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THE INFLUENCE OF TECHNOLOGY TRANSFERS ON THE DEVELOPMENT OF INNOVATIONS IN THE PROCESS INDUSTRY OF CROATIA (ISTRIAN COUNTY CASE)

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Abstract. This paper studies the influence of technology transfers on the development of innovations in the process industry in Croatia (Istrian County case). The technological regime identifies characteristics of the learning processes, sources of knowledge and the nature of knowledge bases linked to the innovative process in the company happening as part of production activities. The research supports Schumpeter's standpoint in his theory of creative destruction. When a new and more efficient design for the production of a commodity is created, the enterprise that first starts using the new design conquer a part of its competitors' market. The competition reacts either by introducing the same design or one even newer or completely loses the market, as this is the case in the process industry in Croatia.

Keywords: technology transfer, innovations, intellectual property, technological regimes, Schumpeter's theory of creative destruction, processing industry.

JEL Classification: L24, O14, L60, O00.

1. Introduction

The notion of "creative destruction" linked to Schumpeter describes the paradoxical situation where the pacing of innovations in an economy is proportional to the pacing by which economic subjects of the same economy decline. Schumpeter differentiates innovations in the general sense from entrepreneurial innovations. The entrepreneur gives contributions to innovations not only by using other's innovations, but also by introducing new ways of production, new products and new forms of organisation. These innovations demand the same level of knowledge and courage as the sole innovation process in general.

What makes Schumpeter's theory different from "standard" theories on enterprises' behaviour is that he recognises heterogeneity between producers (Rahim 2009). He considers the continuing moves in the composition of an enterprise's population through entrances, exits, expansion and contraction essential in the development and

creation of new processes, products and markets. Thus, the relocation of resources from less productive process units to more productive production units is made easier (Schumpeter 1951).

The concept of technological regimes describes the technological environment in which the enterprise functions. Nelson and Winter (1982) give a model of endogenous technological changes as the key source of productivity growth. The technological regime identifies characteristics of the learning process, sources of knowledge and the nature of knowledge bases linked to the innovative process of the enterprise happening in the group of production activities. Two technological regimes are described in the literature (Carreira, Teixeira 2003). The "entrepreneurial" one makes the innovative entrance easier while the "routine" one facilitates innovations of those indigenous to industry (Winter 1984). A low and high level of technological possibility can be distinctive to both regimes (Breschi *et al*. 2000).

The process industry has, along with the sector of financial mediation, real estate business, rentals and business services, the largest share in the structure of the gross domestic product (GDP). That also holds for the total employment and total export with process industry as strategic growth determinant.

The purpose of this paper is to research and understand the significance of technology transfers in the process industry and how to stimulate innovations within it. Particularly, this paper identifies major factors of innovation in the process industry and explains how technology transfers limitations affects innovation. Authors rationalize the interdependence of technology transfer and development of innovations in the process industry starting from Schumpeter's theory of "creative destruction". Companies and capitalism are evolution systems and process growing and developing or declining – if not creatively destructive – by the logic of evolution and natural selection (Nicholas 2003; Diamond 2004, 2006). Key factor in growth and development is the institutionalization and technological advance. Through constant destruction of the old (organization, production process, product) and an innovative creation of a new and better in terms of competition (Aghion 2002). The research of the technology transfer influence on the development of innovations is based on the data obtained from the Croatian Chamber of Economy and the Financial Agency. A questionnaire surveying business subjects in the process industry of the Istrian County is also used. Paper results show technology transfer is important in the formation of the industrial competition model in Croatia.

The paper is structured as follows: introduction offers a view on the importance of the technology transfers and innovations for growth theories. In the section two an overview of the growth models is presented and in section three technological regimes, innovation and the transfer of technology dynamics explained. Section four offers an insight into the developmental characteristics of the Croatian processing industry. Data and methodology of the paper is presented in section five. Paper empirical analysis and results are summarized in section six and conclusion in section seven.

2. Growth models based on research and development

Endogenous growth models follow the former finding that growth mainly depends on technological changes. From the literature review, a number of basic models of endogenous growth can be abstracted. These are models based on externalia, models based on research and development and AK models (Grossman 1996). This chapter offers a short outline of models based on research and development, which is closely linked to the underlying purpose of the conducted research, namely the influence of technology transfers on the development of innovations.

Building upon some Schumpeter's ideas (1942), the first model of sustainable development was developed by Romer (1990), followed by Grossman and Helpman (1990, 1991) and Aghion and Howitt (1992). Schumpeter (1942) thinks that research and development bring economic growth, and what stimulates them is the conviction that extra profit will be secured. While in perfect competition conditions enterprises may freely use innovations, and there is no stimulus for research and development, this stimulus is ensured on monopolistic markets. These models are often called neo-Schumpeter because of the origin of the main ideas at the base of this group of models. Table 1 represents their systematic overview.

Table 1. Overview of the fundamental groups of growth models based on research and development (source: authors according to Grossman 1996)

Neo-Schumpeterian growth models	
	Schumpeter (1942)
	Uzawa (1965)
	Judd (1985)
1990	Romer (1990); Grossman and Helpman (1990)
1991	Grossman and Helpman (1991)
1993	Aghion and Howitt (1992)

Judd developed the first dynamic model of general balance that explicitly involves the activities of research and development, as well as the monopolistic profits justifying former investments, in 1985. However, in this model innovations show a decreasing contribution and the economy shown by Judd cannot effectuate a sustainable growth. Firms can create new products by investing a fixed quantity of resources into innovations, and each company can protect its innovation by a patent that offers the exclusive right of sale for a particular limited period. The problem of this model comes out of the fact that innovators appear after that period had lower profits because faced with the competition in the search for work. In the end, their profit is insufficient to cover the expenses invested in the research and development of the patent. Romer (1990) thinks that Judd missed understanding that technology is a non-competitive and partly exclusive good.

A detailed overview of growth models can be found in Helpman (1992) and Grossman and Helpman (1994) where monopolistic profits motivate innovations and growth

is based on the innovative activity. Investments into innovation projects do not have the characteristics of gradually declining incomes. Thus, the productivity of new investments within innovative activity does not decrease, enabling a constant sustainable growth. The growth rate depends on the quantity of funds intended for the innovation activity, i.e. research and development. It also depends on new technologies share in the private sector (i.e. the level of monopolistic power) and on the time horizon of the investor. Grossman and Helpman (1990, 1991) discuss the implication of the international market, in general while Rivera-Batiz and Romer (1991) give a warning that global integrations can offer additional stimulus to the industry.

Romer builds his 1990 model on three fundamental assumptions:

- Technological changes are at the core of economic growth,
- Technological changes are mostly caused by purposeful actions undertaken by individuals reacting to market stimuli and finally,
- Technology differs from other economic goods according to its characteristics. This assumption is directly followed by the conclusion that equilibrium is not possible in conditions of perfect competition, but a monopolistic competition has to exist. Namely, if all inputs would be paid as the border product, the enterprise would encounter losses coming out of the additional expenses linked to former investments in research and development of a new product.

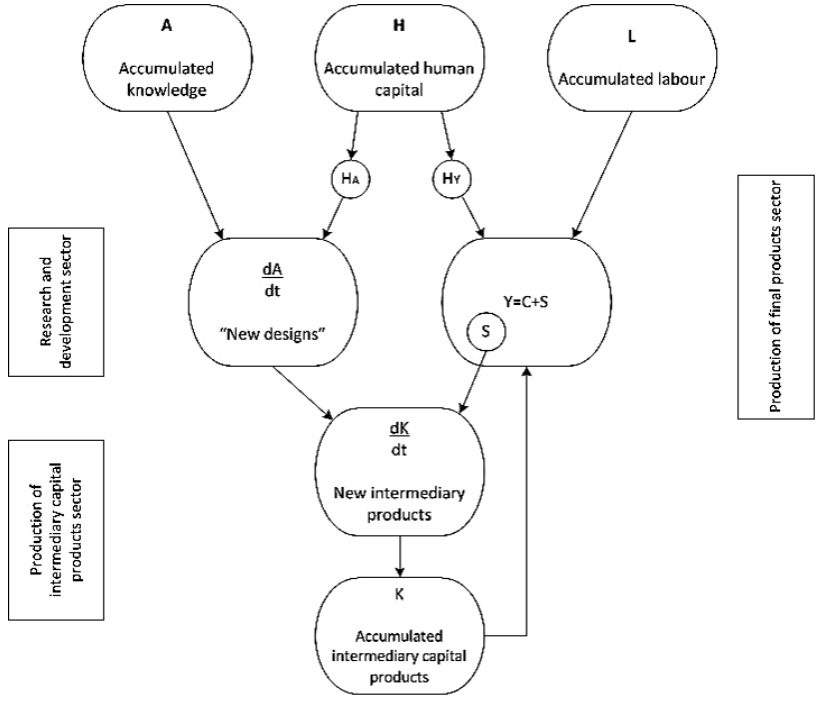

Fig. 1. The structure of romer's model (1990) based on research and development (source: Valdés 1999)

In the completely simplified Romer's model (1990) there are four basic factors (Fig. 1): physical capital, labour, human capital and technology. Economy, then, has three sectors: a research sector using human capital and the existing level of accumulated knowledge (technology) to produce new knowledge. More precisely, this sector produces "new designs" for the production of intermediary capital goods. The second, sector for the production of intermediary capital goods, uses new designs coming from the research sector along with the earlier created products from the final sector (which has not been spent, but saved) with the aim of producing different new intermediary capital goods. The sector of final goods uses labour, human capital and intermediary capital goods to produce end consumer goods. The product may be produced for consumption or cutting down expenses (see Reinhart, Rogoff 2009).

However, some authors (Valdés 1999) have noticed the defectiveness of Romer's model. The research sector uses not only knowledge and human capital, but also labour, and that the sector of intermediary goods uses human capital and labour as consumptions, which has been left out in this model. The analysis of individual activity departments' characteristics inside the process industry, the twenty-four of them (data from the Financial Agency for 2012) shows a significant dispersion of production to a relatively large number of activity departments in the process industry. The dispersion is understandable since many final products, very different in their purpose, are produced in the process industry. Regarding the number of entrepreneurs (a total of 10,830 entrepreneurs), the largest part of them (16.2 percent or 1,750) produces finished metal products, except machines and equipment, followed by the production of food stuff (11.8 percent or 1,278). Regarding the achieved total income, the production of food stuff has the largest share (17.7 percent or 30.8 billion HRK) followed by the production of coke and refined petroleum products (16.0 percent or 27.9 billion HRK). Other departments, the 22 of them, have a share in the total income lower than 10 percent (from 0.5 percent in the other process industry to 7.3 percent in the production of finished metal products, except machines and equipment).

With the difference of this model, in which the number of new designs is constantly increasing as the result of new research, new products can also replace the old ones. This characteristic of technological advancement was especially studied by Grossman and Helpman (1991) and Aghion and Howitt (1992).

Schumpeter's idea of "creative destruction" is at the base of these models. When a new and more efficient design for the production of a good is created, the enterprise which first starts using this design will conquer a part of its competition market because it can offer a better good for the same price or the same good for a lower price. The competition reacts either by introducing the same design, or an even newer one, or they completely lose the market (Gordon 2000; Foster, Kaplan 2001).

According to these models, it is possible to improve a product for an endless number of times, while the new generation of goods always ensures more services per

expenditure unit than the former generation. The race for the production of a product's new generation includes expenditures for research and development while the winner keeps the monopolistic profit until a new innovation appears. Models based on research and development has often been used to study the role of an economy's openness. Rivera-Batiz and Romer (1991) show that a balanced growth is faster in an integrated world than in the world of isolated countries, even in the case when there is no exchange of goods between the countries. In the world of relatively cheap communications, the general knowledge existing in one country is readily available by researchers in other countries (Romer 2001), but there are also other ways in which openness encourages technological advancement. Enterprises in open economies have thus the chance to sell their innovations on the world's market and, anticipating a larger profit, invest in research and development more than enterprises selling only on the home market. Besides, a part of the models based on research and development is directed toward the analysis of processes in which technologically less advanced countries imitate technological advancements in countries leading the technological advancement (Grossman, Helpman 1991; Rosenberg 2000).

3. Technological regimes, innovation and the transfer of technology

The notion of technological regimes is linked to the technology that enterprises lean on when solving problems, thus giving the widely defined "way of doing things". Nelson and Winter (1982) emphasize the concept of the cognitive nature regarding the conviction that something is achievable, or at least worth succeeding. The technological regime sets the boundaries of what can be achieved in activities of problem solving. This regime is linked to production activities and instructions (natural orbits – trajectories) that will possibly offer the solution. Dosi (1982) develops the definition of the technological regime and the technological (or "natural") trajectories. The technological regime can be determined taking into consideration some fundamental dimensions:

1. Characteristics of the learning process are linked to problem solving activities in an enterprise;
2. The system of sources of knowledge, internal and external, relevant for solving problems;
3. The nature of the scientific and technological knowledge basis from which enterprises take solutions to a problem.

According to Carreira and Teixeira (2003) there are two forms of technological regimes (entrepreneurial and routine). In the entrepreneurial regime a direct competition between innovative enterers and existing enterprises can be found and the industrial productivity growth is higher. A lower level of competition in the routine regime leads to a lower level of exploitation of the dominant technology potentials, thus leading to a lower industrial productivity growth. Regimes are defined by the combination of certain factors like the level of technological opportunity for existing enterprises, the easiness of an enterprise's approach to new technological regimes and the cumulativeness of learning.

The technological environment that facilitates the innovative activity of new (mostly small) enterprises improves the entrance of new companies in the industry. At the same time, technological conditions that facilitate the innovative activity of the existing (large enterprises) ones represent an obstacle to the entrance of new enterprises (Audretsch, Acs 1994). When the entry technological barriers are low, as in the case of the entrepreneurial regime, innovative entrepreneurs encourage less efficient enterprises to exit (Acs, Audretsch 1987, 1989). Studies including indicators of the entrepreneurial regime presence in industry, with difference to the routine regime (determined by the innovative rate of small enterprises) have shown that technological regimes are important in understanding the relationship between innovation and entry (Caves 1998; Bartelsman *et al*. 2003).

When the entry barriers are high, usual for the routine regime, the reallocation of the market share between existing enterprises is the largest source of productivity growth, despite irregularities in elements of an enterprise entry dynamics. Moreover, other studies have applied more direct measures of technological possibilities than the innovative rate have shown a systematic connection between the regime and entry (Bain 1956; Orr 1974; Van Dijk 2000).

Utterback and Suarez (1993) say that the entry of new enterprises is helped by a relatively huge role of academic researchers in industrial innovations, and hampered by the powerful scientific basis of knowledge in the process of innovation in the enterprise because this demands innovative activities to be performed in large R&D laboratories. The entry is also hampered by a high level of uncertainty caused by fast changes in the product specification.

Some researchers (Cohen, Levin 1989; Kamien, Schwartz 1982) deal with the analysis of the market structure with the aim of reaching an answer to the question: What are the conditions in which a new technology is being exploited through the foundation of new enterprises? For instance, scientists have studied the influence of the average enterprise size, disposability of capital, intensity of investment in research and development and the industrial concentration on the foundation of new enterprises (Cohen, Levin 1989; Baldwin 1995; Marsili 2000). However, it is stated that the lack of success in explaining variations among industries occurred because little attention was paid to technological regimes or systems of knowledge where the innovation happened (Malerba, Orsenigo 1997).

The notion of "creative destruction" linked to Schumpeter describes the paradoxical situation where the pacing of innovations in an economy is proportional to the pacing to which business subjects belonging to the same economy decline (Mayhew 1980). Schumpeter differentiates innovation in a general sense and an entrepreneurial innovation. According to Schumpeter, an entrepreneur gives contribution to an innovation not only by using other's innovations, but introducing new ways of production, new products and new forms of organisation. These innovations require the same level of knowledge and courage as the process of innovation, in general (Schumpeter 1950).

Following Schumpeter's contribution, some authors emphasize that innovations could be a way for new enterprises to enter the market successfully. The innovative entry is treated as the main power carrying competition among enterprises (Dosi *et al*. 1997). Smaller enterprises have a higher rate of innovations per employee than bigger enterprises. Innovation rates are lower, compared to larger competitors, in industries that are less innovative or have "substantial industrial" characteristics like high concentration, intensity of capital (Christensen *et al*. 2004). When innovation rates are analysed, it is noticed that smaller enterprises' innovation rates are not less dependent on the level of expenditures for research and innovation in the industry in question. Small businesses entry rates are lowered by entry expenditures, but increased by human capital or working force which is consistent with the high entry rate in the innovation's early phase of life and the declining rate with the detachment of the process.

The role of innovation is especially important to entrepreneurs, and it implies the application of improved or new procedures, products, business services, and they can move from the application of less useful ideas to the complete change of business politics in the enterprise development (Scherer 1965). Innovations are given special attention in developed economies, while inventiveness of a company and its intellectual property are considered its most valuable resources or non-material property for which there are various methods of evaluation (cost, market, profit method, etc.), (Christensen 2000).

Elaborating on the commercialisation and applicability of innovations, the transfer of technology is the key activity of a company founded on knowledge and innovations (Baldwin 1995). The transfer of knowledge and technology is a process running among scientific institutions and economies, as well as among economic subjects on the home or foreign market. Technology implies a product, process or service protected as intellectual property and has the potential of commercialisation. The transfer of technology is a dynamic, multi-phase, interdependent and complex process. Figure 2 shows a diagram of the course of technology transfer. It displays a transfer of economically applicable technological solutions, knowledge and experiences from one economic subject (distributor of technology) to another (recipient of technology).

As can be noticed in Figure 2, the process of technology transfer from its beginning to the final point is an extremely complex and multi-phase process. Innovative solutions can appear as a result of individual business subjects' research and development or as a result of the scientific and innovative community's work. Companies not having own research and development departments can secure innovative solutions and technologies, and in the end products and services, only through the transfer of technology from the scientific and innovative community. Significant contribution to the advancement of existing products and their characteristics can be also brought by the cooperation between the innovative community and economy.

In the process of technology transfer, particular attention should be paid to the decision whether to protect intellectual property or not. The protection of intellectual

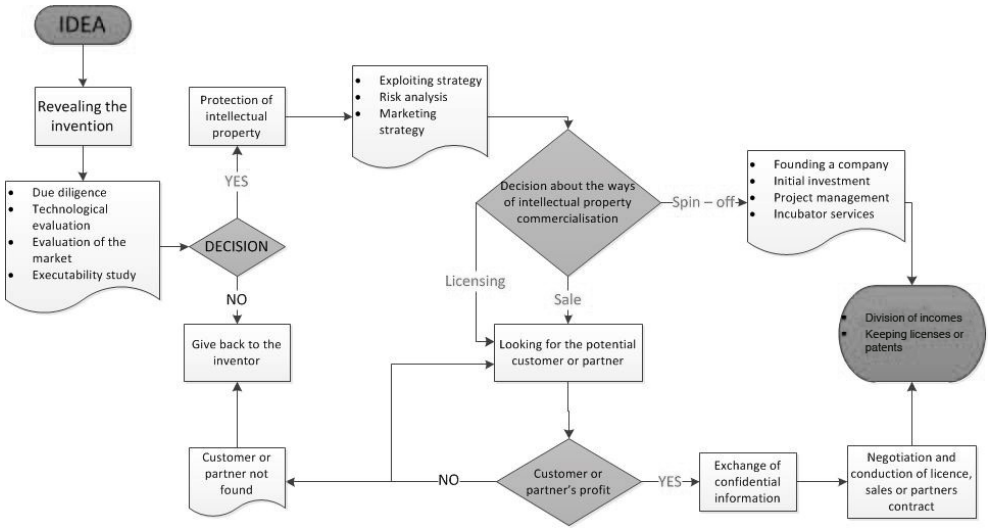

Fig. 2. Diagram of the course of technology transfer (source: made by the author)

property is useful on the competition market, for the development of relationships with employees, consultants, customers and business partners and the acquisition of capital. In the creation of the company's business plan, by which resources for reaching business goals and business politics are defined, it is necessary to define the commercial value of the intellectual property and its managing logistics, because intellectual property rights increase the company's negotiating power. Its efficient use creates the business image and along with other marketing tools (for example, advertising and other promotion activities) it represents the structure to recognize and promote its products and services.

The process industry is a very complicated area of defining the way in which technology is transferred and innovations developed because of the dispersion of sub-activities enclosed in it, as well as because of the fact that it includes the production of final, but also intermediary products. There is a perfect competition in the sector of final products. However, this is not possible in the sector of intermediary products, because every producer in this area has a patent on the production of the intermediary capital product, either by investing into research and development and thus coming to the new design to be protected by patent or by buying the patent. Regardless of the way the patent has been secured, the individual producer is the only one with the legal right to use the patent for the production of a relevant capital good, and is thus a monopolist in its production. In the research and development sector, where human capital and the existing level of knowledge are used, there is a perfect competition because of the following reason: every single enterprise uses the two mentioned factors to produce new designs. On the market there are individuals owning human capital and enterprises, which are in its demand. That is why the human capital market is characterized by

a perfect competition. When an enterprise produces a new design, a large number of potential customers of the patent belonging to the sector of intermediary capital goods appear. This is the reason why the price of this sector's product, i.e. the new design and human capital price, is determined by the actions of the perfect competition.

4. Developmental characteristics of the Croatian processing industry

The Croatian processing industry has lately been characterized by changes manifested in the increase of significance and volume of production in technologically intensive activities (i.e. in industries of a low or lower technological level). Such changes express the need of undertaking activities to change the structure of the process industry of the Republic of Croatia in the direction of raising the competition and the ability to produce export products with a higher added value, having in mind that Croatia is a small and open developing economy which has to export goods if it wants to achieve economic growth and prosperity.

According to the data of the Analysis of the processing industry made by the Financial Agency in 2008, running a business in the process industry in 2008 was happening in the complex and challenging business conditions. All economic trends in the Republic of Croatia, as well as certain segments of earning, are strongly influenced by activities in the process industry because many products from many other areas of activity are linked to them. On one hand, these products represent the entry raw materials in finalizing the process industry products while on the other; this activity final product is used in almost all earning areas, and even wider.

According to its potential and reached financial results, the process industry is a very important activity in the Croatian economy, and its 2008 shares are as follows: 12.1 per cent in the total number of entrepreneurs, 27.9 per cent in the number of employees, 24.6 per cent in the total income, 25.0 per cent in the total expenditures, 20.3 per cent in the periodical profit, 31.5 per cent in the periodical loss and 8.8 per cent in the consolidated financial result – net profit.

The processing industry achieved financial results in 2008 were positive in its entirety because a positive consolidated financial result was achieved (periodical profit reduced by the periodical loss), but significantly lower than the previous year. In 2008 the processing industry recorded a 1.2 per cent increase in employment, an 8.5 per cent increase of total incomes, a 11.6 per cent increase of total expenditures, a 17.7 per cent loss in periodical profit, a 72.3 per cent increase in periodical losses and a 71.6 per cent loss in the final consolidated financial result. In 10,830 companies, in 2008 the processing industry entrepreneurs had 260,392 employees who reached a total income of 174.4 billion kunas, a total expenditure of 171.7 billion kunas, a periodical profit of 7.0 billion kunas, a periodical loss of 5.5 billion kunas and a consolidated financial result – net profit of 1.5 billion kunas. The net profit was significantly lower, even 71.6 per cent lower, than the achieved net profit in 2007.

Table 2. Basic financial results of the processing industry in 2008 (amounts in million kunas, shares in percentages, index 2007 = 100) (source: FINA, Analysis of the processing industry in 2008)

Description	2008	Index of the processing industry	Index Croatia	Shares in Croatia
number of entrepreneurs	10,830	98.0	107.3	12.1
number of employees	260,392	101.2	105.1	27.9
total income	174,398	108.5	110.6	24.6
total expenditure	171,710	111.6	112.4	25.0
profit before taxation	8,447	83.0	97.6	20.1
loss before taxation	5,759	176.7	160.00	32.4
value added tax	1,168	74.4	96.7	16.8
periodical profit (after taxation)	7,041	82.3	97.2	20.3
periodical loss (after taxation)	5,521	172.3	158.4	31.5
consolidated financial results – net profit	1,519	28.4	69.8	8.8
investments in new long-term property	12,136	116.7	105.7	19.0
average monthly net salary in hrk	4,409	106.9	106.3	-2.9

Entrepreneurs and activities in the processing industry achieved 1.5 billion kunas of net profit in 2008, followed by 642 billion kunas of net loss in 2009, which in 2010 increased up to 1.9 billion kunas.

In 2010, 234,356 employees in 11,686 entrepreneurs of the process industry achieved 152.9 billion kunas of total profit, 153.1 billion of total expenditures, 7.7 billion kunas of periodical profit, 9.6 billion kunas of periodical loss and 1.9 billion kunas of net loss. Exporting brought 53.6 billion kunas profit, 31.6 billion kunas were paid for imported goods and the commercial surplus of 22.0 billion kunas was reached.

Compared to 2009, in 2010 the number of employees in the process industry dropped by 3.9 per cent, total incomes raised by 1.9 per cent, total expenditures raised by 2.1 per cent, periodical profit raised by 25.9 per cent, periodical losses raised by 41.7 per cent and net losses raised by 193.1 per cent. The raise of the commercial surplus of 30.5 per cent, as the result of an increase in export by 14.3 per cent and in import by 5.1 per cent, is a positive fact.

A total of 11,133 entrepreneurs of the Croatian process industry managed their business relatively successfully in the first nine months of 2012 and made a gross profit of 12.7 billion kunas. Entrepreneurs of the processing industry in the structure of the Croatian economy participate in the total business results of the entrepreneurs paying the value added tax with 12.0 per cent in the total number of entrepreneurs, 26.6 per cent

in the total number of employees, 26.8 per cent in total incomes, 25.4 per cent in total expenditures and 50.6 per cent in the gross profit of the first nine months in 2012. Entrepreneurs of this activity had 224,752 employees who made a total profit of 123 billion kunas, total expenditure of 110.3 billion kunas, 12.7 billion kunas of gross profit and set aside investment funds of 4.7 billion kunas. Not all entrepreneurs in the process industry ran their business positively. Of them all, 6,694 or 60.1 per cent from a total of 11,133 made a gross profit in the first nine months of 2012, while the rest, namely 4,439 or 39.9 per cent made gross losses.

In the nine months of 2012, compared to the same period of 2011, entrepreneurs belonging to the Croatian process industry increased the number of employees by 1.0 per cent, total incomes by 0.9 per cent, total expenditures by 0.8 per cent and decreased investments in long-term property by 2.2 per cent. Because they had a bigger increase in incomes than in expenditures, their business efficiency, or economy, increased. On every hundred invested kunas they made an income of 111.5 kunas compared to the 111.39 kunas of the nine months in 2011. The reason of the 1.9 per cent increase in the gross profit is the increased business efficiency, i.e. economic quality.

Regarding the Istrian County, in 2012 the Croatian Chamber of Economy recorded 757 trading companies belonging to the process industry. The number of employees has been pretty stable in the last five years and it stands at about 10,000 employees. According to this index, industry employs about 31 per cent of all employees in the economy of the Istrian County.

The total income of the process industry of the Istrian County achieved a growth of 9.3 per cent in 2008, then a loss of 5.8 per cent in 2009, then again a growth of 17.3 per cent in 2010, followed by a foundering of 16.5 per cent in 2011, and of 6.4 per cent (or 7.5 billion kunas) in 2012. In the period from 2008 to 2012 the industry registered a constant decrease in profit, and the fact that a loss in companies from the process industry is constantly growing in the mentioned period and doubled in relation to 2008 is also disturbing. Based on the expressed financial results for 2012, the process industry participated by 35.6 per cent in the total profit and by 19.5 per cent in the total losses of the Istrian economy. Industrial investments, which were considerably falling up to 2010, have registered a light growth of 1 per cent in the last two years and in 2012 it amounted to 300 billion kunas.

As regards the current solvency and indebtedness, the process industry has been on the average in the Istrian County in the last five years. The current solvency coefficient ranges from 0.94 to 1.07, while the indebtedness ranges at about 0.60.

In activities of the Istrian process industry, the strongest is the markedly export-oriented shipbuilding industry that has successfully built technologically most sophisticated ships on its slipways in the last 150 years. It is followed by the production of other external clothes, other parts and requisites for motor vehicles, production of cement, other non-metal mineral products, other plastic products, cutting, shaping and dressing

stone, production and processing glass, production of paints and varnishes and other activities the export value of which was under 10 million USD in 2012.

The process industry activities which participate in import with more than 10 million USD are the production of electrical power, other parts and requisites for motor vehicles, production of other external clothes and other non-metal mineral products, production of other plastic products, wavy paper and cardboard as well as packages made of paper and cardboard, steel pipes and requisites.

5. Data and methodology

The starting point for the empirical part of this paper are the data about business subjects of the Industry Sector of the Croatian Chamber of Economy following its members' state and needs, and in line with the National Classification of Activities. The 2007 classification is as follows: production of tobacco products (C12), production of textile fabrics (C13), production of clothes (C14), production of leather and similar products (C15), production of paper and paper products (C17), printing and multiplying recordings (C18), production of coke and refined petroleum products (C19), production of chemical substances and chemical products (C20), production of basic pharmaceutical products and pharmaceutical preparations (C21), production of rubber and plastic products (C22), production of other non-metal products (C23), production of metal (C24), production of finished metal products, except machines and equipment (C25), production of computers and electronic and optical products (C26), production of electric motors, generators, power transformers and appliances for the distribution and monitoring of electrical power (C27), production of machines and devices (C28), production of motor vehicles, trailers and semitrailers (C29), production of other means of transport (C30), other process industry (C32), repair and installation of machines and equipment (C33).

The data obtained from the Croatian Chamber of Economy consisted of the following: name of the company, headquarters, contact data (telephone, fax, e-mail address and web page), representative person, type of activity, size of the company and number of employees.

According to the analysis of these data, out of the 350 business subjects belonging to the Istrian County process industry, 322 of them are small enterprises, 21 of them are medium enterprises and seven of them are large enterprises (considering the total number of employees criterion).

The research was conducted through an anonymous questionnaire created by Google docs and sent by e-mail to 350 business subjects to be filled out. The multiple filling out of the questionnaire by the same business subject was disabled by a software restriction. The questionnaire consisted of 12 questions, 10 closed ended and two open ended questions.

The open-ended questions regarded the development direction and the area of innovation coverage inside the process industry sector, the thematic areas of research and development inside a company, as well as the development of certain sector niches. The latter were used to obtain (detailed) individual information. Closed ended questions were used for the needs of ranging and presence of certain elements.

The research was conducted in July and August 2014 and the questionnaire was accessible only in that period. Out of the 350 business subjects covered by the study, 117 of them answered the survey, which is a return of 33.43 per cent.

6. Empirical results and analysis

In the context of the research on the influence technology transfers have on the development of innovation in the Istrian County process industry the first question regarded the definition of developmental needs among the questioned business subjects, and it can be read in the answers (Fig. 3) that the largest number of them, namely 72 of them, defined needs for investments as the most important developmental need, while technology was considered the most important developmental need by only 22 of them. Human resources were the most relevant to 12, and needs for access to the market to 11 business subjects.

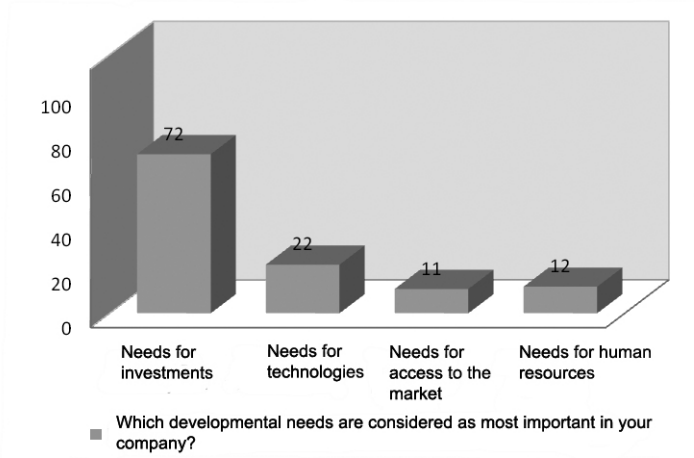

Fig. 3. Developmental needs of the questioned business subjects (source: authors' calculation)

Figure 4 shows developmental components that business subjects mostly have at their disposal. It can be seen that out of the 117 business subjects who answered the questionnaire, 72 of them possess adequate technology. The idea that technology is important in the formation of the industrial competition model is at the core of Sutton's "bounds" approach. This approach states that technologies differing in productivity in research and development activities and in the volume of different technological trajectories studied by companies can implicate different profit possibilities for the "potential" enterer who innovates and thus forms different market configurations in industries (Sutton 1998).

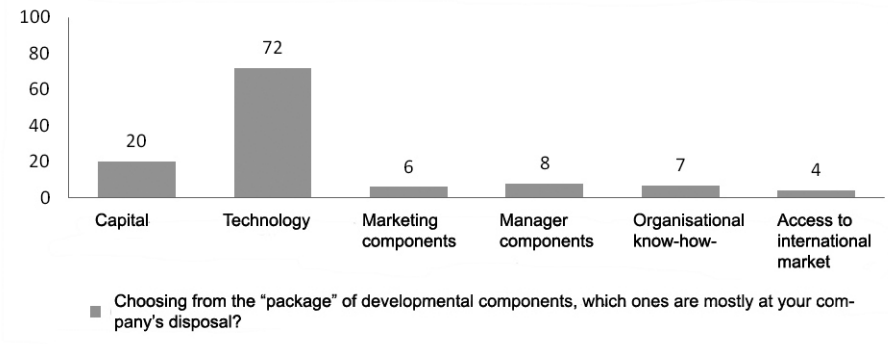

Fig. 4. Developmental components of the questioned business subjects (source: authors' calculation)

Further on, Figure 4 shows that after technology, for 20 business subjects capital is the second developmental component at their disposal, eight of them have managerial components, seven of them have the organisational know-how, six of them have marketing components and four of them have the approach to international markets. The last is in favour of the fact that the Istrian process industry products are insufficiently placed on international markets.

The task of business subjects linked to the third question was to evaluate on a 1–5 scale (Likert's scale) how much the untimely implementation of innovations influenced the "withdrawal" or decline in sales of their product on the market. Figure 5 shows that most of the questioned subjects think that the untimely implementation of innovations partly influenced or either influenced or not the "withdrawal" or decline in sales of their products on the market.

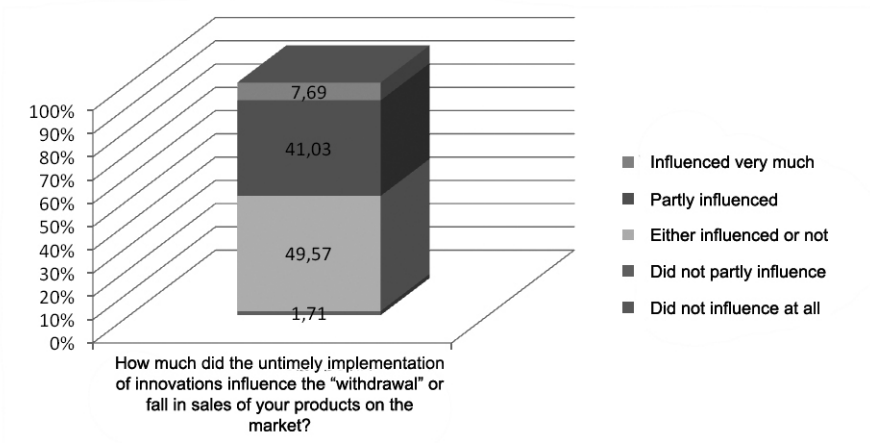

Fig. 5. The influence of untimely implementation of innovations on the placement of products on the international market (source: authors' calculation)

In favour of what has been said are the relationships between the industrial competition and technology illustrated through different approaches. Gort and Klepper (1982) state that an enterprise's demography, including entries and exits, is formed by the nature of technologies linked to the various phases of a new product's life cycle. According to this interpretation, innovation is what brings the current of new enterprises' entry in the early phases of a new product development, as long as a dominant design is founded (Utterback, Suarez 1993). A competitive and efficient industrial sector depends primarily on the ability of the industry to adapt continually and react to environment changes, directing its activities to structural reforms and adaptations to the demands of the market.

After that (Fig. 6) information was gathered about the cooperation between questioned business subjects from the process industry and the scientific-research institutions and about the plans for future cooperation.

The first question regarded the establishment of a certain cooperation model with the scientific-research institutions (common research, transfer of technology and similar). Of all the questioned subjects, 76.07 percent answered that they did not establish any cooperation with the scientific-research sector, while 23.93 percent of them established cooperation in the form of conducting common researches, technical support, etc. The second closely linked question regarded a future intention to conduct common researches with the scientific-research sector, where 63.25 percent of the business subjects expressed an intention of cooperation with the scientific community, while 36.75 percent of them said they did not have plans for cooperation.

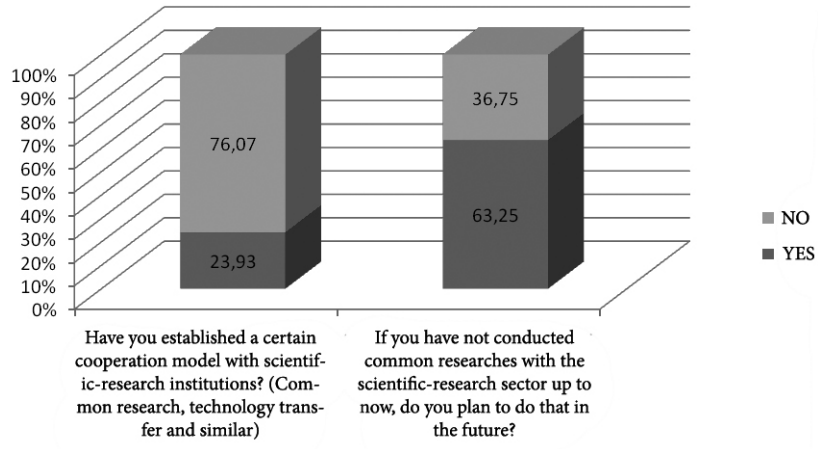

Fig. 6. The cooperation of questioned business subjects with the scientific-research sector (source: authors' calculation)

Results from figure 6 about the cooperation with the scientific-research institutions, or the 76.07% of questioned subjects not cooperating with the scientific-research institutions are not positive at all. Cooperating with the scientific community companies could ensure a quality and cheap development and research, the application of new

technologies and innovations, the estimation and procedure for the protection of intellectual property, and finally the creation of a comparative precedence on the market. On the other hand, 63.25% of the questioned subjects who intend to cooperate with the scientific community in the future lead us to the possible existence of the problem of a subjects' insufficient level of information about a potential cooperation.

The next, sixth question in the questionnaire (Fig. 7) was about the forms of technology transfers used by questioned business subjects and it showed that 45.30% of them used technical help and technical cooperation, followed by licenses (19.66%), and consultancy on the third place (11.97%). Other ways of technology transfers (leasing, franchising, know-how, joint investments) were used by a considerably smaller number of questioned subjects.

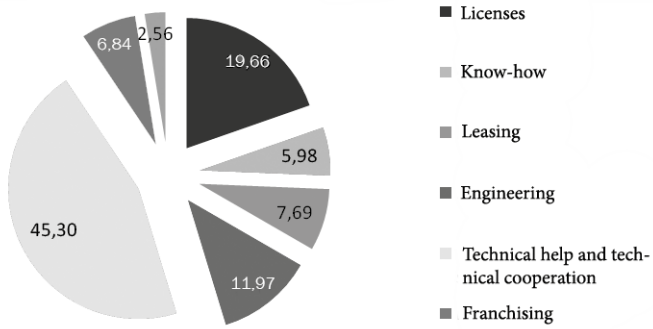

Fig. 7. Forms of technology transfers used by questioned business subjects (source: authors' calculation)

The research next shows (Fig. 8) factors considered by the questioned business subjects as most important in the influence on technology transfers. The offered answers were subjects and distributors of technology, the technology market, contract, training, rules and culture. Distributors and recipients of technology were considered as the most important in the process of technology transfer by 52.99% of the subjects, while 14.53% of them found the technology market as the most important in the transfer of technology.

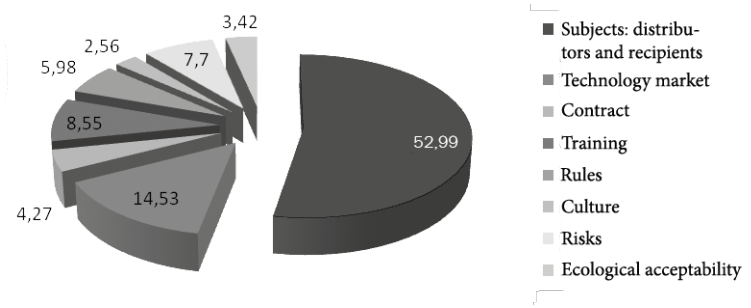

Fig. 8. Factors of influence on technology transfer expressed by the questioned subjects (source: authors' calculation)

Regarding subjects – distributors and recipients of technology – the advantage of the former is that they exploit their own research results through third persons thus achieving significant financial effects, while the benefit of the latter is manifested in the fact that without engaging their own financial means they gain already finished technological solutions and by their acquisition they develop their own product line thus increasing their business success and competitiveness on the market.

The eighth question of the questionnaire (Fig. 9) regarded the evaluation of the transfer of technology success. The possible answers were: by profitability of the project/product, by the correct conduction of the project/placement of the project, by the correct use of technology, by safety in running business and by the constant accessibility of information. To 51 of the questioned business subjects the most important thing contributing to the transfer of technology was the profitability of the project/product, followed by the correct conduction of the project/placement of the project, considered most important by 27 subjects. The correct use of technology was the most important to 19 subjects, safety in running business to 16 questioned subjects while the constant accessibility of information was on the first place for only four subjects.

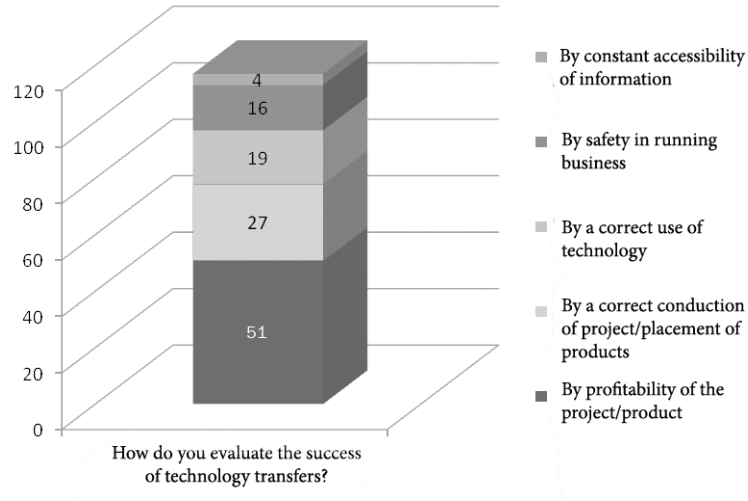

Fig. 9. Evaluating the success of technology transfer (source: authors' calculation)

Linked to the profitability of the project/product considered as key to the success of the technology transfer process by the largest number of business subjects, during studying Romer's model (1990) shown earlier, Valdes (1999) says that each research laboratory tries to produce a new product which can be patented and which will ensure incomes in the form of monopolist profit, at the same time contributing to the level of general knowledge. Information, which cannot be patented or kept secret, is in question. That is why general knowledge is a common good serving as the cost amount for further innovation. In line with that, Valdes thinks that the cost of innovations has to fall quickly

to keep pace with the decline of monopolistic profits gained by the new product. Thus, a linear connection between the productivity of the research and development sector and the cumulative number of new patents is necessary. The solution to this model, among others, drives to the conclusion that the incomes of the enterprise involved in the production of the new design have to be higher of the border expenditure in order for the expenses of interests on the starting investment of the new product to be covered.

In the following question (Fig. 10) the business subjects were asked to define the most serious obstacles to the transfer of technologies. The following answers were offered: not knowing the economic resources, lack of information about the contributions of science to the economy, lack of transparency of the knowledge market and lack of financial funds. Out of the 117 questioned business subjects, 77 of them recognized the lack of financial funds as the most serious obstacle to the development of technology transfers. Lack of transparency was seen as the most serious problem by 23 of them, not knowing economic resources by 11, and lack of information was considered as the most serious obstacle to the process of technology transfer by six business subjects.

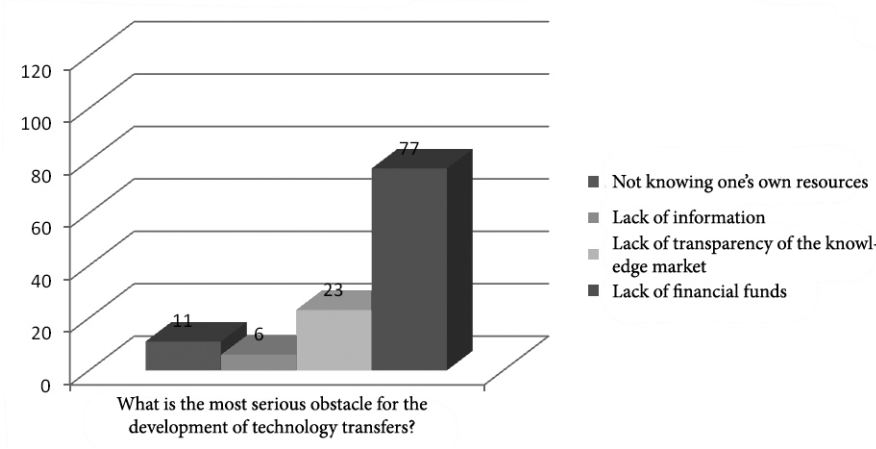

Fig. 10. Obstacles to the development of technology transfers (source: authors' calculation)

Concerning the lack of transparency of the knowledge market it is possible to trace the problem in high transactional expenses occurring during purchase, for example, the import of finished solutions (license agreement) instead of turning to home scientific institutions already having developed solutions of a possible technological use or a patent registered at the State Intellectual Property Office.

The last closed-ended question (Fig. 11) of the questionnaire regarded the familiarity with the work of technological centers. The obtained result was beating, because even 75 business subjects were not familiar with the work of technological centers, while 42 of them answered the question affirmatively. The result is beating because the aims of technological centers are more successful transfers of technological processes and the

increase of competitive efficiency of the home industry, as well as the technological development as the lever and precondition for raising the level of competitiveness and life standard.

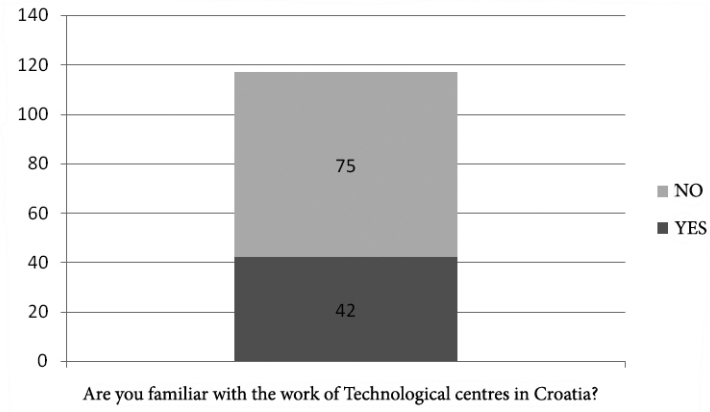

Fig. 11. The business subjects' familiarity with the work of business centres (source: authors' calculation)

Some researchers (Christensen, Raynor 2003) have shown that the best success can be achieved by the cooperation of enterprises (innovators) and networks specialised for technology transfers. The combination of knowledge about the technology owned by the distributor and knowledge about the international market mechanisms and the network of contacts owned by the supporting institutions form an optimal cooperation that, along with the effort made, brings results. The internal channels of technology supply and demand and the organisation of business meetings can serve as main tools for the purpose.

7. Conclusions

The Croatian process industry is in need of a technological restoration to diminish the gap between the demand and supply of products of a higher level of technological complexity. Because of the negative effects which could emerge from limiting the import of goods, the industrial policy measures should be directed toward the increase of competitiveness on the international market through the improvement of the home entrepreneurs' technological basis, encouraging research and development, educating employees and attracting direct foreign investments directed toward sectors of a higher level of technological complexity.

In the upcoming period it is necessary to define new measures which will initiate a new industrial impetus, while the most important trends in the following medium-term period should be the continuation of the process of structural adaptations and reforms in the economy system, repositioning traditional industries and activities with a move toward products of a higher added value, increasing the competitiveness of the process

industry, an increased care about the protection of the environment and sustainable development by the implementation of acquired directives, investment in technology and innovations, making faster adaptations to the market needs, flexibility on the working force market. The economic restructuring should be in the spotlight of the Croatian industrial policy with the aim of making economic activities more dynamic and increasing productivity in all economic sectors, from the process industry to agriculture and tourism.

According to Schumpeter's theory of "creative destruction", new, entrepreneur innovations push out the old ones provoking waves of "creative destruction". The mere process of creative destruction that includes the destruction of both old technologies and enterprises is the cause of progress and increase in competitiveness, as well as standard of life. The cooperation with the scientific community realises a comparative precedence by a quality, faster and cheaper research and development while the use of new technologies and innovations solves the existing technological problems. Such cooperation could lead to a "win-win" combination. The benefit for the scientific community is manifested in the possibility for compensations from licensing the intellectual property, cooperating with economies (sponsored research projects, common investments), various consultant services (professional evaluation, data analysis, questioning and analysis) and proprietary shares in spin-off and start-up companies.

Business subjects of the Istrian County process industry have to find the way (either by using the scientific community services or by developing their own R&D departments) to develop and commercialise their innovations, and as an effect, to protect their intellectual property in time. It is also necessary to realise a proper model of technology transfer through licensing, funding spin-off companies, joint investments or through know-how, licenses, franchising etc.

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