# Innovation Policy in Croatia: the First 10 Years

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## Abstract

The paper examines the development of innovation policy (IP) in Croatia during the 1994-2004 period and it does so from the R&D sector's point of view. The paper argues that Croatia has failed to make the necessary shift from the standard research and industrial policies towards an innovation policy which is seen as the new policy paradigm necessary for the structural adjustment of the national economy to the knowledge-based economic growth. To support the thesis, the convergence of the science and technology policies into the innovation policy is explained. Also, the chronology of the development of the innovation policy in Croatia is provided. The major shortcomings of the research system are described to illustrate the failings of that policy. The inadequate and fragmented national system of innovation (NSI) – being the direct outcome of the social factors such as the climate of "semi-modernism" which caused the lack of the social and political will for the change towards innovation-driven development – is seen as the main reason for this failure. The solution offered is to build social capability for the introduction of the pro-active innovation policy and related NSI.

**Keywords:** innovation policy, Croatia, knowledge-based economy, semi-modernism, social capability
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# 1 Introduction

Even if during the last 15 years, in the process of transition towards market economy, Croatia has had some significant results, it has, almost universally, been recognized that the exclusive orientation towards market regulation of economy, neo-liberal concept of *laissez faire*, privatization and macroeconomic stabilization has not produced the expected effects on economic growth.

Following the theory of the socio-economic roots of technology change and economic growth (OECD, 1992; Nelson and Winter, 1982; Dosi, 1982; Freeman, 1988a, Knack and Keefer, 1997; Knack, 1999; Perez, 1996), the main thesis of the paper is: Croatia's slow economic growth is related to the obsolete management of technology change and the related slow development of the new policy paradigm of economic growth – the innovation policy (IP). The innovation policy "has only recently emerged as an amalgam of science and technology and industrial policies" (OECD-EUROSTAT, 1997, p. 6). It is, in practice, focused on the creation of the national system of innovation (NSI) (Lundvall, 1992; Freeman, 1988) as the mechanism for the structural adjustment of the socio-economic structures and of the management of the national resources towards the emergence of the knowledge based economy (KBE) based on the appropriation of knowledge.

In contrast to the developed and fast growing countries which have, during the 1980s and the1990s, introduced IP as a new way of socio-economic adaptation to the KBE, Croatia, pursuing the market economy, has simply applied some neo-liberal recipes to the old economic and social structures. Such twisted construction has dragged many aspects of social and economic life into the pre-industrial era and has produced a distorted version of post-socialist wild capitalism (Županov, 2001). Due to the social climate and the state of mind characterised by the state of semi-modernism (Županov, 2001), Croatia in general and the ruling elites in particular have been very slow in adapting to the new technological regime and have demonstrated very low level of the social assimilation of the changes in global economy and the related changes in growth management.

The innovation policy and the corresponding NSI which provide mechanisms and instruments for the strategic integration of science, industry and technology policies for the purpose of the capitalisation of knowledge, have, by the end of the 20$^{th}$ century, become the essence of the strategic development polices in many developed and fast growing countries, the EU included. Nevertheless, the idea of the integration of science

and innovation, as well as of the integration of science policy and industrial and technology policies, has, in Croatia, been poorly received and understood. From the socio-economic and cultural point of view, it has hardly been accepted at all. The last two decades of the 20th century spent in the majority of the developed countries in making the necessary shift from the standard research and industrial policies to the innovation policy, have, for Croatia, been lost. Although the Croatian Program for Innovative Technological Development (HITRA) launched in 2001 (MoST, 2002), marks the turning point towards innovation policy and NSI, the general environment is yet not stimulating enough to enable the appropriate development of NSI as a comprehensive system. Since the further development of HITRA strongly depends on the strength of the other parts of the system, the weakness of NSI threatens the future of HITRA, too.

To prove the thesis, the paper will explain the shift from the standard research and industrial policies to the innovation policy and will, then, provide the chronological review of the development of the innovation policy in Croatia together with its main failings.

## 2 The Shift from Science Policy to Innovation Policy

The notion and the scope of science policy has radically changed since the mid 1970s. Focused on the administrative regulation of science traditionally divided into three categories of basic, applied and development research mostly conducted and financed by the public sector or the State, it has, gradually, been replaced by the innovation policy oriented primarily towards innovation as a mechanism of utilization and capitalization of science and seen as a factor of economic growth.

The dramatic change from science to innovation policy is the result of the growing convergence of science with the broad field of innovation as well as of the convergence of science, industry and technology policies into the unique policy of development (Lemola, 2002, p. 1482).

These convergence processes were initiated by the several interrelated changes in analytical approach to the innovation as complex socio-economic phenomenon that occurred during the last three decades of the 20th century.

The new conceptualisation of innovation emerged within evolutionary economics pioneered by Nelson and Winter (1982) and Dosi (1982)[1]. In contrast to the mainstream neo-classical economy (Solow, 1957; Abramovitz, 1956) that emphasised the exogenous character of technology and the linear model of innovation, the evolutionary economics argues that innovation is endogenous to economy and society and that, therefore, it can not appear spontaneously and in a linear succession from R&D in some ideal market conditions.

Comparable to the "evolution of genes" in biology, technological innovation is the result of the long process of evolution of technology trajectories as well as of the evolutionary adaptation of companies to the market and socio-economic environment (Nelson and Winter, 1982, p. 9). The evolutionary economics and the numerous studies of innovation process led to the conclusion that technology does not appear as "manna from heaven" (Petit, 1995) which is beyond the reach of socio-economic agents (Lente, 1994). In result, the causality between technological innovation and socio-economic context was reversed while the linear model was abandoned as "primitive" (Abramovitz, 1989, p. 29). Instead, the interactive model of innovation presuming the emergence of innovations at any phase of innovative chain, not necessarily involving scientific research, was introduced.

Thanks to the evolutionary economics which has revealed the heterogeneous and pervasive nature of innovation, it has been widely accepted that managing innovation involves not only science and technology, but also the functionally interrelated sectors of finance, trade, management, industrial production, marketing as well as socio-cultural changes and public polices as their common integrator. Thus, the innovation policy is essentially oriented towards building an appropriate national system of innovation (NSI) (Lundvall 1988 and 1992; Freeman, 1988; Mowery and Oxley, 1995; OECD, 1997) – a concept which has had an astonishing take-up and still has the greatest impact on policy thinking (Mytelka, 2002, p. 1472).

The fundamental idea of NSI is that economic growth is not a spontaneous process, but rather a process constructed within specific socio-economic environment. Therefore, the production of innovation requires deliberate policy action, economic resources and social recognition. In other words, it is the result of the tentative action of a human being (or

[1] *It was Dosi, among others, who elaborated on the interaction between the technology paradigms and trajectories and the socio-economic environment (1982), which lead some authors to note the Nelson-Winter-Dosi model of technology development (Belt and Rip, 1987, p. 135).*

enterprise) that responds to the economic (e.g. market demands, profit gains, administrative benefits) and social incentives (e.g. respectability, recognition, power).

Therefore, economic growth could be accelerated by creating proper socio-economic and institutional environment that stimulates the production of innovation above incentives provided by the mere market forces. Since this recognition has paved the way for the state interventions in terms of public support and deliberate policy actions in accelerating technology change, it makes the second and the most decisive change in analytical approach to innovation that has contributed to the innovation policy.

NSI is of the greatest importance for the development of the transition countries such as Croatia because of its fundamental assumption that the competitiveness of a nation does not depend on the scale of R&D but rather "(…) upon the way in which the available resources are managed and organised, both at the enterprise and at the national level" (OECD, 1992, p. 80). NSI could enable a country of rather limited resources to make very rapid progress and vice versa, inadequate NSI might waste abundant resources. The examples of Japan, Korea, Ireland or Finland are the living proof of it.

However, in the 1970s, the recognition of the interactive model coupled with the pressure of achieving national competitiveness, seriously shook the faith into the power of scientific achievement[2] as the driving force of economy and technology. The reliance on the science policy as the core of development strategies deteriorated. By the end of the 20th century many countries have reconsidered their strategic polices and have shifted from science to technological innovation as applied and commercially exploited knowledge. The academic community was distressed by the difficult question which, after the "golden age" of science during the 1950s and the1960s (Lente, 1994, p. 302), government laboratories and universities had to face: If innovation does not originate from R&D, what, if any, is the use of academic research, science and university?[3]

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[2] *Innovation and technology in the neo-classical model appear according to the linear model of innovation where innovation is just the last phase of a chain beginning with research and development. Many governments, therefore, assumed scientific research to be an implicit factor for generating new technologies and supported it with lavish financial resources. In such a way the neo-classical theory made room for growing public interest and investments in science end education. The "golden age" of science during the 1950s and the 1960s when science was socially and economically accepted as a value per se promoted science policy to the position of the central policy of many a national development strategies.*

[3] *The numerous books and studies analyze the changing role of universities and public research stressing their loss of supremacy in R&D systems. The culmination of transformation is probably best outlined in the T. Kealey's (1996) astonishing book persuading us that public funding of science and technology is not only unnecessary but also counter-productive.*

The answer was given by the new growth theory formulated by Paul Romer (1989; 1990) whose endogenous model of sustainable long-term growth fed by new ideas implies public investments in R&D seen as a rational and acknowledged principle of accelerating technical change above pure market inventiveness. Although there is a direct link between the investment in research and the number of innovations, economic growth depends on technology change defined as "improved instructions for mixing together raw materials" (Romer, 1990, p. S72), which absolutely involves the capitalization of knowledge. Technology change is, however, considered endogenous since it "(…) arises in a large part because of intentional action taken by people who respond to market incentives" (Romer, 1990, p. S72). Since economic growth is seen as greatly affected by an institutional structure and state policy that induces innovation, the new growth theory makes the third factor that pinpoints the importance of the long-term, deliberate and committed innovation policy.

At the beginning of the 1990s the majority of the developed and fast growing countries began to support industrial innovation and new technologies by applying different measures and instruments. In addition to the direct support to companies and innovators, the emphasis was on stimulating cooperation between science and industry to integrate science and technology policies. Many governments started to fund and orchestrate large national cooperation programs for new technologies, primarily information technology, materials technology and biotechnology (Lemola, 2002). The innovation policy was born as a strategic integration of science, industrial and technology policies and as a powerful tool for the structural adjustment of national economies to the knowledge-based economy

# 3 Innovation Policy in Croatia: the First 10 Years

## 3.1 The Social Roots of the Slow Development of Innovation Policy

In Croatia, the public policy was deeply influenced by the provincial spirit of semi-modernism. The term was coined by the Croatian sociologist Josip Županov (2001) to mark the mixture of modern and traditional elements in the Croatian society in the last decade of the 20$^{th}$ century.

This semi-modernism is driven by the domination of the so-called de-industrializing political elite and consists of the three mutually linked socio-economic processes that

frame the nature of the transition process. The first is *re-traditionalisation* – the process of de-secularization and the so called "moral and social renewal" back to the ethical values of the 19th century. The social type of "Gemeinschaft" which was believed to have disappeared during the migration and urbanisation was resurrected surprisingly successfully as a new normative integration. A kind of «Hobbesian incivility" and anomy was quite visibly at work, because the old business and political norms and values were destroyed while the new ones were based on de-industrialization as a second process that constitutes semi-modernism. *De-industrialization* is a process of the privatization of the previously state owned industrial companies according to the "empty shell model" meaning that the tycoons and corrupted managers suck out the company's substance. This privatization regularly ended in the devastation of company's fixed assets, competences in technology, skills and market competitiveness. It usually turned companies into empty shells dependent once again on the state support. The "political capitalism" hidden behind the "privatisation" allowed the new class of businessman who had no management skills to take over the firms with minimal investment. The so-called "rent-seekers", who earned themselves the rent by selling the property accumulated by the previous generations, swapped out the 'profit seekers' who, led by the profit maximization, are interested in technological accumulation and industrial development. The third process, *de-scientization*, is the natural consequence of the two previous processes and designates the marginalization of science by both the political and business elites that have induced the climate of anti-intellectualism and anti-academism. The infamous brain drain, the financial starvation of the research sector and the stagnation of scientific productivity and the general shrinkage of science base was, therefore, the inevitable outcome.

These three processes constitute Croatian socio-cultural and politically specific historical heritage that, helped by the general disorientation of population after the collapse of socialism, shape the state of mind and practical day-to-day governance. Although the failure of adaptation could definitely be ascribed to the painful process of "creative destruction" (Perez, 1996), the examples of other, less myopic countries, illustrate that different scenarios are possible in creating own future and welfare.

In Croatia, the suggestions involving common and deliberate action or a national policy involving state interventions in the long-term resources for growth such as ICT, technology accumulation, innovativeness and R&D, were rejected with disdain, because

they were seen as the relics of the socialist past of planned economy[4]. The rule of de-industrializing elite and the limited vision of Croatia as the "country of waiters and peasants" obstructed the other different visions of Croatian future that would take into account the need for structural adjustment of institutional and economic structures to new techno-economic paradigm. The innovation policy and NSI were, as accordingly, ignored.

## 3.2 The Development of Innovation Policy: the Chronology

Due to the influence of the neighbouring western countries (Germany and Italy in particular) as well as to the exposure to the foreign literature and international seminars, some among the Croatian administration at the Ministry of Science and Technology (MoST) together with a number of scholars from the academic community have, by the mid 1990s, discovered the modern methods of innovation policy and tried to apply them in Croatia. They have initiated the socio-economic and cultural changes of the rigid political and academic environment leading towards the idea of the Croatian NSI and paved the way for the innovation policy as a new growth paradigm. In the development of innovation policy in Croatia the three phases could be identified.

The first phase, from 1991 to 1993, begins with the collapse of the socialist regime. It was the period of standard R&D policy characterised by the deep political fractioning among intellectual elite and by the groups struggling for control and supremacy. The year 1994, the beginning of the second phase, is marked by the first attempts of transfer of advanced "western" methods and IP know-how to Croatia, while the beginning of the third phase is marked by the launch of the *Program of Innovative Technological Development* – HITRA at the beginning of 2001 (MoST, 2002). HITRA marks a turning point in science policy since it is the first program that created and implemented the IP measures, paving the way for the new paradigm of economic growth.

[4] *"Ironically, while "Western" states are more prepared to adopt state interventionist policies to foster innovation, post-socialist states regard intervention as a hangover from the past " (Webster, 1996, p. 1).*

## The First Phase: Centralized Science Policy (1991-1993)

During the first phase the science policy was centralized. It was governed by MoST, the main goal of which was to sweep away the old socialist ways of organizing science and to introduce new models designed in the image of those of the neighbouring "western" countries. Although many new organizational elements like public competitions for grants, the pyramidal organization of projects, young researchers schemes, etc. were introduced, the role of science didn't change much. It was still seen as the dominant factor of the national cultural heritage, while the connection to the national economic development was not recognized.

The state of mind was adapted to the maintenance of the traditional perception of science as an "ivory tower" of fundamental research reserved for the scientific elite. Such perception had both the positive and the negative influence on the science system. The positive impact was the preservation of the national knowledge base in terms of keeping alive academic community, their competences, equipment and skills – quite an important achievement in those turbulent times when the national economy was brought to ruins and when the science system was also at peril.

On the other hand, the elitist approach which ignored engineering, applied sciences and technologies has seriously slowed down the recognition of innovation as a driving force of economic growth and the science-industry cooperation as a development mechanism. The elitist approach as the dominant way of thinking (among natural scientists kept alive to the present day) together with the exhausted industry left at the mercy of the anti-intellectually disposed tycoons prevented the recognition of the research, innovation or education as the ways of the recovery from economic collapse. The "rent–seekers" supported by the political elite who perceived them as the pillars of the privatization and the prime agents of the planned restructuring to market economy hindered the convergence of the science and industry sectors as well as of science and technology policies towards the national system of innovation.

The obsolete linear model of the innovation process upon which the traditional approach to technology was based and which was largely accepted and exercised during the socialist period, was still very influential in Croatia. At the beginning of the 1990s, when many countries were introducing innovation policy as a new form of science management, both the scientific community struggling for its "academic freedom" and

the industrial business elites seeking “fast and vast” gains rejected the public research orientation towards market, industry and innovation.

Such a rigid scientific system seriously deteriorated by the end of the 20th century when the lack of academic autonomy and scientific dignity, budget cuts, the exclusion from the regional research networks, etc. finally brought the R&D sector to stagnation and lethargy causing the loss of the scientific excellence (Silobrčić, 2000) and the general shrinkage of the science base[5].

The second process of semi-modernism, the so called “de-industrialization” according to the "empty shell model" was the cause of the major failing of the innovation policy of that period: the devastation of the industrial research institutes, the so called “heart of the capitalist machine”. In Croatia, same as in other transition countries like Hungry, Poland, Romania, Bulgaria, etc., the political elite, pursuing the dominant “mantra” of liberal market economy, withdrew the state funding to the institutes and left them at the mercy of the market or to the care of their parent companies The transformation of the socialist industrial research sector according to the model known as “shock without therapy” (Radošević, 1996) caused the heavy losses in technology accumulation and skills, the negative effects of which can, to their full extent, be seen today, when the absorptive capacities of companies appear as the fundamental prerequisite for research-based technology development.

### The Second Phase: Building the Infrastructure (1994-2000)

The idea of innovation policy which goes beyond the mere organization of scientific research and which stresses the interaction of science and industry for the purpose of economic growth wasn't readily accepted by the public administration. The initial steps were taken in 1994 when MoST, developing the models of science-industry cooperation and financial support for innovative small and medium sized enterprises (SMEs), tried to

*For example, according to some estimates, in 1989, Ruđer Bošković Institute, the leading Croatian scientific institution earned 40% of its revenue from the business sector and published 0.75% of a scientific paper per employee. In 1999, only 13% of revenue came from businesses while publishing activity is reduced to 0.68 % of a paper per employee (Pisk, 2001). Radošević (1996, p. 17) finds that, in socialism, the Croatian R&D system was a mixture of different activities. For example, in 1989, 52% of the total revenue of R&D system came from research, 37% from the production and 11% form the services rendered.*

apply the principles proven successful in Germany[6] (Lange and Švarc, 1994) and Italy.[7] To promote the idea, MoST organized in Istria in November 1994 the first international conference entitled *"Technology parks: European experience for Croatian development"* (Ružinski et al., 1994). The participation of more than 200 experts from every part of Croatia illustrates the scope of attention the topic aroused. This conference was a kick-off meeting for the dissemination of the idea of technology business incubation in Croatia.

As the IP measures resulting from the cooperation with Germany and Italy, same as everything else connected to IP, were, for Croatia, *terra incognita*, the first practical results came almost two years later when the first guidelines of the innovation policy were outlined within the National scientific and research program 1996-1998 (The Official Gazette 16/1996). In spite of the fact that these guidelines were firmly incorporated into the research policy, they formed the legal basis for MoST to implement two framework programs that have determined the future of the whole innovation system. The first program was oriented towards setting up of the national network of institutions for the development, transfer, implementation and financing of new technologies, while the second stressed the importance of government support measures for innovations and technology-based businesses.

The program of institutional technology infrastructure comprised the government support for the establishment of the business-innovation[8] and technology centres which were assigned the ambitious and important task of local economic development. They were understood as intermediaries between universities and industry as well as institutions that were to assist the companies in their start-up and expansion phases. Furthermore, the centres were expected to become the points of reference for the future international and regional aid-programs (like PHARE or INTERREG, etc.). These centres never received

[6] *Projects were made within bilateral cooperation of MoST and the German Federal Ministry of Research, Science, Education and Technology using the expertise of FhG-ISI, Karlsruhe and VDI/VDE-IT, Berlin.*

[7] *The Business Innovation Centre Friuli-Venezia Giulia, Trieste according to the model experienced by SPI - Promozione e Sviluppo Imprenditoriale in Italy.*

[8] *Since at that time there was no other government or non-government body for supporting business incubation, MoST has naturally incorporated these activities under its umbrella. The Department for small entrepreneurship of the Ministry of Economy started with its activities little bit later and the demarcation line between responsibilities and scope of the work between the two ministries was drawn in 2001, when the Ministry of Crafts, Small and Medium Sized Enterprises was established as the separate Ministry (merged again into the Ministry of Economy in 2004).*

any funding from these aid-programs, even if, at the time, those fund were seriously reckoned with.

The implementation of the Program went quite well. From 1996 to 1998, in the major university centres (except Osijek) three technology centres were established and supported by MOST: Centre for Technology Transfer, Zagreb, 1996, Technology and Innovation Centre Rijeka, 1997, Technology Centre Split, 1997 (MoST, 2002).

The cooperation with Italy resulted in the establishment in 1998 of the Business Innovation Centre of Croatia – BICRO. It was a coordinating body of the technology network the primary aim of which was to create the financial models and instruments for the support of the innovative entrepreneurship. To fill the gap with the foreign special financial instruments such as venture capital (risk, seed capital, etc.) which did not (and still do not) exist in Croatia was an extremely important task.

Following this task BICRO has outlined its *Program for the establishment and the promotion of the production based on new technologies* with the aim to support 200 companies in 4 years (Program 200/4) by equity financing (Salamon, 1998). The criterion used for granting support to companies was scientific intensity. The companies were differentiated as knowledge-based companies, engineering and know-how companies. Even if the Program was quite avant-garde, it was approved by the Government in 1998 and it found its place in the budget plans. However, the planned financial resource were never actually allocated to it, and the Program never came into function.

Even if these centres were established by almost mechanical application of the western know-how to the "East" (which, by the way, received some serious criticism from some scholars[9]) from the point of view of the future development of the innovations system this was the most decisive phase. This phase has not only provided some precious experience and assimilated new ideas, but during it the basic "institutional infrastructure" was established. Also, a group of managers emerged forming the nucleus for creating national IP after 2000.

[9] *Establishing of government-backed business and technology centers in Central and Eastern Europe was estimated as widespread but mostly unsuccessful attempts of building technology infrastructure (Dyker and Radoševiæ, 1999, Webster, 1996).*

### The Third Phase: The First Step in Innovation Policy Measures (2001 - )

The last and not yet concluded phase of the development of the innovation policy is marked by the establishment of the separate Ministry for Crafts and Small and Medium Businesses (MOMSP) (recently merged with the Ministry of Economy) and by the launch of HITRA - the first government innovation policy program in 2001 (MoST, 2002). Both initiatives reflect the desire of the government elected in 2000 to give the impetus to innovation and entrepreneurship.

MOMPS played an important role in innovation policy in the sense of fostering entrepreneurship culture and upgrading technology capabilities of companies. A range of different programs for the provision of credit lines, technological upgrading of companies in the sense of the procurement of the new equipment, training managers, donating grants for innovators, etc. were developed and introduced into the policy agenda (Jurlina-Alibegović, 2002).

Trying not to interfere with the other ministries', especially not with MOMSP's responsibilities, MoST has confined its efforts to the companies and activities with higher value added and therefore involving cooperation with R&D sector. For that purpose, HITRA was transformed into a program especially tailored to encourage the science-industry cooperation and providing a framework for direct cooperation between entrepreneurs/industry and Croatian universities and research institutes. Within this framework HITRA maintains its central mission of restructuring R&D sector towards the requirements of KBE by reversing the share of the state and the business sector in R&D system. The predominance of business over public R&D is perceived as the most important aspect of structural adaptation and involves three main activities (Švarc, 2003):

- fostering science-industry cooperation,
- reviving industrial R&D and
- encouraging commercialization of the research results.

HITRA is a big step forward in innovation policy because it is public administration's first attempt to formulate the functionally related elements of innovation policy for the purpose of establishing Croatian national innovation system. The three constitutive parts were planned, as follows:

1) The creation of stimulating *policy measures*, mechanisms and programs;

2) The creation of technological *institutional infrastructure;*

3) The establishment of the *control mechanisms* for the innovation and technology policy.

The most substantial part of HITRA, the policy measures, consists of two complementary subprograms (Table 1). The first one, TEST, focuses on technology projects. Its aim is to finance the pre-commercial development of new products, processes and services in the public and private R&D sectors. The outcomes are to be commercialized through the second *sub-program RAZUM (Development of Knowledge-Based Companies)*, aimed at the provision of support to commercial entrepreneurial projects (start-up, development and expansion of companies) based on new technologies and/or cooperation with research institutes and universities.

Table 1. **Policy measures of the HITRA program**

| Sub-Program | Type of projects | Targets of the policy measures |
|---|---|---|
| TEST | "Simple" technology projects (TP) | Development of the commercially promising products, processes and services prior to their commercial use up to the stage of original solutions (prototype/pilot stage) |
| | "Complex" technology projects (STIRP) | Development of the multidisciplinary, cooperative research for launching new or developing the existing technological areas |
| | Nucleus (Jezgre) | Research and technological NUCLEUS aimed at concentration of R&D resources (experts, equipment, instruments) both from public and private sector to gain critical mass for technology and research based services. |
| RAZUM | Knowledge-based companies | Development of the Knowledge-Based Companies at start-up or expansion phase, aimed at commercialization of research by entrepreneurial projects |

As the system developed and matured, it was planned for BICRO to be restructured to become an investment institution, close to the venture capital fund as was its original purpose. In 2001 some new centres were established: Technology innovation centre in Osijek, Research and Development centre for mariculture in Dubrovnik and Centre for production processes, Zagreb, 2001.

HITRA has envisaged the establishment of the Research and Development Technology Institute (ITP) as the centre of research and professional excellence in innovation policy, technology studies, technology foresight exercises and the creation and management of the specialized innovation programs. Program TEST was planned to be outsourced to ITP, like RAZUM is to BICRO.

In order to control the overall operation of HITRA, and the distribution and spending of budget resources in particular, as well as to create a space for inter-ministerial discussion on innovation policy issues, the Inter-ministerial Control Group was founded on December 6, 2001 (The Official Gazette of the RH, No.108/2001). The program has also envisaged The Ethical Committee, a body affiliated to the Ministry, to take care of the harmonization of moral criteria and public welfare with the new technologies and their commercial use.

HITRA has introduced a range of completely new instruments and organizational and institutional arrangements to science policy like the Technology Filed Council, the regulations on intellectual property rights (IPR), the new methods of evaluating and monitoring of projects, etc., which have paved the way for the innovation policy in Croatia (Table 2). In spite of these novelties, HITRA, due to it exclusive orientation to science-industry cooperation, is rather limited as a common ground for the establishment of the comprehensive NSI. Some important aspects of NSI were, from the political point of view, outside the competences of HITRA. For example, the commercialization of research results requires sound intellectual property protection policy, new financial support instruments, the involvement of business planning in research management, etc. To overcome these obstacles that threaten HITRA's further development, MoST used the opportunity to launch, by the end of 2001, the World Bank technical assistance project (TAL2) entitled "Science and Technology Project" (STP) aimed at designing comprehensive innovation system. The underlying idea was to use the World Bank's "brand name" to disseminate among political and intellectual elite the idea of NSI in order to secure its broader implementation.

Table 2. **Some new IP instruments introduced by the HITRA Program**

| TEST | RAZUM |
|---|---|
| Budget grants for developing prototypes, pilot plans, feasibility studies | Subsidies to companies for research and development (30% of the total project value) |
| Grants and subsidies of small and large scale equipment | Favourable commercial loans with the interest equalling the discount rate of the Croatian National Bank |
| Co-financing with private partner(s) of developing new technologies/innovations | Conditional loans in case of risk projects and particularly in case of academic entrepreneurship, i.e. spin-offs from the university |
| Arrangements of IPR among partners and introduction of business secret | Monitoring of the project realization |
| Re-payment of 21% of grants in case of commercialization | Assistance in business management, marketing, cooperation with R&D organizations, etc. |
| Public defence of the project, "on the spot control" of project realization | |
| Grants for feasibility studies for establishing market oriented research service centres (Nucleus) in private company or research institution | |

STP did actually initiate the comprehensive framework for NSI that provides a new impetus to innovation policy, especially by starting the “White paper of Croatia”. The project is still under discussion and preparation. In addition, the separate project on the establishment of the system of the protection of the intellectual property rights in academic sector was also initiated within CARDS program and recently approved by the European Commission.

# 4 The Restructuring of R&D Sector: The Shortcomings

HITRA, STP and numerous other activities of different groups and local authorities during the last 10 years began the irreversible processes of convergence of science and technology policies towards innovation system and new policy paradigm.

Croatia still lags behind in implementation of IP and the related structural changes of research sector towards requirements of KBE. The innovation policy focused on the restructuring of R&D system towards the predominance of the business sector investments hasn't yet achieved its central goal. The four aspects of the current research and innovation system illustrate this:

a) Weak industrial R&D sector and the low technology capabilities of companies
b) Croatian research paradox
c) Weak science-industry cooperation
d) The lack of stimulating environment.

## A. Weak Industrial R&D Sector and the Low Technology capabilities of companies

The full effect of the negative impacts of the loss of the industrial research institutes and the centres of high-tech competence together with almost 15 years of not accumulating technological capabilities in companies, are seen today, when competition is ultimately based on technology and innovation.

While in the developed countries industry dominates the science system since it funds nearly 63%, performs about 72% of the total R&D (OECD, 2004, p. 10) and employs the majority of researchers and scientists, e.g. 50% in EU and 65% in OECD countries on average, the Croatian R&D system is still dominated by the public sector. State funds more than the half of research activities and employs the significant portion of

researchers - about 83% out of which 53% are affiliated to universities and 30% to public institutes. In contrast, business finances about 44% of total R&D and employs only 17% of researchers. It is obvious that the vast majority of R&D potentials heavily depends on the scarce budget resources, which amounts to only 0.55% of GDP (The Official Gazette, 2003).

The total investment of business sector in R&D is extremely low and amounts to 0.43% of GDP, while in the developed countries business sectors invest more then 1% of GDP and in the fast growing countries more then 2% of GDP. It is a valid argument for both the government and the industry to urgently join efforts in restructuring of R&D sector so that their current roles may be reversed.

Table 3. **R&D and innovation indicators for selected countries in 1999 (or the most recent available year)**

| Indicators | Croatia | EU | OECD | Finland | Nordic countries | Poland | Hungary | Slovenia |
|---|---|---|---|---|---|---|---|---|
| The Global Competitiveness report | | | | | | | | |
| - Rank of GDP per capita (2001) | 44 | | | 14 | | 38 | 30 | 25 |
| - Rank of national competitiveness | 58 | | | 2 | | 51 | 29 | 28 |
| - Rank of technology index | 43 | | | 3 | | 36 | 21 | 25 |
| - Rank of innovation capacity | 42 | | | 3 | | 35 | 28 | 25 |
| GERD | 1.19 | 1.85 | 2.21 | 3.19 | - | 0.75 | 0.68 | 1.51 |
| % of GERD performed by business | 44.4 | 65.6 | 72.4 | 70.0 | 69.2 | 41.4 | 45.4 | 55.0 |
| % of GERD performed HE and public labs | 51.2 | 34.4 | 27.6 | 26.0 | 30.8 | 58.6 | 54.6 | 45.0 |
| % of GERD financed by business | 44.5 | 54.7 | 63.2 | 65.0 | 62.8 | 38.1 | 38.5 | 56.9 |
| % of GERD financed by the State | 52.7 | 36.0 | 29.8 | 30.0 | 30.0 | 58.5 | 53.2 | 56.9 |
| BERD | 0.43 | 1.20 | 1.54 | 2.18 | - | 0.31 | 0.28 | 0.84 |
| Public expenditures on R&D as % of GDP (GOV+HE) | 0.55 | 0.64 | 0.61 | 0.99 | - | 0.44 | 0.37 | - |
| R&D expenditures per capita (USD) | 70 | 415 | 500 | - | 690 | 60 | 90 | 220 |
| Researchers in business sector (%) | 17.3 | 49.8 | 64.9 | - | 50.5 | 18.3 | 25.9 | 34.8 |
| Researchers in public sector (%) | 82.7 | 50.2 | 35.1 | | 49.5 | 81.7 | 74.1 | 63.6 |
| Researchers per 1000 labour force | 3.2 | 5.2 | 6.1 | | 8.1 | 3.3 | 5.7 | 8.9 |
| PhD in science and technology (aged 25-34) | 0.17 | 0.55 | 0.47 (USA) | 0.97 | - | - | - | - |

*Source: Radas (2003); Strategy of Development, "Croatia in 21st century - Science", (Official Gazette, 108/2003), The Global Competitiveness Report, 2002-2003, Annual Competitiveness Report of Croatia, 2002, NVK, 2003.*

## B. Croatian Research Paradox

However, the total investment in R&D in Croatia (GERD) is quite satisfactory (Table 3) placing Croatia high on the list of the newly-integrated European countries[10]. At the same time, industrial R&D which is the heart of the modern industrial societies has almost disappeared, while the technology capacities of companies and innovation capacities have been seriously weakened.

The diagnosis is that the problems are not so much in "inputs" but in "outputs" revealing that Croatia suffers from the same "pan-European" paradox (European Commission, 1995), of the effective use of research and science for economic development.

Such outstanding neglect and under-use of research and innovative technology capability in industry for making structural adjustments to global changes has a negative impact on both the macro and micro-level of economy. To illustrate, the overall structure of the industrial sectors of economy and export has not significantly changed for the last 25 years and is still dominated by the low-profit "Croatian traditional industries" like wood and textile industry, fishery, tobacco and shipbuilding (Jurlina-Alibegović, 2003).

Similarly, on the micro-level of the technology capability of companies, the comparison of some selected indicators like the number of patents, ISO standards 9000 and Internet hosts reveals that Croatia doesn't only lag behind the developed countries, but also behind the newly integrated European countries that Croatia used to compare to (The Official Gazette, 2003) .

In addition, the National Competitiveness Council (2002) ranked Croatia 58$^{th}$ by its national competitiveness and 43$^{th}$ by technology index among 80 countries (Table 4).

## C. Weak Science-Industry Cooperation

The strengthening of industrial R&D sector greatly depends on the science industry cooperation, a mechanism which is widely used in developed countries for translation of R&D potentials into new marketable technologies. The low level of the technology capabilities and industrial research in Croatia resulted in very weak science-industry cooperation. The industry is not capable of absorbing and using research services, while

[10] *Still below Slovenia with 1.5% of GDP, but above Slovak Republic and Hungary with 0.68% of GDP, or Poland with 0.75% of GDP.*

the research sector is traditionally closed system focused on the basic research and state support. It is estimated that today only about 10% of the revenues of the institutes and 6% of the revenues of the universities come from the contract research with industry (Švarc et al., 1996)

This cooperation was better even in the socialist period when it was dictated by the State through the socialist organization of the scientific work ("providers" and "receivers" of R&D activities). At that time almost the 30% of the revenues of public institutes and the 23 % of the revenues of universities was coming from industry. (Peruško et al., 1989)

### D. The Lack of Stimulating Environment

Since the roles of innovation and knowledge based factors of growth in economic development were not recognised, the setting up of the proper environment was also seriously neglected. The elements commonly found in NSIs all around the world, in Croatia simply do not exist:

- Domestic venture capital industry for start-up and technology based SMEs;
- Encouraging the system of the protection of intellectual property rights in research sector (project is still in its initial phase within STP and CARDS);
- Large infrastructure institutions for technology development like technology or science parks and other forms of the centres of technology excellence;
- Technology foresight exercises;
- The centre of competences in generic technologies like biotechnology, nano-technology, new materials, even computer technologies which today play the same role as electricity did in the past;
- The mobility of researchers and experts between industry and academia.

It is obvious that in Croatia, unlike in the developed and fast growing countries, there are businesses capable of performing and investing into R&D. There is a great need to develop supportive environment for upgrading the technological capabilities and innovativeness of companies, stimulating science-industry cooperation and developing in-house R&D activities.

# 5 Conclusions

The transition from the mere market economy to the knowledge based economy requires the new policy paradigm of growth, an innovation policy focused on the productive and commercial use of knowledge instead of standard production factors. In practice, it is oriented towards the establishment of the NSI as a model of integration of domestic science and research potentials with the other sectors of national economy and society that all take part in the production of innovation as commercially exploitable knowledge.

Such a change in development paradigm towards KBE is overwhelming, pervasive and rather painful process since it requires radical changes not only in science and technology but also in socio-economic environment that includes various sectors such as financial sector, legal arrangements, management and decision making as well as changes in cultural values and patterns of communication.

Providing the review of the chronological development of innovation policy in Croatia with its main failings, the paper describes the difficulties in the emergence of the innovation policy in Croatia. It also argues that innovation policy and national innovation system are, in Croatia, still unrecognised as tools for economic development and as the essence of strategic policy.

The rule of de-industrializing elite and the spirit of semi-modernism resulting in the fundamental miscomprehension of the roles of knowledge based factors and innovation for economic growth are seen as the underlying reasons. Since the need for the structural adjustment of national economy to the knowledge based economy was not recognized, innovation policy and NSI were, consequently, disregarded and ignored.

De-industrialing elite has not recognised that innovation crosses the boundaries between science and industry and that the innovation policy as their strategic integration is needed for knowledge based growth. Instead, the obsolete dualism between science and industrial policy is maintained. Therefore, the role of science is restricted to the autistic policy of scientific research isolated from country's economic development. On the other hand, industrial policy is focused on financial rehabilitation and the privatization of traditional industries which lost their technology dynamism and dragged the whole economy to structural crisis and unemployment.

The paper, therefore, emphasises that failure in innovation policy and as well as moving towards KBE strongly depend on "hidden factors" of growth embodied in country-

specific socio-cultural and political factors. The different aspects of the historical heritage of a nation, the particularities of a national culture, political context, moral values, the way of industrialization, etc., produced in Croatia the "social incapability" for growth. These usually underestimated "soft" factors hinder the most important condition for change – the social assimilation of the new technology style that generates economic growth in the particular moment of historical development – today KBE.

Probably the most valuable experience earned from the 10 years of innovation policy is its practical demonstration that economic growth is primarily a social process (OECD; Sundqueist report), a complex socio-economic phenomenon that does not happen spontaneously, but is constructed within the certain economic and social system (Freeman, 1988). Therefore, economic growth calls for the deliberate policy action, economic resources and social recognition. It is the result of the intentional activity of the whole society and the political elite in particular to install the new way of management of economic growth, today inclined towards commercial application of knowledge.

Today, the only policy program in Croatia that is intentionally aimed at the integration of knowledge based factors and economic development is HITRA. Although HITRA is almost marginal program in terms of financial resources, scope and related capacities, it is of capital importance for the Croatian overall future perspectives since it paves the way for the new policy paradigm that should become the dominant way of management of the national resources directed towards knowledge based growth.

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