the project initiator, this would allow small countries, such as Bosnia and Herzegovina, to set up ethanol production, with export potential.

The innovation: Commercialising three products from field peas

The proposed project involved the establishment of a value chain, which included the cultivation of leguminous crops that were to be processed into three products. The stems were to be used as pellets for fuel or bedding for livestock. The peas were to be processed into ethanol (fuel) and protein, in the form of concentrated feed, although after further treatment proteins for human consumption could be obtained.

The main innovation was the efficient use of the entire plant, and the identification of relevant market needs for each component. The pellets meet a market demand for renewable energies, ethanol responds to market trends towards "green" fuel, and protein substitutes for feed imports. Because the whole plant was to be processed, no waste would be produced.

An important externality would be the effect of field peas in the crop rotation, which would reduce the quantity of fertiliser required for other crops.

A comprehensive partnership

The project proposal was comprehensive, and had already identified potential markets and partners abroad. It also listed a variety of potential products, making the business plan of the proposal less dependent on a single product and thus less exposed to market fluctuations. The role of partners was clearly defined.

The process had already been tested with field peas grown in Sweden; however, it was necessary to conduct a field trial with peas growing in Bosnia and Herzegovina in order to verify whether the output would be the same. The project initiator highlighted that ensuring sufficient quantities of raw materials is the main factor for successful project implementation. Without sufficient quantities of raw materials, the return on investment will be lower which would increase the price of the final product and thus reduce the product's competitiveness on the market.

The feasibility study concluded that the proposed business model was not viable

A feasibility study was undertaken to verify the proposed business model and determine the conditions under which such an innovative production could be successful.

The conclusion of this study was that, contrary to the original proposal, ethanol production would not be economically feasible without specific government subsidies due to the fact that ethanol production from fossil hydrocarbons (mostly from natural gas) is less costly than any production using biomass. The only exception is the use of sugar cane in Brazil, where climatic conditions are favourable for the production of sugar at very low cost which can then be processed into ethanol. Even in a subsidised environment, such as ethanol production from corn in the United States and Germany, economies of scale are needed to make ethanol production profitable, and the smallest economic plant size refines 50 000 tons of corn every year[8]. In addition, production of ethanol from peas is more costly than from corn, according to the results of a study by Gustafson et al. (2008). Therefore

[8] Personal communication from C. Wandrey, Director, Institute of Biotechnology 2, Forschugszentrum Juelich GmbH.

the original idea of small-scale ethanol production from 4 500 tons of field peas had to be abandoned.

A second scenario was proposed where the starch fraction, instead of being processed into ethanol, could be further processed to glucose by a local producer. The other fractions would be processed as in the original proposal: the protein fraction would be sold to animal feed manufacturers, the stems and the pea shells would be further processed to pellets.

The financial analysis of this scenario found that the costs exceeded revenues under the most realistic hypotheses. The main reason for this is the relatively high projected cost of field peas, which represents about 77% of the cost structure, and the relatively low price of the resulting products. Field peas are more expensive in Bosnia and Herzegovina than on the world market for two reasons: first, because of the subsidised prices of cereals in Bosnia and Herzegovina, the revenue a farmer expects from his land is higher than if world market prices would prevail, and second, the climatic conditions in the region limits the yield of peas due to insufficient rain at a critical period of the year. Processing field peas into products of low added value cannot compensate for the high cost of field peas.

The proposed alternative: Functional food as a higher value-added end product

The project was thus redefined a third time due to its lack of economic viability. An alternative option was to process the field peas into three fractions: (i) starch; (ii) protein; and (iii) fibre, and seek high value-added products based on those fractions, using them for food wherever possible, rather than cattle feed.

The starch fraction could then be offered to starch refiners such as HPK Dubica (a local company processing corn) to feed into sugar/candy manufacturing and the protein fraction could be used either directly as a component for animal feed, or processed further to be offered to the food industry. The cellulose fraction would probably be used as animal feed. First results of the economic analysis showed that processing field peas into proteins for (human) nutrition could be economically viable since pea proteins would have a far higher added value if used in the food industry for products such as sports food, dairy products or pet food, or in the meat industry.

A market study was performed on the application of pea proteins in various market segments such as sports food, dairy products, pet food, etc. However, first results of the study show that the market for the application of pea fractions is very limited in size, the whole market for the Western Balkans being estimated at 800-900 tonnes, less than the projected size of the plant of 1 000-1 200 tonnes. In addition, the market is dominated by two main European producers, making market penetration difficult for a new entrant. The risk is seen as too high, particularly considering the high initial investment.

Another possibility was to pilot the production of pea flour, a product which can be sold directly to consumers. Pea flour is intended for baking gluten-free bread, or making diet pasta, and sells for a relatively high price on the North American market. However, this product is not very well known in Europe, and even less so in the Western Balkans. It would take a considerable effort on the communications and marketing side to be able to commercialise this product.

Nevertheless, producing pea flour does not require high initial investment, since test production can be done in existing mills. In an R&D project, the team could analyse how pea flour is produced, test its taste, and launch a small-scale marketing campaign in co-operation with a nutritionist who could explain health benefits, for example through a tele-shopping channel. Depending on the outcome of the marketing, production could be gradually scaled up as needed.

Project 3: Ecological disinfection product

This Triple Helix partnership, a disinfection product with 100% natural ingredients, was proposed by Krsto Stojanović, representing his company KIKO, in the town of Bijeljina. In this case the product already existed before the project started but its application and testing had been limited. The first step was therefore to analyse the potential market for such a disinfection product and to conduct further efficiency tests in co-operation with the scientific partner at the Veterinary Faculty at University of Sarajevo. A third partner from the government, the Ministry of Health and Ministry of Environment would be involved at a later stage to certify the positive impact of this natural disinfection product on human health and environment, with respect to the traditionally used formalin.

The context: The most commonly used disinfection products have negative health and environment effects

Sanitation and disinfection procedures support the prevention of diseases. Disinfectants are chemical agents that kill pathogens on contact and result in the destruction of all forms of micro-organisms. The prevention of diseases has a significant role in the food processing industry, including poultry and egg production. The sanitation of hatching eggs and the hatching area require the most attention, given the fact that these areas have the most critical points in production which can affect the vitality, hatching results and health condition of both embryos and chickens (Flammer, 1984). Formalin or formaldehyde fumes are most commonly used for the sanitation of hatching eggs. They have very good antibacterial properties, are effective and have relatively simple application for mass deployment, but also have proven carcinogenic properties and adverse effects on exposed humans (Kustura et al., 2009). Since most of the disinfectant agents have at least some level of negative effects on humans, animals and/or the environment, there is an increasing need for disinfectants to be developed with less harmful side effects. In this context, numerous studies are being conducted at an international level with the objective to find alternative products that are as easily applicable as formaldehyde, with less harmful effects on health and the environment.

The innovation: A non-toxic disinfectant made from natural ingredients

Aroma Aqua is an ecological disinfectant made from natural ingredients with no synthetic additives. The product consists of essential oils produced from medicinal and aromatic herbs, vegetable and fruit oils and oilseed oils. Because of its ingredients, the product can be used in the production of healthy food in line with halal standards. It is intended mainly for industrial application and it can be applied as a disinfection agent in livestock production (including organic livestock production), disinfection of facilities, equipment and transport means, food production, disinfection of animal origin products etc.

Because of its completely natural basis, the Aroma Aqua product is expected, upon scientific confirmation, to be used as a replacement for synthetic disinfectants, resulting in a significant reduction of pollution of the working environment. It is completely biodegradable in water and has no corrosive effects on metal, plastic or ceramic surfaces. In addition, Aroma Aqua has a mild and pleasant fragrance, unlike chemical disinfectants which usually have strong and unpleasant odours.

According to the producer, it can be used in:

- livestock production and eco-production, for disinfection of facilities and equipment, and in food production (without direct contact with food due to the fragrance of aromatic oils);
- food production, for the disinfection of animal products and equipment;
- other areas where there is risk of bacterial infection.

The producer of Aroma Aqua claims that it is harmless to humans and animals. Products treated with Aroma Aqua may be used without restriction for human consumption and it does not pollute the living or working environment in any way.

The market study showed a positive attitude of potential customers towards a natural disinfectant, provided efficacy is proven.

A market study was prepared based on research on the demand for the organic disinfectant Aroma Aqua in Bosnia and Herzegovina and in Croatia. Based on interviews and discussions held in a focus group setting, potential users expressed an interest in using the product under the following conditions:

- the product efficiency is scientifically confirmed and proved to be as effective as formaldehyde/formalin;
- the product is proven to create no autoimmune resistance over time;
- the product is proven to have a wide range of applications (on bacteria, fungi and parasites);

- the product is proven to be efficient regardless of weather conditions (air temperature, humidity, etc.);
- the product is completely harmless for both people and animals;
- the product is simple to use and requires no additional training of workers or additional equipment;
- the product can be used for disinfection of larger/higher/less accessible areas;
- the product can be used both in fumigation and with sprinklers (to satisfy the preferences of all potential users);
- the product's price is not more than 10-15% higher than prices of other similar disinfectants.

The main factors that drive the demand for disinfectants include the trends in agricultural production (with a focus on poultry and livestock) and the prescribed or predominant disinfection standards. Due to increased health risks, it is likely that the demand for disinfectants will remain stable or gradually increase.

Although the negative effects and potential health hazards of formalin usage are well known to farmers, it remains the commonly accepted standard in the disinfection process and is widely available in the distribution network at affordable prices. However, according to a new EU directive all products containing formaldehyde were supposed to phase out by 1 November 2011. Due to the trend to harmonise legislation with the EU, the product is expected to soon disappear from the market in Bosnia and Herzegovina and in Croatia. Since other widely used disinfectants all have negative side effects on health and the environment, the demand for efficient, safe and affordable disinfectants in Bosnia and Herzegovina and in Croatia will significantly increase. This creates opportunities for new entrants into the market, provided that they prove their effectiveness, keep the price in line with market expectations and secure distribution in key market segments such as larger egg and poultry farms.

The market size estimate, on the other hand, shows that there is very limited potential for the successful commercialisation of an ecological disinfectant product if the business limits itself to the egg fumigation and poultry farm market. Many competing disinfectants are offered by multinational companies with strong marketing and distribution networks, which may hinder the opportunities for new smaller entrants into the market. In order to improve the commercial prospects of the Aroma Aqua disinfectant, the entrepreneur should continue testing additional options (such as disinfection of pheasants, geese and ducks), as well as considering placing the product on the larger regional and EU markets after establishing a good product reputation on the local market.

Product efficiency testing shows encouraging results, but more testing is needed

The results from the market analysis showed that demand for the product would depend largely on its effectiveness, with potential users willing to consider Aroma Aqua if the product is as effective as formaldehyde/formalin. The project initiator had already tested Aroma Aqua at several institutions and universities which showed positive results. In co-operation with the scientific partner of the Triple Helix project, further tests were conducted at the newly accredited Veterinary Faculty at the University of Sarajevo. The project team agreed to test the disinfection product's efficiency on the most common bacteria/micro-organisms[9] under laboratory conditions as well as in the field (on both pig and poultry farms). Regarding the field tests, samples were taken from objects/farms where instead of Aroma Aqua, a regular product was applied.

The results of the tests showed that although the product does have some disinfection properties, it is too early to conclude that it is as effective as formalin. Further testing is necessary.

Next steps: More tests will be needed to convince customers

Field tests would have to be continued under different climatic conditions, and also in additional settings. Due to the estimated limited market size for the ecological disinfectant product, further tests will be necessary in order to investigate other applications for the product.

Potential users would need to be convinced about the positive effects and efficiency of the disinfection product, for example through a marketing campaign. The market study suggests that the product should first be placed on the local market in order to establish a good product reputation, then sales and distribution channels should be built before proceeding to other countries in the region or EU countries.

Intellectual property protection should be considered to protect the product. However, the relatively limited market size might not warrant the expense of a costly patent procedure. In this case a trade secret might prove the best protection.

The product's positive impact on the health of workers and on the environment exceeds by far the immediate market potential. The replacement of carcinogenic formaldehyde by a natural disinfectant would provide huge returns to society. Therefore such a product would warrant additional public grants to continue the validation process of its use in various disinfection applications.

[9] *Escherichia coli, Salmonella enteritidis, Yersinia enterocolitica* and *Campylobacter jejuni*

Chapter 4

Conclusion and future outlook

The three Triple Helix partnerships implemented in Bosnia and Herzegovina demonstrate that the model can produce practical results, even in an environment with weak business-science linkages and little predisposition for R&D and innovation in general. It showed that low levels of public spending in R&D, and very low business spending on research in the agri-food sector do not preclude countries from introducing some tangible innovations, as long as projects leverage the complementary skills of scientists, businesses and government.

The Triple Helix project brought together members of academia, business and government around a common theme of innovation. The open nature of the project, as well as its bottom-up approach enabling participants to both learn from others and express their own ideas, led to a constructive atmosphere which built sufficient trust in order to create sustainable partnerships.

An important effect of the project was the establishment of a network, which paved the way for future collaboration. Partnership projects developed outside of the project by participants who met during the Triple Helix meetings, creating what could be considered a nascent agri-food cluster in Bosnia and Herzegovina.

Value added of pilot projects

The analysis of the three projects undertaken shows that, in each case, the Triple Helix project helped bring innovative ideas closer to market:

- **The "Omega egg": taking an idea from research labs to market.** A scientist's "theoretical" idea was put in action. The initial idea was theoretically sound, based on a real problem of public health, but it lacked both the technology and the market access to be implemented. The project helped in three aspects:

  – The absorption of an "off the shelf" technology from abroad – in this case, through the intervention of a Slovenian consultant who transferred the technology and trained the Bosnian scientists. This is a classical example of technology absorption from abroad, a very efficient channel for innovation in developing economies which are in the process of catching up.

- The definition of a business model: market research confirmed that the consumers are prepared to pay a premium price for omega eggs, and a cost analysis verified that the extra cost could be covered through the price premium which the customers would pay.

- The transfer of a policy model which would allow ensuring sustainability of the new product: a new food label which would define a norm and warrant the protection against disloyal competition.

- **Natural disinfection products: developing new markets and consumer demand.** In this example the innovation - a disinfection product for egg incubators - already existed before the project had started. Through project support, new potential markets for the product were identified:

  - Field tests in poultry and pork farms showed the product's efficiency in these segments.

  - A market study helped identify a demand for the product as a viable alternative to formalin. This is important as regulatory changes in European legislation will force producers to search for alternatives to the currently widespread usage of formalin. This shows a sizable opportunity for Aroma Aqua as a 100% natural and non-toxic alternative.

- **Pea processing: an evolving project adjusting to complex market realities.** In this example, the initial idea was quite innovative, but represented producers' needs rather than market demand. The project was in essence a search for a viable business model. It started by showing that the idea of producing ethanol, animal feed and pellets is not economically feasible under the local climatic and regulatory constraints. A potentially risky investment was avoided through analysis of the technology as well as the local economics. Other variations of this business idea were explored, leading to a redefinition of the project proposal, in more realistic terms, giving the project a new impetus. The final project has a lower risk since the investment is not as high. This project partnership provides a good example of how important it is for an innovative project initiator to stay open to recommendations that were not initially planned. At the outset, the project initiators did not doubt the feasibility, and some investors were ready to invest money in a venture which would most certainly not succeed.

The economic and social effects of these outcomes could go beyond this project. If successful, the production of the "Omega egg" in BiH could by itself achieve economic benefits alongside those associated with health improvement. Siscovick et al. (1995) reported a strong negative relationship between fatty acid intake and sudden death: a treatment with 5.5g omega-3 fatty acids per month led to a 50% reduction in the risk of primary cardiac arrest.

There is potential to apply this endeavour to other segments such as poultry, meat fish and other foods. Prospects for export are also large as the current producer has confirmed first significant export opportunities. As for the Aroma Aqua disinfectant, it could potentially be successful in the EU, especially following the regulatory changes that prohibit formalin usage. In addition to the economic impact, it could also have positive effects on the health of employees, as well as sizable environmental benefits in the form of reduced pollution to water, soil and air.

This experience shows that Triple Helix projects are a cost-effective manner of stimulating innovation. Relatively modest sums invested in seminar organisation, field trials, market studies and working meetings can bring sizable return in the economic and social sense. In this case, the projects were financed by donor contribution, but to ensure sustainability, financing from the national budget is necessary.

Success factors

The critical success factors for projects encouraging Triple Helix partnerships are:

- *Open and inclusive communication between stakeholders.* The development of a formal network between academia, business and government (by means of a series of events) serves as a platform for exchanging ideas on potential innovations and leveraging the strengths of each actor: technical and theoretical knowledge from scientists; market knowledge and business acumen from the private sector; and government capacity to create incentive schemes and reform the regulatory environment. To ensure inclusiveness, all actors and stakeholders linked to the sector need to be invited to the events. The organisation of events and online platforms to facilitate such a network are an important way to stimulate the participants to move forward with their ideas, and help overcome the inherent barriers between stakeholders.

- *Agreement on objectives* In order to overcome the different interpretations of innovation for the different stakeholders, a set of guidelines needs to define the objectives sought by innovation projects. Proposed innovations have to be both technically feasible and economically viable, and partners from business, academia and government need to be clearly identified, and their respective roles defined. Project proponents should develop an action plan to define major steps for implementation. Finally, potential risk factors, and the means to mitigate them have to be identified.

- *Clear roles and incentives.* In order to ensure the quality of the final result, each partner needs to pursue a clear objective in line with their skills and incentives. For example, the research partner has to pursue a research objective consistent with his specialties and research priorities. In a middle-income country like Bosnia-Herzegovina, such a partner will also need financing for the tasks performed within the partnership, since institutions have little or no general purpose financing. The business partner can have a role in performing the field tests in an operational environment, and needs to see a clear business interest in the application of the innovation. The government partner can have both a regulatory and a financing role. Specific regulations can be needed to enable or protect the innovation (such as the labelling issue for the omega egg), and financial support may be needed in the feasibility and proof-of-concept stages.

- *Competition between participants based on transparent criteria.* Competition for the best project creates additional motivation among participants, even if no financial prizes are available. Project selection criteria need to be defined from the outset: quality of partnerships, project coherence, project attractiveness and feasibility, and quality of action plan.

- *Market focus of projects.* Throughout the project, all ideas are welcome provided they are anchored in customer needs. Participants need to justify their ideas from the customer's viewpoint, and market research needs to be conducted to verify potential success of the innovation on the market, assessing the customer need, the degree to which the proposed innovation satisfies that need, as well as the price the customer is willing to pay.

- *Support for project implementation.* This support should include:

  - a critical assessment of proposed innovation and action plan;

  - a feasibility study to determine the concept's economic and technical viability. The study should determine the process that could achieve the needed functionalities under specific cost, quality and timeliness constraints. The feasibility study typically includes field tests, process design, laboratory tests, and business model analysis;

  - a market study to determine client needs, purchasing criteria, and the price point and market volumes to be expected. The market study typically includes focus groups, surveys and individual interviews with potential customers.

- *Flexibility.* If a certain business model proves unfeasible, variations need to be explored until a viable alternative is found. The entrepreneurial innovation process is not an easy road, and several attempts are usually necessary to succeed.

Outlook for future Triple Helix partnerships

Bosnia and Herzegovina would appear to benefit from sustaining the effort to develop Triple Helix partnerships, potentially broadening the focus to other important sectors of the economy. Sustaining the effort could take place in stages with successive steps increasing both spending and impact:

- Increasing the number of pilot Triple Helix partnerships by operating similar pilots in the same or another sector, mainly through facilitation of seminars and technical assistance to best proposals. Pre-conditions for this have been improved through capacity-building of officials at the Ministry of Civil Affairs, who can now implement such pilots. A proposal for such a project is currently under review under the European Commission's Instrument for Pre-Accession Assistance.

- Broadening the approach to a number of sectors under the same model. In this case a broader co-ordination body would be needed, and this could be linked to the recent policy of establishing innovation centres.

- Setting up an innovation voucher system. For example, Slovenia has followed the example of the Netherlands and many other OECD countries and developed knowledge vouchers which provide a large number of small grants to encourage first steps in science-business co-operation. These vouchers allow SMEs to obtain support from universities and other types of institutions. This system provides an incentive for firms to benefit from the expertise of academics and can help bridge the gap between the two types of stakeholders.

- Providing financial grants specifically targeting on collaborative research between universities and industry (for example, based on the model of the Fleimish Agency for Innovation). Today the general trend in EU countries has been to limit direct research subsidies to targeted programmes to support SMEs and collaborative, needs-driven research projects. Since Bosnia and Herzegovina has very small research budgets, their gradual increase could be most efficiently channelled through such a needs-driven channel, rather than the traditional financing of public R&D in public research organisations.

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Annex A

Survey on innovation behaviour in the agri-food sector

In the framework of this project, a business survey of 150 enterprises from the agri-food sector of Bosnia and Herzegovina was conducted in March 2011. The survey examined the different aspects of firms' approaches to innovation, and co-operation in the agri-food sector of Bosnia and Herzegovina. The OECD Investment Compact for South East Europe prepared a questionnaire, which was then implemented using CATI (computer-aided telephone interface) technology.

The data analysis was also performed by the OECD Investment Compact for South East Europe. The sample was split into four size categories based on the number of employees. "Micro" indicates a company with 10 or fewer employees; "small", a company with between 11 and 50; "medium" between 51 and 150; and "large" more than 150 employees.

The survey concentrated its efforts on larger companies since larger firms tend to be more innovative (Zoltan and Audretsch, 1987). Even so, more than two-thirds of the sample surveyed was in the category of micro or small and only 10% (15 firms) were categorised as large. The general population of firms in the agri-food sector is weighted even more towards micro and small enterprises.

Most of the firms surveyed (56%) do not export. Of these, smaller firms are less likely to be exporters, with only 33% of micro firms and 35% of small firms exporting whereas 57% of the medium-sized firms and 87% of the larger firms exported at least some of their production.

Agri-food firms from our sample are, in general, quite optimistic about growth prospects over the next three years, with 83% of all firms seeing some growth ahead and 33% of all firms expecting sales growth of more than 20% in the next three years. Micro firms are less optimistic, with 21% predicting negative growth.

Key outcomes of the survey can be summarised as follows:

- Overall, the survey results show encouraging innovation patterns in the agri-food industry. At the same time, they point to significant opportunities for partnerships, providing two major issues are addressed: networking with scientists and financing of innovation.

- The survey shows a very significant innovation activity among firms in the sector, with an overwhelming majority of respondents (86%) reporting innovation of at least one type. Even allowing for selection bias, in absolute numbers this means that 129 companies in the Bosnia and Herzegovina agri-food sector do innovate in at least one way. Larger firms consistently innovate more than smaller ones, but even micro firms report significant innovation behaviour.

- Despite firms reporting a positive impact from their innovations, there is still potential for improvement as two-thirds of the firms identified at least one opportunity to innovate which they were unable to seize, overwhelmingly due to lack of financial resources. At the same time, 79% of firms have received no subsidies for their innovation activities. International funds supporting innovation and research activities are not fully exploited in Bosnia and Herzegovina.

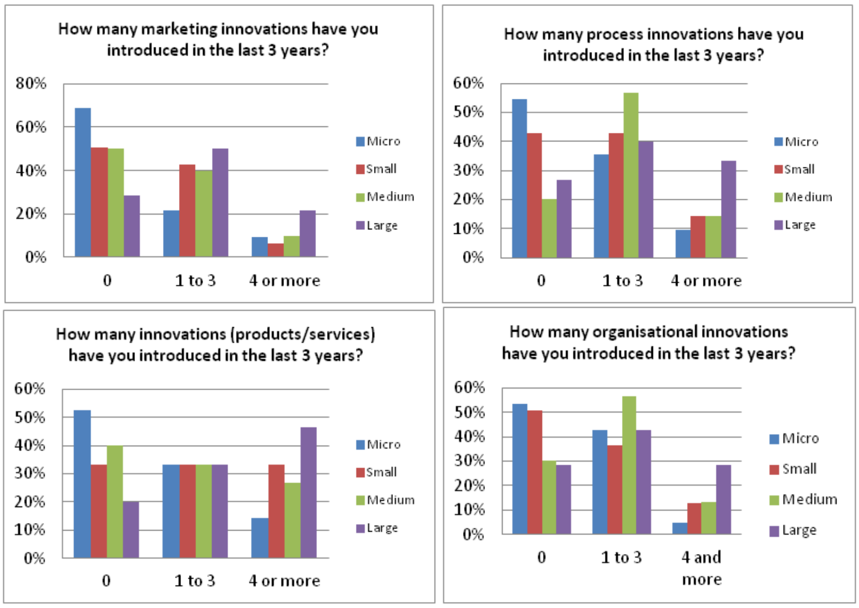
- Although many firms rely mainly on external resources for R&D, and most have co-operated with researchers and rated them highly, only 21% of firms quote research institutions as being the primary source of external know-how used for innovation. This is far behind the dominant source of know-how which is consulting, with 58% of respondents. Firms need a better understanding of the science community and have direct contact with them, if they are to be willing to use them more.

Innovation activities of firms

The study of the innovation behaviour of firms in the agri-food sector of Bosnia and Herzegovina started by asking how many innovations they had introduced over the past three years across four distinct areas: products and services, processes, marketing, and organisation[10]. The results indicated that larger firms are more likely to introduce innovations of any type than smaller companies. In addition, large firms also have a much larger propensity to introduce multiple (four or more) innovations. According to the survey, most micro firms report no innovations in a given category whereas on average 32% of the larger firms introduced more than four innovations of a given type. The percentages in the figures refer to surveyed firms only, and are not normalised to the total population of enterprises.

[10] Product and service innovations refer to new or improved products with new features and functionalities. Process innovations refer to a different production process for the same product. Marketing refers to the same product or service being marketed differently for example through a different distribution channel, different pricing, market positioning or advertising. Finally, organisational innovations could refer to different logistics, storage or procurement practices.

Figure 12. **Figure A.1. Innovation activity among agri-food companies in Bosnia and Herzegovina**



Source: OECD Investment Compact Company survey in BiH, March 2011

When asked to provide examples of innovation, firms gave a broad range of answers:

- For product innovation, the most common responses included new products, new recipes for existing products, and better quality packaging techniques.

- For process innovations, responses mainly included the utilisation of new machinery, superior manufacturing processes, automation, and new and improved techniques relating to the freezing and drying of food products.

- For marketing innovations, media advertisements were the most popular, as well as new packaging designed to keep pace with changing consumer tastes. Other responses included the introduction and improvement of promotional material such as leaflets, brochures and catalogues, and new distribution channels, such as sales in supermarkets. One respondent in the baking sector had created a competition and concealed a gold coin in a loaf of bread as a marketing action to attract consumers.

- Organisational innovation was dominated by logistics and distribution issues. More effective storage techniques and locations to provide more rapid access to the final retail destination, fleet management and strengthening of distribution network were most cited examples.

The survey went on to identify the business impact of innovation. Nearly all (97%) of the respondents who had introduced innovations in recent years indicated that the innovations had a positive impact on turnover and profit. Two-thirds (67%) of the companies indicated an increase of between 6-30% on average. Medium-sized companies appear to have had the greatest positive impact, with 70% of respondents reporting an increase of 11% or more on turnover, and 50% reporting an increase of 11% or more on profit. In the case of large companies, these percentages are respectively 40% and 27%.

Investment in equipment and research and development was also examined. Micro and small companies invested close to 10% of sales on new production equipment, whereas medium and large companies invested significantly less as a percentage of sales. Small and micro firms from the sample also invested proportionally more in R&D, ranging from 1.5-1.9% of sales, while medium and large firms invested less than 0.8% of sales. The proportion of outsourcing was significantly larger for the micro firms, presumably due to insufficient internal R&D capabilities. These percentages probably overestimate R&D spending for the general population of firms due to a selection bias: firms with large R&D spending were most probably more likely to answer our survey than those with low R&D spending.

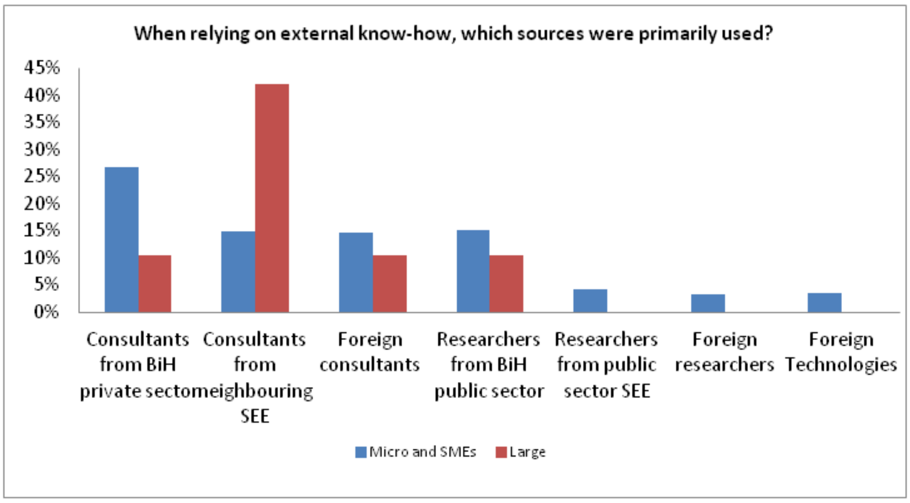
Table A.1. **Investment and R&D expenditure in the BiH agri-food sector**

	Average amount invested per year from 2008-10 (% of sales)			
	Production equipment related to new products and processes	**Total internal and external R&D**	**Internal investment in R&D**	**External investment in R&D**
Micro	9.97%	1.89%	0.62%	1.27%
Small	9.97%	1.46%	0.93%	0.53%
Medium	3.75%	0.59%	0.44%	0.15%
Large	7.63%	0.78%	0.55%	0.23%

Source: OECD Investment Compact Company survey in BiH, March 2011

The firms were then asked to report the number of staff engaged in R&D activities. More than half (57%) have less than one full-time employee dedicated to R&D[11]. Even out of the larger companies, 53% of respondents employ less than one full time staff member in this area. Only nine companies in the sample (or 6%) had a team of five or more employees working in R&D.

Figure A.2. **Sources of external know-how**



Source: OECD Investment Compact Company survey in BiH, March 2011

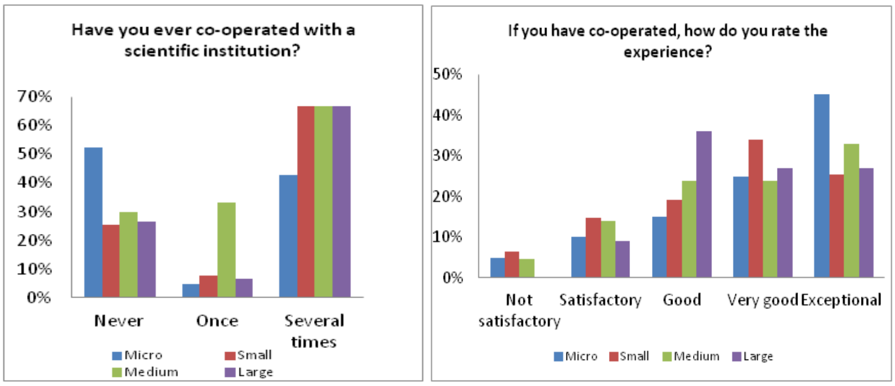
The low level of internal R&D capacity explains the openness of firms to external know-how when innovating (Figure a2). The survey shows that 85% of companies use external know-how in various forms. Consulting was the most dominant, with 58% of the total share. Large firms tend to source their knowledge mainly from regional consultants within South East Europe, which may be because consulting firms commercially target larger rather than small enterprises as the economic rewards are bigger. This result confirms that innovation is very much a networking activity and external organisations are very valuable in helping firms in problem solving. In addition, 21% of firms used researchers as a source external knowledge, for the most part domestic partners. Small and medium firms tend to partner with researchers much more frequently than large firms do, presumably since the latter have more in-house capabilities. Foreign technologies and licenses are used comparatively less frequently, by just 7% of micro and small firms and 12% of large firms.

11 This figure includes respondents reporting no staff in R&D and those reporting one person part time.

Co-operation with academia

Most companies (67% of all firms) report at least some experience in co-operation with scientific institutions, and most of them rate it highly with 60% of companies reporting the experiences as being “very good” or “exceptional”. When asked about the sources of satisfaction, firms cited the technical knowledge of scientists and the understanding of their problem, as well as timely execution. Favourable financial conditions were considered less relevant by the interviewed companies. When asked about sources of dissatisfaction, most respondents cited none. Of those that did have some reason for dissatisfaction, respondents cited some instances of insufficient technical knowledge, the lack of a sound understanding of the business problems, and unfavourable financial conditions.

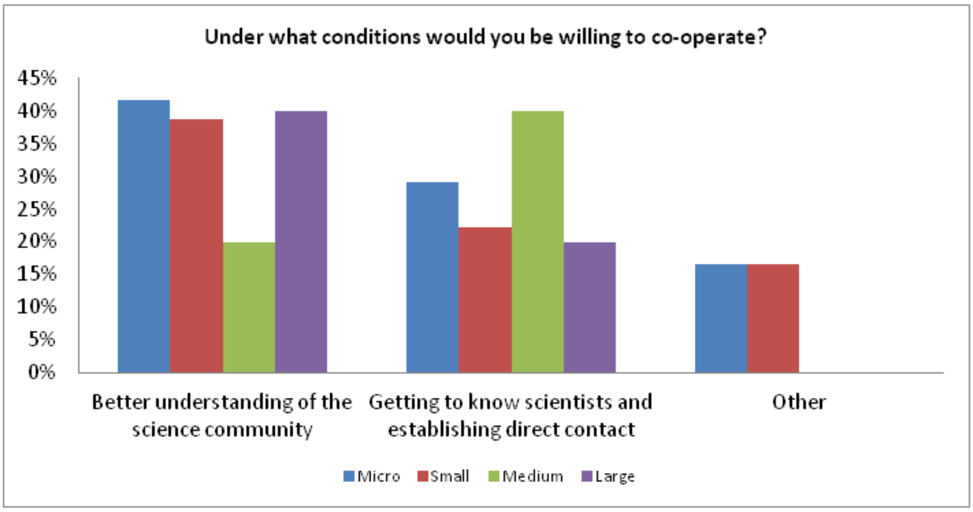
Figure A.3. **Co-operation with scientific institutions**



Source: OECD Investment Compact Company survey in BiH, March 2011

Among the firms which have never co-operated with the scientific sector, the reasons varied. They ranged from lack of finance to having no need for co-operation (since they either do not innovate in a way that would necessitate co-operation with researchers, or have all necessary know-how in house). Some respondents also said that they were ill-informed about what scientists do, and had not had the opportunity to meet and network with them. When asked what would make them more willing to co-operate, the firms that responded indicated they needed a better knowledge of the science community and assistance in establishing direct contact with the scientists

Figure A.4. **Factors making firms more willing to co-operate with the scientific sector**



Source: OECD Investment Compact Company Survey in BiH, March 2011

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