

## **ENTREPRENEURIAL TECHNOLOGY-BASED ECONOMIC DEVELOPMENT IN CROATIA**

*by Ronald Kysiak*

### **Introduction**

Developing an environment for technology-led entrepreneurship is a complex and long term process, sometimes spanning decades. In the United States some of the most well-known technology regions in the country either invested heavily in creating an environment for technology commercialisation and collaborative research over a long period of time (Research Triangle Park, North Carolina; Cummings Research Park, Huntsville, Alabama) or had such an environment accidentally grow out of a nurturing combination of entrepreneurial university researchers, accessible sources of equity capital and a high quality of life (Silicon Valley).

As these areas of the country began creating and attracting technology-based businesses and, as a result, drew to them sources of seed and venture capital, other communities sought to replicate the conditions that spawned these entrepreneurial environments. Today there are over 180 research parks in the US and Canada and some 1 000 incubators.<sup>16</sup> A 2003 a study sponsored by the National Business Incubation Association estimated that some 375 of them could be classified as technology-based incubators.<sup>17</sup>

A critical driver of technology-led entrepreneurship in the US and in other Western countries is the strong involvement of research universities in the commercialisation of university technologies as well as the legislation that allows and rewards such commercialisation activities. In December of 1980 the US Congress passed the Bayh-Dole Act that allowed for the transfer of exclusive control over many government-funded inventions to universities and businesses that created those inventions through federal research grants or contracts. This allowed both universities and private companies to license their discoveries to third parties and generate additional revenues from the results of their federally-sponsored research. And, for the first time, many university faculty members were also encouraged to consider building new companies around their inventions. The results of Bayh-Dole enhanced an existing entrepreneurial culture in the United States, a country that already was known for its individualism and inventiveness.

Yet many US universities still resist giving too much entrepreneurial support to their research faculties, mostly because many of these schools still strongly believe that they have only two primary missions: teaching and research. This has resulted in varying degrees of success of research parks. Those parks associated with universities that rewarded commercialisation, such as MIT or Stanford, do well and grow rapidly. Other universities that do not support entrepreneurial activities find it

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<sup>16</sup> National Business Incubation Association, Athens, Ohio, [www.nbia.org](http://www.nbia.org).

<sup>17</sup> Linder, S. (2003).

difficult to grow successful parks., Some US universities sometimes punish faculty that seek to develop new businesses from their discoveries by denying them tenure or deanships.

So strong, entrepreneurial universities along with federal legislation assigning ownership of new discoveries made through federal research grants to universities and their faculty have had a lot to do with successful technology incubators and research parks in the United States.

Over time there have been any numbers of criteria for success proffered by those that study technology-led innovation. A benchmarking study of North American technology-led incubators in 2003 listed the following requirements as necessary for an entrepreneurial environment:

- Research universities, federal labs, and corporate research and development facilities, with stocks of technology-based intellectual property and an orientation to technology transfer (e.g., patenting and licensing) that emphasises an entrepreneurial approach.
- Entrepreneurial scientists and engineers wanting to commercialise technologies through new company formation.
- Business professionals (e.g. accountants, lawyers, consultants, and human resources specialists) familiar with the problems of launching a technology-based company.
- Sources of debt and equity investment – public and private – that can capitalise the early development stages of a new, technology-based enterprise.
- A concentration of existing technology companies that could be a source of experienced professionals who could assume leadership positions in technology start-ups, or provide advice to start-ups<sup>18</sup>.

Other researchers and incubator practitioners would add at least one other necessary component to an effective entrepreneurial environment: a relatively high quality of life. However, that may be more of a North American requirement because of the easy mobility of its populations.

It is not difficult to see that Croatia comes up short in most of the requirements listed above. And it will need the help of many Croatian institutions, including universities, regional development agencies (RDAs), equity investors, the primary and secondary educational systems and the finding and development of “champions” for it to compete with other former “command economy” nations that have a major head start.

Countries such as Croatia that have not had a history of capitalism do not have the benefit of the US university system or national intellectual property policies encouraging and providing incentives to innovation. This makes transferring any innovation model – good or bad – from Western countries to Eastern or Central European countries most difficult. Unfortunately, the “flattening” of the world through a major convergence of technology, entrepreneurship and telecommunications – resulting in a rapid levelling of the economic playing field for such recently “backward” countries as India and China – has made entrepreneurship and technology transfer even more important to the economy of every country, particularly those that are only now developing healthy capitalist systems.<sup>19</sup>

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<sup>18</sup> Tornatzky, Sherman and Adkins (2003).

<sup>19</sup> Friedman (2005).

Unfortunately the command economy has also had another serious impact on innovation and technology transfer – the layered governmental bureaucracy that now controls that economy makes it all the more difficult to energise change.

It should be noted here that there are many similar Eastern and Central European countries in which entrepreneurship is a focus for many cities and regions, though major support from national governments is still very weak. In many of these countries there are entrepreneurial university faculty and university officers working to develop technology incubators – usually associated with a major polytechnic university. Poland, the Baltic countries, Hungary, and the Czech Republic have national organisations of incubators and science parks and have been trying to develop entrepreneurship and innovation with little help from the national government, e.g. Society of Science and Technology Parks of Czech Republic, and the Polish Business and Innovation Centres Association (SOOIP).

However, the Republic of Croatia is not without its strengths. We will look at these now in light of the major economic changes that is now shaping our global economy.

### **Current policy approach in Croatia: strengths and weaknesses**

#### *Strengths and Opportunities*

##### *Federal Programmes*

The national government of Croatia recognises the importance of entrepreneurship to the competitive growth of the country's overall economy. There are numerous federal programmes to encourage and support entrepreneurs, including loan interest-rate reductions, loan guarantees, and grants to entrepreneurs, incubators and research parks. In addition the government –mostly through the Ministry of Economy, Labour and Entrepreneurship (MELE) – has established a number of technology development centres, business development centres, entrepreneurial centres, etc., scattered throughout Croatia. In addition the federal government also provides various forms of tax abatement and special “free zone” designations – all aimed at helping both entrepreneurs and existing businesses to form and/or grow in Croatia.

##### *HAMAG (Croatian Agency for Small Business)*

HAMAG is the major business assistance delivery system for MELE. It administers most financial and grant programmes and works directly with businesses to assist in their development and success. HAMAG also provides shared cost consultancy assistance to individual companies for up to five years. HAMAG is just beginning to deliver its services through Regional Development Agencies (RDAs), a new approach to economic development encouraged by the EU and local government leaders. Many of HAMAG's consultants were initially trained by USAID.<sup>20</sup>

##### *BICRO (Business Innovation Centre of Croatia)*

BICRO was specifically created to work with technology entrepreneurs. It is a small agency with a staff of 17 and is funded through the Ministry of Science, Education & Sports. It has a number of technology assistance programmes which it uses directly with individual entrepreneurs or through regional development agencies. It also has some seed capital and a small venture fund. BICRO also works with the Croatian universities that have technical or engineering faculties to help them build tech transfer capacities. BICRO is professionally directed by two individuals with private sector

<sup>20</sup> USAID briefing May 24, 2007, during the study visit.

## *Entrepreneurial technology-based economic development in Croatia*

backgrounds, one a former Vice President for Research with a major Croatian pharmaceutical company (PLIVA), the other a former seed and venture capital manager from Switzerland.

BICRO is currently working with the EU to establish three single-technology incubators: one specializing in bio-science, one supporting CIT/IT start-ups, and one in advanced materials. It also has a three-year, € 000 000 matching grant from the EU for creation of a seed capital fund. BICRO is working with MELE and the World Bank to create the match. BICRO has also been given the authority to take over responsibility for the five Technology Development Centres in Croatia and staff them with business professionals. BICRO has also authored a national Science and High Technology Policy paper that is awaiting discussion by the Croatian Parliament. Of all governmental agencies that met with the consultants, BICRO was by far the most professional and private-sector oriented. Much of its success seems to be its ability to work either through or outside the ministries.<sup>21</sup>

### *Croatian Universities*

The strengths of the technology entrepreneurial support system in Croatia are few and tend to be concentrated in and around Zagreb and in other urban areas that have some university presence. There are five universities in Croatia: University of Osijek, University of Rijeka, University of Split, the University of Zagreb and a fairly new liberal arts university at Zadar. The University of Zagreb has strong faculties in engineering, geodesy, ICT and bio-science. There is also a college of naval technology in Pula, former home of the Austro-Hungarian Navy.

The University of Zagreb has a strong list of technological disciplines that have the internal capacity to spin out new technologies for commercialisation including Chemical Engineering & Technology, Electrical Engineering and Computing, Food Technology and Bio-Technology, Geothermal Engineering, Mechanical Engineering and Naval Architecture; Metallurgy, Mining, Geology and Petroleum Engineering, Textile Technology and a School of Business. Its faculty of Geodesy includes Geomatics Engineering, Physics, Cartography, Instruments and Informatics – a collaboration of computer science and geological science.

The J.J. Strossmeyer University of Osijek has 11 faculties including Engineering and Naval Architecture, Medicine, Civil Engineering, Electrical Engineering (Medical Informatics). The University at Rijeka has a Faculty of Medicine, Engineering and Maritime studies. The University of Split includes faculties in Electrical, Mechanical and Naval Architecture, Chemical Technology, Medicine and Maritime Studies. The recently created University of Zadar is primarily a liberal arts institution, though it has some curriculum capacity in Informatics and Communications Sciences.

The universities which have stronger schools of engineering and applied science tend to draw technology companies close to them since these companies need a highly educated workforce – something that universities can provide through their graduate student programs. Graduate students are preferred by start-up technology companies for part time employment because of their intelligence, flexibility, low cost and quality of work. Universities are also centres of creative thought and innovation, and create cultural islands within regions attractive to those well educated and interested in culture and the arts.

### *Nodes of Technology*

In discussions with Croatian government representatives, regional development organisations and USAID, the consultants were apprised of technology commercialisation activities in Split (the

<sup>21</sup> Discussion with BICRO management, May 20, 2007, during the study visit.

Mediterranean Institute for the Life Sciences) a private research facility funded by larger technology companies in Croatia; Bjelovar (energy generation through geothermal system/interest expressed by Siemens); Varaždin (informatics/Microsoft Technology Centre), Pula (19 engineers working on new marine engine model); and, Zagreb (Barr Pharmaceuticals interest in making its recent Croatian acquisition, Pliva Pharmaceuticals, an outsourcing centre for its bio-science research).

#### *Technology parks*

Most technology parks in Croatia are really incubators, single buildings serving small and growing technology companies. Most, if not all, have outgrown their space and desperately need expansion room. Both Zagreb Technology Park and Varaždin Technology Park buildings are filled to capacity with companies and both have long waiting lists of tenants.<sup>22</sup>

The Zagreb Technology Park was created by Koncar, a large electrical engineering and product development company located in Zagreb. It provided a building and a manager some years ago to help commercialise inventions created by its engineers who were being laid off as part of the overall shrinkage in manufacturing at Koncar and throughout the Balkans. The Zagreb park is currently managed by a former Koncar engineer and has five engineering students who act as advisors to the small companies in the building (16 at present).

The Park is now owned by the City of Zagreb which purchased it a few years ago from Koncar. One of the Park's entrepreneurial programs is the creation of entrepreneurial business teams between male students from the nearby School of ElectroTechnics with female students from a School of Economy to brainstorm and develop real products from idea through manufacturing and then to marketing and sales. Funding for this program comes from the EU. Most of the companies in the Zagreb Park are either developing CIT or electrical engineering-based technologies, some of them from Koncar. Koncar recently gained some large contracts to rebuild electromotive diesel engines for Serbia and other nearby countries.

The other operating technology park the consultants visited was in Varaždin, a city just to the north and east of Zagreb. Varaždin is also the home of the Development Agency North (DAN), a large regional economic development coalition encompassing four counties and the City of Varaždin. It has a staff of 10. DAN focuses on Foreign Direct Investment (FDI), new business creation and export development. Its technology focus is on IT, though it has a strong food, textile and wood products emphasis, including some research support.

The region is home to the Varaždin Technology Park, the Varaždin Regional Development Agency and another tech park in Bjelovar to the southeast. There are approximately 17 RDA's in Croatia and more are being encouraged by both the EU – which provides funding to many of them – and the federal government as well. Varaždin's technology park uses EU monies to help fund business plans for new entrepreneurs as well as help entrepreneurs apply for federal government grant and loan programs. It also assists businesses and governments within the region to apply for EU funding and assists companies in finding competent employees through its workforce programs. The Park is owned jointly by the City of Varaždin and the University of Applied Sciences and Secondary School of Electrical Engineering.

One unusual entity in Varaždin is the Microsoft Business-Technology Centre, a training and information centre, sponsored by Microsoft, with similar offices throughout Eastern and Central Europe. These centres work with local software entrepreneurs, showing them Microsoft approaches to

<sup>22</sup> Discussions with Zagreb and Varaždin Technology Parks' management during the visit.

software development, training others who want to become software developers, and sponsoring business development seminars. The Centre is currently planning to create its own software incubator. The Microsoft Centre building includes classrooms and a large conference room; work stations with modern equipment; high speed Internet connection, wireless LAN and HP Proliant Servers and CISCO Systems network equipment. This is not a totally charitable undertaking by Microsoft –the Centre provides Microsoft a “window on technology”, tapping into new IT developments as well as a virgin talent pool before anyone else has had a chance to see their new ideas. Centre staff also looks to bring young software designers to work cooperatively with more mature software developers and vendors, including Microsoft itself.

The two technology parks above seem to both have good private sector management coupled with strong programmatic underpinnings. Unfortunately, both parks have run out of space. The Varaždin Park has 35 tenants – mostly ICT companies – and the Zagreb Park building houses 16 companies focused primarily on electrical engineering.

### ***Weaknesses and Threats***

#### *Federal Programmes*

The major difficulty entrepreneurs have with Croatian federal government programmes supporting entrepreneurs is the existence of many different SME programmes coming out of at least three or more ministries – usually with no seeming coordination or interaction. Evidently there is a “Ministerial Council,” that meets informally once a month to coordinate business assistance programs but there does not seem to be a formal process to connect entrepreneurial policies and programs between the ministries. The one entity that seems to have a clear federal mandate to promote technology-led economic development is BICRO, the Croatian Business Innovation Centre. Though it has an interesting set of programmes aimed at growing new technology programs, it is a very small agency – overshadowed by such larger bureaucratic systems like MELE – and has too few resources to spread across a growing number of technology-led companies seeking help in building new businesses.

Comment [p3]: Too strong....

Though there are a number of federal programmes aimed at entrepreneurship, few of them focus on technology-based economic development, other than BICRO programmes. There is one programme in MELE that directly targets technology companies. It provides small grants along with subsidised rent in a nearby entrepreneurial or high technology centre. It also provides shared cost consultancy support for five years to individual technology entrepreneurs. Though the programme names ICT as its focus, it also allows for other kinds of technology-based companies to participate. This programme can be beneficial, but much depends upon the quality of the consultants made available by the Ministry. In meetings with various business groups the consultants found little praise for the current group of consultants being made available by MELE – particularly those consultants involved with technology-based business development.

Another MELE programme provides grants to incubators and technology parks. Both MELE programmes require at least seven, if not more, complex documents that must be provided by any entrepreneur, incubator or tech park seeking help. For example, applications to fund entrepreneurs are first reviewed by a special committee appointed by the Minister of MELE. If the committee agrees with the funding request, it goes to the Minister for his personal approval. A second related program to fund incubators and tech parks requires applications to first go to a different committee – one appointed by the President of HAMAG. If the committee agrees, it then goes to the HAMAG

President for his or her final approval.<sup>23</sup> A general complaint made by SMEs and others involved in economic development is that MELE still focuses on directly managing programmes (see above), rather than developing and setting policies.

There are also financing programmes managed by MELE and HAMAG to assist SME's to obtain financing through interest rate subsidies and loan guarantees. These programmes are not only complicated extensively by the bureaucratic requirements similar to the programmes above, but they have a problem that tends to make the programs very difficult to use. A bank must first be willing to make a loan to an entrepreneur in order for the loan to be submitted to the government for interest rate write-down or guarantee. Unfortunately, the current policy at Croatian banks is to not make loans without hard collateral as security. So most entrepreneurs never get to ask for guarantees or loan subsidies – they are many times turned down by the bank at the very beginning of the process. There is also the added problem that banks will not accept intellectual property as collateral, and most technology-based entrepreneurs have little or no other collateral to guarantee their repayment of the debt.<sup>24</sup>

#### *HITRO, Croatian Programme for Innovative Technological Development*

One federal programme that was mentioned as the Croatian version of a “one-stop-shop” for helping new businesses get started was HITRO. Its responsibilities are to 1) foster science and industry cooperation; 2) revitalise industrial research and development programmes; and, 3) encourage commercialisation of research results. HITRO operates with a government owned, private financial partner, FINA, an outgrowth of the Social Accounting Service under the previous Socialist government. HITRO is also part of the federal government, but works directly for a State Secretary and does not operate through any ministry. Its function is to help new businesses to incorporate or form limited liability companies by shepherding them through the many bureaucratic mazes that are required to register a business in Croatia. Neither HITRO nor FINA were mentioned by interviewees and there was no consultant contact with any of their representatives. The level of impact of HITRO and FINA on the success of SMEs and technology-based companies is unknown.

#### *Croatian Universities*

We spoke of the strengths of the five Croatian universities earlier, especially the University of Zagreb. Unfortunately, there does not seem to be a clearly stated legal structure in Croatia dealing with intellectual property rights and ownership. There also appears to be a general lack of university technology transfer policies at Croatian universities or staff to implement them. As mentioned earlier, even US universities find it difficult to encourage and manage commercialisation of university technologies. In some cases, such activities are punished rather than rewarded within US university systems because some administrators feel commercialisation somehow takes time away from a university's two major missions: research and teaching. In Croatia, without the legal infrastructure clarifying ownership of intellectual property and without a governmental directive to universities to actively engage in technology transfer, few new university research products will have a chance to see the marketplace.

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<sup>23</sup> MELE programme translation: Project of “Entrepreneurial Incubators and Technology Parks” for the year 2007; The Project of “Entrepreneurship of Target Groups” for the year 2007.

<sup>24</sup> Discussions with Chamber of the Economy, BICRO, USAID and others, during the study visit.

*Regional Development Agencies and Technology parks*

RDAs seem to be working more effectively because of their strong local leadership. But does Croatia want 17 regions competing with one another for the few economic prizes that will either move to Croatia or expand there? Though the US has 50 states, some of them as large as Croatia, it is not unusual for two or more states in the US to vie with each other in luring a major economic development project like a new Toyota plant, matching and raising their subsidy offers, with the poorer state usually offering the higher subsidy. Such squabbling over a new project is roundly criticised by many in the US, but local and state politics require the game to continue, until someone wins. Such bidding wars could be dangerous for the Croatian nation, especially if it creates long-standing enmity among and between regions, not to mention the power it gives industry over the government.

Regional agencies can be efficient and effective, but they need a national policy to guide them. If there is an opportunity to bring a Toyota plant into Croatia, there should be a national effort to first get it into the country, and then the national government would work cooperatively with the RDA where such a plant could be most strategically placed. Whether the RDAs would find such a process agreeable is unknown since each region seems to be seeking foreign direct investment within their own boundaries.

As noted earlier, Croatian technology parks are really incubators. They will only truly become parks when they begin generating enough economic activity that private developers will want to build new, multi-tenant buildings to capture the growth of expanding incubator companies and when international companies agree to expand within them. This kind of real estate investment is not that far away in places like Zagreb or even Varaždin or Split. But it will take some time before it comes to Bjelovar or other primarily smaller and more rural Croatian counties. It will be mostly the universities and urban centres that will determine where expanding technology parks will grow because the universities have the smart people technology companies require and the urban centres are where an educated workforce is more likely to want to live.

To complicate even more the regional development agency movement in Croatia is the recent EU division of Croatia into three economic and demographic regions; opening up the possibility that these “new” regions may spawn larger RDAs and may develop economic development strategies consistent with their regional demographics and economies. Whether that will occur is unknown, but discussions between the federal government and the EU should take place about such an eventuality.

*Education and Human Resources*

One serious deficit not discussed much with the interviewed partners is Croatia’s lack of a large, technical workforce. That lack will make it very difficult for Croatia to compete successfully in the “new economy” which requires a high level of trained workers to attract technology-based companies. Outside of those Croatian regions with universities, polytechnics or other technical schools and colleges, there does not seem to be enough human capital within Croatia to support a growing technology sector into the future. To counter this, the Croatian primary and secondary education systems will need to dramatically be improved if Croatia can hope to compete in this new, global economy. Even crafts – which do not require a highly educated workforce – are not without growing competition from China, India and Oceania’s inexpensive factory approach to craftwork.

MELE does sponsor some classes on entrepreneurship in Croatian schools and there does seem to be a growing number of IT workers in urban areas like Zagreb, Varaždin and Split – but that growth is being matched, if not surpassed, in other places in Eastern Europe as well as in Asia where computer

and software technologies are strongly supported by government, Estonia being the most visible in Central Europe. Croatia is vulnerable to being left behind in the race to adapt to the rapidly changing economy – especially in the commercialisation of applied technologies and the corollary development of a technically-trained workforce. This workforce issue needs to be thoroughly studied by the federal government with strong participation by technology companies, the ultimate customer for a broadly educated population. Without a competent workforce, technology-based economic development will diminish rather than increase.

Comment [C4]: Please add references

### *Examples of Good Practices in Croatia*

Examples of “good practices” in assisting technology-based entrepreneurs are few in Croatia. In evaluating the programmes on the federal level, mostly developed and applied through MELE and HAMAG, it was clear that entrepreneurs found most of them extremely time-consuming and difficult to access, or found them unsuited to the special needs of technology-based companies which mostly require access to seed capital and mentoring by experienced businesspeople or successful entrepreneurs. Though HAMAG is attempting to improve its implementation of these programmes – including improving the training of more consultants – most efforts will be of little help to technology entrepreneurs as long as there remains a lack of mentors and experienced business advisors to become directly involved with technology SME’s. MELE and HAMAG are run, for the most part, by government bureaucrats who have little understanding of the entrepreneur’s world. In interviews the consultants were told that field operatives from these agencies who are supposed to deliver government programmes at the local level have little or no training, or do not understand the added complexities of dealing with a technology start-up business.

### *BICRO*

BICRO, on the other hand, is a government agency with usable programmes – most funded through the EU – that are designed specifically for technology entrepreneurs, e.g. access to seed capital, provision of experts in market analysis and business planning, access to mentors who understand their business and can advise and help these companies, etc. BICRO has this expertise because its management comes from the private sector. BICRO is certainly a “best practices” example that needs to be expanded and strengthened. It is short on personnel and money and hopefully the involvement of the EU will find ways to provide more of both.

### *Development Agency North and Varaždin Technology park*

There are concentrations of technological entrepreneurship, as we discussed earlier, primarily within the Zagreb region and in a few urban areas near major universities. In both Varaždin and Zagreb there are well-managed incubators providing services to young technology companies. Both these incubators/technology parks are filled, but providing additional space is expensive and the government programmes of MELE do not have enough resources to make major capital investments in new facilities without making such resources available to other regions as well. However, the regional impact of DAN and the Varaždin Technology Park are excellent models of local cooperation in developing a regional strategy for technology-based growth. The Varaždin/DAN model is one for the rest of Croatia to follow.

### *Teaching young entrepreneurs*

Most students in the Croatian education system usually do not learn about entrepreneurship until well into their secondary education phase. And even then, much of it is taught as an after-school

subject.<sup>25</sup> Though the Zagreb Technology Park has little space and is hidden away in an older industrial area, it has an understanding of the bigger picture that needs to be made clearer to the national government.

Here the park serves its purpose as a centre of innovative thinking developed over many years in helping young, technically-minded entrepreneurs to develop new products and processes. But it does not focus only on new businesses. Rather, it has taken on the difficult assignment of making entrepreneurship understandable and important to young students – both male and female. By matching engineers-to-be from the Elektrotehnicka Skola in Zagreb and businesswomen to-be from the Katarina Zrinski School of the Economy, and showing them how to jointly create a product, market it and sell it is a small but important template of what the national government needs to do on a larger scale within its educational system. Teaching entrepreneurship early is probably never early enough; in the US a number of high schools are now integrating entrepreneurship into their curricula for graduating seniors. And most US graduate business schools have seen a major shift of career choices among their students – with many of them looking for advanced degrees in business entrepreneurship rather than in management or marketing.<sup>26</sup> The programme at the Zagreb Technology Park referenced above is certainly one of Croatia's "best practices".

Comment [p5]: Please add references

### **Policy recommendations**

Based on the analysis of strengths, opportunities, weaknesses and threats, five main policy recommendations are made below:

- ***Identify technology niches in Croatian universities and existing technology-based companies and focus government attention and resources on the strongest.***

Seeking to generate technology entrepreneurship throughout all of Croatia at the same time is impractical and a waste of scarce resources. If the federal government is to effectively support the growth of technology-based entrepreneurship, it should determine where such policies and programs will have the greatest chances for success and focus existing resources on them. Currently it appears that the federal government's technology policies and programs have focused on developing broadly scattered technology or entrepreneurship zones and programmes that are not focused on particular geographical locations or existing strengths of universities and technologies

If this were done, the government could then target scarce mentoring and financial resources on those areas of technology and entrepreneurship that are strongest in both university labs and within private industry, e.g., pharmaceuticals, ship building technologies, IT and CIT, alternative energy systems, and advanced materials to name a few. Federal programs could then be concentrated in those areas of the country where there are major research universities with strength in some of these technologies as well as applied engineering curricula, multi-disciplinary research programs and a trained technology workforce. In technology-based economic development it is many times more important to do a few things well than many things poorly.

- ***Move federal technology program delivery out to regional development agencies and put all technology-based entrepreneurial support under one agency or ministry.***

<sup>25</sup> EUROPEAN CHARTER FOR SMALL ENTERPRISES, Questionnaire 2003.

<sup>26</sup> Northwestern University Kellogg Graduate School of Management curriculum, 2007-2008.

As we have seen, most current federal technology and entrepreneurship programs currently suffer from lack of resources and apparent diffusion across a number of ministries, each with layers of time-consuming bureaucracies. As a result, many people feel that these programs and policies need to be simplified and integrated into a single business support system – one managed by a single government agency. In addition, these programs need to be made readily accessible to entrepreneurs and other clients at a regional level and need to be implemented by experienced entrepreneurs and business people.

By placing all federal technology and entrepreneurship management under one agency, clients could be more easily tracked and helped through an integrated business development support system that could include “proof of concept,” strategic business planning, mentoring and financing. In addition, the success or failure of such an integrated strategy could be more easily measured and modified to account for changes in business development strategies and resource needs and availability.

The agency that appears to have the most ability to implement such an approach is BICRO which currently provides mentoring and small amounts of seed capital to technology-based entrepreneurs. In addition, BICRO staff also has private sector experience in building new technology companies.

- ***Develop and gain approval for a national science and technology growth strategy that would create intellectual property rights to discoveries by university researchers and entrepreneurs.***

It does not appear that there are adequate protections for scientific discoveries made in Croatia. Without some means of granting ownership of technology innovations to entrepreneurs and university researchers who develop new technology-based products, there will be little interest in pursuing technology commercialization. That protection must be created at the highest levels of government and be a crucial part of a national Croatian science and technology policy.

That strategy should also include a clear statement from the central government that encourages the commercialization of technologies by state-sponsored universities, in addition to their other two missions of research and teaching. Universities are rapidly becoming a major economic development force in the United States as state governments look to them as a source of “new economy” businesses...

- ***Reform banking and financing laws and create seed capital through tax incentive.***

As noted earlier, the current business financing policies of the federal government are difficult to implement because current legislation does not allow banks or investors to quickly recapture their investment if a company fails. Because of this impediment many start-up companies – particularly technology-based companies – find it almost impossible to gain financing through regular banking or equity channels. Though the federal government has done what it can in providing both guarantees and interest rate subsidies, most banks will not lend without collateral and most seed and venture capitalists will shy away from high risk investments. Appropriate legislation will be required to encourage equity investments in start-up technology companies.

Seed capital is the life-blood of entrepreneurs and technology-based company growth. Unfortunately there is little seed capital available in Croatia, other than some funding that has begun to be provided by the EU to the ministries and organizations such as BICRO. The federal government should consider enacting tax credits or some other form of incentive to encourage the formation of early-stage seed capital funds in Croatia. Both the central government as well as RDA’s should look to

the EU for help in developing such funds. Seed and venture capital programmes are being studied in other Eastern and Central European countries that have recently joined the European Union. They should be looked to as well.

Though the temptation is great to recommend that the federal government create a national seed and venture capital fund, it has been the experience in the United States that providing incentives to the private sector to create such funds is a much preferred option. If the government then wants to invest in these “fund of funds,” to create a larger source of seed capital, it can do so, without the added responsibility of deciding which companies are eligible for such investments.

- ***Start to build a better workforce now. Make the teaching of entrepreneurship and business building a required subject in both primary and secondary schools. Develop a strong science and technical curriculum within the school system and provide incentives to students to study it.***

Croatia needs a stronger technical workforce and more entrepreneurs. One way to accomplish this is through new education and training policies aimed at getting young people to understand that the only future in front of them is not necessarily going to work for someone else. There is a more thorough discussion of this issue in another part of this report.

### **International learning models in OECD countries**

#### ***Centre for Emerging Technologies, St. Louis, Missouri, USA<sup>27</sup>***

##### *Description of the approach*

The Centre for Emerging Technologies (CET) is an example of a local public/private partnership between the University of Missouri Louis and the Missouri Department of Economic Development to create bio-science incubator space for emerging start-ups from two major medical centres within a mile from each other in an older neighbourhood in St. Louis. Its operations are financially supported by the two partners. Capital funding to develop incubator space was provided by the St. Louis Development Corporation (a city government entity), Missouri Development Finance Board (a state financing entity), US Economic Development Administration (a federal economic development agency) and St. Louis technology companies that wanted to see the incubator created.

The CET provides both lab and office space for start-up companies and delivers a number of services to help them in their growth. Space is provided in some 8 000 sq.m. of laboratory and office space located in two buildings between Washington University and St. Louis University. Technical assistance is provided by both staff of the CET and business consultants. The provision of mentoring for the companies is a very important function of the incubator and is an effective incentive for companies to locate there.

Creation of the space was only made possible through a partnership of many government and private entities. Creation of the two incubator buildings has generated an additional private sector initiative to redevelop the area between the two universities as a “bio-science corridor.”

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<sup>27</sup> Information on the Centre for Emerging Technologies was partly taken from a work paper prepared for the New Orleans Plan Commission in 2006 by Eva Klein Associates, a consulting company in higher education and technology-based economic development.

### *Rationale*

The second half of the 20<sup>th</sup> century, St. Louis was one of America's most depressed cities, having lost over half of its population in the previous 50 years. The city was pocked by large areas of cleared land, dotted by empty houses – the tenants and/or owners long since moved to more prosperous areas of the region or to another region or state where there were more jobs. Most well-to-do residents had moved out to the suburbs, leaving the distressed city to its poorest and most unskilled residents. Though St. Louis was the home of the nation's largest brewery, Budweiser, as well as home to a major aero-space development and manufacturing company, McDonnell Douglas, much of its industrial base had moved away or went out of business.

St. Louis needed to re-seed itself with a new economy – one based on growth like bio-sciences or information technologies. Though St. Louis was losing its manufacturing base and saw its expanding service economy choose the more affluent suburbs for its growth and job generation, it did have two major medical centres situated less than one mile from another. Major medical infrastructure is very difficult to move, so many American cities retain these large institutions, many of which are surrounded by older, decaying neighbourhoods.

In addition to a major concentration of health-care and bio-science research, St. Louis also was the headquarters of Monsanto Corporation, a major American provider of food technology and fertilisers and had a strong plant sciences research interest and capacity. The impetus for the creation of the CET came from a University of Missouri - St. Louis economic development staff member who became aware that there was no receptor entity or space for start-up bio-science companies that were beginning to spin out of the two university health science centres. Armed with examples of spin-out companies having to leave St. Louis this staff member began to bring a coalition of government and private sector institutions together to create the CET

The CET was developed as a not-for-profit entity with a board of 30, including university representatives (Washington University, St. Louis University and the University of Missouri – St. Louis). Other board members include City of St. Louis economic development agencies, technology companies, a venture capital firm, regional private economic development organisations and entrepreneurs. CET's staff are employed through the University of Missouri—St. Louis.

### *Relevance to Croatia*

The key lessons here for Croatia are how partnerships must be built between many public and private entities to create a bio-science presence, and that such partnerships can be built at a local and national level only through perseverance and patience. The creation of the CET is also relevant because of the cooperation of local, state and federal governments that made the project financially feasible. It is highly unlikely that any one of the three governmental entities would have or even could have made this project work on its own. Also of key importance was the presence of the two major medical and research facilities. Without those two bio-science and medical technology engines, the project could not have been completed.

But, overarching all of the factors that made the CET a reality, the most important reason the project succeeded was the initiative and perseverance of the woman who believed that a bio-science incubator had to be developed, and then worked for a number of years to get it accomplished. Whenever complex projects are put together and then made to work, there usually is a “champion” leading the effort. In Croatia the creation and development of DAN and the Varaždin Technology Park had their “champion” as well.

## *Entrepreneurial technology-based economic development in Croatia*

If there is to be a bio-science incubator in Croatia, it must be located close to the largest concentration of medical and bio-research activity in the country. It will take major resources and a good deal of time to get it off the ground. And, as can be seen from the history of the CET, a bio-science incubator would be a necessary first step.

### *Reasons for the success or failure of the approach*

The reasons for success of the project are the same factors that make the creation of the CET relevant to Croatia. In St. Louis it was the vision to create the CET and the determination of the person with that vision who brought the project to fulfilment. It was also the grouping of two major health science centres and their innovative cultures that created the necessary environment for the success of the project.

The multi-government coalition that brought the funds necessary to build the CET also gave it political strength at all levels of government. Such coalitions tend to be more acceptable to many government agencies because each gains credit for the project but no one entity need fund the totality of the cost. In Croatia the same kind of financing coalition would probably have to include the EU since Croatia's federal and regional governments do not have enough resources to accomplish such a project.

The project was not without its difficulties. It took a number of years to develop a financing package from many different sources to find the funds to build the first incubator. There were major difficulties in getting public officials, politicians and others to see the dire need for such a development. A 4 200 sq.m. empty warehouse building was finally chosen near Washington University's Health Sciences Campus and BJC Medical Centre, and less than a mile from the St. Louis University Health Sciences Centre.

Though its buildings are fairly well occupied, only one company has emerged from the CET and gone on to rapid growth. Sterotaxis, a cardiological medical systems developer, came out of the CET and raised \$40 million in new capital in an Initial Public Offering. It now employs almost 200 people and has moved into a new building within the bio-science corridor.

This single success, however, should not be looked upon as a failure. Rather, the nature of start-up companies, especially bio-science start-ups, tend to either fail or grow very rapidly. However, it is also true that many small technology-based companies are acquired by larger companies which many times moves the company to another location in the country. In the case of Stereotaxis, the development of the bio-science corridor allowed a developer to build a large, multi-tenant building for Stereotaxis close to the CET.

### *Considerations for successful adoption in Croatia*

There is interest by BICRO to create two speciality incubators: one a bio-science incubator with help from the EU – the other that would focus on IT and CIT companies. A third incubator, one focused on advanced materials, may also be developed. The bio-science incubator would need to be located close to sources of bio-science research and development, either near a medical centres or a cluster of bio-science companies. Zagreb would be a likely location.

As discussed elsewhere, Croatia does not have a large concentration of bio-science companies, though it has some mid-sized technology companies, mostly in or near Zagreb as well as the Mediterranean Institute for the Life Sciences in Split., Croatia is also home to a large pharmaceutical company, PLIVA which was recently purchased by Barr Pharmaceuticals in the US. In order for the

CET approach to work in Croatia it would need to be located close to a critical mass of bio-science companies or a major university – most likely in Zagreb, or perhaps Split.

Though these initiatives to create specialized incubators for bio-science and IT, it is important that the federal government and RDA's understand that they also need to have ready expansion space for growing technology companies so that companies like Sterotaxis will remain and expand within the region in which they were born.

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***Advanced Technology Development Centre, Atlanta, Georgia***

*Description of the approach*

The Advanced Technology Development Centre (ATDC) was created by the State of Georgia in 1980 as a means to leverage Georgia Tech University discoveries into economic activity through new SME growth. Though the ATDC is a State of Georgia entity, its management and personnel are employees of Georgia Tech University in Atlanta and have faculty benefits. It has only one function, to help technology-based entrepreneurs create businesses out of discoveries. Though ATDC staff are university employees, they are directly focused on commercializing new technologies, whether those technologies come out of Georgia Tech or not.

The State of Georgia could be compared to a large region in Croatia, or to Croatia in total. It has a main major city, Atlanta and some mid-sized satellite cities. But most of the state is still rural with a great deal of agricultural activity. And though the ATDC has its main incubation centre, composed of three buildings, on the Georgia Tech Campus in downtown Atlanta, it also has two satellite facilities in other parts of Georgia as well.

Services provided to new companies include a wide variety of scientific equipment provided at no cost to tenants, such as water systems in all labs, chemical hoods, and biological safety cabinets. Companies also get to use—free of charge—pH meters, centrifuges, spectrophotometers, microscopes, balances, electrophoresis equipment, refrigerator/freezer combinations, a -80 degrees freezer, ice maker, full lab cabinetry and all office furniture.

Other benefits include access to Georgia Tech core lab facilities, at a reduced rate; use of the Georgia Tech Library, student recreation centre at faculty rates, and a shared copy and fax machine at minimal cost. The ATDC serves any and all technology companies, except service-based companies, emerging from Georgia Tech or elsewhere—as long as they are from Georgia and are technology based. ATDC says that it has over 110 “successful graduates” from its facilities.

## *Entrepreneurial technology-based economic development in Croatia*

### *Rationale for the policy intervention*

Georgia's economy is a mixture of agriculture (tobacco, cotton, and peanuts), forest products (lumber, pulp), textiles, automobile manufacturing, and tourism. It also has a number of federal military and research institutions located in the state. Like most states in the US that saw their manufacturing economy begin to weaken in the late 1970's, the Governor of Georgia commissioned a study on Georgia's competitive position in engineering, science and technology. The results were not encouraging. Following on the results of the study the Georgia State Legislature created the ATDC, a state-wide technology commercialisation and incubator organisation focused on strengthening Georgia's competitive position through the creation of new, technology-based companies.

At its largest centre on the Georgia Tech campus in Atlanta, the ATDC has 14 000 sq.m. of office and "dry-lab" space in two buildings and 2 200 sq.m. in a new Biosciences Centre, almost all of which is lab space.

### *Relevance to Croatia*

The Croatian government does not seem to be getting the results it wants through its current technology assistance programs, possibly because it spreads its meagre resources throughout the country, even though most technology-based activity is occurring in only a few places, those closest to existing research universities (Zagreb, Split, Rejeka, Zavadzin. The government might consider using a single state-funded and managed technology development programme like ATDC on a regional or even national basis to serve the nodes of technology-based entrepreneurship now occurring near universities throughout the country.

The strength of a program like the ATDC is its core group of competent technical and business mentors who have the resources of a strong technical university and are supported by a well thought-through innovation policy. Rather than trying to put competent technology advisors in every county, a small, but competent group could serve most technology-based entrepreneurs within the Croatian borders.

Use of adjacent university laboratories, equipment and graduate students reduces costs of start-up companies and helps conserve their resources for more important uses. Few start-ups can afford to own an electron microscope or non-destructive testing instrumentation. And by hiring graduate students as interns or part-time employees, it provides a method for these growing companies to evaluate those students for possible hiring into the future.

A model such as the ATDC uses the combined strengths of a central technology incubator and assistance centre, along with the resources of a major research university. Such a Croatian organization could also have satellite locations in other parts of the country where there is particularly strong innovation activity. In short, a focused technology assistance program like the ATDC could use the resources of a major research university, say in Zagreb or Split; but at the same time, it could provide resources to specific nodes of technology throughout Croatia.

### *Reasons for success or failure*

In response to a recent survey, ATDC members were asked what the success factors that made the ATDC so effective in starting up new technology companies were.

One response was a "sense of community" that exists among its incubator companies. Most incubator surveys in the US show that incubator companies consider the concentration of other like-

kind entrepreneurs in the same building as the greatest benefit they receive from the innovation system. There is another school of thought in the US that believes incubator companies should be mixed in with more mature companies. In that way, it is believed, the incubator companies would benefit from the stability and experience of the larger and more experienced companies.

ATDC also said that its ability to provide start-up companies with access to lab equipment and specialised lab facilities at Georgia Tech was a strong resource that it could use to help lab-based companies at very little cost. Almost all bio-science companies in the ATDC are affiliated in some way with Georgia Tech. Access to university equipment and space can be a major help to start-up companies. Croatia has five universities where such programs could be established.

As to challenges and possible failure, ATDC felt that not having wet lab facilities until recently for those start-ups needing labs was a weakness. Soon after a wet lab incubator was built, and was promptly filled with start-up lab users.

Another weakness noted by ATDC management was the lack of commercial quality lab space for rent in the area for those bioscience incubator companies that needed expansion space. Once companies grow too large for the Bioscience Centre, they have no readily available wet lab facilities in the Atlanta area. Georgia Tech is currently building a research park adjacent to campus to provide such space for graduates and other companies needing lab space.

A final problem for ATDC, one that plagues Croatia as well as American technology programs, is a lack of enough qualified staff with sufficient experience to provide advice and support to entrepreneurs.

#### *Consideration for successful adoption in Croatia*

As discussed above, the ATDC organizational model might fit well in Croatia, assuming the government would agree to put all technology support programs within a single agency. However, to be effective, such an organization must have the means to hire experienced business and technical staff who can work closely with small companies and help them in many different areas including both business and technical “proof of concept,” marketing, business planning, financing, workforce development, etc.

The ATDC is one of a number of US state-supported models, including the Ben Franklin Partnership initiative in Pennsylvania and the Illinois Technology Enterprise Centre program in Illinois. Because Illinois and Pennsylvania are very large states, both programs provide for regional technology business assistance centres, usually directly associated with a local university. In the case of Illinois, universities granted funds for such centres must match the state funding. But not all Illinois Centres are the same. The Centre in Evanston – located inside of Northwestern University - specializes in IT, bio-science and advanced materials because those three technologies are major research strengths of the University

As was discussed earlier in the “Croatia’s Strengths” section, there are nodes of technology commercialization occurring adjacent to or within most of Croatia’s universities. A program similar to the one in Illinois might fit Croatia’s existing patterns of technology development.

In Chicago there is a Women’s Technology Enterprise Centre dedicated to women-owned technology companies. Many of the MELE programs are aimed at women, war veterans and the handicapped. In addition, BICRO has plans to establish bio-science and IT incubators. So Croatia is already familiar with targeted economic development programs.

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***The TechnologieZentrumDortmund (TZDO) Dortmund, Republic of Germany***

*Description of the approach*

The TechnologieZentrumDortmund (TZDO) is a business incubator programme developed by the City of Dortmund 20 years ago as a way to help rebuild its economy after major losses of heavy industry to both lower-cost and off-shore competition (coal and steel). The purpose of the programme was to promote regional economic development through technology and knowledge-based start-ups and SMEs. TZDO is the core of a regional network of “competence centres” for key technologies. TZDO also functions as a development and testing centre focused on key technologies, e.g. Information Technology, Biomedicine, Micro System Technology, and Production and Automation Technology. As of 2006 the TZDO had 283 companies within their centres employing 8 500 people.

The TZDO has a supervisory board made up of six representatives of the city, three from financial institutions, two from the Chamber of Commerce and one from the University of Dortmund. Close relationships with the university and R&D institutes such as MPI (molecular physiology) and Fraunhofer Institute for Material Flow and Logistics provide a steady stream of new ideas for technology transfer.

A staff of more than 40 employees on-site provides technical and advisory assistance to the tenants. These are business specialists trained in both technology and business skills, including mentoring services for those companies that need them. Other services provided include start-up consulting/business planning, marketing, distribution & sales assistance, office services, high-speed Internet access, contacts for insurance/legal contacts/patents/tax preparation and advice, project counselling, financing, training courses/seminars, management and organisation advice, technology and product advisory services and accounting. It also provides relocation services for those companies that need to expand into larger space.

*Rationale*

The aim of the City of Dortmund was to create a “breeding ground” for new companies based on innovative technology applications and with collaborative links with research and educational institutions. It built on its regional strengths by:

- focusing on technologies related to logistics (because in the mid-eighties there were a large number of businesses in this sector already active in the city); and
- securing cooperation with other local players, including: the Chambers for Commerce and Trade as well as for Handicraft Industries, the local savings bank, and research institutions. This cooperation was established formally—the named institutions became shareholders of the management company of the business incubator) as well as informally by building a network involving all potential regional players and supporters.

*Relevance to Croatia*

The relevance of the Dortmund experience is in the way in which one region with a major city and research University was able to develop a strong regional economic development program based upon the creation and growth of new companies. By providing a central place for innovation by locating the incubator at the university, rather than in the city, Dortmund understood the necessary relationship that needs to be forged between the university and the place where new companies can get help to get organized and to grow.

In addition, by bringing in as partners other communities within the region, Dortmund helped create a strong regional partnership, with each community developing its own incubator to suit its particular strengths. If specialized incubators are developed in Croatia, a look at the Dortmund model would help guide those plans.

Another relevant point for the Croatian government to consider is that the university supported the initiative by encouraging cooperation between its faculty and industry. Croatian universities need to hear directly from the federal government that technology commercialization is a high priority of the nation's science and technology policy.

*Reasons for success or failure*

The image of the region and the city of Dortmund has changed from a declining coal and steel city to a growing and future oriented technology hub. The main components for this success were:

- A local city government ready to take initiative and the lead with a long term perspective.
- A community ready to invest in building an infrastructure for innovative businesses and research facilities.
- An understanding that a combined effort of the public and the private sectors would be needed to involve research and educational institutions as well as the industrial and financial sectors from the beginning.
- A quality management team recruited from the private sector.

The program also had some challenges which it had to overcome.

Though close cooperation with the city, the chamber of commerce and trade, the universities, and banks created a successful programme, it remains a continuous challenge to keep all the stakeholders pulling in the same direction.

- Even with a substantial entrepreneurial support system, it remains difficult to attract and motivate students and graduates to take a chance and establish new companies. It requires continuous seminars, workshops, business plan competitions, etc. to encourage the entrepreneurial spirit of students.
- And there is still only limited access to equity financing for start-up businesses. Business "Angels" do not exist in the Dortmund region and though local financial institutions are ready to make classic loans, with collateral, they are not ready to provide investment money without security. Venture Capital, though available, is not the appropriate instrument for early stage financing.

## *Entrepreneurial technology-based economic development in Croatia*

### *Consideration for successful adoption in Croatia*

Lessons here for Croatia include the ability of a single city to plan and execute a regional technology commercialisation system using mostly its own resources, including the intellectual capital of the local university and the strength of the financial sector. The ability to create a regional economic development organization and strategy cannot be stressed enough. In the global economy it is competition of regions, not cities, that are becoming most relevant.

This model seems most compatible to the current Croatian experience with the creation of RDA's. It can be applied to not only Zagreb, but also to other Croatian cities with universities or polytechnic colleges and entrepreneurial local and regional governments. If there is to be a successful technology-based entrepreneurial development strategy for Croatia, it must be built around partnerships of academia, government and private business – and it will most likely only occur in urban places with universities or colleges doing applied research.

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## **Conclusions**

Each of these three learning models has unique strengths that might be transferable to Croatia.

The **Centre for Emerging Technologies (CET)** in St. Louis had to build complex partnerships over time among and between city, state and federal governments, local financial institutions, and the two major health science centres located at Washington University and St. Louis University. Those partnerships not only resulted in a layered capital financing package that built the bio-science incubator, but those partnerships also resulted in an informal coalition of interests that ultimately brought the private sector in to launch a major bio-science park redevelopment for the surrounding area. Without this real estate initiative a growing bioscience company could have been lost.

The **Advanced Technology Development Centre (ATDC)** in Atlanta showed how a strong partnership between a technical university, Georgia Tech, and a state government could create an effective delivery system for technology commercialisation. Of particular interest were the development of two satellite facilities in other parts of the state, and the private sector use of the university's facilities and instrumentation that reduced both the cost and time entrepreneurs needed to build their businesses.

The **Dortmund technology initiative** showed how a regional coalition of partners, including city government, a university, local financial interests and the private sector could create a regional innovation system of incubators. Of particular interest is the direct way in which the private sector

followed university research initiatives with private sector investment in incubator development to house resulting spin-out companies.

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