The Competitiveness of National (Croatian) Economies through Development of Industrial Clusters

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This article reflects upon some Croatian industrial and R&D conditions with the aim of providing an answer to the hypothetical question, what the possible role of the National science and technology (S&T) potential could be within the existing embryos or clusters to be developed in the forthcoming period. Particular attention is given to the national automotive industry, which is continuously struggling with tough international competition.

Clustering, as a worldwide accepted industrial organizational model based on inter firm linkages and industrial and technological networking; could be an excellent source of competitive advantage, not only in comparison with the countries in the surrounding geographical area, but also much wider. Based on the first most recent experience with cluster development in Croatia, and having in mind Croatia's existing research and development potential, the question arises as to whether Croatia is ready to initiate its automotive cluster and what the role of R&D could be in this process. Should the analysis of the automotive sector result as unfavourable for future organizational networking, further research will be necessary related to cluster development in the framework of better performing industry sectors, within which, after all, the first Croatian cluster development initiatives are precisely at the moment being triggered.

Understanding current worldwide processes; even if the answer to a research question regarding cluster development in Croatia under present circumstance turns out to be unfavourable, a logical hypothetical question that arises could be: ***is there any alternative?!***

Keywords: Clusters and clustering, organizational networks, research and development, innovation; technology transfer, Croatia, competitiveness, automotive industry

1. National competitiveness

There is no single definition for the term of national competitiveness. Earlier definitions linked national competitiveness to macroeconomic variables as exchange rates or government deficits, some other with the availability of cheap labour, as the result of government policies such as e.g. protection, subsidies etc., or finally as a result of management practices and management - labour relations.

In order to explain overall national competitiveness one has to focus on specific industries and industry segments and how they gain competitive advantage to compete internationally, including trade exports and foreign investments. One of the most relevant and most quoted contemporary theorists of global competitiveness Michael E. Porter categori-

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cally states in his speech in Wellington Town Hall, New Zealand (1998) that productivity is *de facto* the only synonym for competitiveness.

Beside this affirmation, Porter further offers his vision of competitiveness in the global economy:

"A nation, state or city's standard of living (wealth) is determined by the productivity with which it uses its human capital and national resources: productivity depends both on the value of products and services (e.g.: uniqueness; quality) as well as the efficiency with which they are produced, it is not what a nation, state or city competes in that matter, but how firms compete in those industries productivity in a nation is a reflection of what both domestic and foreign firms choose to do in that location. The public and private sectors must each play different but interrelated roles in creating a competitive economy."

Kevin X. Murphy (2001) one of '*Porterian*' competitiveness theory supporters uses Porter's bases foe defining competitiveness and states that:

"Competitiveness is the ability of products and services to meet the test of the marketplace in competitive conditions, resulting in sustainable increases in standards of living"

The above-mentioned Porter's theory that competitiveness derives directly from productivity is followed with the hypothesis that productivity is closely related to performance efficiency and products value adding. Both processes are supported and developed by innovations through applied scientific research and implementation of new technologies or upgrading existing processes.

Porter further recommends, as innovative approach, the creation of network organizations under the term of clusters in order to boost, among other aspects, innovation within clusters as well. Therefore, innovation is one of the most important factors in global competitiveness on both national and organizational level.

There are however different approaches to innovation interpretation and its implementation as a process, and it is usually in direct relation with the status of the country in the global economy.

In developed countries where macro and micro economic conditions are well set; there is usually a low level of governmental direct influence on economy and innovation, as a result of scientific and technological development is used as a strong instrument to achieve organizational and national competitive advantage.

On the other hand, developing countries; countries of the Third World and European transition countries use different innovation development strategies, or strategies that prefer technology copying and license importing.

In the period of transition Croatia should (and most probably does) by all parameters fit into the second group of listed economies. However, understanding recent national orientation, there is a clear vision among existing and particularly emerging intellectual forces that innovation and further development based on intensive use of scientific and technological development should be the top priority on the governmental agenda when analysing organizational competitiveness and setting national development strategies.

1.1. The role of science and technology in national economies

The share of knowledge-based products in the world trade and output is increasing. In the circumstances of the scientific technological revolution, technology is set apart as a separate production factor with a key role in determining the production possibilities and structure of foreign trade. In addition, knowledge emerged as a new factor of production in terms of business competence of successful companies, regions and nations. In short, knowledge-based economic activities rely on possessing specific information and abilities in order to effectuate the specific advantages with respect to products or production processes which will ensure a considerably greater added value.

According to Posner (1961), permanent development of products and innovation of production and services enable single countries certain advantage to master technologies that enable the creation of higher quality products or lower prices, as well as new products not represented on the world market so far. The technology must not be considered *per se* available in factorial sense, because its availability in a certain country is not a given condition, but a result of innovation, learning and imitation process.

The goal of building capacity for technology adoption is not easy to achieve due to the variety of knowledge needed, i.e. technical, technological, organizational and managerial skills. According to UNCTAD (1999), successful countries do not apply the policy of import substitution or passive market liberalization. Generally, those countries have built a strategic approach of adopting technology based on the curve of active learning specific for each technology; as well as developing the possibilities, which are crucial in locating the high-technology production in a certain country.

Investment in science and technology development, particularly in the business sector is a precondition for adopting new production processes and creation of new competitive products that will en-

able high added value. Therefore, it is necessary to stimulate companies' developmental function based on knowledge, technology and innovation.

The state has a relevant role in terms of developing the education system, corresponding to entrepreneurship requirements, organizing state funded research projects as well as of stimulating scientific and technological development in the business sector as well as linking research conducted by universities, both state and private ones.

1.2. Clustering and organizational networking

In the Oxford dictionary a cluster is defined as '*close group or bunch of similar things*' and that is approximately what the networking organizations in their linked business interactions are.

The role of geographic concentration in competitiveness was first studied by Marshall (1920), who identified three reasons for localization. First, the concentration of several firms in a single location offers pooled markets for workers with industry-specific skills ensuring lower probability of both unemployment and labour shortage. Second, localized industries can support the production on non-tradable specialized inputs. Third, informational spillovers can give clustered firms a better production function than isolated producers.

Groups of interconnected companies can be called as *value networks, value nets, or value webs*. According to Timmers (1999), value networks can be defined as "multi enterprise networks of relationships focused on integration of information flows to exploit information and knowledge in the network for strategic business objectives". The common feature of value networks is to realize external economies of scale and of scope by relying on fragmented rather than vertically integrated forms of industry organization (Berger et al., 1999).

Berger at al. (1999) sees three types of value networks that play important roles in the world economy today. First, there are '*captive value networks*' that rely on dominant lead firms coordinating tiers of largely captive suppliers. The advantages of captive value networks include efficiency and close coordination, while the main negative aspect is that strong interdependence makes it difficult to begin and end supplier relationships. Captive value networks are typical in Japan; where the suppliers are usually highly dependent on a few key customer firms (Aoki 1987, Sako 1989).

Second, there are highly fragmented '*relational value networks*' that are built on social proximity and long-term contracting relationships between firms. These networks can adapt to volatile markets rapidly, while the drawbacks are high barriers to entry and geographic boundlessness. (Berger et al. 1999) Examples of relational value networks include the industrial districts of Italy (Brusco & Righi 1989) and even Silicon Valley (Saxenian 1996).

The third network type consists of '*turnkey value networks*', which are based on highly qualified suppliers with the capability to provide customers with end-to-end solutions (Sturgeon 1997). In these networks, the suppliers are of merchant character, which is achieved through the development of a large and diverse pool of suppliers. To facilitate this; turnkey suppliers often specialize in a cross-cutting base process, base component, or base service.

Turnkey value networks are highly flexible systems characterized by fluid relationships, geographic flexibility, low costs, and rapid technological diffusion. In these networks, the brand-name firms are in a risky position: they may lose their expertise after extensive outsourcing and, as a result, the turnkey suppliers might take their business (Berger et al. 1999). The concept of value network successfully broadens the original view of value chain. With the help of the value network, relationship between companies can be described in a realistic way.

Literature review on networking will commence with theoretical grouping formed by closely linked industries and companies. Cluster concepts are stretching beyond traditional sector boundaries. The focus is not on distinction between individual industries or companies but on the mutual connections and interactions.

Clusters are therefore formed through the flow of information or products between companies and industries that are functionally linked with each other. The agglomeration of producers, customers and competitors, whether based on geographical proximity or know how, promotes efficiency and increases specialization. Agglomerates create positive externalities through increasing innovation, and especially through technological spillovers. The core idea is that the cluster is better equipped to succeed than individual companies and industries acting separately without the benefit of resources that complement each other.

Clusters affect competition in three broad ways: by increasing the productivity of the firms and institutions, by increasing their capacity for innovation using recent science and technology development results, and by stimulating new business formation that supports innovation and expands the cluster. (Porter 1998)

There are several reasons for analysing the economic growth through clusters rather than industries or sectors. First, clusters align better with the nature of competition and the sources of competitive advantage. Second, clusters capture important linkages, complementarities and spillovers of technology, skills, information, marketing and customer needs that cut across firms and industries. Third, viewing a group of companies and institutions since a cluster highlights opportunities for coordination and mutual improvement in areas of common concern without threatening or distorting competition or limiting the intensity of rivalry.

ment but only 24 on overall microeconomic competitiveness. On the contrary, countries that score much higher on overall microeconomic competitiveness than on cluster strengths are Greece and, surprisingly, Denmark.

Many observers have speculated on the evolution of clusters in Europe as European markets are becoming increasingly integrated. It was argued that a fall in barriers to trade would remove artificial barriers to agglomeration and thus foster the growth of clusters.

Unfortunately, there is no direct cluster data available to look at this question. However, a number

Sector approach	Cluster approach
Organizations within an industry sector form a value network	Organizations in different industrial sectors form a cross-industrial value network
Some industries offer greater wealth-creating prospects and should thus be supported.	All clusters are desirable and have the potential to contribute to prosperity.
"Wasteful" domestic competition and foreign rivals are eliminated until the supported industries reach sufficient economies of scale.	Both domestic and international rivals are welcome to enhance cluster externalities and productivity.

Table 1: The main differences between cluster thinking and traditional industrial policy by Raines (2001)

Clusters in Europe

Porter's (1990) *The Competitive Advantage of Nations* already included a significant number of European examples and until recently, information on clusters in Europe has been based mainly on individual case studies. In the years since then, numerous individual case studies have been conducted; one compilation of cluster case studies includes a total of 449 entries from European countries. While nobody has an exact figure, it is obvious that Europe is home to a large number of clusters.

The Global Competitiveness Report provides comparative data on overall cluster strength for 75 countries including all European countries. The survey generating the data includes a specific question on the state of cluster development, and it includes a set of additional questions that can be used to calculate an overall measure of cluster strengths.

Table 1 reports the ranks for these two measures as well as for broader business environment quality and overall microeconomic competitiveness. On average, Europe ranks slightly lower on cluster development and cluster strengths than overall on microeconomic competitiveness but the difference is small. Nevertheless, just as regarding many measures, the high degree of heterogeneity among the European countries makes it more interesting to look at individual countries. Clearly, a special case is Italy, which scores best in the world on cluster develop-

of researchers have looked at the regional dispersion of industries across Europe instead. Their work has two main results. First, there is no strong trend for increasing geographic concentration of economic activity across European industries.

This was contrary to some expectations because the initially more integrated U.S. economy displays a higher level of geographic concentration. Concentration increased mainly in low growth industries that restructured to focus less production in fewer locations. Concentration decreased, however, in some high growth industries that spread out into new locations with additional manufacturing activities. Second, the European economies have become more unequal over time after 1992 when the Common Market legislation took effect. This has reversed an earlier trend of increasingly equal industrial structures that was observed in the 1970s and 1980s, and brought European industrial patterns closer in line with the U.S. economy.

Clusters in Croatia and Slovenia

In the very sense of their meaning, we can hardly say that clusters exist in Croatia at all. While in neighbouring Slovenia the number of active and functional clusters exceeds two dozens and even more, Croatia struggles with the first initiatives targeting cluster development. There are various forms of associations of related industry members created

within the Croatian Chamber of Commerce, as well as independent groups, but direct and concrete government supported associations or initiatives are hardly visible.

However, it would not be justified not to mention some very first initiatives in favour of cluster development in the past year or so, which at least confirm that this relevant model of industrial organization has raised the interest of some relevant associations, as well as policy makers.

First, within the National Competitiveness Council an expert and policy makers working group for regional and cluster development was established in 2003. Together with the results of several other working groups, aimed at proposing measures to the Croatian government for raising economic competitiveness, the recommendations of this joint experts/ policy makers working group were included in the document "55 Recommendations for Developing Competitiveness in Croatia", which was presented to, as well as accepted by the Croatian government. Among the recommendations was the establishing of a task force for cluster development and the development of cluster pilot projects. Among other government initiated task forces for raising competitiveness, the task force for regional and cluster development was established a year ago; but still with no concrete results.

A more recent, as well as more promising initiative took place in April 2005 with a project initiated by the Croatian Employers Association to develop 8 clusters in Croatia by the end of the year. This association established the National Centre for Clusters and is expecting to sign an agreement with the government related to a joint project "Clusterising of the Croatian Economy". At the moment, within this centre, several clusters are in different stages related to their establishment. The most developed one is the metal cluster; which was established within this centre, but the textile, wood and additional metal clusters are not far behind with their establishment. Clusters in the informatics and food industry will be established in 2006, along with other 10 planned, as well as further 14, as planed by the end of 2007. It remains to be seen how far this initiative will go, particularly having in mind the previous initiatives with no substantial results. However, the very positive reactions from high positioned policy makers give grounds for optimism.

On the other side, the Slovenian Ministry of Economy has been promoting cluster development since 1999. The results of clustering have been encouraging. Several clusters have been institutionalised and are functioning while several other initiatives are very promising. 450 companies and institutions are involved in the clustering and 29 projects of company linkage are in progress. The Ministry will continue to promote cluster development. Developmental initiatives will be aimed at supporting the implementation of research and development projects of clusters and at targeted support for cluster development projects.

Slovenia's case proved that the active government role in cluster creation is essential, and it seems that the Croatian government could learn from the neighbours and follow the same course.

2. The role of R&D in rising economic competitiveness

The role of research institutions as drivers of cluster development has been emphasized by the experiences of places like Silicon Valley in the USA and Cambridge in the UK where universities have been important components in the development of the cluster. In the Cambridge, cluster estimates of the proportion of new firms that have spun out of the university are up to 31% of new firms. 42 out of 50 firms in one survey reported free technological advice from University based staff, through formal or informal networks, with 14 reporting these as critical to the success of the firm.

2.1. Croatian current R&D capabilities and its profile

In the past decade, Croatia was behind in using knowledge as a production factor, losing export markets for technologically demanding products. Companies were more focused on privatisation, surviving and defensive restructuring. Restructuring, by ways of developing the existing technologically intensive activities and moreover by entering more advanced production segments, suitable to Croatian rather high labour costs and educated workforce, is necessary. However, the business sector so far has not adequately used this potential by investments in their own research and development. Only in the past few years, a greater intensity in research-technological activities in business sector has been recorded.

The expenditure for research and development in Croatia is relatively modest, but the situation is rather similar in the more developed EU candidate-countries. The estimated R&D intensity in Croatia (share of expenditure for research and development in GDP) in 2001 (1.25%) is considerably lower than the EU average (2.21% in 1999), but higher than in Ireland and Italy. In comparison to the new member states, only Slovenia and the Czech Republic have higher R&D intensity than Croatia.

Table 2: Main indicators for R&D in 2001 (or last year with available data)

	Expenditure for R&D (mil. €)	Expenditure for R&D per capita	Expenditure for R&D %GDP	R&D in business sector	Number of researchers per 10.000 persons of workforce	Patent registration of residents per mil. residents (1999)
Croatia (2001)	276	63	1,25	42	37	61
EU-15	141,200	374	1.90	66	52	-
Germany	50,316	612	2,46	70	60	904
Austria	3,687	455	1,79	56	34	380
Ireland	1,076	283	1,21	74	51	327
Italy	11,524	200	1,04	54	33	167
Slovenia	297	149	1,52	56	21	147
Czech Republic	744	72	1,33	60	26	60
Hungary	405	40	0,80	44	31	77
Lithuania	73	21	0,60	22	-	24

Source: Annual report on Croatian Competitiveness 2002-2003, National Competitiveness Council, Zagreb, 2003

There is a relatively large number of researchers in Croatia, with 37 researchers per 10 000 persons of workforce. In that respect, Croatia is ahead of Italy, Austria, the Czech Republic and Hungary, but considerably below the average of EU countries (52 researchers). However, the share of researchers in the business sector with 16% of the total researchers' employment in Croatia is exceptionally low, whereas the same indicators for the EU countries are 49% and for the OECD 63%.

Concerning patent registration, Croatia is similar to the new EU member states, which are behind the EU old members; except Slovenia. This activity in Croatia is 6 times lower than in Austria and 15 times lower than in Germany.

There is a considerably large share of natural science in research-development activities which account for 41% of total expenditure, whereas the share of engineering is relatively low, only about 22%, which puts Croatia considerably behind the compared countries.

However, the presented indicators cannot show precisely the quality aspects of science and technology development activities and these data are usually obtained by comparing surveys. One of the most known "benchmark" surveys of entrepreneurs in various countries is conducted every year in the frame of the Global Competitiveness Report, published by the World Economic Forum (WEF). In the year, 2002 Croatia was for the first time included in the report, which enables us to benchmark survey data concerning research and development activities.

The average mark on science and technology development related survey responses of 3.71 (in range from 1 to 7) and average rank value of 52, roughly matches the average assessment of Croatian national competitiveness.

Croatian managers that contributed to the survey have stated that licenses are a good way of obtaining new technologies. However, licenses are as a way of obtaining old technology, whereas the developed technology could be obtained by direct proprietary investments.

Although managers have a relatively positive attitude towards the quality of research and development scientific institutions and Croatia is ranked on the 37th place, the cooperation with local universities is assessed as poor (rank 56). Relatively satisfactory is the assessment of their own research and creation of new products, acceptance of new technologies and technological development of production process.

According to managerial responses in the survey, the level of companies' investment in research and development is rather low, whereas the innovation is of insignificant importance for companies' revenues. According to entrepreneurs, the state support for research and development as well as the cooperation of the business sector with universities is inadequate.

Entrepreneurs assessed the contribution of foreign investment in the use of new technology as very poor. However, that refers to the evaluation of the existing international direct investment in Croatia, and not the FDI potentials in high technology sectors. The poorest mark in the survey is linked to the general technological development of the country, ranking Croatia on the 67th place, most probably

Table 3: Results of the survey: Global report on competitiveness 2002-2003

	Mark		Rank	
	Croatia	EU	Croatia	EU
Average mark of R&D activities	3,71	4,84	52	24
Licence as a way of acquiring new technologies	4,87	4,96	33	29
quality of scientific research institutions	4,25	5,05	37	19
Research and creation of new products, processes or imitations	3,28	4,96	41	16
Interest of companies for accepting new technologies	4,82	5,17	45	32
Working or technological intensity of production	3,42	5,34	50	16
Public purchase of high technology: focused towards innovation stimulation or low price	3,40	4,11	51	25
Cooperation with local universities	2,90	4,55	56	18
Importance of innovation for companies revenues	5,11	5,37	57	36
Subventions or tax-deductibles for R&D	2,66	4,21	58	18
Company investment in R&D	2,87	4,58	59	20
Direct foreign investment as a source of new technologies	4,21	4,88	65	41
Country's technological development	2,77	4,93	67	22

Source: Eurostat, Statistics in focus, Theme 9 – 1/2003, 3-2003 "Research and development 200", State Bureau of Statistic
Note: R&D indicator is calculated as the rate of GDP in gross expenditure for research and development. Official data on Croatian R&D expenditures are adapted to include the assessed R&D activities within small enterprises that are not included in the R&D statistics.

due to the obvious falling behind regarding new investment in technologically demanding production segments.

These survey data, together with R&D and information and communication (ICT) indicators, contribute to the technology index; as defined in the Global Competitiveness Report, by which, with a rank value of 43, Croatia was surprisingly placed significantly above the average rank value of indicator of potential future growth (rank 58). However, as evident from Table 4, that outcome is far behind the values of technology index of the Czech Republic, Hungary and Slovenia, ranked 20, 21 and 25 respectively.

The technology index in Croatia was pushed up by rather well ranking statistical data on innovation (rank 43) and ICT (rank 37) as well as on survey data on technology transfer (rank 35). On the other hand, survey data on ICT (rank 51) and moreover on innovations (rank 78) indicate that rather advanced communication technology infrastructure and a significant innovation potential do not transmit to innovative and technologically modern business sector.

2.2. Current projects and development trends of S&T in Croatia

A question is posed as to how to stimulate scientific and technological research in order to alleviate the previously mentioned shortcomings. There is no unique answer. Optimal measures for the reali-

Table 4: Technology index and its components – rank values

	Czech Republic	Hungary	Slovenia	Lithuania	Croatia
Technology index	20	21	25	40	43
Innovation sub-index	42	34	24	33	50
Statistical data	48	37	23	34	43
Survey data	27	32	30	51	78
ICT sub-index	28	29	26	40	37
Statistical data	30	31	22	39	38
Survey data	26	21	33	49	51
Technology transfer	4	6	38	32	35

Source: National Competitiveness Council (2003), Annual Report on Competitiveness in Croatia 2002

zation of this goal depend on the country's economic strength, tradition in supporting scientific and technological development, certain technologies' properties, the scientific and technological support infrastructure, as well as the society's vision regarding scientific and technological development. In any case, it is necessary to develop the system of organization, financing and evaluation of government supported research and development activities; particularly in line with the interests of the business sector.

Theoretically, the optimal share of government in project financing is determined as a share that considerably decreases the uncertainty of project realization[1]. Alternatively, the share of government in supporting the projects regarding the technological development should be proportional to the public content of this project. Both approaches have a justified logic, but could be mutually contrasted, i.e. the difference between the entrepreneurs taking risks in full and by government subventions decreasing private risk of certain technological development does not have to be linked with social expenditure and benefits that arise as the consequence of the development of new technologies.

The main reasons for increasing the collaboration between government and private sector in technological development financing are:

- The need of a country to support development by way of technological development, in order to increase the competitiveness on the global market;
- Limited possibilities of the Government financing of the development of technology due to the necessity of decreasing overall government consumption;
- Strengthening private sector activities in scientific and technological research and transfer towards establishing generic technologies from universities to industrial institutes.

The systems and policies of scientific and technological research very much diverge in different countries. The scientific-research system of major countries, besides the standard government system includes the system of private scientific foundation; government supported commercial research and mixed partnership financing. The aim of research financed by different parties is, as a rule, totally different from non-commercial research within the public universities to work on technological projects financed by ministries of economy, with companies as end users.

Germany is a good example, where large research organizations are financed, as a rule, by government and are under the responsibility of the Federal Ministry of education and research, additionally supported by scientific programs. However, the Ministry of Economy and Technology finances the largest part of technological research, especially in the sector of small and medium enterprises. The central role for supporting the scientific technological development is assigned to two institutions; Max-Planck-Gesellschaft (MPG) and Fraunhofer-Gessellschaft (FG). Whereas the MPG deals with basic research in the field of strategic importance for the country's future, the FG activities are concentrated on applicable research and research results transmission in new products, processes and services, with some 40% of income from contractual research for the industry. Hereby the success of scientific-research work is evaluated according to the research type i.e. the basic research is evaluated through reviews and bibliometrics, whereas the evaluation criteria for applicable research are indicators of established commercial cooperation.

Generally, the allocation of government funds for R&D depends on the system of organization financing model, research type and field. The traditional concept of quality, based on scientific competency, i.e. scientific contribution is applied for basic scientific research. Researches linked to projects or programs with defined goals and tasks are evaluated, in general *ex ante* while choosing respectively financing decisions but also *ex post* evaluation of the realization of initially set goals. The survey research with precise questions of research impact evaluation is used in the case of research with a precise purpose, respectively known end users. Impact evaluation on the level of activities, total economy or socio-economic goals poses problem due to long-term and complex nature of these impacts and is conducted for evaluation on higher levels, respectively for financing large research programs.

Sometimes it is possible to avoid the unreliable direct estimation of success in demanding process of choosing the projects and programs. Norway is the example of very instructive evaluation experience of innovative research in industry. The parallel valorisation of projects has been replaced, after half of the projects of the second generation support scheme to new scientific-technological projects ended unsuccessfully, with the «implicit» evaluation based on 50% project co financing for which companies warrant with readiness for financing. Namely, it is assumed that companies themselves will assess

best where to invest their own funds and co financing based on that criterion is therefore the best way of assigning government support.

According to Norwegian experience, the success of projects is greater if the governmental financing is lower. This is a good example and shows to which extent the supporting tools have impact on project realization.

In Croatia, there is a traditional, relatively inflexible model of research activities at universities and institutes, classically organized and financed by the state. At the same time, a contraction of research activities and decrease of the number of institutes occurred. In the past few years, the activities increased in pharmaceutical industry, telecommunication and computers as well as in food industry.

Government support to research and development activities within the business sector is still in the very initial phase in Croatia. There are programs of co-financing the risky and new projects presumably in technologically intensive activities within the TEST and RAZUM programs of the Ministry of Science and Technology. Apart from that, there are certain support programs within the activities of the Ministry of Economy and small and medium enterprises. An important step in supporting business R&D activities was made this year by implementing special tax benefits for research and development expenditure and the Science and Technology project proposed from the Government of Croatia (STP) with the objective to improve business infrastructural environment for science and technology and to reorient them to benefit the economy.

The ultimate objective of the proposed STP would be to improve the business support infrastructure environment for science and technology, including restructuring Research and Development Institutes (RDIs), upgrading Technology Centres, improving technology development financing programs (including venture capital). The Project will help to reorient the R&D infrastructure to benefit the real sector and economy at large.

It appears that the currently leading government is supporting this project as well. There is obviously an increasing awareness among governmental authorities to initiate stronger involvement of the R&D capabilities in support of the national economy. The project practically stimulates various R&D institutions to start offering or strengthening (or products) to the market, particularly in regard to industry, and in that case, institutions are additionally stimulated to collaborate with national (and international) SME's.

In certain conditions, those institutions (Brodarski Institute (Croatian Institute of Advanced Technologies), Institute Rudjer Boskovic and others involved) could lead the process of intensive industrial networking in various fields.

However, strong opposition is met among eminent scientists, particularly within the leading institutes in the segment of natural science (IRB), due to the uncertainty that the project is bringing along. Although there is no alternative to upgrade knowledge in Croatia, the pace of the process should be balanced through years and it should mitigate the risk as much as possible.

2.3. Croatian industry and cluster embryos

The Croatian industrial sector is intensively changing and the effects of the full scale and strategically thought out restructuring of this sector are evident in many areas, from privatisation to the strengthening of exports to western markets, development of new products and innovations to existing products and manufacturing processes, to increasing the level and standardization of quality, satisfying environmental protection conditions, reaching cost effectiveness, etc.

The 2003 industrial production growth totalled approx. 4%, while a lower growth rate is expected in 2005 and further (3-4%). Again, in 2004 industry employed more than 270,000 workers, who represent 26 percent of Croatia's total workforce.

Industrial goods account for 97% of Croatia's total exports and the highest share in Croatia's GDP at approx. 20% level. Industry thus remains the most important branch of the Croatian economy.

The profile of Croatian industry and its competitiveness level could be extracted from the national competitiveness chapter as well as from sources from the Croatian Chamber of Commerce, where clothing; wood processing, leather and food processing industries are the most competitive branches.

As can be noticed, tourism as one of the most profitable and attractive Croatian sectors was not listed in any of the competitiveness or industry list-

ing for the simple reason that tourism is classified as a service sector and not industry.

Within the industry, the largest sector's domestic income is made within industry of food and beverages, followed by petroleum, chemicals, electrical manufacturing, paper printing and publishing, and shipbuilding. Leading income earners in export industries are shipbuilding, food and beverages followed by metal and electrical industries.

Transportation industry is highly placed in industry classifications as well, but as already mentioned, the large share derives from the shipbuilding industry.

The Automotive Sector, which will be examined in the further text, is present with a limited number of vehicle components producers spread around Croatia with some focal points around the capital of Zagreb. Although the industry is relatively weak and segmented, there are indications that clustering could help some branches to improve their performance.

From previous discussions, it could be understood that industry clustering is a powerful framework for regional economic development because it captures economic relationships among specific industry sub-sectors, and it provides a set of tools to help define economic development strategies. Industry clustering can improve short-term industry attraction efforts through the identification of industry gaps and definition of specific advantages. In addition, industry clustering is useful in defining medium-term strategies for retaining, establishing, and growing of the regional industry, as well as for organizing long-term strategies to sustain industrial growth within a region.

Saying that, it is very indicative that 'cluster' or 'organizational networking' as terms, did not un-

Table 5. Croatian producers of automotive components (mostly SME's)

Producer	City	Product	Employees
AD Plastik	Solin	Plastic components	854
Cimos	Buzet and Roc	Components for bodywork, breaks gearshift and engines	416
Elcon	Zlatar Bistrica	Electric cables, devices and accessories	70
Eloda	Zagreb	Switches and electrical parts	30
SAS	Zadar	Special machining centres	200
Končar alati	Zagreb	Tools and moulds	124
INA	Zagreb	Oil refinery	13867
TUP	Dubrovnik	Brushes	186
Chromos	Zagreb	Paints and varnishes	220
Dalit	Daruvar	Casting of iron cast and steel	466
Feroimpex	Bregana	Cone-cylinrical bearings, housing for Y-bearings	151
Intermobil	Vukovina	Ball joints, steering linkages, radius arms, suspension joints, angle joints and yokes	13
Jedinstvo TMS	Ivanec	Clutches and clutch equipment	45
Metalservis-TAD	Bjelovar	Tie rods, steering arms, homikin. etc. joints, rubber-metal parts, gear wheels	24
Munja	Zagreb	Batteries for cars	190
MU ROS	Sveta Nedjelja	Clutches, brake drums	NA
Polim	Sv. Križ Začretje	Plastic components	NA
Prevent Zlatar	Zlatar	Cover for seats	75
Sila	Zagreb	Radiators, seats and gaskets	109
Straža plastika	Hum na Sutli	Plastic components	290
TANG	Nova Gradiška	Forging as component parts	NA
Tehnoelektro	Samobor	Contactless and multipurpose alternators	NA
TLM-Promal	Šibenik	Commercial vehicles (superstructures) using different truck chassis	NA
TLM-TAL	Šibenik	Secondary casting aluminum alloys an die casting	NA

til recently exist in the Croatian national economy development strategy. Promotions and discussions related to potential future clustering are performed at a low level of individuals, enthusiasts or groups of economists who are limited to theoretical generalizations having no executive power for project realization.

3. Automotive case

3.1. The automotive sector in Croatia

The automotive industry in Croatia is certainly not a massive and particularly developed one. In reality, it is segmented and dispersed countrywide. There are no original vehicle manufacturers (OEM in further text) present in Croatia, but only component manufacturers that operate as the first ring of components suppliers (three of them) while others belong to the second and further rings. Besides three larger (Cimos, Elka and AD Plastika) there are more or les 20 smaller companies that are in the automotive business directly, ranging from 13 up to 850 employees (table 5).

Until the 1990s, manufacturers of components were producing exclusively for the industry of the Yugoslavian group of OEM producers (Zastava, TAS-VW, etc.), With the dissolution of the Yugoslav federation Croatian companies have turned completely to the European marked and today automotive industry employs 3500 persons with the turnover of approximately 100 million euros.

The largest components manufactures produce parts such as: plastic components of interiors and exteriors, casting shops for bodyworks for breaks gearshifts and engines, cables and switches etc. Final customers of those components are large OEM producers in Austria, France, Italy, Russia and Germany as PSA group, VW, BMW, Ford, etc.

The association that presently gathers automotive components manufacturers operates under the name of '*Association of Manufacturers of Parts and Accessories for the Automobile Industry*'. It is a rather loose association that operates within the Croatian Chamber of Commerce and which apparently does not support their members in their business needs at all.

Croatian Automotive Association is another association that supports and analyses Croatian automotive industry and operates more as an industry support association organized by Dr. Marusic (employed at the Zagreb Faculty of Mechanical Engineering and Shipbuilding).

This association prepared and held back in 2002 an extended focus group in Zagreb on the importance of Croatian and world automotive industry attended by Croatian experts that created a respectable and competent group, which focused the main part of the discussion on technical aspect of the industry. Nevertheless, some recommendations and conclusions from the group meeting were extrapolated:

- Croatia should continue to intensify its production of components and subsystems
- Improvement of present production should be improved by dynamic introduction of innovations
- Special vehicles (fire fighting, police, ambulances, TV-trucks, funeral vehicles etc.) could be manufactured in Croatia. These products require a higher level of technical and manufacturing skills with lower volumes required for the market
- Rijeka (a north Adriatic port) should be more aggressively proposed and subsequently used in automotive industry as products entry-exit hub as well as a manufacturing centre for finishing and personalizing of ordered vehicles
- Tourism, particularly related to sport such as races, could be the nest promoter and booster of the automotive industry.

Besides some generic declarations, the listed group conclusions are reasonable and realizable. No matter how unintentional it may seem, the clustering issue was not raised at the meeting, thus ignoring an important aspect that became reality in neighbouring countries such as Slovenia, Hungary and Austria.

Focus group meeting of experts in various fields (R&D, producers, financers, GVT authorities etc.) held in 2003 with discussion topic on future clustering in automotive industry generated fairly concentrated conclusions and recommendations, along with an 'action plan' that could guide future approaches to the clustering process.

A very concrete conclusion reached by the focus group was the confirmation that clustering was definitively a process to continue with, understanding it as a '**best practice**' option that achieved more or less success in a large number of countries. The question is, which option and what initiation process should Croatia select, and if it is going to be a

top-down or bottom-up approach etc. Therefore, in Croatia, it is necessary to select one of the already functioning cluster creation methodologies and to adjust it to the particular Croatian circumstances.

The next conclusion of the meeting related to the industry. It appears that the automotive industry, due to its relatively small size, should be extended with the metalworking and tooling sector in order to create a critical mass of potential clustering members.

This conclusion was followed by the assessment that clusters should emerge at the national level, but that, in the second phase, they should become members of the neighbouring stronger clusters, such as the Styrian one from Austria.

The next proposal at the group meeting was that the government should pay far more attention to economy improvement processes such as the introduction of organizational networking.

It is a common opinion that without previous extended and aggressive promotion activities organized by governmental and nongovernmental bodies, a premature cluster creation request addressed to government bodies would not receive particular attention. Industrial networking should be intensively introduced and prepared for further concrete government initiatives. The government is recognized, as it was the case in Slovenia, as the initiator and the trigger of the future networking process, not only of the automotive industry, but also other industry sectors.

3.2. Automotive sectors and clustering in neighbouring countries

The mentioned neighbouring and other countries in the region, such as Slovenia, Hungary and Austria, have quite different experiences and different automotive industry backgrounds, as the consequence of their different history of industrial development.

Austria is not a large OEM manufacturer, however it hosts Eurostar Chrysler's and Daimler Pooch vehicles production lines that have helped to create an extremely efficient and substantial industrial network in the recent 10 years under the name of Styria Automotive Cluster.

Edward M. Bergman, and Patrick Lehner (1998)[2] quote: "The cluster's development is an excellent illustration of how regional and industrial development policies can help stimulate the successful restructuring of a regional economy following Austria's entry to the EU and the opening of Styria's eastern borders to market competition. The exceptional governance and structure of AC Styria is likely to be its most interesting feature."

Among other stakeholders, a strong presence of the R&D institutions, which are significantly contributing to create added values among cluster members, is very evident. Very similar configuration and position of the R&D could be found among other automotive clusters in other automotive clusters in other developed EU member economies in Germany, Spain and Holland.

Hungary has attracted by intelligent governmental FDI-attraction-policy 4 OEM manufacturers (Ford, Audi, Opel and Suzuki) in the beginning of the last decade (1990s). Those manufacturers created the first and the second ring of local OEM suppliers in northern Hungary, which significantly contributed to the creation of the first automotive cluster in that area. The mentioned Hungarian cluster operates in the whole Transdanubian region and besides basic structure and initial budget, the cluster, according to Andreas Grosz[3], aims at performing business services; capital development, members' cooperation, information and communication, diagnostics and consultations, etc.

Slovenia is another neighbouring country that has constituted clusters as forms of industrial networking. Among other (tooling industry, furniture) the automotive cluster was created only recently under the initiative of the Slovenian Minister of Economy Dr. Tea Petrin that realized the importance of industrial networking. The cluster was created by at least 10 manufacturing members and minimum three institutions (universities and innovative centres), as conditioned by the Slovenian government in order to initiate the network. Surprisingly, the biggest OEM manufacturer, Renault, that has the assembly line of Clio model, is not a member of the cluster yet. On the other hand, a large first ring supplier of important European OEMs named CIMOS, was one of its initiators.

The common denominator of these countries is the presence of the automotive industry cluster in each of them. Of course, the technological level of their clusters and the clusters' life cycle position fairly differs. The Austrian Styrian automotive cluster[4] could be, for example, considered as a cluster in

the **mature phase** with more than 220 members (as producers), involvement of several investment and financing groups and active presence and membership of **universities and research institutes**. The Croatian Chamber of Commerce is a member of the Styrian cluster as well, and that is a fact that could strongly influence premises and ideas for the future possible Croatian automotive networking association.

On the other side, Hungarian and particularly Slovenian cluster, far from the size and strength of the Austrian association, are positioned low within the **growth phase**. Yet, they were created in a systematic way, functioning with clear missions and targets that were realistically projected for long periods of time. Understanding clustering as a relatively slow and systematic process, Hungarian and Slovenian cluster creators focused their activities primarily on educational and, as much as circumstances allowed it, innovation activities as well.

It is obvious that the mentioned neighbouring countries have realized the importance of networking organizations and benefits that can be derived from such organizations. Could Croatia after all benefit and learn from these three clusters?

3.3. Current R&D in the Croatian automotive industry

The cooperation and the role of the R&D institutions with automotive components in Croatia are rather weak. It is increasing in certain fields of R&D, but generally, the perception of the national institutions, particularly within the SME's, is still negative. Some embryos of cooperation could be found in certain areas; cooperation of CIMOS with the university of Rijeka and Polytechnic study in Pula, cooperation of the Brodarski Institute with the bus producers and others. However, those linkages are on an ad hoc basis and are fairly segmented.

Previous research done within national automotive sector demonstrated that various initiatives that were launched in the top-down (GVT-sector) and bottom-up (sector-GVT) directions failed due to the insufficient institutional support, here also including the Croatian Chamber of Commerce.

Further to institutes of advanced technologies, there are fairly strong university centres in engineering (Zagreb, Rijeka, Split, Osijek and Slavonski Brod) within the country that could more intensively support R&D within the component producer SME's and even multinational companies - such as INA.

Beside trust, another crucial condition for the boost of such cooperation and networking is of financial nature. As elsewhere, SMEs are struggling with the finances, and the Croatian government did not manage to introduce in the proper way a financing instrument that could facilitate the R&D operations within companies. A good basis for such an initiative could be the current EU FP6 program CRAFT that promotes innovation, SMEs, R&D and networking.

Nevertheless, although the cooperation between the industry and the R&D institutions is not on a desirable level, it has to be said that the universities and institutes are developing their R&D capacities and skills by conducting individual research and projects.

Recent developments within the sustainable mobility field are raising the awareness among the national institutions. One of them is the initiative among groups of scientists to introduce automotive hybrid power for the taxi and minibus fleets in the city centres, particularly in Zagreb.

4. Summary and conclusions

National and transnational clustering and organizational networking is undoubtedly an efficient instrument to increase national competitiveness. On the other side, research and development activities are very important for knowledge and innovation-based economic and technological development.

Although there is a very negative attitude of Croatian managers towards general Croatian technological development and collaboration with scientific institutions, a more positive attitude exists towards licenses than towards technology transfer through foreign investments.

In the long term period, it will be necessary to develop new mechanisms - particularly from the point of view of organization and financing the research system, but also to support the cooperation between government, public and private sector involved in R&D as well as through evaluation of research programs and projects. This would be possible only with carefully planed and prepared upgrading of the organizational system, as well as financing research and development activities in Croatia in such a way as to develop and support the pluralism of organizational forms and types of research, develop partnership models and linkages between industry and science, as well as to foster research activities in the private sector.

On the other hand, R&D institutions are expected to take an initiative and leading role within organizational networking and cluster creation due to their natural position within those agglomerations. The government, as the main stakeholder of these

institutions, should implement approaches and measures to promote and further support these initiatives in line with the approach undertaken by the Slovenian government.

Due to the relatively weak national automotive sector, it appears that one of the feasible options in networking could be the transnational network with the surrounding countries. However, the embryo should be created nationally, and at a later stage linked to the surrounding networks.

Will then the automotive sector be finally integrated and capable to gather segmented component producers within the Automotive Industrial Cluster?

In addition, the answer is: **yes it could work**, regardless of the general economic circumstances. Future organizational networking should not wait for drastic and dramatic improvements within the country's economy, because we have learned that the level of competitiveness could simply change in a few years, and the cluster itself could even contribute to it.

In the segment of cooperation and networking of R&D institutions and the industry, the most important issue is the generation of stimulating financial arrangements due to the incapacity of the SME's to finance the extremely needed R&D in order to increase individual competitiveness. This topic is getting even more interesting form the point of view that R&D institutions are recently being forced to the free market, which complicates their financial sustainability for the benefit of the society. ■

NOTES

1 Which is already in earlier phases of new technologies development

2 In the paper released by Austrian Chamber of Commerce: 'Industrial cluster learning platforms: Methodology and Case Studies of four local Austrian industry clusters'

3 In his paper 'Cluster initiatives in Hungary as new forms of economic and regional development' Gros has described in details creation, structure and targets of Hungarian Automotive Cluster

4 The strongest automotive association in Austria is present in Styria county around the county capital Graz

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