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MASTER THESIS

TRANSFER OF NEW KNOWLEDGE FROM RESEARCH INSTITUTES TO ENTERPRISES

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IZJAVA

Študentka Polona Renko izjavljam, da sem avtorica tega magistrskega dela, ki sem ga izdelala pod mentorstvom prof. dr. Staneta Možina in dovoljujem objavo magistrskega dela na fakultetnih spletnih straneh.

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1 INTRODUCTION

1.1 Major issues

If we have been discussing the natural and human resources as being the most important assets of an enterprise in the past, in today's **knowledge-based society** we are mainly focusing on the importance of knowledge.

We can talk about a knowledge-based society when knowledge as a main productive factor makes an important contribution to domestic product. Most developed countries have already achieved knowledge-based society.

Why is knowledge so important?
The main reason for the great importance of knowledge is quite simple and derives from the following deliberation. The market and consumers require and expect new products which would be of higher quality, user- and environmentally-friendly. As a result companies need to adapt to the ever stricter environmental and other standards and directives. New products, technologies and services can be produced only through the latest discoveries from specialised areas, which should be transferred into practice (industry) as soon as possible. A new scientific achievement that has not been made published yet, can be patented and protected by the industry thus not increasing only the added value of products and services but also the competitive power of a company on the market.

The driving force in technological innovation is new scientific knowledge. The resulting new technologies accelerate the development of new processes, products and services. These need to be successful on the market or trigger new investments into research and development. Industrial investment is proportional to the success of commercial activities (Kornhauser, 2001, page 18).

Knowledge-based society is therefore characterised by the operation of an organisation which is based on innovation and knowledge and not on mass production. It is closely connected with the individualisation of production and the adaptation of services or products to consumers.
Knowledge regarding intellectual property, patents, innovations and inventions is therefore one of the key areas that researchers/students should focus on during their undergraduate studies.

The analyses of some surveys show that Japan and the USA have a much larger number of researchers and patents and that these two countries allocate more financial funds to research than the countries of the European Union. Europe can compete on the global market and with the USA and Japan only by increasing its investments into development, namely to 3% GDP or to one and a half times more than current investments figures adopted till 2010 thus increasing the added value of its products. Knowledge and the transfer of knowledge into practice has become one of the essential elements in evaluating the success of a country.

In order to achieve the above mentioned goal Europe has joined its "research forces" and established The European Research Area (ERA) during its European Council in Lisbon in March 2000. The European Research Area (ERA) is responsible for the

coordination of national research policies of the member states of the European Union and the preparation of guidelines for the achievement of a common objective, expertise and resources.

After entering the European Union Slovenia will have to adapt its industrial policy and observe industrial policy regulations of the European Union. Slovenia currently exports 2/3 of its GDP to the EU countries. This is also one of the reasons for Slovenia's close cooperation in the EU legislative frameworks and the resulting harmonisation of its policy with EU demands and requirements.

What is the current state-of-affairs in Slovenia?

The analysis of certain indicators, such as the number of researchers per 1000 inhabitants, the number of patents, innovations and the amount of funds intended for research and development, proves not to be favourable for Slovenia (Appendix 1 and 2). The value of the creation of knowledge has also not been supported on the national level (Svetlik, 2004, page 2).

The current situation in the field of education can be analysed on the basis of Slovenia's educational structure, the inclusion of adults in the education system and the number of learning organisations.
The application or the use of knowledge is also an important indicator. We need to ask ourselves which price range is achieved by Slovene products, how common is electronic business and what proportion of GDP is created by knowledge.

Which are the major issues?

The main problem seems to be the **method of financing**. The contribution of the state for science and education on the macro level is very important as it demonstrates the recognition of knowledge as a value. The programme of basic research is financed mainly on the basis of scientific references and publications. It is therefore extremely difficult to expect that such programmes will be adapted to the needs of industrial sectors and other organisations since they measure success in terms of the number of scientific articles.

A classical institutional division to those institutions that create knowledge and institutions that transfer and use knowledge is becoming obsolete. Institutions are becoming more open and the cycle of knowledge is becoming a basic principle of organisations and individuals.
As previously mentioned the classical division to scientific institutions (universities and institutes) and departments of development in enterprises is becoming obsolete. In order to achieve knowledge-based society organisations have to enable everybody to be involved in the production of knowledge. Every organisation has to organise their activities in a way that supports, promotes and encourages the knowledge development of individuals thus enabling them to search for new solutions and complement their knowledge (Svetlik, 2004, page 2).
Every company is responsible for the sustainable and rapid transfer of knowledge into an organisation, between individuals and departments within the organisation. Their activities and operations need to be organised appropriately in order to enable the monitoring of new knowledge and training of employees on a daily basis. The

transfer of knowledge is becoming the main principle governing the organisation of companies' activities.

The gap between the spheres of work and education should be surmounted by both sides, namely by the rotation of experts or teachers between schools and work environments, by involving students in work environments during their studies and by introducing more real work situations into the educational process. According to Kornhauser (2001, page 19) the following forms seem to be efficient in building up the university-industry cooperation: visiting professorships, participation of academics in industrial and governmental bodies, jointly prepared and presented lectures, seminars at industrial sites, industrial leaders participating as members of university governing bodies, etc.

Notwithstanding the form of cooperation, personal links among university and industry staff are emphasised in all reports as being the most decisive factor. Technology transfer takes place in person-to-person interactions and requires close contacts between industrial experts and researchers.

Since Slovenia does not have important sources or large stock of raw materials or capitals, it needs to take care of science and development and provide a rapid and efficient transfer of the latest knowledge from research institutions into practice. Slovenia's size, reputation and its importance depend on knowledge which should become a nationally recognised value (Svetlik, 2004, page 2).

1.2 Purpose and objectives

The main objective of this master's thesis is to provide an insight into the process of transfer of new knowledge from research institutions into industry, to highlight the methods and the frequency of such transfer and the interest expressed by both sides. The present thesis also strives to provide a detailed review of these issues and suggest some constructive improvements that should be made in the field.

The following empirical research wishes to establish the current situation on the field of knowledge transfer from research institutes to industrial sector on the basis of a representative sample involving Slovene researchers and scientists working in research institutes and in industry.
The main purpose of empirical researches (made on the basis of questionnaires) is to promote and raise the awareness of researchers and scientists regarding the need of a successful and efficient transfer of knowledge into practice.

The present master's thesis wishes to achieve the following objectives:

- ✓ To review the bibliography from the field of the transfer of new knowledge from research institutes into industrial sectors;
- ✓ To determine the quantity of new knowledge that is acquired by researchers in industrial sectors from research institutes and from other sources;
- ✓ To determine the quantity and the methods of knowledge transfer from research institutes into industry;
- ✓ To evaluate the interest of researches working in industrial sectors and researchers and scientists working at research institutes in the transfer of knowledge from these institutes into industry;

- ✓ To discuss main issues and problems that researchers and scientists need to face during the transfer of knowledge into industry;
- ✓ To provide practical solutions and suggestions for a more efficient transfer of new knowledge from research institutes into industrial sectors.

1.3 Methodology

The present master's thesis is composed from the following sections:

- ✓ *The overview of theoretical fundamentals through the available literature.*
- ✓ *The theoretical basics of knowledge transfer from research institutes to enterprises.*
- ✓ *Questionnaire for scientists and researchers working at research institutes.*

The analysis of questionnaires will provide information regarding the frequency of cooperation between research institutes and enterprises, their way of transfer of knowledge from research institutes to enterprises, the most common problems they deal with, their opinion about possible improvements and necessity for new knowledge in this field of area.

- ✓ *Questionnaire for enterprises (researchers and development department).*

The analysis of questionnaires will provide information regarding the frequency of cooperation between research institutes and enterprises, their way of transfer of knowledge from research institutes to enterprises, the most common problems they deal with, suggestions and recommendations for improvement of cooperation.

- ✓ *Testing of the questionnaire's quality.*

We will test the comprehensibility and quality of questionnaire on selected individuals from research institutes and R&D departments in enterprises.

- ✓ *The explanation of methods used for the evaluation of answers received.*

The answers from questionnaires given by individuals from research institutes and R&D departments in enterprises will be evaluated on the basis of selected theoretical methods.

- ✓ *The presentation of results.*
- ✓ *Conclusion based upon the results of analysis. Fundamental practical comprehensions.*

The master's thesis will try to search for connections in the field of knowledge transfer from research institutes to enterprises. Possible improvements will be proposed in the fields where individuals from R&D departments in enterprises find weakness for better cooperation with individuals from research institutes. Possible improvements will also be proposed in the fields where individuals from research institutes notice problems for better cooperation with enterprises.

- ✓ *The propositions for possible improvements of the current situation.*

Master's thesis will propose practical improvements in transfer of new knowledge from research institutes to enterprises.

1.4 Contents

The present thesis is divided into two main parts; the first part focuses on the *review of existing bibliography,* while the second part presents an *empirical survey*. The thesis is divided in eight chapters.

The first chapter is an introductory part which presents the major issues in the field of *transfer of new knowledge from research institutions into industrial sectors*. The first chapter also focuses on the purpose, methods and the objective of the present thesis.

The second chapter gives a detailed overview of the role of new knowledge in modern, knowledge-based society. It also defines different types of knowledge and the importance of new knowledge both for research institutions as for industry which has been facing extremely harsh competition both on the European markets as well as globally in this relatively new period of globalisation.

The third chapter describes the scientific and research activities in Slovenia, the role of such activities, work methods and the characteristics of individual research organisations as well as the issues they are facing nowadays.

The central part of the master's thesis represents the fourth chapter which focuses on some examples of a successful transfer of new knowledge from research institutions into industrial sectors.

The fifth chapter defines and focuses on a problem which represents the basis for empirical survey and derives from the broader issues regarding the transfer of new knowledge from research institutions into practice. It first describes the methodology of the survey, which is followed by the presentation of results obtained from the analysis of questionnaires. The presentation of results include the following analytical elements: the frequency of cooperation between research institutes and industry in the transfer of new knowledge, ways and methods of transfer, the willingness for cooperation, the evaluation of key factors governing the successful transfer of knowledge, issues with which researchers and scientists from research institutions and R&D departments in enterprises need to face and some proposals and solutions for the improvement of such cooperation.

The above mentioned factors represent a basis for final conclusions of this thesis which can make an important contribution to the improvements in the transfer of new knowledge from research institutions into industrial sectors while considering the current situation and possibilities. Final findings and conclusions are presented in the sixth chapter.

The seventh chapter presents bibliography that has been used by the author, while the eighth chapter describes bibliography that has been quoted in this thesis.

The ninth chapter includes appendices. Appendices 1, 2 and 4 represent comparison between Slovenia and other EU member countries according to the following categories: number of patents, number of researchers and knowledge transfer. Research organisations, which do not posses a status of public research institute, are presented in Appendix 3. Appendix 5 (and 5a) is a questionnaire which focuses on the transfer of new knowledge from research institutions into industrial sectors which was given to researchers and scientists working at research institutions. Appendix 6 (and 6a) includes a questionnaire focusing on the transfer of new knowledge from research institutions into industrial sectors which was intended for researchers working in R&D departments in enterprises. Appendix 7 includes some statistical

forms and the results of statistical data processing which were obtained by the aforementioned survey (T - test).

2 THE ROLE OF KNOWLEDGE IN KNOWLEDGE - BASED SOCIETY

Research creates new ideas and advances the frontiers of knowledge. To put this knowledge to work, it must be transformed into new technologies, new products and new services. Through support of scientific research, industry aims to achieve explorations and inventions that would give it advantages, such as the lower cost, faster development, higher productivity and better quality etc., that enable its products to win competition in the global markets.

Thus, an innovative economy is driven by research and development. In order to secure continued success in the 21st century, a company or a country must be among the first to integrate new knowledge and put it to use.

The greatest challenges to the leaders of the information age, will be to create an organisation, which is able to share its knowledge with others. However, knowledge is not transferred only within an organisation or an institute but also beyond them, between countries and continents. Such transfer of knowledge could be achieved mainly on the basis of cooperation and integration of all well-known centres of knowledge into networks which enable the transfer of knowledge in both directions. Some authors believe that the 21st century will become the period of Network Society.

Knowledge networking - The Network Society

The importance of interacting in innovation processes makes it clear that networking is an essential means of knowledge exchange and learning. Networks bring actors, resources and activities together and are thereby to be regarded as a system. Innovation networks are a specific mode of this arrangement. They are understood as all organisational forms between market and hierarchy which serve the purpose of information, knowledge and resource exchange and which help to implement innovations by mutual learning between the network partners (Fritsch, Koschatzky, Schätzl and Sternberg 1998, page 28).

Networks are not conducive to development per se; they only encourage development if they are able to learn and adapt to new challenges. From the perspective of planned-economy innovation and production processes, in which innovation-oriented contacts could only evolve in a selective way within the value added chain, horizontal network relations with low hierarchical structures now represent an additional opportunity to gain knowledge. However, due to routines adopted in innovation and co-operation behaviour, it must be presumed that the co-operation and networking experience gained during the socialist period, coupled with the fear of an uncontrolled knowledge transfer, still leads to the preference of vertical co-operation which is embedded in existing contracts.

2.1 Knowledge

We are entering the knowledge society in which the basic economic resource is no longer capital, or natural resources, or labour, but is and will be, knowledge.

Knowledge, enriched with values, provides the main opportunity for solving the four major global problems: population growth, poverty, environmental degradation and violence (Kornhauser, 2001, page 17).

Knowledge, however precious, is only the opportunity. To transfor it into a developmental force, knowledge has to be applied with responsibility in the processes of work and decision making, and generate added value. Combining research and education with knowledge transfer for production and environmental protection is the way towards higher levels of development. However, this way, leading to added value and more knowledge-intensive employment, involves many steps (Kornhauser, 2001, page 17).

Knowledge has become the driving force of economic growth, social development and employment and the primary source of competitiveness in world markets. New business opportunities, productivity gains and jobs are to an increasing extent dependent on new knowledge. Knowledge has become a factor of production equal in importance to capital. This change of the paradigm has many implications for our current understanding of policy and the appropriate role of government. In order to generate economic growth, social development and job creation knowledge has to be developed, diffused and applied throughout the economy.
Through diffusion knowledge becomes available for innovation in all sectors. Efficient diffusion and application of knowledge is a key to economic and social benefits of knowledge. These observations have created new challenges for the science, technology and innovation policies (ASEM, 1999, page 2).

Generation, diffusion and application of knowledge

Traditional science and technology policies were mainly concerned with knowledge generation.
New understanding of the role of knowledge in economic and social development created new challenges for policy. While the traditional S&T policies have maintained their relevance the scope of the policy has gradually been extended to cover new issues. These new concerns are related to the economy-wide diffusion and exploitation of new knowledge (ASEM, 1999, pages 2-3).

Diffusion-oriented policy requires an understanding of how knowledge is generated, how it flows and how it relates to innovation. Knowledge generation is part of the diffusion and application process. Research needs to develop knowledge which is relevant for innovation both in a short and long term. Close cooperation with the users facilitates the orientation of research towards innovation. In addition, co-operation enhances the use of research results. Research and the application of its results progress in an interactive process strengthening each other. The traditional conceptual distinction between knowledge generation and diffusion has to a large extent lost its relevance. Knowledge generation and diffusion have become mutually interdependent. This conclusion is supported strongly by recent observations from

many scientifically leading academic institutions that high-quality research is usually also very relevant to economic and social development.

Recent experience of knowledge diffusion indicates that diffusion is a multidimensional process. Knowledge flows over national borders and commercialisation of publicly funded research has traditionally been key issues of science and technology policies. The experience suggests that the other dimensions of knowledge flows should deserve similar attention. Knowledge flows between firms and industrial sectors have turned out to be very important in terms of competitiveness, productivity gains and employment. Finally, the flows of tacit knowledge with and between people are a relevant dimension of knowledge diffusion. Human capital mobility and cultural communication habits play, therefore, significant role in the diffusion process. The final conversion of knowledge into innovation takes place in industrial firms. Firms' innovative performance is dependent on many internal characteristics of a firm. Firms need to develop their absorptive capacity to benefit from external sources of knowledge. They need to be able to create incentive structure and management practices, which facilitate organisational learning, continuous development of human capital and sufficient flexibility to adjust when new technologies or management principles are adopted. Networking, skills, R&D and training play a significant role in this effort (ASEM, 1999, pages 2 - 3).

Diffusion policies

Governments have learnt to exploit the experiences gained and adjusted their schemes accordingly. On the other hand, experience has shown that separate schemes to promote diffusion are not sufficient. Individual schemes cannot substitute direct interaction between knowledge producers and users. Despite active endeavours in that direction cultural differences and institutional rigidities are still hampering user/producer relationships in most of the countries. New schemes involving public/private partnerships can be very instrumental in efforts to overcome these kinds of problems. In the long term good user/producer relationships together with the quality and relevance of the national knowledge base will have a significant influence on the efficiency of knowledge diffusion and on the national innovative capacity.

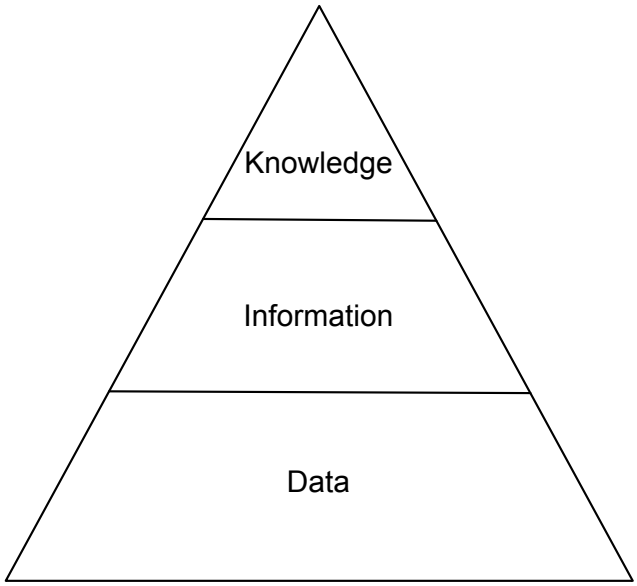
2.1.1 The definition of knowledge

Knowledge is a mixture of framed experience, values, written information and professional opinions which ensure successful absorption on new experience and information. Knowledge is originating and applied in human conscience.

Knowledge is a much more complex concept than data and information. Its meaning is also much deeper, comprehensive and richer in comparison to the two previously mentioned concepts.

The connection between knowledge, information and data can be described in a pyramid form, as presented by the Figure 1.

Figure 1: Relationship between data, information and knowledge



Source: Bezjak, 2002, page 14

Data consists of facts and observations and become information in connection and in context with other data.
Information as such does not represent knowledge. Information becomes a part of knowledge when it is appropriately analysed, structured and connected with other, yet unknown information.
We are most often faced with the issue of differentiating between knowledge and information. The main characteristic of both information and knowledge is represented by the fact that these two concepts, in comparison with other sources, do not suffer from depletion if and when submitted to others. On the contrary, they are usually enriched and upgraded through the interaction with others. Nevertheless, there are still certain important differences between knowledge and information which are presented in Table 1.

Table 1: Differences between knowledge and information

INFORMATION	KNOWLEDGE
tangible	intangible – human process
physical object	mental object
independent of context	context determines its meaning
easily transferable	transfer is only possible through learning
can be reproduced	cannot be reproduced identically

Source: Amidon and Skyrme, 1997, page 30

Knowledge and information are therefore closely connected but not synonymous. Knowledge represents a higher form in this hierarchy while information represents a precondition for the formation and spreading of knowledge.

The meaning of knowledge therefore does not include either data or information. Even though knowledge is connected with both concepts it is also clearly and obviously different from them. Success or failure of a company is often depending on what we need, what is available and what we can do with the available data, information or knowledge. The understanding of differences between these two concepts and the transition between one to another is extremely important for the successful and efficient knowledge management (Davenport and Prusak, 1998, page 1).

2.1.2 Types of knowledge

We distinguish between two types of knowledge, namely between:

- ✓ ***Tacit knowledge***, which is based on personal experience and can hardly be transferred, and
- ✓ ***Explicit knowledge***, which can easily be transferred and documented.

Explicit knowledge can be expressed in words and numbers; it can be transferred and discussed, as this type of knowledge can be described in scientific formulas, tables, codified procedures or universal principles.

In a company explicit knowledge can be described as the tip of an iceberg, since it often coexists together with tacit knowledge, which was defined by Nonaka as a concept that is extremely difficult to define and observe. The author also states that tacit knowledge is often very intimate and almost impossible to form. This type of knowledge features a high degree of intuitiveness, personal opinions and convictions (Nonaka and Takeuchi, 1995, page 8).
Both types of knowledge are equally important in any form of knowledge management. In every company the establishment of a connection between the two types of knowledge and their contribution to an efficient use of synergy effects is one of the key challenges.

In order to transfer knowledge successfully we need to build and establish transfer mechanisms between individual knowledge holders. Since there are different forms of knowledge present in every organisation it is obvious that some forms can be transferred easier and faster that others. Knowledge recorded in documentation (explicit knowledge) or reports is easily transferred, while knowledge which exists in the subconscience of individuals (tacit knowledge) is more difficult to transfer. Such knowledge can mainly be transferred through communication (Davenport and Prusak, 1998, page 69).

In companies knowledge is most often documented not only in internal documents but also in applied processes, customs and practices, activities and norms.

Any organisation possesses a great deal of knowledge – in memories and subconscience of its personnel, namely tacit knowledge which is usually not documented, in documents, products, services, organisational structures and processes. The content of such knowledge can be very different, as it dispersion, organisation and value presents different characteristics. Some parts of knowledge can be described as topical and up-to-date, others as already “redeemed”; some are still circulating while others are carefully “piled”; some parts of knowledge can be

found in abundance while there is a lack or absence of other knowledge (Peršak, 2001, page 25).

We can conclude by saying that knowledge is not as simple to define as it may seem at first sight as it represents a mixture of many different elements. Knowledge originates from information while information originates from data. It is people who transform information into knowledge, the transformation of information into knowledge occurs through the following four processes which in the English language begin with letter *c*:
Comparison: How certain information can be compared with similar situations which we have experienced?
Consequences: What is the influence of information to our decisions and activities?
Connections: How this part of knowledge is connected with others?
Conversation: What other people think of this item of information?

2.1.3 Knowledge as a part of professional system

Knowledge represents information which a system or a programme needs for a successful and efficient problem-solving. Knowledge consists of facts which express certain recognised or partly recognised statements and rules in a certain domain.

According to different criteria knowledge can be divided into solid and delicate knowledge, specialised and general knowledge, knowledge of "things" and knowledge of knowledge (meta - knowledge), and to formal, theoretical and informal, empirical knowledge (heuristic). To a certain extent these distinctions are mutually interconnected.

Solid and delicate knowledge

One of the main characterisations of knowledge is its distinction between solid and delicate knowledge. Solid or categorical knowledge is defined by the fact that data and rules are not always and only right or wrong, but often unreliable (imperfect or imprecise) and only partly valid. Such knowledge can be characterised as delicate or unreliable knowledge. According to the same principle certain specialised areas or domains can also be divided into solid and delicate. In general exact sciences are closely connected to solid while inexact sciences are closely connected to delicate domains (Bratko, 1989, page 14).

Specialised and general knowledge

Specialised knowledge is a collection of specific facts and rules, which are connected to a certain exercise or task that the knowledge system wishes to solve. On the other hand general knowledge is independent form context and consists of general rules and problem-solving procedures (Waterman, 1986, page 55). Knowledge which is often described as "common sense" is also a part of general knowledge. More than any individual and unique characteristics of knowledge as such, the distinction between specialised and general knowledge usually depends on the definitions of exercises and tasks carried out by a knowledge system (Shapiro, 1992, page 17).

Meta - knowledge

In general meta-knowledge can be defined as knowledge of knowledge. It entails knowledge regarding the extent and the organisation of knowledge in a system, and knowledge on how to use knowledge or draw conclusions, on when and how to carry out certain activities, etc. Meta - knowledge directs the activities and decisions in a knowledge system (Shapiro, 1992, page 18). The following statement represents a simple example of a meta-rule (a rule of rule): “If the answer to a general question is negative, do not ask more specific questions”, or “If you do not posses facts that support rule A, use rule B.”

Heuristic

For a great deal of problems and issues that are being solved by knowledge systems exact algorithmic solutions are either inexistent or too extensive when it comes to their calculation. For this reason extremely complex problems that are not clearly defined or supported by reliable facts are most often solved by using heuristic methods of problem-solving or by heuristic search. When compared to algorithms, heuristic search does not always guarantee a solution or it provides us with a solution that is not completely exact but approximate. However, approximate solutions are acceptable as they can be very close to optimal solutions (Shapiro, 1992, page 18).

When compared to algorithms the main advantage of heuristic search is represented by a limited search area. Such search area is an implicit group of all possible paths that lead us to a solution. Heuristic search is guided by one or many searching strategies or heuristic knowledge from the initial to the final state – these strategies are defined as “short-cuts”, which are derived from the knowledge of nature or structure of a problem (Fenly, 1988, page 116).

Heuristic knowledge is defined as informal and empirical knowledge whose validity is confirmed by experience. It represents a very important part of knowledge possessed by a professional or an expert. This knowledge enables us to reach a satisfactory solution to a problem without having to consider and explore all possible paths. Heuristic methods are especially suitable for processes of problem-solving that can benefit from a narrow extent of heuristic knowledge in order to obtain an almost optimal solution of the problem.

2.2 The importance of knowledge in an enterprise

Enterprises that wish to successfully compete with strong rival companies are aware that knowledge and knowledge management are extremely important. It is the intellectual capital and its appropriate management that distinguish successful companies from the unsuccessful ones.

Companies find themselves on the “knowledge market” where they have to deal with supply, demand and price fluctuation issues on a daily basis (Peršak, 2001, page 37).
In order to present themselves successfully they need to master two very important skills:

- ✓ Get familiar with and form the price of knowledge,

- ✓ Know how to protect the very knowledge that enables them to establish a competitive edge.

Knowledge has an absolute value and generally represents the strategic role of development and operative survival. The price of knowledge increases according to the demand present on the global knowledge market and according to its topicality in specific business frameworks of individual organisation.

As intellectual property is becoming more and more important companies are making every effort to determine the administration and management of intellectual property in order to produce competitive and high-quality products. Intellectual property also influences the reputation and the competitive value of a company on the market.
If a company decides to adopt knowledge management, its decision has to form a part of business strategy, since the company is obviously aware of the importance of proper intellectual capital. A company also needs to decide how the management of intellectual property influences tits business objectives. Knowledge management requires a corporate culture that promotes and encourages the exchange of knowledge, cooperation between employees and business units. The company needs to have a clear direction towards innovativeness (Zakrajšek and Gašperišič, 2002, page 64).

2.2.1 Knowledge acquisition

Every successful company generates and applies knowledge. Companies obtain information through their activities, transform information into knowledge and take great care of their experience, values and internal rules. They recognise the importance of knowledge and act accordingly. Companies are aware that they would not be able to operate and organise their work efficiently without knowledge. Companies acquire knowledge in many different ways and according to their interests, needs, possibilities and the reasonableness of acquiring individual parts of knowledge.

Companies acquire knowledge in the following ways:

- ✓ ***Acquisition.*** Acquisition or purchase is the most direct and effective method of acquiring knowledge. A company can acquire knowledge by acquiring another company or by engaging individuals who master certain parts of knowledge which suits the company's needs. A company that acquires another company is basically acquiring its employees and the knowledge they possess. Besides the knowledge of employees the company can also acquire certain documented knowledge, processes and skills.

  More and more companies decide to hire professional help from outside sources, which enables them to introduce certain projects more efficiently and to bring new experience or independent and impartial opinions into their organisation.

- ✓ ***Knowledge hiring.*** Companies can entrust certain parts of their operations and activities to other companies. For example, companies can hire financial organisations that help them with the calculation of costs; they can also hire another company that is going to carry out a survey regarding the satisfaction

of customers, etc. By doing so companies renounce a certain part of control, save money and decrease organisational expenses.

When a company hires an outside planner it has to cover the charges for his or her services or knowledge, but it does not have to provide lunch facilities, health insurance and similar contributions.

- ✓ ***The formation of special departments*.** Companies can establish departments for development and research (R&D – Research & Development; for example Andersen Consulting), departments for innovation (for example Ernst & Young), special learning centres and libraries.

- ✓ ***Fusion.*** Cooperation between people who possess different skills, ideas and values can have an important contribution to creative conclusions. The main characteristic of fusion is that people with different skills and capabilities cooperate in the same project and reach a common result. Fusion mainly entails project work, the formation of multi-dimensional teams and the exploitation of synergy effects of constructively conflict situations.

- ✓ ***Adaptation.*** New competitive products, new technologies, social and economic changes have an important influence on the acquisition of knowledge, since those companies that are not able to adapt to these new conditions cannot expect to be successful.

  Companies' ability to adapt depends on two factors:
  - ✓ The existing means and capabilities that can be used in new ways, and
  - ✓ Their activities which are in favour of changes.

- ✓ ***Cooperation in informal knowledge networks.*** Knowledge is also generated outside the company during various meetings, while socialising with people with similar interests, during business meetings, during the cooperation with customers, freelance consultants and similar. Knowledge networks represent the overcoming of organisational limits and the cooperation with company's broader environment (Davenport and Prusak, 1998, page 66).

2.2.2 Knowledge management

Successful knowledge management in a company represents a key that enables the expansion of many business objectives and is a source that reinforces the competitive edge of every company.
Knowledge originates and derives from individual's subconscience and can be very intimate. This is why knowledge management requires the application of methods that create appropriate atmosphere in organisations and a systematic tackling of creating, preserving, protection and spreading of knowledge between employees which is an important source of economic success of every company.
There are no uniform definitions of knowledge management as this is a very broad concept and refers to the corporate culture, the organisation of a company, the human resources management policies, the promotion of employee motivation, educational processes, awarding and similar. Knowledge management basically

represents the intellectual capital of a company. Its definition is therefore depending on different aspects and opinions.

The most important factors in knowledge management are:
- ✓ People,
- ✓ Technology, and
- ✓ Culture.

A great deal of the success of a company depends on the realisation of knowledge possessed by individuals and the successful management of their knowledge. On the basis of the above statement we can conclude that knowledge management is defined as a planned activity within the company which consists of the recognition of key knowledge in the company, the formation of new knowledge that is necessary for the company and the active transfer of knowledge between its employees.

Knowledge Management - Information or data management with the additional practice of capturing the tacit experience of the individual to be shared, used and built upon by the organization leading to increased productivity (Tacit Knowledge - Innovation, creation of new knowledge often comes from collaboration and interaction with experts. These are some of the many ways to create a culture where there is greater collaboration, team work and sharing of ideas.).

Knowledge Management is the systematic process of finding, selecting, organizing, distilling and presenting information in a way that improves an employee's comprehension in a specific area of interest.

Knowledge is a fluid mix of contextual information, values, experiences and r. For an organisation this resides within employees (human capital) and represents a source of creativity, innovation and adaptability to change. Knowledge management is an explicit system to use this capital.

2.2.3 A learning organisation

The concept of a learning organisation has been widely discussed and recognised in the past ten years. The term was used for the first time in 1988 in America by authors such as Hayes, Wheelwright and Clarc (Kavčič, 1994, page 424). The theory of learning organisation emphasises the importance of constant learning and the participation of all employees in the training and education processes. Flexibility of the organisation and its openness to narrow and broad environment is of key importance.
Garvin has stated that learning organisations operate according to the following recognisable factors (Kavčič, 1994, page 425):
- ✓ Systematic problem-solving,
- ✓ Experimenting with new approaches,
- ✓ Learning based on proper experience, and
- ✓ Learning from others (benchmarking).

There are, however, some common points:
- ✓ The acquisition of knowledge is a constant and long-term process and not a single act or a one-off activity,

- ✓ The constant acquisition of new knowledge and the changes in the activities performed by an organisation form a basis and pan integral part of organisation's strategy,
- ✓ Learning processes in an organisation create a common opinion regarding the future development of an organisation,
- ✓ Learning organisation is flexible and open to broader environment, and
- ✓ Learning is constantly promoted both on the individual as on the group levels.

A comprehensive approach that also includes the modifications in behavioural patterns and overcomes the mere cognitive phase, which consequently improves the performance of a company, is one of the key factors in any learning organisation. Such approach introduces the changes in corporate culture as a whole. This obviously means that we are dealing with a long-term process which can be carried out only by organisations that enjoy the support of their management and encourage the participation of every employee (Planko, 2001, page 33).
In practice it can be very difficult to carry out the aforementioned changes and introduce them in a successful and efficient manner. The main reasons for this lie in the lack of awareness between employees regarding such changes, fear of economic and social consequences of such changes and the fear of unknown. It is therefore very important for companies to introduce these changes comprehensively and systematically.
Basic definitions of knowledge management correspond to a great extent to the basic guidelines of the theory of learning organisation. However, knowledge management provides a much more comprehensive and broad view of knowledge and its management in an organisation, as it mainly focuses on the transfer of individual parts of knowledge within and beyond the organisation.

Following the comparison between the theory of learning organisation and knowledge management we could conclude that the latter represents an upgrade of the theory of learning organisation. The introduction of knowledge management to a company represents a strategic decision which is directed and monitored by top management levels and includes not only the acquisition but also the appropriate management of the acquired knowledge. Every organisation that introduces and operates according to the principles of knowledge management is at the same time a learning organisation.

2.3 Intellectual property - general

The importance of new knowledge, managed effectively by organizations as intellectual property, has grown dramatically in the past decade. Original discoveries, know-how, software and new technologies - protected by patent or copyright - are the foundations for new products, process innovations and commercialization in the world's marketplaces.

Intellectual property refers to the rights which results from intellectual activities in industry, research, literature and art. The intellectual property has to be protected for two main reasons:

- ✓ To protect moral and economic rights of the author for his (her) work and to define the rights of the general public to access the same work,

- ✓ To promote creativity, extension and use of results of this work and to encourage fair trade which will contribute to economic and social development.

Intellectual property includes two main branches:

- ✓ Industrial property, mainly in inventions, trademarks, industrial designs, and appellations of origin;
- ✓ Copyright, mainly in literary, musical, artistic, photographic and audiovisual works.

An invention is a novel idea in practice which permits the solution of a specific problem in the field of technology. Inventions which are new, involve an inventive step and are industrially applicable and patentable (Art. 52 of the European Patent Convention). According to the United States International Trade Commision, a patent is a grant issued by a national government conferring the right to exclude others from making, using, or selling the invention within the national territory (D'Amato in Kornhauser, 2001, page 187).

Patents play a vitual role in research, both for the protection of inventions as well as providing a unique source of research information (over 70% of information in patents is never published elsewhere). Scientists planning to work in a particular research field will first need to check the patent literature to understand fully what has already been patented, and secondly check the wider scientific journals to find out what has already been published, becouse one of the conditions for gaining a patent is »no prior disclosure«.
Converting research innovation into a patent is a very specialised (and expensive) activity normally undertaken by industrial partners (ASEM, 1999, page 5).

National patents are normally granted without a novelty examination 18 months after the application. The protection of inventions is limited in time, generally 20 years from the filling data of the application for the grant of a patent. In certain cases, e.g. pharmaceutical products, the term can be extended up to an additional five years. The patentee has to prove, by submitting a written proof (Document of Evidence), that the patented inventions are novel not later than before the end of the ninth year of validity of the patent (ASEM, 1999, page 6).

With the development of industrial research activities which includes a great deal of fundamental research in strong multinational enterprises, the publication of new discoveries seems to be in favour of patents. A branch of industry has the power to stop and seal all fundamental publications before the patenting of priority knowledge. This is extremely important for any industrial branch since it is impossible to obtain patent protection for something that has already been published. It is only after the publication of patents that information about new knowledge – most often only partial – is published in scientific magazines. If university research relies mainly on traditional scientific and research publications it is self-evident that its information lags behind for at least two to three years.

Thus, linking basic and applied research to create inventions and patent them should be at the top level of university education. Scientists must teach how to protect the traditional knowledge, using patents as an important source of information and to write patent applications. Students need to acquire the skills to monitor innovations in

their field of interest and to generate new R&D ideas as a result. However, this is not sufficient: without industry, added value cannot create. University education should prepare students for cooperative tasks.

2.3.1 Basic definitions of innovations, improvements and inventions

A newly acquired knowledge is called an **INVENTION** (DISCOVERY) (Vuk, 1999, page 54). An invention as such does not guarantee any form of application. It can therefore be stated that applicability is one of the features that cannot be interlinked with inventions. When speaking of inventions, these are not necessarily associated with applicability, which is, however, most desirable if we wish to turn it into an innovation.

What is an **innovation**? In his book Drucker (1992, page 37) stated that an innovation is an activity that modifies the potential of a well-known or a new object or process, which has been added a new applicable value.
The aforementioned author also describes an innovation as both a social and a technical concept. According to this theory the innovation is not considered only as a technical improvement but places innovation into a broader social framework.

One of the main characteristics of innovation is that a society or a system, in which a certain innovation exists, uses objects and carries out processes differently instead of in the already existing ways. Drucker's theory considers innovations and entrepreneurship as useful and wholesome changes. Other authors, e.g. Waterman (1987, page 40), consider an innovation and the innovative activity in a much more narrow sense. As such, the act of innovation is considered as a process while an innovation is a result of the aforementioned process. According to their theory an innovation is a consequence of thinking and creating a competitive edge of an individual or a group and all activities that are applied in order to realise such thinking. Waterman even believes that in this way an innovation is merely a "commercialisation" of an idea that creates benefits for the system itself. This means that an idea brings a certain amount of revenues to the system, while it does not necessarily bring profit. Other authors, for example Majaro, define innovation as a practical use of ideas that are applied in order to achieve the objectives of a system effectively (Majaro, 1992, page 6). Such definition of a practical usage is a little bit broader than mere commercialisation. The above mentioned author is here mainly referring to all ideas that can be practically used in a process of adding value to a product or a service. A concept of practical use also includes all those ideas whose benefits and advantages cannot be simply determined in the material sense.

We can therefore conclude that practical application does not necessarily means the commercialisation of the idea, while any act of commercialisation must entail a practical use of ideas.

If we try to define an innovation we can surely state that an innovation represents the realisation of an idea. Innovation does not necessarily entail commercial benefits, but focuses on the ascertainable advantages that an innovation possesses in a system.

When dealing with the concept of innovation we often come across the concept of improvement. An **improvement** is usually not based on certain new knowledge but

uses the already known and recognised principles in order to master certain processes more efficiently. The mastering of certain processes can contribute to the decrease of production time, a more precise and less expensive production, the use of safer productive processes and similar. It includes every single activity that is of benefit to a system. Such benefit cannot be measured only in value as it is connected to other non-valuable areas. An improvement does not necessarily represent anything new. On the contrary; an improvement represents the transfer of an existing solution into similar products or processes which contributes to the improvements of the system. It is this very notion that distinguishes improvement from innovation as the benefits of both concepts cannot be contradicted. If we consider the criteria of usefulness or advantage improvements cannot be distinguished from innovations. These two concepts can only be distinguished on the basis of novelty which they represent. However, if we focus on the descriptions of the aforementioned concepts in the European Union legislation we can notice that the EU does not recognise improvements as a special part of knowledge and that such distinction is not necessary. Nevertheless, I am convinced that the above defined concepts present far too many differences and that these cannot be taken for granted.

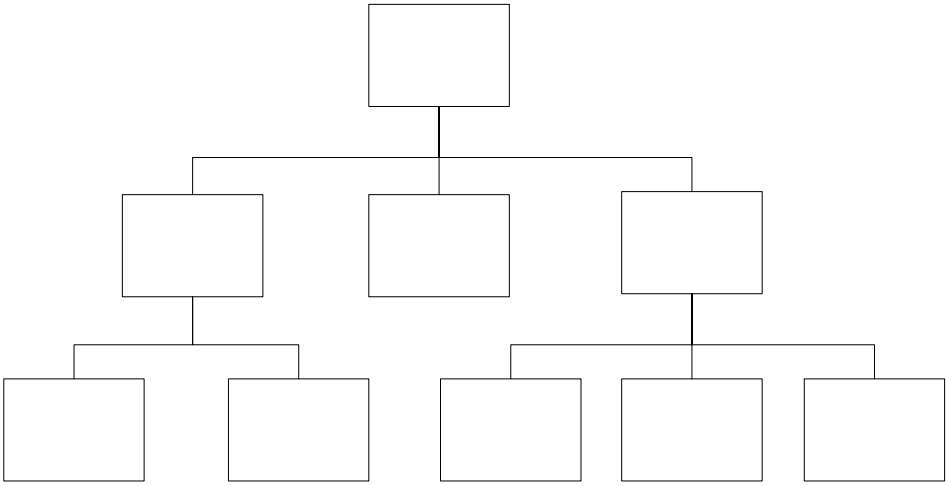
2.3.2 Intellectual property in Slovenia

After its independence Slovenia has began its close cooperation with the European Union already in 1991. The Republic of Slovenia has established the Slovenian Industrial Property Protection which has cooperated with well-known legal advisors and some representatives of Slovenian industry in the drafting of a new Industrial Property Act. This new Act has set two main objectives: to ensure an efficient protection of inventions and other rights deriving from industrial property, and to harmonise Slovenian legislative acts with contemporary legislation in the (developed) world.
The aforementioned Act has harmonised the extent and scope of rights with modern patent and legal regulations which are strongly based on PCT (Patent Cooperation Treaty), EPC (European Patent Convention) and GATT-TRIPS (Agreement on the harmonisation of legislation in the field of industrial property). The aforementioned act has enabled Slovenia to adopt the adequate Decision on the Ratification of Cooperation Agreement between the Government of the Republic of Slovenia and the European Patent Organisation.

The Slovenian Intellectual Property Office (SIPO) was formally established on 25 June 1991, when Slovenia became independent, under the name the Slovenian Industrial Property Protection Office and as an autonomous body within the Ministry of Science and Technology. In 2001 it started operating under the authority of the Ministry of Economy.

Figure 2 shows the classification of Intellectual property (adapted according to the Slovenian Intellectual Property Office – SIPO, 1998):

Figure 2: Classification of intellectual property



Source: Devon, Kardoš and Kornhauser (2001, page 186)

Appendix 1 shows comparison between Slovenia and other EU member countries according to the following categories: European patents per million population, Average annual growth in European patents, Number of scientific publications per million of population, Average annual growth in number of scientific publications and Number of scientific publications and number of researchers (FTE) - average annual growth.

Copyright and related rights

Author's rights

Related ri

3 SCIENTIFIC AND RESEARCH ACTIVITIES IN SLOVENIA AND IN THE WORLD

3.1 Definition of research

For purposes of the NRF, research is original investigation undertaken to gain knowledge and/or enhance understanding.

Research specifically includes:

- ✓ The creation and development of the intellectual infrastructure of subjects and disciplines (e.g. through dictionaries, scholarly editions, catalogues and contributions to major research databases);
- ✓ The invention or generation of ideas, images, performances and artefacts where these manifestly embody new or substantially developed insights;
- ✓ The use of existing knowledge to produce new or substantially improved materials, devices, products, policies or processes.

It specifically excludes:

- ✓ Routine testing and analysis of materials, components, instrument s and processes, as distinct from the development of new analytical techniques.
- ✓ The development of teaching materials and teaching practices that do not embody substantial original enquiry.

3.2 European Research Activities

Europe has a long standing tradition of excellence in research and innovation, and European teams continue to lead progress in many fields of science and technology. Member States generally have their own research policies and structures, quite often of a high standard, but on a European level this leads to fragmentation and inefficient use of resources.
In the past, collaborative actions have been initiated at European and Community level. In March 2000 the Lisbon European Council adopted the European Research Area (ERA) in order to build a research and innovation equivalent of the "common market" for goods and services.

3.2.1 European Research Area (ERA)

The European Research Area (ERA) is working to coordinate national research policies in the direction of shared objectives, expertise and resources. In keeping with this thinking, heads of state and government have confirmed a new ambition which will give a decisive impetus to the ERA's dynamic: the European Union is to increase its global expenditure on research to 3% of GDP - or one and a half times the current level – by 2010. This substantial increase will enable us to bridge the gap with the United States and Japan.

Many indicators show that European research lacks the dynamism found in the United States and Japan, and thus lose its competitive advantage in the global market.

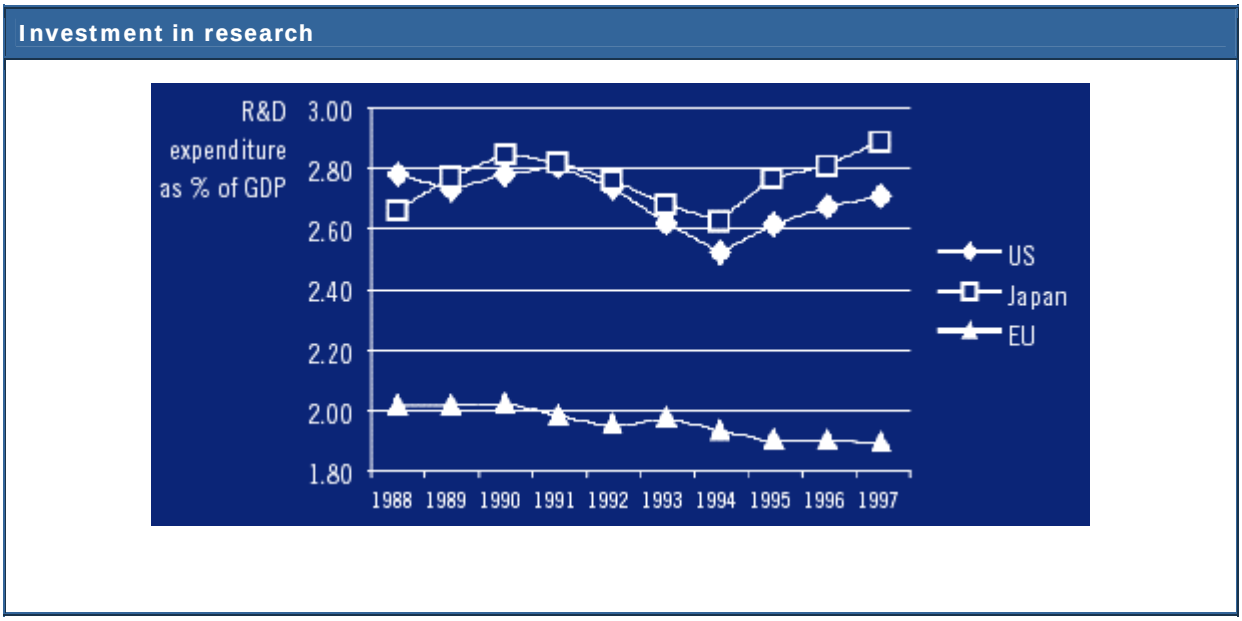
What are the reasons for the gap between Europe on one side and USA and Japan on the other, and for the lack of **dynamism**?

- ✓ *Insufficient financial and human resources,*
- ✓ *Lack of innovation,*
- ✓ *Dispersion of effort.*

Insufficient financial and human resources

In GDP terms, the European Union's research expenditure has been shrinking over the past ten years. Expenditure has been far higher, and expanding, in the United States and Japan, as showed in Figure 3.

Figure 3: Investment in research



Source: Eurostat

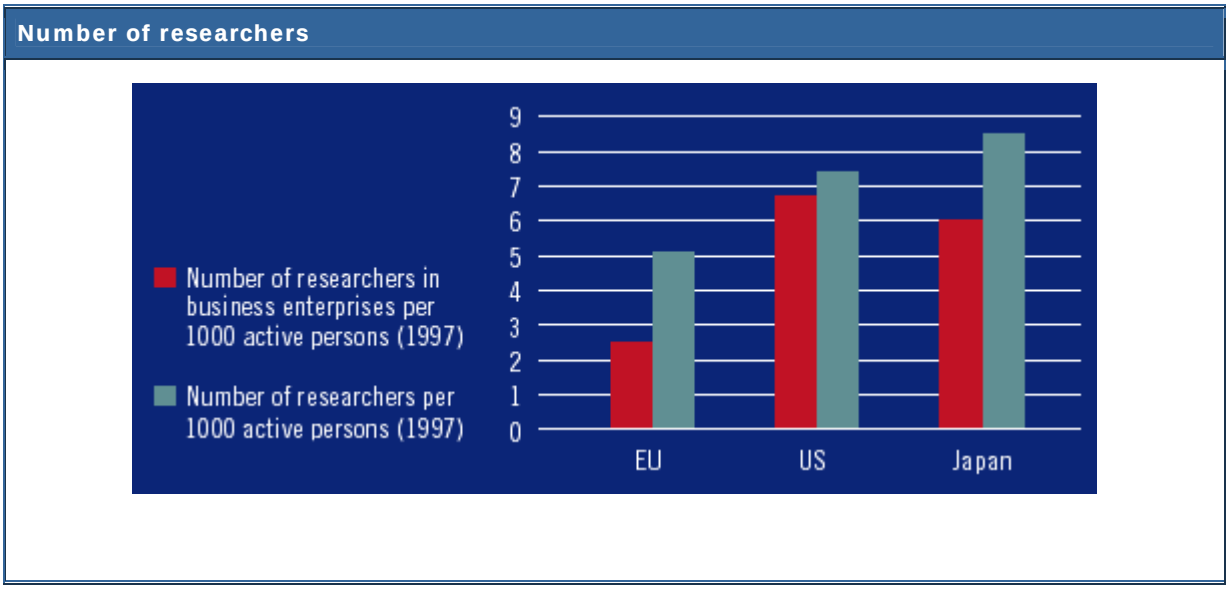
Across the Union, research funding is stagnating at an average of 1.8% of gross domestic product (GDP), while it is growing in both the United States (2.7%) and Japan (3.1%). In 1999, with a similar GDP, the USA spent 75 billion euro more on research and development than the EU[1]. This gap has been widening since 1994. The United States and Japan also devote much larger parts of their so - called venture capital resources to new enterprise creation, in particular in high technology.

[1] In 2000 the 15 Member States of the European Union had a total population of 377 million, the United States 272 million and Japan 126 million.

Number of researchers

As a percentage of its active population, Europe has considerably fewer researchers than the USA or Japan even though the number of science students is proportionally higher. With investment in research stagnating, it is hardly surprising that young people are not interested in research careers and that we are faced with the worrying phenomenon of the »brain drain«. For example, 83.101 European researchers and engineers were working in the United States in 1997, compared with 77.283 in 1993. And half of the 8.760 European students completing doctorates in the USA between 1988 and 1995 opted to continue their careers in that country. See Figure 4.

Figure 4: Number of researchers

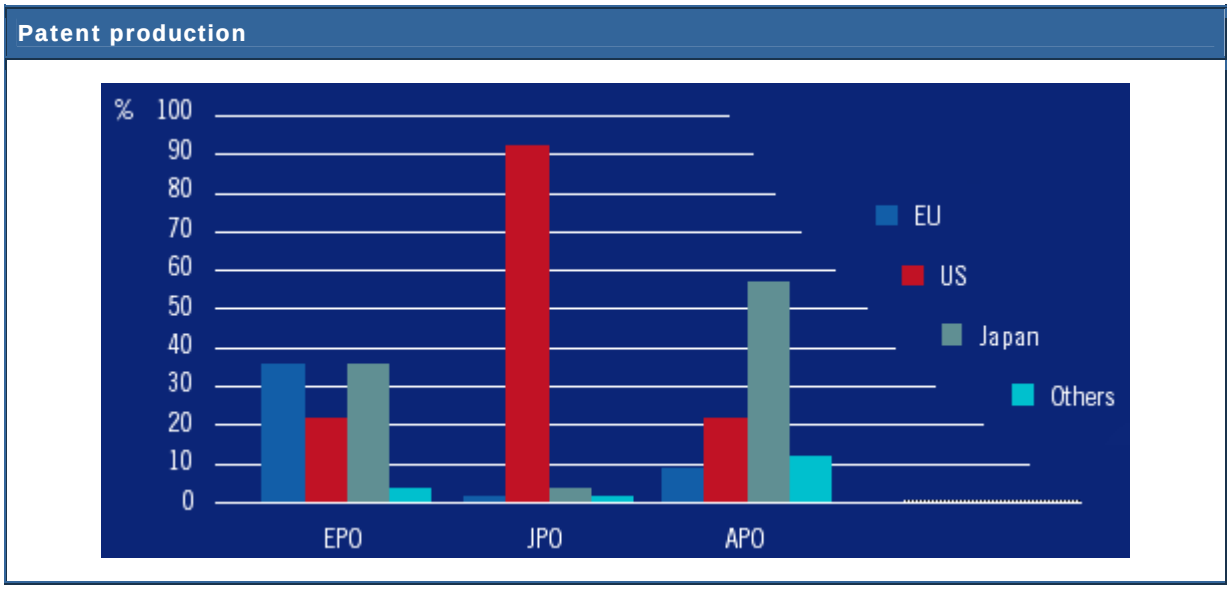


Source: Eurostat

Patent production

European countries lodge, via the European Patent Office (EPO), just 36% of the high technology patents registered in their territory, and only 9% and 2% of the patents registered at the American Patent Office (APO) and Japanese Patent Office (JPO) respectively. The bulk of the remaining 63% of high-tech patents at the EPO is by the United States (36%) and Japan (21%), as showed in Figure 5.

Figure 5: Patent production



Source: Eurostat

These figures, which do not exactly flatter the Old World, are due not just to a certain lack of culture of innovation, but also to the very high cost and complexity of registering a patent in all Member States – a situation which significantly penalises Europeans vis-à-vis their competitors. Unlike in the United States or Japan, European research represents a jigsaw of 15 often very different national scientific and technological policies.

Dispersion of effort

As explained above.

The ERA is not limited to the European Union countries. For several years now, Community research programmes have been opened up to associated countries of European Union.

3.3 Research Activities in Slovenia

Proportionally to its small size, Slovenia's research potential is impressive: the number of students trained at the universities of Ljubljana and Maribor is 38.000; in addition, besides the Academy of Science and Arts, there are approximately 50 independent research institutes including the two most important ones, the Jozef Stefan Institute and the National Chemistry Institute (Stanovnik, 1998, page 64). See appendix 2[2].

[2] Appendix 2 shows the comparison between Slovenia and other EU member countries in the following categories: Total researchers (FTE) per 000 workforce, Average annual growth in total researchers (FTE), R&D intensity, Total researchers (FTE) per 000 workforce and R&D intensity, Industry-financed R&D as a % of industrial output, Share of government budget allocated to R&D, Civil R&D as a % of total government R&D budget.

In the private sector, the first years of the economic transition saw a reduction in expenditure and in research personnel. This decline was halted in 1994. Right now there are around 180 R&D units operating in Slovenian enterprises, mainly in the electronics, biotechnology, materials and industrial technology sectors.

Promoting S&T is a primary objective of the Slovenian Science Foundation and the Slovenian Academy of Sciences and Arts.

Scientific and research activities are carried out by scientists and researchers in cooperation with other technicians, experts and professionals working for Scientific and Research organisations, institutes and enterprises which are registered in the field.

Table 2 shows the number of employees in scientific and research organisations in Slovenia in 1997.

Table 2: The number of contract or permanent staff working in the field of research according to sectors and level of education; 1997

Employees	Total		PhD		MA		Specialisation	
	total	women	total	women	total	women	total	women
1997 **TOTAL**	**11 586**	**4 659**	**2 176**	**513**	**1474**	**608**	**217**	**99**
Researchers	6 072	2 047	2 032	479	1 256	523	192	91
Young researchers	916	418	25	12	304	138	2	1
Professional staff	1 588	583	78	24	147	66	14	5
Technical staff	2 491	1 184	1	0	3	2	1	1
Management	345	74	64	10	61	14	10	2
Other employees	1 120	771	1	0	7	3	0	0

Source: Statistical chronicle of the Republic of Slovenia 2000, page 145

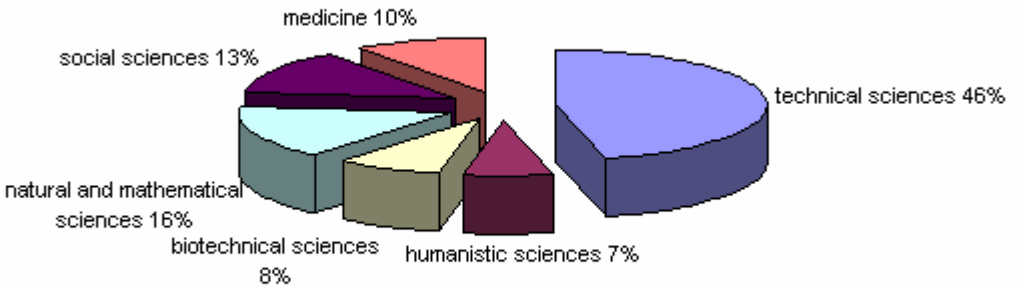
3.3.1 Research human resources according to disciplines

In the following section some basic information regarding the research human resources in Slovenia will be presented from the point of view of its distribution in different scientific disciplines. Records obtained from the Ministry of Science and Technology which are kept according to the Regulation on standards for the estimation of quality of research activities and on records and the Regulation on monitoring of research activities (Pečlin, 1998, page 1) represent the main source of information presented below.

Research activities according to disciplines

The records of the Ministry of Science and Technology include 753 research groups. If we focus on their distribution according to scientific disciplines we can observe the following in Figure 6:

Figure 6: The structure of research groups according to disciplines

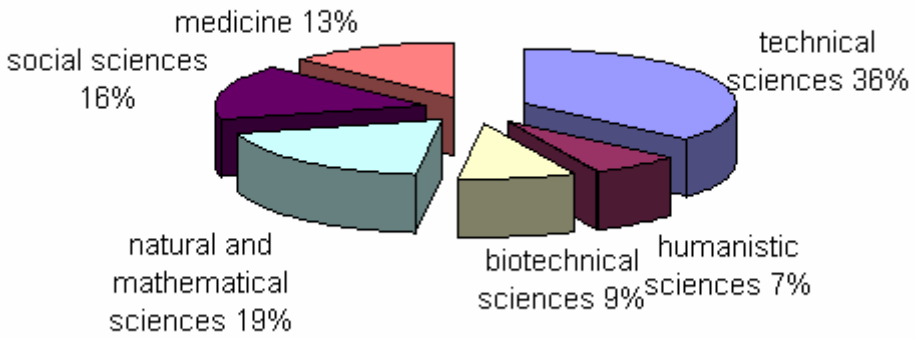


Source: Pečlin, 1998, page 2

Researchers according to disciplines

The records of the Ministry of Science and Technology currently include 6971 researchers (this figure includes researchers, teacher - researchers, researchers working in the field of development and young researchers). Their distribution according to disciplines is presented in Figure 7.

Figure 7: The structure of researchers according to disciplines



Source: Pečlin, 1998, page 3

In the public sector scientific and research activities in Slovenia are carried out by the following organisations:

- ✓ Slovene Academy of Science and Arts (SAZU)
- ✓ Faculties, university departments and academies, colleges that meet the criteria for this kind of activity
- ✓ Public research institutes.

Research activities can also be carried out by:

- ✓ Other organisations
- ✓ Private researchers,

which are registered in the field according to the Act on Research Activity (Pečlin, 1998, page 15).

The Act on Research Activity (Pečlin, 1998, page 15) determines three different areas of research activity:

- ✓ Basic research
- ✓ Applicative research, and
- ✓ Experimental development.

Basic research includes any experimental or theoretical work whose main objective is the acquisition of new knowledge on the basic features of fundamental phenomena and facts obtained during observation.
Applicative or applied research represents original research whose main objective is the acquisition of new knowledge based on certain experience and the production of new materials, products or machinery as well as the introduction of new procedures, systems or services.
Experimental development is a systematic use of knowledge and understanding acquired through applied and basic research and from practical experience whose main objective is to create new materials, machinery, systems and methods, including the phase of product design, the preparation of prototypes, processes, services and organisational systems. It also strives to provide essential improvements to the existing materials, devices, systems and processes.
Apart from the three basic activities scientific and research activity also includes other elements of research and development which are organised in research infrastructure.

3.3.2 Scientific and research organisations

As previously mentioned scientific and research activities are carried out by scientists and researchers cooperating with other professional and auxiliary staff in scientific, research and other organisations.

As a precondition a scientific and research organisation needs to engage researchers, scientists responsible for the execution of research and developmental projects, research equipment, premises and information and documentation support prior to their activities in a certain research area. The adequacy of criteria necessary for research activities in private sector is determined by a national administrative body which is competent for the field of research activities.

Basic objectives of any scientific and research activity are determined by the *Act on Research Activity* (Pečlin, 1998, page 15). These objectives include the following: the expansion and deepening of scientific discoveries, the promotion of scientific applicability, the increase of research activities and the education of top professionals and experts.

Scientific and research organisations and research and development organisations are divided into five different sectors according to their basic activity, objectives, economic and legal status and their source of financing (Statistical chronicle of the Republic of Slovenia RS, 2000, page 143):

- ✓ Business sector includes all corporate and other organisations whose basic activity is market oriented production of goods and services. This sector mainly includes research and development organisations, development departments and groups in businesses and corporations.
- ✓ Governmental sector includes all scientific and research and research and development institutes and other organisations which receive their financing from the national budget.
- ✓ Higher education centre includes universities (public higher education institutes) and research institutes, experimental units and clinics which operate under or are closely connected direct control and management of higher education institutions. The core of this sector is formed by universities and faculties. University hospitals and clinics are included in this sector on the basis of their cooperation with higher education institutions.
- ✓ Private non-profit sector includes private non-profit institutions which provide services to individuals and households. They are financed by their founders while a part of financial funds can be obtained from corporate organisations and governmental sources. According to international conventions this sector also includes research and development activities of citizens (private researchers).
- ✓ Foreign countries represent a special sector in the field of financial inflow and outflow into scientific and research and research and development areas.

The following sections present some of the most important scientific and research organisations in Slovenia.

Universities and institutions of higher education

The traditional role of a university is to form a connection between research and education. University still represents a place providing the development of basic types of science and is the fundamental reference point in the professional career of every scientist and researcher. In Slovenia university education is defined as scientific education, which should encourage general and systematic reflection and promote critical thought. It should also provide a basis for theoretical analysis and scientific reviews, the development of methodology, systematisation and the codification of knowledge. Given the contemporary level of scientific development university science still appears to be divided according to disciplines. Different disciplines form a social area that enables the socialisation and professionalisation of every individual and their scientific career (Mali, 1999, page 20).

The *University of Ljubljana* and the *University of Maribor* are among the most important educational institutions that carry out research activities in Slovenia. There

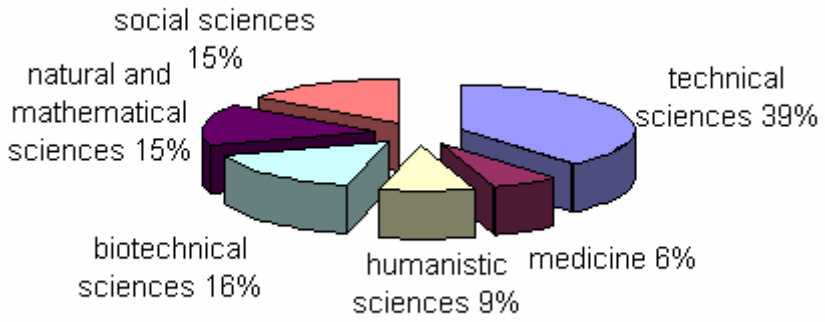
are, however, other institutions of higher education that operate in the field of research in Slovenia: *RS MNZ – Faculty of Criminal Justice, the Polytechnic of Nova Gorica, College of Enterpreneurship and Turistica – Faculty of Tourism*, with headquarters in Portorož and *Faculty of Management* in Koper.

University of Ljubljana

The records obtained from the Ministry of Science and Technology contains data regarding the human resources potential of twenty six member organisations of the University of Ljubljana. There are 255 research groups within the University, namely 39 in the field of natural and mathematical sciences, 97 groups in the field of technical sciences, 16 groups in the field of medicine, 42 groups in the field of biotechnology, 38 groups in the field of social sciences and 23 groups in the field of humanistic sciences.

Figure 8 represents the structure of research groups within the University of Ljubljana according to disciplines.

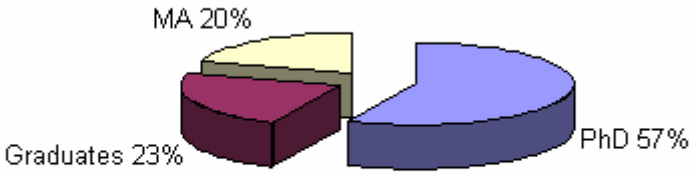
Figure 8: The structure of research groups within the University of Ljubljana according to disciplines



Source: Pečlin, 1998, page 4

The University of Ljubljana employs 2022 researchers, mostly teachers and professors with the educational structure as presented in Figure 9.

Figure 9: Educational structure of employed teachers - researchers and young researchers at the University of Ljubljana

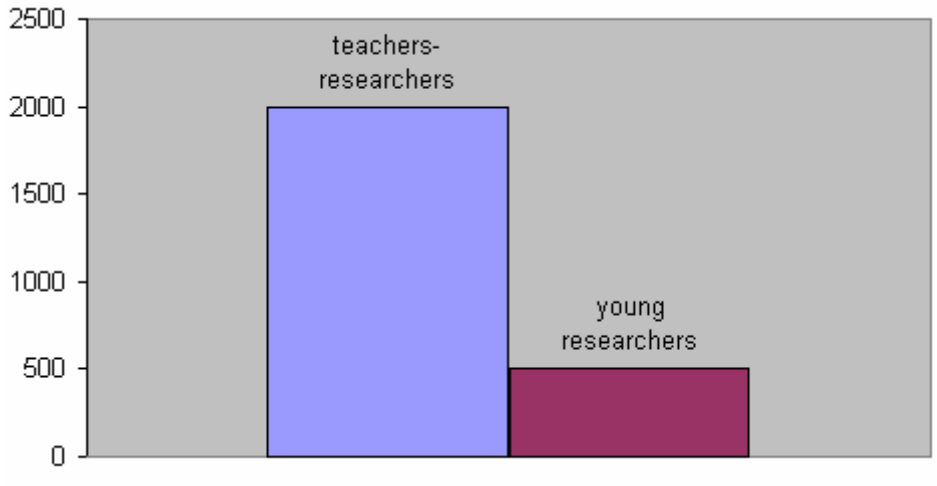


Source: Pečlin, 1998, page 5

There are also 89 teachers - researchers, among which 57 hold a PhD, who work at the University of Ljubljana on a contract basis.

In the period between January 1997 and January 1998 518 young researchers, among which 292 held a MA and 226 held a PhD, were undergoing additional training and education within the research groups of the University of Ljubljana. The relationship between teachers - researchers and young researchers at the University of Ljubljana is presented in Figure 10.

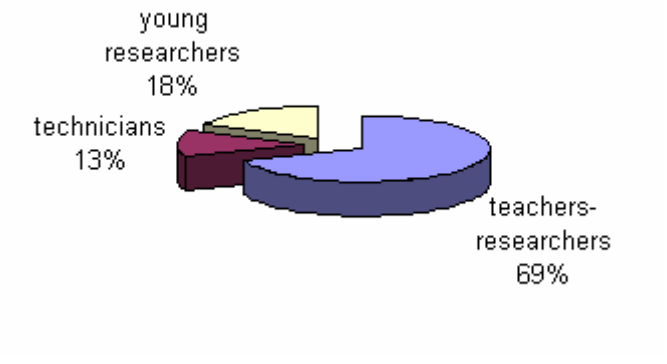
Figure 10: The number of teacher - researchers and young researchers at the University of Ljubljana



Source: Pečlin, 1998, page 5

The University of Ljubljana also employs 377 technicians and experts. The relationship between teachers - researchers, young researchers and professional technical staff is presented in Figure 11.

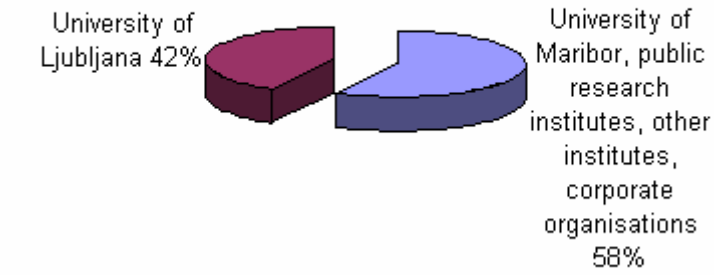
Figure 11: The proportion of teachers-researchers, young researchers and technicians in the employee structure at the University of Ljubljana



Source: Pečlin, 1998, page 5

The proportion of financial funds of the University of Ljubljana in the total funds available for the education and training of young researchers is presented in Figure 12.

Figure 12: The proportion of financial funds of the University of Ljubljana in the total funds available for the education and training of young researchers

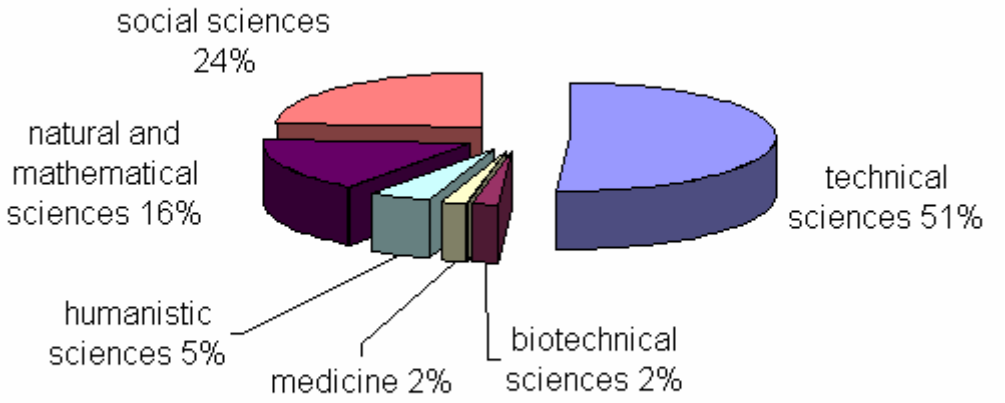


Source: Pečlin, 1998, page 6

University of Maribor

Our records contain information regarding the human resources potential of ten member organisations within the University of Maribor. These include 86 research groups, namely 14 in the field of natural and mathematical sciences, 43 in the field of technical sciences, 2 in the filed of medicine, 2 in the field of biotechnology, 21 groups in the field of social sciences and 4 groups in the field of humanistic sciences, as presented in Figure 13.

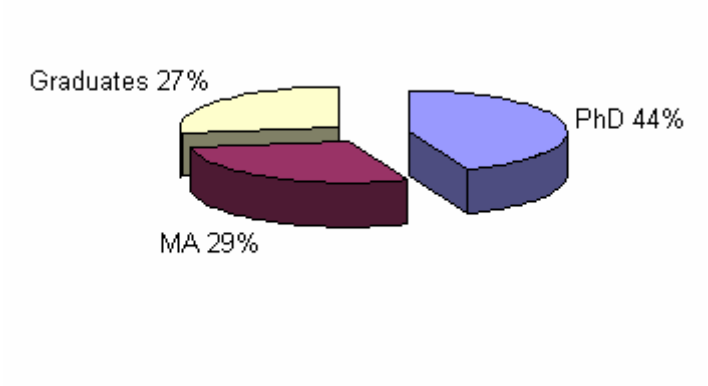
Figure 13: The structure of research groups at the University of Maribor according to disciplines



Source: Pečlin, 1998, page 6

The University of Maribor also employs 587 researchers, mostly teachers - researchers, as presented in Figure 14.

Figure 14: The educational structure of employed teachers - researchers at the University of Maribor



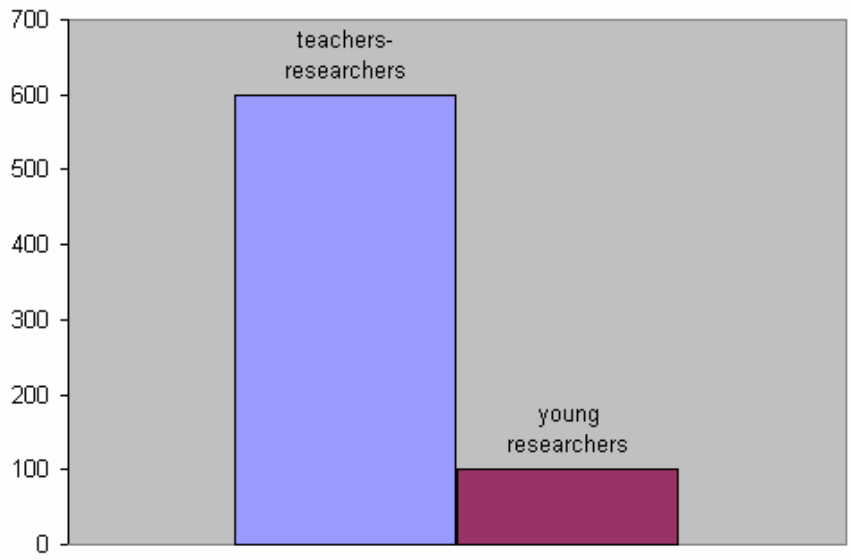
Source: Pečlin, 1998, page 6

There are also 18 teachers-researchers, among which 12 hold a PhD, who work at the University of Maribor on a contract basis.

In the period between January 1997 and January 1998 112 young researchers, among which 75 held a MA and 37 held a PhD, were undergoing additional training and education within the research groups of the University of Ljubljana.

The relationship between teachers - researchers and young researchers at the University of Ljubljana is presented in Figure 15.

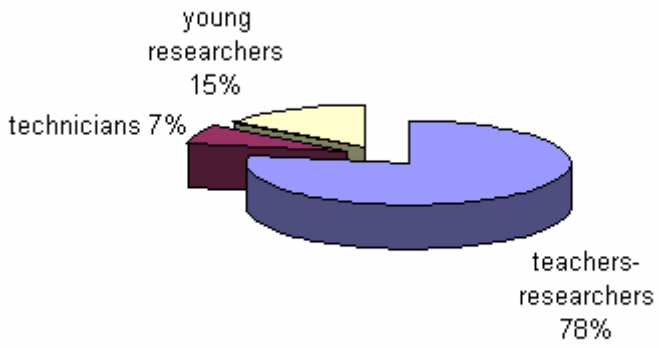
Figure 15: The number of teacher-researchers and young researchers at the University of Maribor



Source: Pečlin, 1998, page 7

The University of Maribor also employs 56 technicians and experts. The relationship between teachers - researchers, young researchers and professional technical staff is presented in Figure 16.

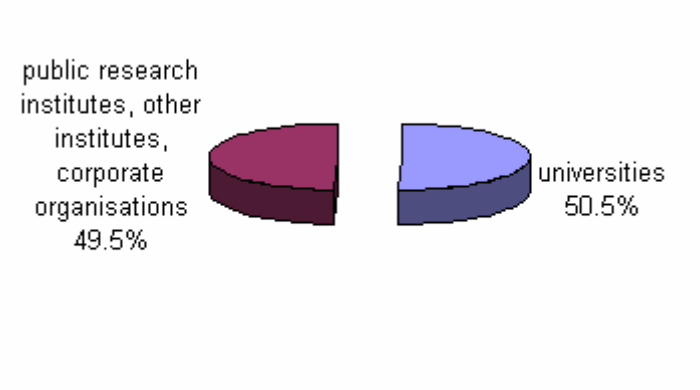
Figure 16: The proportion of teachers - researchers, young researchers and technicians in the employee structure at the University of Maribor



Source: Pečlin, 1998, page 7

The proportion of both universities in the funds available for the education and training of young researchers is presented in Figure 17.

Figure 17: The proportion of both universities in the funds available for the education and training of young researchers



Source: Pečlin, 1998, page 7

Research organisations

Due to different political interests in the recent history research activities has been transferred from universities to research institutes within the academies of science. Some issues regarding research activities at the universities of Central European and Eastern European transition countries, among which is also Slovenia with its two universities, originate from the aforementioned fact and can be described as follows (Mali, 1999, page 18):

- ✓ The lack of understanding and respect for the idea of autonomous university and its connection with broader social environment;
- ✓ The lack of scientific and technological parks situated near universities;
- ✓ Underdeveloped forms of transfer of scientific discoveries into educational process;
- ✓ The lack of involvement of university researchers into international scientific spheres;
- ✓ The protection of intellectual rights;
- ✓ Ethical issues in science.

Nowadays the activities of research organisations in Slovenia which are financed or co-financed by means of national budget are publicly available. The main task of these organisations is to carry out those research projects that are not carried out by universities or industrial sectors due to the lack of specialists, research equipment or other reasons. Research organisations inform the public of their activities by publishing a research programme, the results of their research activities and annual reports regarding their work and the use of financial funds.

Public research institutes in Slovenia include:

- ✓ GeoZS (the Geological Institute of Slovenia)
- ✓ Slovene Instiute of Forestry
- ✓ IER (Institute for Economic Research)
- ✓ IJS (the Institute of Jožef Stefan)
- ✓ IMT (the Institute for Metal Materials and Technology)
- ✓ Institute of Geography
- ✓ INV (the Institute of Ethnic Studies)

- ✓ Institute of Chemistry
- ✓ Agricultural Institute of Slovenia
- ✓ NIB (National Institute of Biology)
- ✓ Institute of Education
- ✓ UI (the Institute of Urban Planning)
- ✓ ZAG (Slovene National Building and Civil Engineering Institute)
- ✓ ZRC SAZU (Scientific Research Centre of the Slovene Academy of Science and Arts)
- ✓ ZRS Koper (Scientific and Research Centre of the Republic of Slovenia, Koper).

Within their research activities and upon agreement with their founders public research institutes can cooperate with universities or faculties or colleges in the execution of their curricula and especially in the carrying out of post-graduate education programmes.

Other research organisations, which do not posses a status of public research institute, are presented in Appendix 3.

Institute of Jožef Stefan

In view of its activities and status, the Jožef Stefan Institute plays the role of a national Slovenian R&D institute, complementing the role of the two Slovene universities (of Ljubljana and Maribor) and bridging the gap between science and applications. The Jožef Stefan Institute is a research organisation for pure and applied research in the natural sciences and technology. It comprises about 20 research departments. Emphasis in basic research is given to high-quality national research, while applied research and development serve for the transfer of advanced knowledge into practice, thereby contributing to the development of the national economy and society in general. The institute has strong links to many universities and other research institutes in Europe and in other parts of the world. It earns an important amount of income through direct or indirect contracts with industry and other partners in Slovenia and also abroad. Typical R&D results for these customers include, among others: environmentally clean technology, special instrumentation, computer-based tools and methods, software and high-tech products, isotopes, environmental measurements and analyses, (nuclear) safety and risk evaluation, as well as various consulting projects.
The total number of research staff is 494: 176 researchers, 64 post-graduates, 178 young researchers and 76 technical officers.

3.3.3 Developmental departments in economy

Industry depends on the input of knowledge from research.

One of the huge challenges to the leaders of the information age, will be to create an organisation, which is able to use “new” knowledge from the international base of research results (knowledge) and share its knowledge with all employees in the company according to the knowledge management system. Of course, fast and effective use of knowledge to create new products, technologies or services is expected in order to keep the competitive advantage in global market.

Slovenia was rather successful in preserving its R&D system after the transition (Bučar and Stanovnik, 2001, page 43). Some decrease of funds was experienced only in the first years (beginning of 1990s) due to collapse of large industrial conglomerates. The state picked up the financing of R&D, which allowed survival of most of the major research units. The side consequence of increased share of public funds for R&D was reorientation of academic and public research organisations in direction of a more fundamental research (see Figure 18) and looser ties with business sector. The negative implication of these trends is often criticised poor link between, relatively well developed public research sector and business community needs: the latter is not satisfied with the level of response or the type of knowledge available in public R&D (Bučar, 2003, page 49).

In recent years the investment of business sector in R&D is growing and accounts for more than a half of total funds, yet little of that money finds its way in the public research sector. A more dynamic growth is called for, it is hard to accept that majority of the research potential of a small country is not involved in activity, which would support the needs of its economy.

Table 3 presents R&D expenditures by source of financing in Slovenia for period 1993 to 2000.

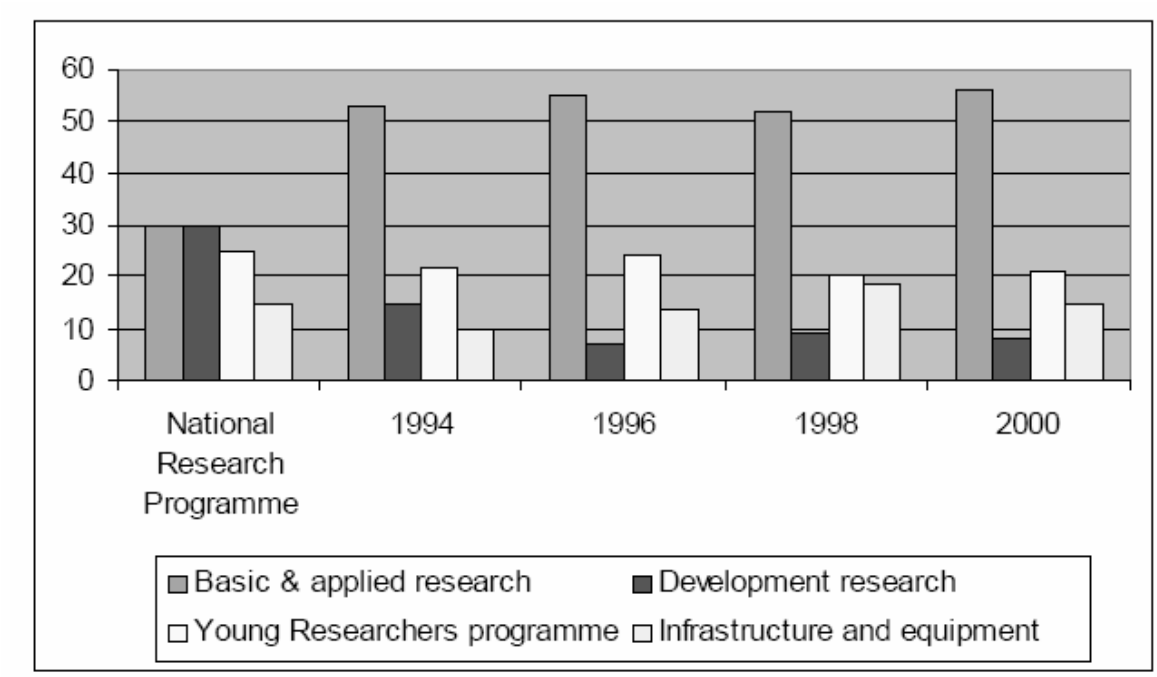
Table 3: R&D expenditures by source of financing, 1993-2000 (in EURO million)*

	1993	1994	1995**	1996	1997	1998	1999	2000
Business	66.0	86.5	112.8	106.6	122.9	135.5	162.2	159.8
Government	101.9	121.8	125.7	104.0	86.7	104.9	106.6	121.1
Private, non-profit	0.2	0.3	0.2	0.8	0.5	0.1	0.2	0.1
Foreign	5.5	5.5	7.2	5.8	18.9	17.3	16.0	18.6
Total	173.7	214.11	245.9	217.2	229.0	257.8	285.0	299.6
As % of GDP	1.61	1.77	1.71	1.44	1.42	1.48	1.51	1.51

* *Calculated from SIT using average annual exchange rate*
***In 1995, the figures for R&D expenditures were overvalued due to a statistical error made in higher education.*

Source: Statistical Office of the Republic of Slovenia, Rapid Reports on R&D for consecutive years

Figure 18: The structure of public funds for R&D in percentages



Source: Statistical Office of the Republic of Slovenia, Rapid Reports on R&D for consecutive years

As previously mentioned the business sector is investing increasingly into R&D, but most of the resources remain within the sector. Several studies of the research in business were carried out by different authors, pointing to the concentration of R&D efforts in manufacturing and further, within selected number of manufacturing branches. The pharmaceutical industry remains the most important R&D performer, followed by electrical machinery, medical and precision instruments, TV and communication equipment, transport equipment, rubber industry, etc. The share of services in R&D is disproportionably low, comparing to the increasing share of service sector in GDP. Larger businesses seem to be much more aware of the need to invest in innovation and R&D, but have low expectations as to the cooperation with public research sphere.

A critical element, which deserves more attention in innovation policy planning, is relatively low absorption capacity of the business sector if measured by current status of R&D units in industry. The research units in business are usually small and employ on average 10 engineers. Education structure of researchers in business sector is substantially lower than in public research units (of 2535 researchers with PhD, only 172 works in business sector). This would imply that with the exception of few, the research conducted in these units is focusing primarily on development or adaptation of imported technical solutions.

Innovation activity

According to numerous data and analyses (Ministry of Economy, 2000, page 8), the existing level of technological and managerial capabilities in Slovenia is not yet at a level where market forces alone would be sufficient for its dynamic and integral restructuring. Slovenian enterprises are too slow in changing and innovating their production programmes, techniques, products and/ or services. Wholly Slovenian

owned companies introduce some sort of innovation to only 37% of their programmes over a five-year period, those with majority foreign ownership 55%, while the most competitive companies in the developed market economies change 75% of their programmes during the same time period (Sočan, 1998, page 56).

Business sector R&D expenditures reflect a high degree of concentration in only very few industrial branches and can be assigned to a small number of individual large companies active in a limited number of industries. These few companies are all export oriented and therefore facing global competition. So it would be premature to conclude that the rising business expenditures on R&D already reflect the positive outcome of macroeconomic policies of open market economy, since majority of these companies were in the forefront of investments in R&D and innovation in the past as well (Bučar, 2003, page 6).

Many research based and innovative industries are aware that mastering new knowledge and technology is essential for their dynamic growth.
In a corporate environment the sum of the knowledge of individual persons forms the "corporate knowledge" or "memory". This does unfortunately not mean that the corporate knowledge is also shared knowledge. To obtain shared knowledge it is necessary to transfer the knowledge that exists in the heads of the individual persons to others who need this knowledge and to make at least a "shadow" of knowledge in the heads of people available as computerised knowledge. However, knowledge transfer is not necessarily a synchronous process. Rather, this process is problem-driven: whenever users have a problem they can learn from others that have already solved the problem or from courseware specifically prepared for this purpose. On the other hand people having solved a problem need not necessarily be available when the problem arises. For this reason one of the most important requirements in a corporate environment is to be able to store knowledge to make it accessible on a problem driven basis. The principle of knowledge transport is to map the knowledge in the heads of people to information that can actively be used, structured and enriched, and, when the need arises, be transferred to those who need it. Hence the vehicle for knowledge management is computerised knowledge. However, knowledge management also comprises processes that influence corporate culture to ease knowledge capture and knowledge transfer in the sense of human to human interaction.

3.4 Financing of scientific and research organisations

The Government of the Republic of Slovenia has developed and adopted its scientific and technological policy in the National Research Programme (NRP, 1995) and in the Technological Policy of the Government of the Republic of Slovenia.

A part of Slovene budget is allocated for the financing of research activities. Financing of research groups in public research organisations is carried out on the basis of programme financing.

Tables 3 and 4 present information regarding budget funds that were allocated to research activities and the revenues created by experts employed in research organisations.

Tables 3 and 4 clearly show that in 1997 funds allocated to research activities increased by 20% when compared with 1996, while the revenues deriving form research and development activities in 1997 increased by 36%.

Table 4: State budget funds (in million SIT) intended for research and development activities according to transfer types and sectors

Year/ Type of transfer	Total	Business sector	Government sector	Higher education sector	Private non-profit sector	Foreign countries
1996	13580	1403	7096	4931	123	7
1997	16348	1858	8156	6074	260	0
1998	17828	1588	8892	6919	428	1
TOTAL 1998	**17828**	**1588**	**8892**	**6919**	**428**	**1**
R&D programmes and projects	9934	1411	4718	3646	158	1
Basic research	5532	139	3154	2191	47	1
Applicative research	2857	357	1292	1149	59	0
Experimental development	1545	915	272	306	52	0
Subsidies, donations	7386	177	4174	2765	270	0
General university funds (*) (**)	508	0	0	508	0	0

* General donations received from the Ministry of Education and Sports intended to support research and development activities.

** In 2000 the Ministry of Education and Sports (MES) and the Ministry of Science and Technology (MST) were joined into one single body – the Ministry of Education, Science and Sports (MESS).

Source: Statistical chronicle of the Republic of Slovenia, 2000, page 152

When compared to the rest of the world Slovenia belongs among the smaller research centres. This is why it is extremely important for Slovenia to be involved and cooperate with ERA in terms of a single common basis and the transfer of new knowledge. Even though Slovenia's intellectual potential in all fields of science is high, the funds that Slovenia is able to allocate to research activities remains relatively low in comparison with other countries (see table). This is why Slovenia promotes and encourages bilateral scientific cooperation (at formal inter-state level with 68 countries) and multilateral scientific cooperation (the NATO Scientific Programme, the UN Programme for Development, et.), cooperation in the European Union programmes (the Fifth and Sixth Framework Programme, programmes COST and EURECA, etc.)

It is a well-known fact that small countries such as Slovenia cannot contribute as much knowledge into the world programmes as they can benefit from these programmes. However, small countries can make a great contribution in the framework of national sciences (humanistic and social sciences) and sciences which are closely connected to the economic and non-economic infrastructure (power supply, information technology, transport, agriculture, health, education, etc.) (Bohinc, 1996, page 11).

3.5 The future role of University Institutions

For centuries basic research was the only type of research that was recognised by universities. Even today many universities enable the academic promotion of their staff and students strictly on the basis of individuals' contribution to basic knowledge and the spreading of such knowledge through publications in scientific bibliography. In Slovenia the quality of research is still estimated by the number of articles published in major scientific magazines and the number of quotations, while developed universities and systems have abolished this kind of estimations already in the 1980s. Universities also do not recognise the importance of other indicators, such as the number of inventions and patents, revenues from licences, the number and quality of new procedures and products and their effect on the market, the contribution to the establishment of new enterprises, etc. Many universities also fail to consider such factors as the financial share that industrial sectors contribute for research projects at universities and the number of excellent post-graduate students that were attracted by such projects, which represent a basis for the establishment of criteria and the evaluation of the quality of staff working in institutions of higher education. Universities connect their research and education with dynamic needs of the environment they operate in and reinforce their position in a society (Kornhauser, 1998, page 66).
There are four major reasons why the time has now come for universities to change, too:

- ✓ Increasing focus on higher education; less elitism,
- ✓ Increasing cost of research and education; utilize and control,
- ✓ The IT revolution; loss of monopoly of knowledge,
- ✓ A new mode of learning: less academic ethos.

Many government and academic documents – these are typical of highly developed countries of Western Europe, the USA, Japan, Canada and Australia – contain relatively strongly expressed requests for the transformation of universities which have shifted their focus from merely educational organisations to research centres and should soon reach the next level of a so called developmental university that aim to establish connections between basic and applicative research and education and direct their achievements towards the development of their narrower and broader social environment. The International Commission of Education for the 21st Century (Delors, 1996, page 66) defines university of the 21st century as the centre of education, research and innovation. Universities should be the creators and the carriers of knowledge. The Commission also recommends programmes of cooperation with other knowledge holders, especially with research institutes and development centres that exist in industry. It also emphasises the need for a multidisciplinary cooperation and team work that enables organisations to achieve synergy effects. One of the main synergy effects is defined as "group intelligence", which is very well-known and exploited in industrial sectors based on science (Kornhauser, 1998, page 32).

For several centuries new knowledge cannot be acquired only in scientific sources. With the development of industrial research activity which involves a great deal of basic research in strong multinational corporations the publication of new discoveries is almost exclusively reserved for patents. Industrial sectors namely interrupt and close all fundamental publications until priority knowledge is patented.

Patents – their generation and analysis – have to be included in higher education and research as priority scientific bibliography (Kornhauser, 1998, page 16).

Due to their role as knowledge generators and knowledge exchange agents, research institutions, i.e. university and industrial research institutes, are important players among the innovation actors of a region or a country. They generally carry out two main functions (Koschatzky, Héraud, Bross, Bureth, Demissy and Muller, 1996, page 43):

1. Managing the knowledge base: Universities and research institutes aim towards the development of the common knowledge base of the region. Starting from the production of scientific and technological knowledge, this function includes the diffusion of knowledge through education, the distribution of scientific and technological information as well as the demonstration and transfer of technological or scientific solutions.

2. Providing expertise knowledge: In this case, universities and research institutes are in contact with a single actor, taking into account his very specific needs, and providing training, consulting, contract research and development, or transfer services. These activities aim at reinforcing existing skills and knowledge or at developing new competencies of the individual actor.

In addition to teaching and research, one of the most important tasks of the University is the transfer of knowledge. Expertise is transferred from the University to corporate enterprises through close contacts and co-operation between academic researchers and the business world. The University thus makes an important contribution to the economic development of the city and its environs.

4 TRANSFER OF KNOWLEDGE

In order to create new industries, increase competitiveness and revitalize the economy, it is important for a country to promote business, academic and public sector cooperation to turn important results achieved at universities and national research institutes into practical applications. Cooperation and collaboration between universities and private companies are especially important to promote the contribution of universities to society and to advance scientific research.
However, there are some barriers to scientific knowledge transfer from research institutes to industry from both sides.

4.1 Barriers to Knowledge Transfer

4.1.1 Barriers imposed by industrial sectors

Very often industrial sectors are not keen on the establishment of cooperation between industry and universities. In their opinion such cooperation is unnecessary because:

- ✓ Industrial issues are multidisciplinary while universities focus on mono-disciplinary issues.
- ✓ Universities are used to relatively stable conditions and represent a unique system that does not understand time pressure and the need for constant changes that occur in industry which has to deal wit global competition on a daily basis (Kornhauser, 1998, page 23).

Industrial sector also faces other issues that prevent knowledge transfer and knowledge management:

- ✓ Organisational culture;
- ✓ The resource commitments required to establish knowledge management and transfer strategies;
- ✓ Creating a bureaucracy around the management of knowledge;
- ✓ Perpetuating obsolete knowledge by lack of vigilance in purging or updating codified knowledge;
- ✓ Not achieving a positive return on knowledge management strategies by failing to measure their real impact, and
- ✓ Allowing knowledge transfer to divert attention away from the operations of the department by failing to keep it correctly focused as a support for the work at hand.

4.1.2 Barriers imposed by research institutions

The transfer of knowledge from institutes and universities to businesses is still a one-way process. When one works in industry for a few years it is very difficult to return to institutional research as one does not meet the criteria for participating in academic projects due to the lack of published scientific articles. In countries of the Western Europe many professors often work as consultants in business and industrial sectors and receive their salaries from these sectors.

Universities often fear that their cooperation with industry would:

- ✓ Limit their possibilities for selecting research areas and for basic research;
- ✓ Prolong the publication of research achievements;
- ✓ Endanger their possibilities of communication with other university researchers which should provide their knowledge and services to all interested parties;
- ✓ Diminish professional independence on the university and reduce the number of independent experts;
- ✓ Create a time pressure on universities as industrial sectors expect a rapid return of funds they have invested.

It is important to consider both the advantages and the disadvantages of cooperation between universities and industry in order to establish successful and efficient knowledge transfer.

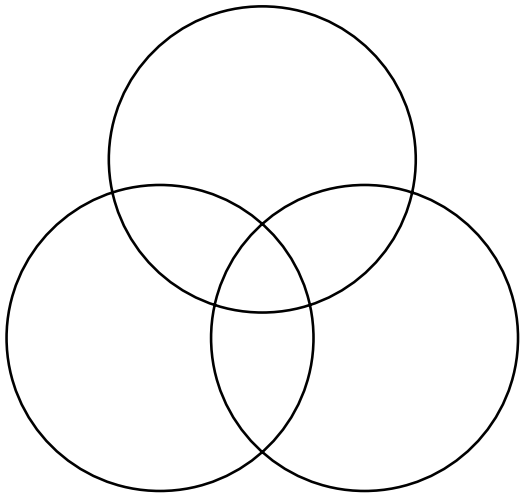
4.2 Transfer of Knowledge

The aim of contributing to national and regional economic development and competitiveness in any country can be achieved through integration of university education with research and innovation (Kornhauser, 2001, page 77).

Activities within the “golden triangle”, then small area in the centre of the figure (Kornhauser, 1992) where education, research, and application overlap, may not only be the most productive, but also the most sustainable in developing countries (Kornhauser, 2001, page 60).

Mutual cooperation should therefore represent only one part – as is symbolically presented by the covering of circles in Figure 19.

Figure 19: The relationship between education, research and applications in the 1990s



Source: Kornhauser, 2001, page 60

Both industrial sectors and research institutions can gain numerous benefits from knowledge transfer.

When cooperating with universities industrial sectors can benefit from, e.g.:

- ✓ Information regarding new discoveries in science and technology;
- ✓ A more clear direction in mid-term and long-term projects due to cooperation;
- ✓ Immediate access to research achievements, methods and techniques that can lead to more efficient procedures and more competitive products;
- ✓ Immediate access to young experts;
- ✓ Possibilities for education and training of proper personnel;
- ✓ Reinforced possibilities for the creation of new high-quality jobs in terms of education and income;
- ✓ Broader international cooperation.

When cooperating with industry research institutes can benefit from, e.g.:

- ✓ Their assistance in strategic changes in businesses by the commercialisation of their research results;
- ✓ Stimulation of innovation;
- ✓ Leading rewarding collaborations with innovative business;
- ✓ Extensive collaborations with developing business;
- ✓ Acquisition of ideas for further research and development projects;
- ✓ Supervising and acting as mentors for postgraduates working on company-based projects;
- ✓ Enhancing their own skills and knowledge;
- ✓ Publication of high quality research papers;
- ✓ Extension of their services to business customers;
- ✓ Enhancing their levels of industrially relevant research;
- ✓ Development of their own staff.

The following forms of cooperation between research institutes and industry are possible:

- ✓ *Scientific knowledge transfer* based on the exchange of personnel;
- ✓ *Initiation and participation in the programmes of professional societies* which promote cooperation between university and industry;
- ✓ *Industrial scientists as resource persons and supervisors of students' projects*, particularly if the project is based in industrial facilities;
- ✓ *Jointly prepared and presented lectures* by universities, industry and government experts, e.g. at conferences and other professional meetings;
- ✓ *Enterprises, such as science parks, centres for innovation organized in industry-university cooperation;*
- ✓ *Seminars at industry sites* are being increasingly offered by universities. Academic staff and students often join these seminars at which discussions of opportunities for cooperation can be initiated;
- ✓ *Industrial leaders as members of university governing bodies* (at departmental and higher levels), as well as members of university evaluation committees for educational and research activities, including recruitment staff;
- ✓ *Arranging visits by university teachers and students to industry;*
- ✓ *Organizing open days and exhibitions for leading entrepreneurs;*
- ✓ Establishing joint bodies such as partnership networks, university and industrial agencies and joint commissions as well as a consortium for the promotion of cooperation in the transfer of knowledge and technologies, university consulting offices and networks of individual consultants;
- ✓ *Participation at academics in industrial and governmental bodies*; governmental advisory group, chamber of commerce and industry;

- ✓ Periodical promotional activities such as joint lectures of university and industrial experts, seminars and study workshops intended to foster the transfer of new knowledge, university seminary in industrial sectors, summer research schools focusing on industrial topics, etc.

Consequently, both bilateral co-operation and multilateral networking relationships are possible between research institutions and companies. In both cases, the spectrum ranges from “soft” transfer activities such as:

- ✓ Information transfer, i.e. the preparation of publications, patents, the transfer of addresses, names of business partners, specialists and experts;
- ✓ Staff transfer, i.e. the short or medium term collaboration of scientists and technicians in companies, or of employees from industrial R&D departments in research institutions, and
- ✓ Technical-scientific training, i.e. the fundamental training of students, the qualification of researchers and developers from industry, as well as firm's training, continuation courses and retraining courses.

to contracted transfer activities such as:

- ✓ Research and Development co-operation, ranging from contacts and consultations by collaborators from research institutions, via research projects on behalf of a customer, to common research projects in which co-operation partners deliver complementary contributions for innovation implementation.
- ✓ The foundation of new firms to commercialise own and others' research and technical development (Koschatzky 1999; Walter 1997, page 77).

Depending on the nature of the exchanged knowledge, spatial and cultural proximity represents a more or less important pre-condition for the exchange process between knowledge producer and the knowledge user. Codified and standardised knowledge can be transmitted over long distances and at low cost, so that spatial proximity is not necessary. In contrast to this, the exchange of implicit, non-codified knowledge, or of knowledge individually considered as sensitive or strategic, requires both personal contacts and verbal and non-verbal communication and reacts sensitively to an increasing spatial distance between the partners who are involved in the knowledge exchange (Foray and Lundvall, 1996, page 34).

There is no inherent incompatibility between **basic research and technology transfer**, but the relationship between the two activities must be made explicit, and managed.

4.3 Knowledge Transfer Organisations

There are a number of types of enterprises organized in university-industry cooperation, such as:

- ✓ Centres for innovation;
- ✓ Science parks;
- ✓ University companies and link units;
- ✓ Consultation services, virtual companies, etc.

4.3.1 Technological Centre

According to the Regulation on Infrastructural Developmental Centres a technological centre is a legal entity which can perform the following activities:

- ✓ Research and development activities for the needs of individual industrial or business sector and, upon agreement, for individual customers. In doing so it needs to guarantee that all results be considered confidential;
- ✓ Assistance in applying for national and international research and other projects;
- ✓ The carrying out of measurements and other tests (a long-term of technological centres is to become an accredited laboratory);
- ✓ The monitoring of new discoveries in the field of research and technology and providing information and assistance in their introduction into individual corporate organisations;
- ✓ Publishing activities, and
- ✓ The execution or the organisation of various professional training for the needs of industrial and business sectors.

4.3.2 Technological Park

The Regulation of Infrastructure Development Centers (IDC, 1999) defines a technological park as a "legal entity which represents an environment providing beneficial atmosphere for the establishment and operation of businesses, which are based on technologies or products and services which require a high degree of knowledge". Technological parks enable businesses to hire infrastructural premises, access to technological knowledge and equipment, establishes connections between the holders of ideas, capital, industry and market and provides management and marketing services. Technological parks must include the headquarters of at least 70 per cent of businesses whose primary activity consists of economic application of results of proper development and research activity. Businesses can use technological parks only for a limited period of time, namely up to four years. After this period they must relocate as the technological park is unable to obtain subsidies for such businesses.

There are 3 technological parks in Slovenia: in Ljubljana, in the region of Štajerska and in the Primorska region. The largest and the oldest TP is the Technological Park of Ljubljana.

4.3.3 Network of Innovation Relay Centres (IRC)

IRC deals with transfer of innovative technology and with ways to bring existent technologies and research results to their users. EU established the network with the goal to strengthen technological cooperation between research and industrial sphere in Europe, and to offer direct support in solving technological transfer problems to companies and research institutions.

European Union's strategic objective is to establish a knowledge-based economy which would become the most competitive and dynamic in the world.

There are 68 centres (so-called Innovation Relay Centres - IRCs) located in EU member countries, Switzerland, Norway, associated members countries and Israel.

One of them is "IRC Slovenia". Innovation relay centres exchange reciprocally the local requests for knowledge and new technologies and place these requests in their local business and research environment.

Innovation relay centres are mainly designed for small and medium companies and industry, but also opened for universities and research institutions wanting to transfer their research results and technologies into industry. IRCs are especially beneficial to technologically oriented companies and organisations with limited or small research capacities, but with the need to constantly stay in touch with new technologies.

Connected with special European innovation network IRC Slovenia is opening the doors for Slovene companies and researchers wishing to participate in European research and technological network while assisting them with specific support on their way.

EU established Innovation relay network in the frame of Innovation program of the 4th framework program concerning research- technological activities of EU. IRC Slovenia is a continuation of Femirc Slovenia project, which began in January of 1997 and got renamed in June 2000 into IRC Slovenia. In its mission it unites more Slovene scientific research institutions with the coordinator at Jozef Stefan Institute.

IRC Slovenia [3] specialises in:

- ✓ Helping local industry specify its new technological needs (technological audits) and with the help of IRC network trying to identify partners to provide these new technologies;
- ✓ Helping local industry identify which of its technologies are suitable for transfer to other regions or industries and promoting these innovative ideas across Europe through the Relay Centres network;
- ✓ Providing assistance in the negotiation process between the provider and the receiver of the technology;
- ✓ Advising on related aspects of research exploitation, such as patenting and licensing;
- ✓ Informing about relevant Community and national financial support schemes for innovation.

IRC Slovenia assisted many Slovenian companies in the search for the right business partner, which resulted in 9 signed cooperation agreements between Slovenian and foreign companies in the 2-year period. From June 2003 till February 2004 5 additional technology transfer contract were signed with the help of IRC Slovenia.

4.4 Phases of technology transfer process

Many experts recommend that the process of technological transfer be planned well in advance in order to increase the possibilities for a successful realisation of the transfer itself and for its commercialisation. We are aware of the fact that in reality every project is different from others and that every exact prescription of the

[3] Source: http://www.irc-slovenija.ijs.si

necessary steps or phases can be deceiving. However, we need to set a framework model which should be of assistance to all businesses and organisations that are undergoing a process of technological transfer.

In general such processes consist of six different phases (Inštitut za ekonomska raziskovanja, 2002, page 5):

- ✓ Evaluation phase;
- ✓ First contact and communication;
- ✓ The definition of a formal strategy;
- ✓ Development;
- ✓ The beginning of full commercialisation.

4.4.1 Searching phase

A key part in a successful search for a supplier or buyer of technology is the identification of appropriate information sources. These include: trade fairs, patent databases, informal contacts, presentation brochures of companies and organisations, searching through Internet databases and similar.

4.4.2 Evaluation phase

The second phase is called the evaluation phase. Before a company decides to face potential partners it should prepare an analysis of its organisation, market possibilities and technology. Technology supplier should also evaluate its rights deriving from industrial property, consider the possibilities for a demonstration of research methods and a prototype and prepare a time frame for the conclusion of development. The evaluation of a technology buyer should include a market review, the analysis of suppliers of necessary materials and knowledge, the review of financial sources and a time frame for an efficient use of acquired technology. This phase is extremely important if an intermediary agent is also included in the technological transfer process, as it enables it to evaluate and determine most suitable suppliers or buyers. Nevertheless, companies should be the ones to choose the most suitable partner for technological transfer on the basis of gathered information.

4.4.3 First contact and communication

The third phase includes first contact and communication between buyers and suppliers. This phase is important for the exchange of information and the debate regarding the expectations of all participating parties. It mainly involves the exchange of information regarding the expected goals, knowledge and skills, other sources, financial aspects, rights deriving form intellectual property, other partners involved in the project, employees and human resources and the model of project management. The discussions between partners enable them to obtain information about the opinions and views of other party, conflict issues and the need for further negotiations. Only when partners reach consensus regarding the most important issues they can move on to the following phase.

4.4.4 The definition of a formal strategy

This phase involves the preparation of a formal strategic plan which is often done badly or insufficiently. The preparation of a precise plan of future activities is necessary as it informs all participating parties of the current state-of-affairs, future objectives and the plans adopted in order to achieve these objectives. In principle this phase consists of two parts:

- ✓ The first part includes the definition of all details regarding activities and responsibilities, and establishes the basis for a business, marketing and financial strategy, management strategies and strategies regarding rights deriving from intellectual property and the determination of the duration of the project and important cornerstones.
- ✓ The second part involves the formalisation of agreement; partners prepare a business plan and then a formal contract which represents a legally binding document for all parties involved.

4.4.5 Development phase

This phase involves the preparation of a precise market survey, the preparation and improvement of existing prototypes, the monitoring of market responses to test products, the involvement of alternative possibilities for the use of a product and the testing of final market with pilot production.

4.4.6 The beginning of full commercialisation

The sixth phase represents the beginning of full commercialisation of new technology. A regular control of the actual state-of-affairs is of key importance in this phase. However, the planning stages are not yet over. Companies should still monitor the course of activities which were determined in the business plan and be prepared to make appropriate modifications and adaptations of the plan if major deviations or the modifications of market demands occur. The original plan might need to be adapted to new conditions and new challenges (Inštitut za ekonomska raziskovanja, 2002, page 5).

4.5 The criteria for the selection of partners in the technological transfer process

In practice there are several evaluation techniques which facilitate the final decision to adopt a certain process of technological transfer[4]. The simplest form of evaluation is the composition of a control check list containing all criteria which need to be considered before choosing a certain project. According to data obtained from surveys conducted by companies control check lists are often used but in practice companies tend to observe only a small proportion of the necessary criteria, among which (Inštitut za ekonomska raziskovanja, 2002, page 9):

[4] A review of techniques can be found in Unid's publication entitled Manual on Technology Transfer Negotiation, 1996.

- ✓ Corporate objectives, strategy, policies or values – is the project compatible with our current strategy and the long-term objectives of the company; does the potential of the project require modifications of the current strategy; is it compatible with the image of the company; is it compatible with the attitude of the company towards risk and innovations; does it meet the needs of the company regarding time harmonisation?
- ✓ Marketing criteria – is the project in line with the clearly defined marketing needs; the evaluation of the common extent of the market; the evaluation of market share; the evaluation of product duration; the likelihood of commercial success; the possible sales scope; the influence on existing products; price determination; competitive position; compliance with existing distribution channels; the evaluation of launching expenses.
- ✓ Research and development criteria – is the project in line with the research and development strategy; will its introduction require modifications in the current R&R strategy; the likelihood of success in technical terms; the availability of funds allocated to R&D; the possibility of further development and the ways of future application of new technologies; its influence on other projects.
- ✓ Financial criteria – the costs of research and development; investments into production and marketing; the availability of funds; influence on other projects, which also require financial funding; potential yearly profit; expected profits; is the project in line with investment criteria of the company?
- ✓ Production criteria – new processes in connection with the project; available production staff – their number and qualifications; conformity with existing capabilities; costs and supply of raw materials; production costs; requirements for additional equipment; production safety; added value in production.
- ✓ Ecological criteria and environmental criteria – possible dangers; sensitivity in terms of public opinion; conformity with legislation; influence on employment opportunities.

By developing a control check list companies can create a project profile, where every criterion is evaluated according to its standard success (excellent - 5, very good - 4, average - 3, poor - 2, very poor - 1). If possible companies should evaluate every criterion on the basis of quantitative analysis. They should also define the importance of every individual criterion. By adding the multiplication of importance and the evaluation of individual items companies can obtain a numeric evaluation that defines the appropriateness of the project for individual company.

Companies should also prepare a business plan containing a financial pro-forma as it represents an integral part of every serious suggestion, new idea, technical improvement or innovation. On the basis of the business plan companies can obtain a number of items of information regarding the project which can be of great assistance when they adopt a decision to undertake a certain project[5]. They should also consider all other elements which are necessary for a successful technological transfer. We are here referring mainly to human resources as it is impossible to realise any ideas or project without the participation of highly capable, motivated and adequately qualified employees. The key to success, which can be demonstrated in a well-prepared business plan, is the understanding of market and business

[5] If a company has a role of technology supplier, we recommend that it drafts its own business plan as this will increase its possibilities to make a precise presentation of ideas to potential partners.

regulations and the inclusion of a new technological solution into existing state-of-affairs (Inštitut za ekonomska raziskovanja, 2002, page 9).

4.6 Evaluation of success of technological transfer

However, the evaluation process is not yet concluded. Even after a company decides to undertake and launches a certain project of technological transfer, it well need to evaluate results or the success of the transfer. Some authors believe that a technological transfer is successful if it is lucrative, while others claim that the mere commercialisation of transferred technology or a product represents a success. I believe that a substantial number of developed technologies never make their appearance on the market. The reasons for this phenomenon are the lack of financial funding, errors regarding the organisation and management of the project and poor forecasts of possible obstacles and problems when determining the time frame needed for the introduction of a new technology, such as the modifications in the economy, the changes in marketing positions or a sudden appearance of unexpected competitors or competitive technology. Nevertheless, companies should define and determine their criteria for a successful technological transfer prior to its execution. This will enable them to define the mission and vision of the project and the allocation of financial sources. Notwithstanding the primary objective of technological transfer, companies should also consider the value of new technology for their future research and development or for the improvement of existing procedures.

In measuring the success of a technological transfer we can establish three important dimensions (Inštitut za ekonomska raziskovanja, 2002, page 10):

- ✓ ***The mechanism of technological transfer*:** this involves formal transfer mechanisms, such as contracts, licences or staff exchange, and provides a company with information that is easier to evaluate. This is not the case for less formal activities such as technical assistance, informal cooperation and similar;
- ✓ ***Time frame:*** technological transfer is often a long-term process, which is why any evaluations should consider the time frame of the project. We should use three evaluation and reporting categories: short-term, mid-term and long-term;
- ✓ ***Economic and technical influences of the transfer:*** here the focus is mainly directed towards economic impacts, i.e. the amount of sales, cost-saving and the number of newly employed personnel. However, in evaluating these influences we often face numerous issues, as it is extremely difficult to determine the impact of technological transfer as such to a certain economic category, which can be a consequence of various factors and activities. It is much easier to define and quantify a technical impact, expressed for example in the number of departments in which new technology has been introduced.

4.7 Transfer of Knowledge in Slovenia

Using empirical data from an innovation survey carried out in the Republic of Slovenia in 1997/1998, the paper analyses the innovation-relevant co-operation pattern between different kinds of research institutes and industry. The results of a survey show that while there is intense co-operation between Slovenian research

institutes and companies, the level of co-operation between university institutes and industrial firms remains below the average of all Slovenian research institutes, although one focal point in the co-operation activities of university institutes is the support of firms in market introduction. Mainly larger institutes co-operate with larger firms, whereas small institutes hardly co-operate.
Consequently, the challenge of innovation policy is to integrate all participants of the Slovenian innovation system in a structure of mutual knowledge and information exchange (Koschatzky, 2002, page 45).

However, Maja Ravnikar PhD, from National institute of Biology, Planta Centre estimates that the Ministry of Science and Technology in the field of scientific-research achievements' transfer to the economy is good and many mechanisms have been established helping to achieve these goals. One of the examples is the Action of young researchers. Since these are mostly recently introduced ways of stimulation, the effects will be shown through time. It is especially important to employ qualified personnel in the economy that will become equivalent collaborators to the researchers in research institutions with regard to planning the developmental work.

4.7.1 2000 young researchers programme

Being aware of the importance of a highly educated and skilled workforce in industrial R&D departments for increasing the competitiveness on international markets, Slovenia in 1985 launched the ***2000 young researchers programme***. The initiative was made by governmental and academic institutions, and was made operational by the funding agency for research and development. The aims were:

- ✓ To promote postgraduate studies of young graduates in science and engineering in order to strengthen academic research departments, and
- ✓ To stimulate continuation of their research and development work in industry.

Governmental funds cover salaries of the young researchers and contributions for material costs.

It was planned that about 30% of postgraduates would, after obtaining their postgraduate degree, remain in academic research institutions, and 70% join business enterprises. Therefore they had contracts of two types: for academic career and for industrial career.

The young researchers programme also included shorter (up to one year) and more specialized postgraduate studies, called *specialization*. This was offered to young industrial researchers for joining teams in academic research institutions, mostly for carrying out joint research projects. This type of postgraduate study turned out to be extremely attractive and successful.
The same scheme was offered also to young faculty staff to join for short periods the industrial research departments. However, there was practically no interest on the part of the faculty.

An evaluation was carried out after ten years in 1995. The results were 260 Doctors, 530 Masters and 300 Specialists. Of these 4% of Doctors, 30% of Masters and 23% of Specialists continued their career in industrial research departments. In total, about 20% of postgraduates joined the business sector, a similar number the public

administration, and 60% remained in academic research institutions (Kornhauser, 2001, page 71 - 72).

4.7.2 Tempus / Phare

Tempus / Phare is a cooperation project between universities and industry and are primarily intended for the development of educational strategies.
As a part of the Tempus/Phare project on cooperation of university and industry for development of university teaching strategies, an introductory study of over five hundred documents (particularly development reports, analyses and recommendations) was carried out. The results were compared with the experiences of universities and industry in cooperating countries (Denmark, Italy, Slovenia and Great Britain). There is a prevailing opinion that, to achieve an adequate contribution of universities to accelerated technological development, the following conditions are necessary:

- ✓ An efficient integration of all sources and types of knowledge by development of networks of cooperating institutions and individuals;
- ✓ Deepening the cooperation between universities and industry (both understood in a wide context);
- ✓ Development of the universities into centres for education, research and innovation;
- ✓ Development of approaches for strengthening the educational dimension of research and design of research-educational projects in cooperation of universities, research institutes and industry;
- ✓ Much stronger motivation for entrepreneurship and for targeting governmental support primarily to medium-term projects with inbuilt interlinking of basic and applied research with industrial development.

With this contribution, the project group joins to the efforts for accelerated technological development which put science and technology together with university education into the core of Slovenian development strategy (Kornhauser, 1998, page 45).

A study of selected documentation was primarily directed towards the forms of cooperation in which research is closely connected with education. These are mainly: (1) cooperative research and educational programmes which include joint research equipment and the possibility of a post-graduate study in industry; (2) the placing of undergraduates, postgraduates and their teachers into industry and the placing of industrial experts to the university; (3) research and educational businesses which are jointly organised by universities, research institutions and industrial sectors, such as innovation centres for the promotion of transfer of new technologies into industry, scientific parks which are also called technological incubators, and on-the-field promotional offices which are being introduced mainly in the field of agriculture and forestry; (4) joint bodies such as partnership networks, university and industrial agencies and joint commissions as well as a consortium for the promotion of cooperation in the transfer of knowledge and technologies, university consulting offices and networks of individual consultants; and (5) periodical promotional activities such as joint lectures of university and industrial experts, seminars and study workshops intended to foster the transfer of new knowledge, university seminary in industrial sectors, summer research schools focusing on industrial topics,

and last but not least planned awards and recognitions for the integration of research, education and development (Kornhauser, 1998, page 167).

4.7.3 6th Framework Programme of the European Union (2002 – 2006)

The European Union has started its cooperation in the field of research activities with the introduction of framework programmes in 1984. The main purpose of these programmes was to increase the competitiveness of economy in European countries and to increase scientific excellence in areas where European economy and science already had a leading role.

In January 2000 the European Commission publishes a common European research policy also called Towards a European Research Area. The European Council has adopted the common European research policy during its Lisbon summit in March 2000 and opened a wide European debate on this topic. The policy entitled Towards a European Research Area summarises the current state-of-affairs in the field of research and provides some guidelines for the future.

6th Framework Programme[6] which will be held from 2003 to 2006, was prepared in order to carry out the new European research policy. Its main features are:

- ✓ The carrying out of large research projects;
- ✓ The focusing of research on selected research areas;
- ✓ The encouragement of participation of small and medium enterprises;
- ✓ The encouragement of researchers' mobility;
- ✓ The integration of research infrastructure;
- ✓ The establishment of closer international cooperation on national, regional, European and global level.

Slovenia has become a full member of the 6th Framework Programme on the basis of a memorandum signed on 29th October 2002.

4.7.4 EUREKA

The main purpose of EUREKA programme is to promote and accelerate innovations in the field of technological development in European industries and ensure the competitiveness of European industry in the world. This programme does not focus on any specific areas. EUREKA is based on the so called bottom up approach which means that partners in individual projects assume all responsibilities for the preparation, application and the carrying out of a certain project. Slovenia has been a full member of the EUREKA programme since 1994.

The comparison between Slovenia and other EU member states according to »Share of turnover linked to new or improved products from innovators by engagement in innovation co-operation« criteria is presented in Appendix 4.

[6] Source: http://www.irc-slovenija.ijs.si

4.8 Knowledge and skills needed for effective and successful knowledge transfer

For the effective and successful knowledge transfer there are several major points:

- ✓ Communication;
- ✓ Planning;
- ✓ Human capital;
- ✓ Multidisciplinarity;
- ✓ Informatisation;
- ✓ Teamwork;
- ✓ Encouragement of early independence of researchers.

4.8.1 Communication

When planning scientific and research activities of individuals, research groups and their scientific cooperation we must be able to realise the extent of research that has already been carried out in a certain field. A great deal of funds that are available and allocated to scientific research is often spent for something that has already been researched and explained. This is why efficient communication between scientists and experts is of key importance.

In science communication is considered as a process of exchange of scientific information, ideas, results and methods. Scientists use and produce information at the same time. In doing so they use different communication methods which were established for different reasons one of the most important being the desire to achieve efficiency and effective work.

4.8.2 Planning

Planning of the research hypothesis and its operationalisation by setting the sequence of research phases represents another quality that young researcher often lack. The first research phase alone, namely the definition of a problem, requires the recognition of the essence of the problem, its solving structure or the definition of sub-problems and their relationships, requires the knowledge of many different approaches and methods that average students very often do not possess. The next phase which also represents a major issue for programmes of higher education is informatisation of problem-solving: the determination of information sources, their revision, the setting and the optimisation of mechanisms necessary for regular intake of information and the construction of project-directed computer support (Kornhauser, 1998, page 26).

Research capacities regarding the building of projects in universities in developing countries often fail to directly promote economic development.

4.8.3 Human capital

Students must be involved in the industrial cooperation, if possible from the start of their studies, both for educational reasons because they represent one of the most important assets of universities, also from the point of view of industry. Efficient

university-industry cooperation involving students will require substantial educational reforms; these are in any case needed at most developing country universities. As a first, important step it is recommended that a considerable part of the traditional course work be replaced with student group project. These should, to the extent possible, be carried out in cooperation with industry and other potential customers for research and services. It may improve industry's capability to benefit from knowledge based services and research trained manpower.

Human capital is central to industry-science relationships. Universities provide the skilled workers that firms need to increase productivity, perform research and innovate. Indeed, innovation surveys indicate that access to human capital and talent is one the main factors driving firms to co-operate with public research. The teaching and the training of graduate students - who play a major role in the execution of public research - are among the main missions of universities. Governments thus have several concerns with regard to human capital. They must ensure there is a sufficient supply of scientists and researchers to work in industry but also in the public sector. In addition, because knowledge and technology transfer takes place mainly through people, governments are relaxing regulatory barriers to interaction with industry. Regulations are, however, only one side of the equation as interaction depends heavily on incentives. Evaluation practices and reward systems for researchers that emphasise tenure and publishing over mobility and collaboration may, in some cases, act as disincentives to collaboration.

Often research capacity in developing countries is not used for real life purposes, even when such opportunities seem to be obvious (Kornhauser, 2001, page 28).

4.8.4 Multidisciplinarity

Multidisciplinarity needs to be considered as a need for cooperation between top experts from certain disciplines. This does not mean that we should expand the scope of discipline(s) by making the existing knowledge shallower, but that we should reinforce and deepen the communication capabilities among experts. Such multidisciplinary communication requires the will (culture) and ability to listen and consider other approaches and arguments and the abolition of unnecessary professional jargon and the return to natural language. The use of such language should be carefully promoted at the university level and used in parallel with professional terminology. Education and training that enable us to make high quality presentations of problem-solving suggestions to our project partners and inform us about important research achievements is a sound basis and an opportunity for successful development and the monitoring of communication abilities of students and their teachers (Kornhauser, 1998, page 30).

These facts also show the necessity that researchers coming from the universities should not only have a deep understanding in one discipline, but also have a broader base to be interesting for the industry. They must have a complementary understanding of fields surround the main working field, so that they are able to talk with specialists in other fields.

4.8.5 Informatisation

When dealing with different approaches to research at the university level universities should give special attention to informatisation not only in terms of management but mainly in terms of research and education. In this period governed by the use of Internet the piling of information in educational approaches became unreasonable. The intake of information during the educational process needs to become more focused on the establishment of links and connections between data and the formation of knowledge networks. This means that educational processes should concentrate on and promote learning at a higher cognitive level which includes the ability of analysis, synthesis and evaluation of knowledge. These features represent a precondition for successful problem-solving.

Such strategy has to promote international cooperation in the filed of technological and developmental projects and most importantly the involvement in European developmental and research programmes such as the 6th Framework Programme of the European Union and EUREKA.

The main quality aspects that are expected for new products are items like improved user profiles, a better understanding of the user's needs, the considerations of social aspects, an optimum capacity and automatic configurations.
As already pointed out, the most important thing here is to understand the needs and wishes of the end users.

4.8.6 Teamwork

To survive in the more and more competitive markets of the future, it will be necessary to work in teamwork, in teams with only a few people, but everyone with a broad knowledge base. And also the university has to be more aware of the problems of the industries, which can be improved by an exchange of views through a higher mobility of people from universities to industry and vice versa.

Industrial employers prefer these graduates because of their:

- ✓ Effectiveness in carrying out job responsibilities;
- ✓ Ability to grasp quickly key features of new opportunities;
- ✓ Depth of technical understanding;
- ✓ Ability to work in teams;
- ✓ Ability to integrate knowledge from different disciplines, and
- ✓ Improved verbal and written communications, networking.

4.8.7 Encouragement of early independence of researchers

Young researchers holding temporary positions should not be excluded from applying for funds for their research projects simply on the basis that they do not have a permanent position. On the contrary, young scientists should be encouraged to take over the responsibility for larger projects at an early stage, if they are ready to do so. More opportunities should be created for excellent researchers to build up their own research teams, which will enable them to construct a scientific career after an initial period of training and mobility. In this context the new Marie Curie Grants for Excellent Teams or the grants within the Emmy Noether Programme of the German

Research Foundation, DFG, should be mentioned as good examples that deserve to be copied not only by other funding bodies, but also by national governments.

5 EMPIRICAL RESEARCH OF KNOWLEDGE TRANSFER FROM RESEARCH INSTITUTES TO ENTERPRISES

5.1 The definition of the purpose, objectives and the methodology of the survey

The purpose of empirical survey is to determine the current situation in the field of transfer of new knowledge from research institutions into practice, the frequency and methods of such transfer, the interest of scientists and researchers form research institutes and industry in knowledge transfer, the success and applicability of new knowledge transferred into industry, the main issues regarding the transfer and the suggestions for the improvement knowledge transfer into industry. These issues are treated separately according to research institutes and industry.

The main objectives of the survey are the following:

- ✓ Frequency of transfer of new knowledge;
- ✓ The methods and ways of knowledge transfer and acquisition;
- ✓ The reasons for certain issues regarding the transfer of knowledge into industry;
- ✓ The financing of knowledge transfer by the state;
- ✓ Some suggestions for a more efficient and successful cooperation between research institutes and industry.

The present survey has been conducted at research institutes and in industry. Scientists and researcher form research institutes were given a questionnaire entitled »The Transfer of New Knowledge from Research Institutes into Industry – institutes«. See Appendix 5 and Appendix 5a.

Researchers from R&D departments in enterprises were given a separate questionnaire entitled »The Transfer of New Knowledge from Research Institutes into enterprises – enterprises«. See Appendix 6 and Appendix 6a. Both questionnaires differ in point 1, where researchers from industry were answering on an additional question marked as 1.a. See Appendix 5 and Appendix 6.

5.1.1 The formation of the questionnaire

The questionnaire, which was compiled for the purposes of empirical survey, is divided into three sections:

The first section, from question 1 to 5 and the question 9, are related to the *actual cooperation* between research institutes and industry, *the ways of cooperation*, the *interest in such cooperation*, the *useful value* of transferred knowledge and the *financing of research* by the state.

The *second section* includes questions 6 and 7 which present statements regarding the *key factors for the transfer of knowledge* from research institutes into industry and regarding *issues* connected to their cooperation. Participants are invited to state the level of their agreement or disagreement with these statements.

The third section involves some *open-end questions.* Question number 10 focuses on the suggestions for the improvement of the transfer of new knowledge from research institutes into practice.

A *five-grade Likert scale* was used for questions 1, 2, 3, 4, 5, 7 and 9, while question 10 requires an actual answer.

A *questionnaire* was used for gathering information. Before the actual survey we have tested the questionnaire in terms of a *pilot questionnaire*. The purpose of pilot questionnaires is to gain information regarding the course of survey, the contact with participants, their issues with individual questions, possible mistakes and vagueness of individual questions. We have also conducted some non-structured scientific discussions with which we have tried to gain information of the adequacy of the questionnaire from participants.

On the basis of results and conclusions obtained by pilot questionnaires we have prepared a final version of the questionnaire entitled »The Transfer of New Knowledge from Research Institutes into Industry – institutes« which is presented in Appendix 5 and 5.a and »The Transfer of New Knowledge from Research Institutes into Industry – industry« which is presented in Appendix 6 and 6.a.

The questionnaire regarding the transfer of new knowledge from research institutes into practice was planned according to the following steps:

1. Determination of target population
2. Determination of the objective of the empirical survey
3. Selection of the way of presenting a questionnaire (personal contact, via e-mail with previous phone announcement)
4. Formation of the questionnaire
5. Formation of questions
6. Selection of method for the analysis of data
7. Selection of a sample plan for the survey.

5.1.2 Sampling

Target population was chosen among:

- ✓ ***Slovene researchers from R&D departments from the following companies:***

1. Krka, tovarna zdravil, d.d., Novo mesto
2. Novartis - Lek Farmacevtska družba d.d., Ljubljana
3. Trimo d.d., Trebnje
4. Kovinoplastika Lož, d.d., Lož
5. Yulon d.d., Ljubljana
6. TIM Tovarna izolacijskega materiala, d.d., Laško
7. Belinka KTM, d.o.o., Ljubljana
8. SavaTech, d.o.o., Kranj
9. Color d.d., Medvode
10. AVTENTA.SI, sistemska integracija in poslovne rešitve, d.o.o., Ljubljana

11. Cinkarna Metalurško kemična industrija Celje, d.d., Celje
12. Litostroj E.I. d.o.o., Ljubljana
13. Adria Mobil d.o.o., Novo mesto
14. Prevent, d.d., Slovenj Gradec
15. Juteks, d.d.,
16. Salonit Anhovo gradbeni material, d.d., Deskle
17. ELAN d.d., Begunje
18. CIMOS d.d., Avtomobilska industrija, Koper
19. Gorenje, Gospodinjski aparati, d.d., Velenje
20. Kolektor d.o.o., Idrija
21. Etol d.d., Škofja vas
22. Akrapovič d.o.o., Ljubljana
23. Revoz d.d., Novo mesto
24. Danfoss Trata d.d., Ljubljana
25. Henkel Slovenija, d.o.o., Maribor.

- ✓ ***Researchers, scientists from research institutes, managers of institutes and managers of departments of the IJS Ljubljana:***

1. IJS (Inštitut Jožef Stefan), Ljubljana
2. ITPO (Inštitut za tehnologijo površin in optoelektroniko), Ljubljana
3. IMT (Inštitut za kovinske materiale in tehnologije), Ljubljana
4. ERICO (Inštitut za ekološke raziskave), Velenje
5. ZAG (Zavod za gradbeništvo Slovenije), Ljubljana
6. Kmetijski inštitut Slovenije, Ljubljana
7. Kemijski inštitut, Ljubljana
8. Inštitut za celulozo in papir, Ljubljana.

The rules of sampling in questionnaire surveys drafted by Kalton and Vehovar were also considered.

5.1.3 The gathering of data

The survey was conducted between 14th June and 15th July 2004. We have invited 55 Slovene researchers and scientists from research institutes and 25 researchers from R&D departments to participate in the survey. The participants were sent a questionnaire with a cover letter inviting them to participate. The cover letter has also described the purpose of the survey and the address where they could submit their filled in questionnaires.

The participants were answering the questions individually and independently.

In total we have received 30 questionnaires from research institutes, which represents a 54.5% responsiveness, and 20 questionnaires from enterprises or 80.0% responsiveness.

5.1.4 The analysis of results

A quantitative analysis of data gathered by questionnaires (from questions 1 to 9 in the questionnaire) was conducted by computer programme MS Office Excel 2003 and by a statistical package SPSS 12.0 in a MS Windows environment.

The answers to open-end questions – *evaluative answers* (question 10) – were processed by a *qualitative analysis of their content.*

5.2 Results of the survey regarding the transfer of new knowledge from research institutes into practice

Question 1: The transfer of new knowledge from research institutions into industrial sectors

With the first question "*How much new knowledge (inventions, innovations, novelties, discoveries, suggestions) from your field of expertise are you transferring into practice?*" (Question posed to researchers from research institutes) or *"How much new knowledge (inventions, innovations, novelties, discoveries, suggestions) do you obtain from research institutions?"* (Question posed to researchers from enterprises) we have invited the participants to choose their answers on a scale from 1 to 5 and got the following answers:

Table 5: Transfer of new knowledge

Answer	Research institutes		Enterprises	
	Frequency	Percent	Frequency	Percent
1 – nothing	1	3.3	1	5
2 – little	4	13.3	13	65.0
3 – average	16	53.3	6	30.0
4 – enough	7	23.3	0	0
5 – a lot	2	6.7	0	0
Total	30	100	20	100
Average value	**3.20**		**2.30**	

Source: Questionnaire ,app.5 and 6, question 1

Table 5 clearly shows that the average values for research institutes or industrial sectors represent 3.2 or 2.3. On the basis of these figures we can draw the following conclusion: researchers from institutes believe that they transfer considerably more knowledge into industrial sectors (3.2) than thought by the employees in industrial sectors (2.3).

We also wanted to find out whether there are certain statistically characteristic differences in the perception of researchers from industrial sectors in comparison to the perception of researchers from institutes. A T - test has proven that such differences in perception of acquired/transferred knowledge between institutes and industry are present (t = 4.2, sigma = 0.001). See Appendix 7, question 1, T-test.

Researchers from R&D departments in enterprises were also asked how much knowledge they acquire from other sources.

Question 1.a: The acquisition of new knowledge from other sources (answers obtained from researchers in industry)

With question 1.a "*How much knowledge do you acquire from other sources: bibliography, development departments within enterprises, employees, competition, trade fairs (visits and exhibitions), internet and other*" we have invited the participants from enterprises to evaluate each source with a value scale ranging from 1 to 5. The results are presented in Tables 6 and 7.

Table 6: Other sources

Answer	bibliography		development within enterprise		employees		competition	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
1 – nothing	0	0	0	0	0	0	1	5.0
2 – little	5	25.0	0	0	3	15.0	4	20.0
3 – average	7	35.0	3	15.0	8	40.0	8	40.0
4 – enough	8	40.0	16	80.0	9	45.0	7	35.0
5 – a lot	0	0	1	5.0	0	0	0	0
Total	20	100	20	100	20	100	20	100
Average value	**3.15**		**3.90**		**3.30**		**3.05**	

Source: Questionnaire ,app. 6, question 1.a

Table 7: Other sources - continuation

Answer	trade fairs, visits, exhibitions		internet		other	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
1 – nothing	2	10.0	1	5.0	1	5.0
2 – little	5	25.0	7	35.0	6	30.0
3 – average	5	25.0	9	45.0	5	25.0
4 – enough	8	40.0	3	15.0	2	10.0
5 – a lot	0	0	0	0	0	0
Total	20	100	20	100	20	100
Average value	**2.95**		**2.70**		**1.89**	

Source: Questionnaire ,app. 6, question 1.a

Researchers working in enterprises believe that they acquire most knowledge from the developments within their enterprises (3.9). This estimate is statistically different form the second highest estimate (Paired Samples T test: t = 3.75, sig. = 0.01). The next most important sources of new knowledge were employees, bibliography, competitors and fairs, visits and exhibitions. These figures do not present any major statistical differences[7]. If we compare the evaluation of knowledge that researchers in enterprises obtain from research institutes (2.25), we can observe that this source of

[7] The extracts of individual t-tests with the Paired Samples t-test method can be found in the Appendix 7 .

new knowledge is only positioned on the last place together with *other* sources (there are no statistically characteristic differences among them; t =1.1, sig. = 0.29). On the basis of the above presented evaluations we can conclude that enterprises do not acquire enough knowledge from research institutes or that this knowledge is not useful enough for industrial sectors. See Appendix 7, question 1.a.

Question 2: The interest expressed by researchers (and scientists) at research institutes and in industrial sectors in the transfer of new knowledge into industry

With the second question "*Please state the degree of your interest in the transfer of new knowledge into your enterprise?*" (Question posed to researchers from research institutes) or *"Please state the degree of your interest in the transfer of new knowledge form research institutions?"* (Question posed to researchers from enterprises) we have invited the participants to choose their answers on the basis of a 1 to 5 scale and obtained the following results:

Table 8: The interest for transfer

Answer	Research institutes		Enterprises	
	Frequency	Percent	Frequency	Percent
1 – not interested	0	0	0	0
2 – slightly interested	0	0	1	5.0
3 – average interest	2	6.7	3	15.0
4 – interested	13	43.3	9	45.0
5 – very interested	15	50.0	7	35.0
total	30	100	20	100
Average value	**4.43**		**4.10**	

Source: Questionnaire ,app.5 and 6, question 2

The average values (4.43 and 4.10) clearly show that the interest in the transfer of new knowledge from research institutes into enterprises is extremely high both at research institutes as in industry. See Table 8.

The average values (4.43 and 4.10) are not statistically different (t = 1.6, sig. = 0.12), which means that both researchers and scientists from research institutes as researchers from enterprises have expresses an equal degree of interest into the transfer of new knowledge. See Appendix 7, question 2.

The reasons for researchers in industry not acquiring enough of new knowledge from research institutes obviously do not lie in the fact that they would not want such knowledge transfer, but should be sought elsewhere. The following section tries to present such reasons.

Question 3: Contacts between research institutions and industrial sectors

The participants have given the following answers to the third question "*How much are you in contact with industry in terms of the transfer of new knowledge?*" (Question posed to researchers from institutes) or "*How much are you in contact with research institutes in terms of the transfer of new knowledge?*" (Question posed to researchers in enterprises).

Table 9: Frequency and percent of contacts

Answer	Research institutes		Enterprises	
	Frequency	Percent	Frequency	Percent
1 – nothing	3	10.0	1	5.0
2 – little	3	10.0	4	20.0
3 – average	13	43.3	8	40.0
4 – enough	9	30.0	5	25.0
5 – a lot	2	6.7	2	10.0
Total	30	100	20	100
Average value	**3.13**		**3.15**	

Source: Questionnaire ,app.5 and 6, question 3

The above results in Table 9 clearly show that contacts between industry and research institutes are relatively frequent; this was expressed both by researchers working in enterprises as by researchers and scientists working at research institutes. It is also interesting to note that average values of answers are almost identical in both groups (3.13 according to researchers at research institutes and 3.15 according to researchers in industry). See Appendix 7, question 3.

The average values (3.15 and 3.13) are not statistically different (t = 0.55, sig. = 0.89).

Question 4: Ways and methods used to transfer new knowledge

We have obtained the following answers from participants answering the fourth question "*How do you transfer new knowledge into enterprises?"*
a) Directly, i.e. through agreements, orders, contracts and similar.
b) Other: articles, lectures, notices, seminars and similar.
(This question was posed to researchers from institutes and from enterprises.)

The participants have chosen their answers on a basis of a scale ranging from 1 (nothing) to 5 (a lot).

Results are presented in the following tables:

a) Directly

Table 10: Ways and methods of transfer - direct

Answer	Research institutes		Enterprises	
	Frequency	Percent	Frequency	Percent
1 – nothing	5	16.7	1	5.0
2 – little	4	13.3	3	15.0
3 – average	11	36.7	0	0
4 – enough	6	20.0	13	65.0
5 – a lot	4	13.3	3	15.0
total	30	100	20	100
Average value	**3.00**		**3.70**	

Source: Questionnaire ,app.5 and 6, question 4

b) Other: articles, lectures, notices

Table 11: Ways and methods of transfer - other

Answer	Research institutes		Enterprises	
	Frequency	Percent	Frequency	Percent
1 – nothing	2	6.7	3	15.0
2 – little	12	40.0	12	60.0
3 – average	12	40.0	3	15.0
4 – enough	3	10.0	2	10.0
5 – a lot	1	3.3	0	0
Total	30	100	20	100
Average value	**2.63**		**2.20**	

Source: Questionnaire ,app.5 and 6, question 4

Tables 10 and 11 clearly show that, both researchers from research institutes as researchers working in enterprises believe that most knowledge is transferred indirectly from institutes into industry. It seems interesting though that researchers from enterprises believe that they acquire more knowledge than perceived by researchers working in institutes (t = -2.034, sig. = 0.047). On the other hand, researchers in institutes believe that they transfer more knowledge through articles, lectures and notices than researchers in enterprises. Again, the differences in results are statistically characteristic (t = 2.005, sig. = 0.05). See appendix 7, question 4.

Question 5: The applicability of transferred knowledge for enterprises

With the fifth question "*In your opinion, how much is transferred knowledge useful in your enterprise?"* (Question posed to researchers from institutes) *or "In your opinion, how much is knowledge transferred from research institutes useful for your enterprise?*" (Question posed to researchers in enterprises) we have invited the participants to choose their answers on a scale from 1 to 5 and obtained the following answers:

Table 12: The applicability of transferred knowledge

Answer	Research institutes		Enterprises	
	Frequency	Percent	Frequency	Percent
1 – not useful	0	0	0	0
2 – slightly useful	1	3.3	4	20.0
3 – averagely useful	6	20.0	9	45.0
4 – considerably useful	15	50.0	5	25.0
5 – very useful	8	26.7	2	10.0
Total	30	100	20	100
Average value	**4.00**		**3.25**	

Source: Questionnaire ,app.5 and 6, question 5

Table 12 clearly shows that average values for research institutes or for enterprises represent 4.00 or 3.25. Since the average value in both groups exceeds 3, we can conclude that knowledge from researchers at research institutes is definitely very useful. However, researchers from research institutes believe it is more useful than researchers working in enterprises (t = 3.098, sig. = 0.003). See Appendix 7, question 5.

It is very interesting to note that more than 75% of participants from research institutes believe that transferred knowledge is considerably or very important, while 65% of participants from enterprises believe that new knowledge is of little or average importance. On the basis of the above presented answers we can conclude that researchers might not be familiar enough with the needs of industrial sectors or that they are not able to make a sound presentation of knowledge they possess, which results in the belief that such knowledge cannot be used in enterprises.

Question 6: Key factors governing the transfer of new knowledge from research institutions into industry

In answering the sixth question *"In your opinion which are the key factors governing the transfer of new knowledge from research institutes into industry"* the participants could choose from the following statements:
Research institutes should become more open, cooperation should be based on a long-term basis, the way of presenting new knowledge should be adapted to the needs of industrial sectors, research institutes should provide more useful knowledge, communication should be "market-oriented" and other" (this question was posed to both researchers from institutes as to researchers from enterprises).

The participants were evaluating the above statements on a basis of a scale ranging from 1 (least important) to 5 (most important). It has to be emphasised that participants were able to assign the same evaluations to several statements or leave them out as unimportant.

Table 13: Key factors governing the transfer of new knowledge from research institutes into practice

Statement	Research institutes		Enterprises	
	Average	Std. Deviation	Average	Std. Deviation
Research institutes should be more open	3.56	1.524	3.85	1.268
Cooperation should be based on a long-term basis	3.83	1.341	3.45	1.394
The way of presenting new knowledge should be adapted to the needs of industrial sectors	3.36	1.473	3.65	1.225
Research institutes should provide more useful knowledge	4.36	0.964	4.50	0.606
Communication should be "market-oriented"	3.13	1.591	3.60	1.231
Other	1.38	2.246	1.25	2.236

Source: Questionnaire ,app.5 and 6, question 6

All participants believed that research institutes should provide more useful knowledge, while all but one agreed that cooperation between them should be based on a long-term basis and that research institutes should become more open. See Table 13.

Both groups agreed that research institutes should provide more useful knowledge (4.36 and 4.50), which was also chosen as the most important statement.
There were no statistically characteristic differences in any of the chosen statements, which is why we have presented only the average figures of the answers submitted from the sample. See Appendix 7, question 5.

Table 14: Key factors governing the transfer of new knowledge from research institutes into practice - average figures

Statement	Average	Std. Deviation
Research institutes should provide more useful knowledge	4.42	0.835
Cooperation should be based on a long-term basis	3.68	1.361
Research institutes should be more open	3.68	1.420
The way of presenting new knowledge should be adapted to the needs of industrial sectors	3.48	1.373
Communication should be "market-oriented"	3.32	1.463
Other	1.33	2.215

Source: Questionnaire ,app.5 and 6, question 6

Table 14 assigned to the most important statement, namely that research institutes should provide more useful knowledge, is also statistically different from figures assigned to other statements or to the figure assigned to the next most important statement (Paired samples t - test, t = 3.22, sig. = 0.02). There are no statistically

characteristic differences between other statements, which is also clearly shown in the t - tests[8].

Question 7: Main reasons for some problems regarding the transfer of new knowledge into industry

With the seventh question *"Do you agree with the following statements?"* (posed to both researchers from institutes and researchers from enterprises) *we* have invited participants to express their dis-/agreement with the following statements by choosing from a scale ranging from 1 (I do not agree) to 5 (I agree). Results are presented in Table 15.

Table 15: Evaluation of statements

Statement	Research institutes		Enterprises	
	Average	Std. Deviation	Average	Std. Deviation
Slovene companies should be more development-oriented	**3.93**	0.691	**3.55**	0.945
Institutes do not provide enough encouragement to researchers to undertake more applicable research	**3.80**	1.063	**4.25**	0.639
New knowledge is too expensive for enterprises	**3.37**	1.188	**2.90**	1.020
The state should provide more funds for investments into development and education with appropriate tax-relief measures	**4.33**	0.922	**4.20**	0.696
The attitude of management personnel in enterprises towards their cooperation with research institutes is negative	**3.27**	0.785	**2.50**	0.827
Cooperation is often established on the basis of personal acquaintances	**4.00**	0.871	**3.90**	1.021
There is a lack of cooperation between the main actors within research institutes	**3.67**	0.922	**3.65**	1.182
There are not enough contacts between institutes and enterprises (apart from regular cooperation)	**4.13**	0.860	**4.25**	0.716
Researchers and scientists from institutes are not present enough in enterprises	**4.23**	0.898	**4.20**	0.696
Researchers and scientists from institutes are not familiar with actual needs of enterprises	**4.13**	0.973	**4.35**	0.587
Researchers working in enterprises cannot get in contact with contact persons from institutes	**2.33**	1.213	**2.45**	0.944
There are not enough formal and informal contacts between researchers from institutes and researchers from enterprises	**3.73**	1.048	**3.60**	0.883

Source: Questionnaire ,app.5 and 6, question 7

[8] Extracts of texts can be found in Appendix 7.

Researchers and scientists from institutes have agreed with all of the above statements apart form “Researchers working in enterprises cannot get in contact with contact persons at institutes” (2.33).

They have expressed the highest degree of agreement with the following statements:

- ✓ The state should provide more funds for investments into development and education with appropriate tax-relief measures (4.33)
- ✓ Researchers and scientists from institutes are not present enough in enterprises (4.23)
- ✓ Researchers and scientists from institutes are not familiar with actual needs of enterprises (4.13)
- ✓ There are not enough contacts between institutes and enterprises (apart from regular cooperation) (4.13), and
- ✓ Cooperation is often established on the basis of personal acquaintances (4.00).

Researchers working in enterprises have expressed the highest level of agreement with the following statements:

- ✓ Researchers and scientists from institutes are not familiar with actual needs of enterprises (4.35)
- ✓ There are not enough contacts between institutes and enterprises (apart from regular cooperation) (4.25)
- ✓ Institutes do not provide enough encouragement to researchers to undertake more applicable research (4.25)
- ✓ Researchers and scientists from institutes are not present enough in enterprises (4.20)
- ✓ The state should provide more funds for investments into development and education with appropriate tax-relief measures (4.20)

and they do not agree with:

- ✓ Researchers working in enterprises cannot get in contact with contact persons at institutes (2.45)
- ✓ The attitude of management personnel in enterprises towards their cooperation with research institutes is negative (2.50).

The survey clearly shows that all participants have mostly agreed with the following statements:

- ✓ The state should provide more funds for investments into development and education with appropriate tax-relief measures
- ✓ Researchers and scientists from institutes are not familiar with actual needs of enterprises
- ✓ Researchers and scientists from institutes are not present enough in enterprises
- ✓ There are not enough contacts between institutes and enterprises (apart from regular cooperation).

There is only one statement that provides figures in terms of statistically characteristic differences between the two groups: according to researchers working in research institutes the attitude of enterprise's management personnel towards the cooperation between institutes and enterprises is more negative than perceived by researchers working in enterprises[9].

Question 8: Main reasons for problems that occur during the transfer of new knowledge into enterprises

With the eighth question "*Please choose 5 of the following statements which in your opinion describe major problems that occur during the process of knowledge transfer between research institutes and enterprises"* (this question was posed to participants from research institutes and from enterprises) we have invited the participants to do the following:

We have asked the participants to read the following twelve statements and select five statements that most describe the major problems that govern the transfer of new knowledge between research institutes and enterprises.

The frequency of answers according to the two groups is presented in Table 16.

Table 16: Main factors which render the transfer of new knowledge into enterprises difficult – comparison of answers

	N (institutes)	N (enterprises)
Institutes do not provide enough encouragement for researchers to undertake more applicable research	**19**	**15**
Slovene companies should be more development-oriented	**17**	**9**
There are not enough contacts between institutes and enterprises (apart from regular cooperation)	**17**	**11**
The state should provide more funds for investments into development and education with appropriate tax-relief measures	**16**	**12**
Researchers and scientists from institutes are not familiar with actual needs of enterprises	**15**	**16**
There are not enough formal and informal contacts between researchers from institutes and researchers from enterprises	**14**	**6**
Researchers and scientists from institutes are not present enough in enterprises	**12**	**8**
New knowledge is often too expensive for enterprises	**10**	**3**
Cooperation is often established on the basis of personal acquaintances	**10**	**12**
The attitude of management personnel in enterprises towards their cooperation with research institutes is negative	**8**	**2**
There is a lack of cooperation between the main actors within research institutes	**8**	**3**
Researchers working in enterprises cannot get in contact with contact persons from institutes	**1**	**2**
Total	**150**	**100**

[9] Extracts of tests can be found in Appendix 7.

Researchers and scientists from research institutes have most often chosen the following statements which denote major problems in knowledge transfer: “Institutes do not provide enough encouragement for researchers to undertake more applicable research, Slovene companies should be more development-oriented, There are not enough contacts between research institutes and enterprises (apart from regular cooperation), and The state should provide more funds for investments into development and education with appropriate tax-relief measures”.

On the other hand, researchers from enterprises have most frequently chosen the following statements: “researchers and scientists from institutes are not familiar with the actual needs of enterprises, Institutes do not provide enough encouragement for researchers to undertake more applicable research, Cooperation is often established on the basis of personal acquaintances, The state should provide more funds for investments into development and education with appropriate tax-relief measures, and There are not enough contacts between research institutes and enterprises (apart from regular cooperation)”.

Table 17: Main factors which render the transfer of new knowledge into enterprises difficult

	Cases	Col Response %
Institutes do not provide enough encouragement to researchers to undertake more applicable research	**34**	68
Researchers and scientists from institutes are not familiar with actual needs of enterprises	**31**	62
The state should provide more funds for investments into development and education with appropriate tax-relief measures	**28**	56
There are not enough contacts between institutes and enterprises (apart from regular cooperation)	**28**	56
Slovene companies should be more development-oriented	**26**	52
Cooperation is often established on the basis of personal acquaintances	**22**	44
Researchers and scientists from institutes are not present enough in enterprises	**20**	40
There are not enough formal and informal contacts between researchers from institutes and researchers from enterprises	**20**	40
New knowledge is too expensive for enterprises	**13**	26
There is a lack of cooperation between the main actors within research institutes	**11**	22
The attitude of management personnel in enterprises towards their cooperation with research institutes is negative	**10**	20
Researchers working in enterprises cannot get in contact with contact persons from institutes	**3**	6
Total	**50**	**492,0%**

Most often the participants have stated that the most important factor rendering the transfer of new knowledge difficult is the fact that institutes do not provide enough encouragement for researchers to undertake more applicable research (see Table 17). The next most frequent statement was that researchers and scientists from

research institutes are not familiar with the actual needs of enterprises. On the basis of the above answers we can conclude that the party "responsible" for the occurring of problems that make knowledge difficult are research institutes and not enterprises (see Appendix 7, question 8).

According to the above information we can conclude that most often cooperation between research institutes and enterprises is established on the basis of personal acquaintances due to the lack of contacts between them. If the researchers be more present in enterprises they would be more familiar with the actual needs of enterprises and could offer them more applicable and useful knowledge.
There is another issue, however: How come researchers do not establish more contacts with enterprises? Most likely, one of the reasons could be the fact that the state does not provide enough encouragement for researchers to undertake more applicable research. On the other hand, researchers at institutes often believe that Slovene companies lack development-orientation and that new knowledge is too expensive for them.

However, there are certain issues that need to be resolved by enterprises, too. Enterprises often seem to lack initiative and openness for cooperation with institutes and often do not even try to get in contact with institutes. A more aggressive approach is therefore a must.

Question 9: State assistance in the transfer of new knowledge into industry

The participants have submitted the following answers to the ninth question "*In your opinion, whom should the state allocate more financial funds intended for the transfer of new knowledge: industry or research institutions."* (Question posed to researchers from institutes and to researchers from enterprises):

Table 18: State assistance

Answer	Research institutes		Enterprises	
	Frequency	**Percent**	**Frequency**	**Percent**
1 – entirely to enterprises	2	6.7	9	45.0
2 – 75% to enterprises, 25% to research institutes	5	16.7	2	10.0
3 – 50% to enterprises, 50% to institutes	14	46.7	5	25.0
4 – 25% to industry, 75% to institutes	8	26.7	3	15.0
5 – entirely to research institutes	1	3.3	1	5.0
Total	30	100	20	100
Average value	**3.03**		**2.25**	

Source: Questionnaire ,app.5 and 6, question 9

The participants have submitted their evaluations on the basis of the following scale: from 1 (to enterprises) to 5 (to institutes), where 3 means to both organisations equally.

According to researchers at research institutes the state should give equal financial support to both organisations (average value 3.03), while the researchers in enterprises believe that the state should give more financial assistance to enterprises (average value 2.25). See Table 18 and Appendix 7, question 9.

The differences in answers are statistically characteristic (t= 2.45, sig. 0.018).

Question 10: Suggestions for a more successful cooperation between research institutes and enterprises

The tenth question "*What do you suggest for an even more successful cooperation between research institutes and enterprises or for the overcoming of existing problems occurring during the process of knowledge transfer from research institutes into enterprises?"* (which was posed to both researchers from institutes and researchers from enterprises) has been answered by 25 researchers and scientists from research institutes, which represents 83.3% of all participants, and 18 researchers from industrial sectors, which represents 90.0% of all participants from enterprises.

All the answers submitted from researchers and scientists working in research institutes are summarised into 22 most common suggestions:

- ✓ "The state should promote investments into development and knowledge transfer by introducing appropriate tax-relief measures"
- ✓ "The system of awarding researchers working at research institutes should be changed"
- ✓ "The state should clearly define its development strategy and its priority developmental sectors"
- ✓ "The financing of research activities should be more conditioned by applicative nature of research"
- ✓ "We should introduce a knowledge market"
- ✓ "Enterprises should be more oriented towards development"
- ✓ "We should form mixed research groups"
- ✓ "There should be more investments into young researchers who should get more possibilities for training and education abroad"
- ✓ "The number of our research teams in enterprises should be increased"
- ✓ "Enterprises and research institutes should establish the "knowledge sharing centres"
- ✓ "The competent ministries (Ministry of Education, Science and Sports and Ministry of Economy) should provide an appropriate expert system for an objective evaluation of our cooperation"
- ✓ "The cooperation with Slovene research institutes should be more frequent when it comes to applying for EU projects"
- ✓ "The number of personal contacts between research institutes and enterprises should be increased"
- ✓ "The responsiveness of research institutes should be improved"
- ✓ "We should introduce an additional evaluation system and evaluate research institutes according to the results they achieved when working with enterprises"

- ✓ “There should be more developmental stimulation of the state to research institutes and enterprises”
- ✓ “Enterprises should be additionally encouraged to train and educate their staff together with research institutes for the needs of knowledge transfer”
- ✓ “Experts from research institutes should be directly and indirectly involved in the activities performed by enterprises”
- ✓ “The obsolete infrastructure in research institutes and enterprises should be upgraded and modernised”
- ✓ “Researchers should be employed in enterprises on the basis of their actual needs”
- ✓ “We should increase the reputation of such cooperation and thus increase the interest of enterprises in the cooperation with research institutes”
- ✓ “We should educate adequate technical personnel, as there is already a lack of such qualifications in Slovenia”

Researchers working in enterprises have submitted the following answers to the same question:

- ✓ “We should introduce presentation seminars during which research institutes could present their guidelines for development and the opportunities for cooperation”
- ✓ “We should improve/update our knowledge regarding the needs of research institutes and enterprises”
- ✓ “We should increase the reputation of such cooperation and thus increase the interest of enterprises in the cooperation with research institutes”
- ✓ “We should stimulate such cooperation when it comes to management personnel in enterprises”
- ✓ “The system of awarding researchers working at research institutes should be changed”
- ✓ “The number of personal contacts between research institutes and enterprises should be increased”
- ✓ “We should introduce a knowledge market”
- ✓ “We should improve our knowledge regarding the needs of enterprises”
- ✓ “The state financing of research institutes should gradually be decreased; the state should only finance projects of national importance”
- ✓ “Responsiveness of research institutes should be increased”
- ✓ “Universities and institutes should be transformed into centres of knowledge and cooperation”
- ✓ “We should raise the awareness of researchers and employees in enterprises regarding the benefits of cooperation with research institutes”
- ✓ “We should introduce an additional evaluation system and evaluate research institutes according to the results they achieved when working with enterprises”
- ✓ “The state should promote investments into development and knowledge transfer by introducing appropriate tax-relief measures”
- ✓ “The cooperation with Slovene research institutes should be more frequent when it comes to applying for EU projects”
- ✓ “We should develop new forms of cooperation which are more connected with industrial sectors (e.g. applicative RR projects and projects regarding the centres of excellence) mainly in terms of interest and pre-competitive cooperation in technological networks”
- ✓ “Research institutes should adapt to the needs of enterprises”
- ✓ “Our thinking and activities should be more European-oriented”

The most common suggestions submitted by participants:

- ✓ “The state should promote investments into development and knowledge transfer by introducing appropriate tax-relief measures”
- ✓ “The system of awarding researchers working at research institutes should be changed “
- ✓ “The state should clearly define its development strategy and its priority developmental sectors“
- ✓ “The financing of research activities should be more conditioned by applicative nature of research”
- ✓ “We should introduce presentation seminars during which research institutes could present their guidelines for development and the opportunities for cooperation”
- ✓ “We should improve/update our knowledge regarding the needs of research institutes and enterprises”
- ✓ “We should introduce a knowledge market”

5.3 Summary of the empirical research

Research – directed at the acquisition and application of knowledge – is now the fundamental driving force of social development.

The main objective of this master’s thesis is to provide an insight into the process of transfer of new knowledge from research institutions into industry in Slovenia, based on empirical research, to highlight the methods and the frequency of such transfer and the interest expressed by both sides. The present thesis also strives to provide a detailed review of these issues and suggest some constructive improvements that should be made in the field.

Acquisition of new knowledge

By means of an empirical survey and its analysis we have tried to determine how much new knowledge is transferred into industrial. We have asked the researchers working in research institutes how much knowledge is in their opinion transferred into enterprises, while researchers working in enterprises were invited to state how much knowledge is in their opinion acquired from institutes.

Researchers from enterprises believe that they do not acquire enough knowledge or that they acquire less knowledge than believed by researchers from research institutes.
We were also interested in finding out how much knowledge do researchers from enterprises acquire from other sources.

Researchers in enterprises believe that they acquire most new knowledge from development processes carried out in their companies. The next most important sources of new knowledge were the employees, bibliography, competitors as well as trade fairs, visits and exhibitions. If we compare the evaluation of knowledge that is obtained by researchers in enterprises from research institutes we can observe that this source of new knowledge is placed last together with *other* sources. On the basis

of these results we can conclude that enterprises do not acquire enough knowledge from research institutes.

Even though, according to researchers from enterprises and research institutes, contacts between enterprises and research institutes are relatively frequent in terms of knowledge transfer, enterprises do not acquire enough knowledge from research institutes or acquire knowledge which is not applicable or useful enough. The survey also tries to look for reasons of such perceptions.

Interest in knowledge transfer

Researchers and scientists working at research institutes and researchers from enterprises were asked to state their degree of interest into the transfer of new knowledge from research institutes into enterprises. Both researchers working at institutes and at enterprises have expressed the same degree of interest into the transfer of knowledge and the degree of interest is substantial. This leads us to believe that the reason for researchers from enterprises not acquiring enough knowledge obviously does not lie in them not wanting to acquire it but should be searched for elsewhere.

Applicability of transferred knowledge

When we compared the applicability of knowledge transferred onto enterprises we have determined that the knowledge of researchers from research institutes is definitely useful, but that researchers from institutes believe that such knowledge is more useful than believed by researchers working in enterprises.
It should be emphasised that more than 75% of participants from research institutes believe that the transferred new knowledge is relatively or very important, while a total of 65% of participants from enterprises believe that new knowledge is of little or average importance. On the basis of these answers we can conclude that researchers are not familiar enough with the actual needs of enterprises or that the knowledge they have is not well presented to employees in enterprises which makes them believe that such knowledge is not useful.

Key factors governing a successful transfer

The participants have been asked to state which factors in their opinion are of key importance in the transfer of new knowledge from research institutes to enterprises. The most important and frequent statement that was expressed by both groups was that research institutes should provide knowledge that is applicable and useful. All but one respondent have agreed that cooperation between institutes and enterprises should be based on a long-term basis and that institutes should become more open.

Main reasons for problems which occur during the transfer of new knowledge into enterprises

Even though there is a high degree of interest in the transfer of new knowledge expressed by both researchers from institutes and from enterprises, and that contacts between the two are relatively frequent as well as that the transferred knowledge is considered useful, enterprises still estimate that they do not acquire enough knowledge from research institutes.

Let us try to explain where the main problems lie.

The participants have expressed the highest degree of agreement with the following statements:

- ✓ »The State should provide more funds for investments into development and education with appropriate tax-relief measures«
- ✓ »Researchers and scientists from research institutes are not familiar with the actual needs of enterprises«
- ✓ »Researchers and scientists from research institutes are not present enough in enterprises«
- ✓ »There are not enough contacts between research institutes and enterprises (apart from regular cooperation).«

The above statements lead us to draw the following conclusions: Since researchers from institutes are not present enough in enterprises, they are unable to become familiar with the actual needs of enterprises. Both sides agree that there are not enough formal or informal contacts between institutes and enterprises. Researchers from institutes do not get any encouragement from the state while researchers in industry lack initiative and just wait for research institutes to contact their company. We have also found out that Slovene companies lack development-orientation and that development in general does not take an important part in management's programmes.

The above premise is confirmed by the survey which clearly shows that institutes do not encourage researchers to undertake applicable and useful research which seems to be one of the main problems in the field of knowledge transfer. The next most commonly chosen statement was that researchers and scientists from institutes are not familiar with the actual needs of enterprises which makes us believe that most problems occurring in knowledge transfer originate in research institutes.

State financing of knowledge transfer

Participants were invited to answer the following question: In your opinion should the state allocate more financial funds intended for the transfer of new knowledge to enterprises or to research institutions?

According to researchers working in institutes the state should allocate equal amount of financial assistance to both institutes and enterprises. On the other hand, researchers working in enterprises believe that the state should allocate more financial funds to enterprises.

Suggestions for improvements of knowledge transfer

Finally, participants were invited to submit their suggestions for improvements in the field of knowledge transfer. Most common proposals are presented below:

- ✓ "The state should promote investments into development and knowledge transfer by introducing appropriate tax-relief measures"
- ✓ "The system of awarding researchers working at research institutes should be changed"

- ✓ “The state should clearly define its development strategy and its priority developmental sectors”
- ✓ “The financing of research activities should be more conditioned by applicative nature of research”
- ✓ “We should introduce a knowledge market”
- ✓ “We should introduce an additional evaluation system and evaluate research institutes according to the results they achieved when working with enterprises”
- ✓ “Enterprises and research institutes should establish the “knowledge sharing centres”
- ✓ “The competent ministries (Ministry of Education, Science and Sports and Ministry of Economy) should provide an appropriate expert system for an objective evaluation of our cooperation”
- ✓ “We should introduce presentation seminars during which research institutes could present their guidelines for development and the opportunities for cooperation”
- ✓ “Universities and institutes should be transformed into centres of knowledge and cooperation”
- ✓ “We should raise the awareness of researchers and employees in enterprises regarding the benefits of cooperation with research institutes”

6 CONCLUSION

Transfer of knowledge from research institutes into industrial sectors: reality and future challenges

The European Union has started to strongly promote innovativeness, as it represents the main competitive factor in today's world. Market globalisation, the increased importance of strategic alliances, the introduction of Asian tigers, the internationalisation of enterprises and R&D activities, the increased development expenses, the shortening of life cycles, the increased complexity and multidisciplinarity and the increased role of social factors (e.g. environment) represent some of the main factors that have contributed to the changes both in the way we generate innovations and the way we diffuse innovations, as well as to modifications of measures taken by authorities to promote and encourage innovativeness.

As far as the generation of knowledge is considered, the situation in Slovenia is relatively positive only in the field of basic science. However, there is often no direct connection between scientific achievements and competitiveness. Due to the increase in the technological complexity of products, the rapid dynamics of technological development and the decrease of the importance of raw materials and cheap labour force the competitive capabilities of a country today depend mainly on its ability to make products and services more innovative, which can only be achieved through technological development. This is why science has to become more connected with practical needs. The presence of basic science is, of course, necessary but it does not represent a major prerequisite for innovativeness.

The main disadvantage of Slovene science and technology is their disability to transfer excellent scientific achievements into industrial sectors. There is a substantial disproportion between the needs of enterprises, which need to be export-oriented and which are frequently exposed to global competition, and Slovene science, which needs to become more market-oriented. There are practically no connection between science and enterprises.

According to exchange theories, knowledge transfer "can sometimes generate lower transition costs with less risk" than alliance between industrial firms. The main incentive for industry to interact with science is the access to knowledge that may provide competitive advantages and to facilities needed to effectively evolve the firm's capabilities.

The main reason for science to interact with industry is the financial sources obtained from research collaboration. Another reason is the possibility to expose students and academic staff to practical problems, create employment opportunities for their graduates and gain access to applied technological areas.

Research institutes should show more interest in the cooperation with enterprises also because of additional financial means of enterprises and international projects (a growing importance of development in R&D programmes of the EU), since state financial assistance will hardly increase in the future. The future financing of research

institutes and universities is becoming more and more dependent on economic situation (negative economic results contribute to the decrease of state funds and the decrease of demand for services provided by research institutes and universities).

On one hand, Slovene science depends on economic situation (state financing), while it is also co-responsible for the situation in economy.

Since Slovenia still imports around 60 % of technology, research institutes have a great opportunity to employ their knowledge and integration in the transfer of state-of-the-art technology. It is true, however, that management boards of Slovene (industrial) enterprises often lack a positive attitude towards development.

Results of empirical survey

By carrying out an empirical survey we wanted to describe the situation in the field of knowledge transfer from research institutes to enterprises by employing a representative sample of Slovene researchers and scientists from research institutes and enterprises. Participants from most developed and successful Slovene enterprises and research institutes were invited to give their opinion regarding the current situation in the field of knowledge transfer.

The results obtained by the survey which focused on the transfer of new knowledge from research institutes into enterprises confirm the fact that the level of transfer is still relatively low even though both sides expressed a high degree of interest in such cooperation. Researchers in enterprises acquire more knowledge from development achievements in their own companies, from their employees, competitors, bibliography, internet, trade fairs and visits than from research institutes.

In searching the possible reasons for these issues we have established that there are enough contacts between institutes and enterprises but that these should become more frequent. Both researchers in enterprises and in research institutes wish that there be more formal and informal contacts between them.

The survey clearly shows that a total of three quarters of participants from research institutes believe that new knowledge is relatively or very important for enterprises, while researchers from enterprises thought that the role of transferred knowledge is not that important. In their opinion new knowledge is useful, but they have given it significantly less importance than researchers from institutes. These results lead us to conclude that researchers working in institutes are not familiar enough with the actual needs of enterprises which results from the fact that there are not enough contacts between research institutes and enterprises (apart from regular cooperation). Both researchers from institutes and from enterprises agreed with the above statements. They have also agreed that researchers from research institutes are not present or involved enough in enterprises.

It is true that industrial enterprises cannot expect that a research institute will invite itself into a company, which is why they need to seek more intense and closer cooperation with research institutes and universities.

Participants working in research institutes believed that Slovene enterprises lack development-orientation which is one of the most important issues in the field of knowledge transfer. Participants from enterprises have agreed with the above statement.

According to researchers from institutes and enterprises *the state should provide more financial funds intended for development and knowledge transfer with appropriate tax-relief measures.* Most participants believed that the lack of state funds represent a serious issue in the transfer of knowledge. They believe that the most important issue that renders knowledge transfer difficult is the fact that research institutes do not provide enough encouragement for researchers to undertake more applicable and useful research. They also believe that the lack of useful research represents a basis for all further problems. Researchers are not present enough in enterprises which makes them unable to recognise the actual needs of enterprises. Some participants suggested that these problems could be avoided and that knowledge transfer could be more efficient if the number of formal and informal contacts between institutes and enterprises increased.

Participants have also suggested that the following would improve the efficiency and frequency of knowledge transfer: the introduction of a knowledge market, the changes in the system of awarding researchers at institutes, the financing of research activities which should depend on the applicable nature of knowledge, institutes should be additionally evaluated according to results they achieve in working with enterprises, the creation of knowledge sharing centres on both sides, competent ministries (Ministry of Education, Science and Sports and Ministry of Economy) should ensure a suitable expert system for impartial evaluation of cooperation and similar.

Suggestions for the increase of efficiency in the transfer of knowledge from research institutes into industrial sectors

On the basis of results obtained by the present survey we can submit some suggestions that could improve the efficiency of knowledge transfer from research institutes into enterprises within a framework of existing circumstances and possibilities. We suggest the following:

A more active role of the State

- ✓ We should change the system used to evaluate success and system of awarding researchers and scientists working at research institutes. Researchers and scientists should be highly motivated for establishing cooperation with enterprises.
- ✓ The state should promote and accelerate the transfer of new knowledge from research institutes into enterprises and introduce appropriate tax-relief measures which would enable companies and institutes to purchase the equipment, technology, programmes and know-how, as for example the supply of new medical equipment.
- ✓ The state should have a clearly defined strategy of development and determine its priority developmental branches.

Reinforcement of R&D departments in enterprises

- ✓ There should be more formal and informal contacts between research institutes and enterprises. Enterprises should seek contacts with research institutes and universities more intensely and show more self-initiative.

Research institutes should become more open

- ✓ The number of formal and informal contacts should also be increased by research institutes (open days, joint presentations, invitations to the introduction of latest achievements, etc.). In this way researchers could become more familiar with the actual needs of enterprises.
- ✓ Researchers should be given more opportunities of education and self-education regarding intellectual property rights, project preparation and planning, time management and other key knowledge and skills that are necessary for a successful transfer of knowledge.
- ✓ We should raise awareness of researchers and scientists both at institutes and in enterprises with respect to the role and importance of knowledge transfer and regarding the inevitable cooperation of both sides.

We believe that the realisation of the aforementioned suggestions could contribute to a more efficient and frequent transfer of knowledge from research institutes into enterprises.

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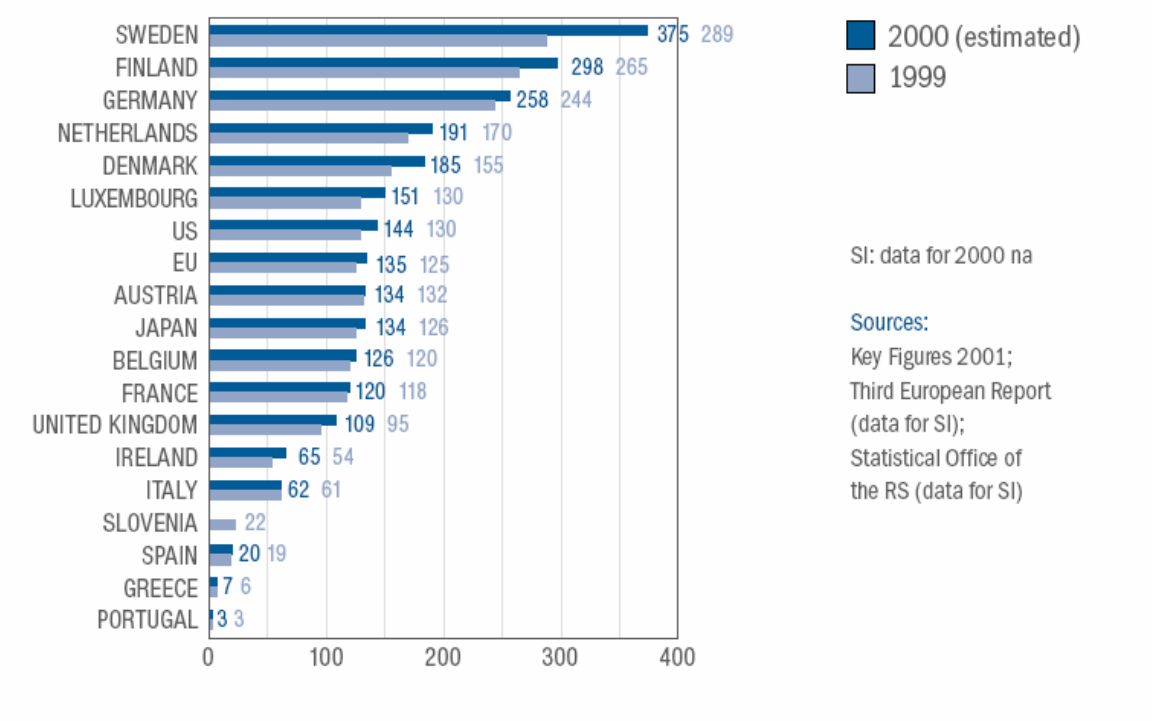
9 APPENDIX

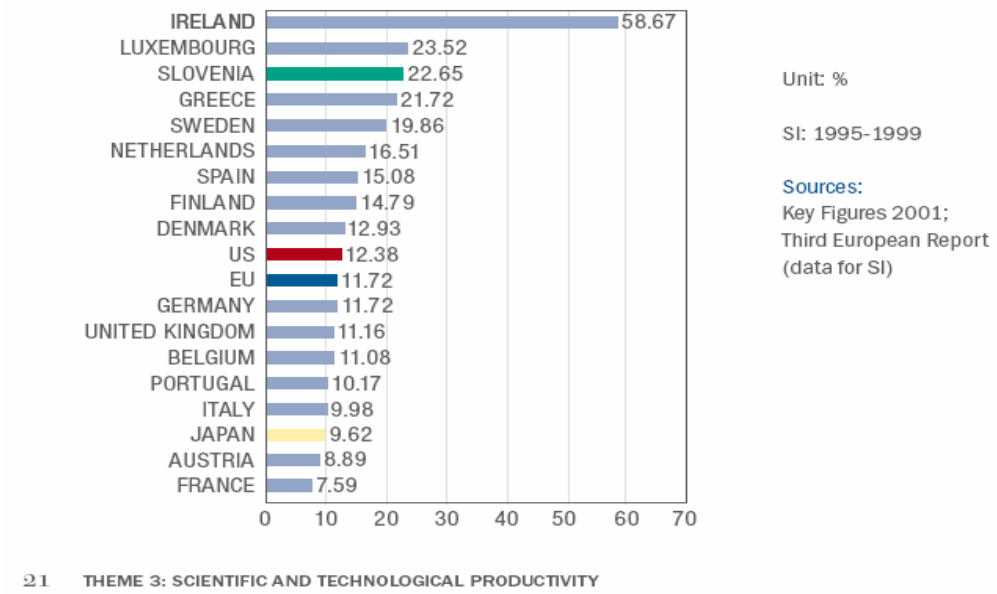
Appendix 1: Intellectual property – figures EU vs Slovenia

App - Figure 1: European patents per million population, 1999 and 2000



Source: Benchmarking, 2002, page 21

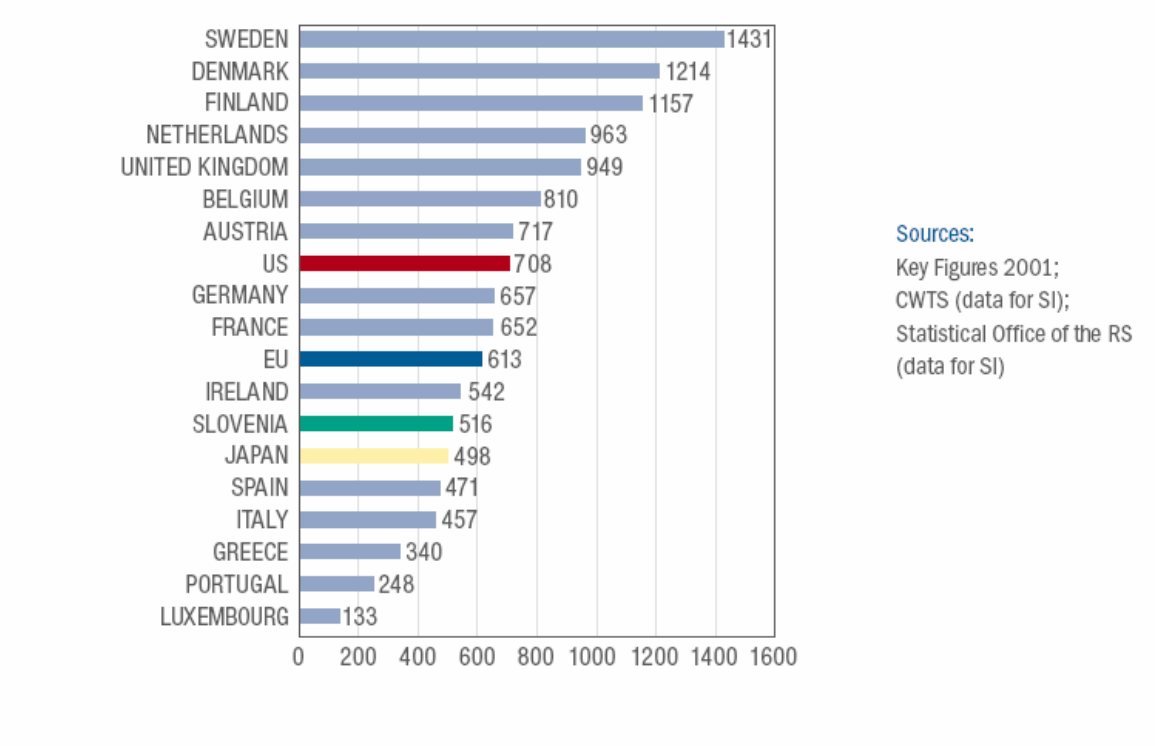
App - Figure 2: Average annual growth in European patents, 1995-2000



21 THEME 3: SCIENTIFIC AND TECHNOLOGICAL PRODUCTIVITY

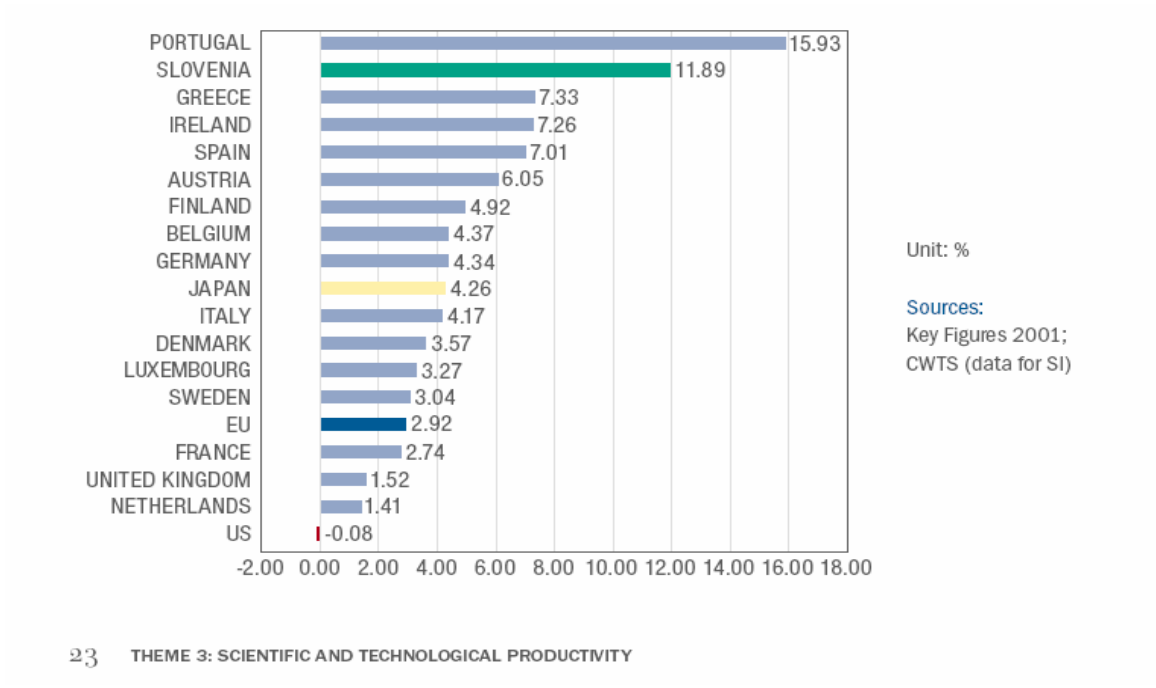
Source: Benchmarking, 2002, page 21

App - Figure 3: Number of scientific publications per million of population, 1999



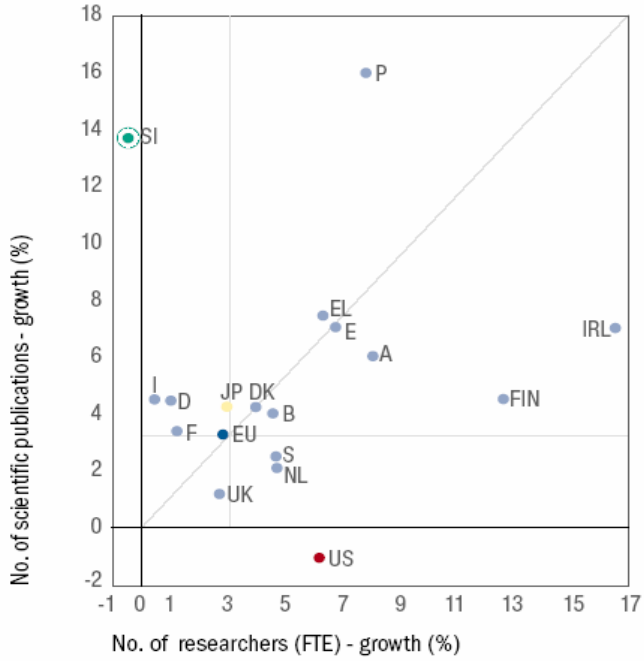
Source: Benchmarking, 2002, page 23

App - Figure 4: Average annual growth in number of scientific publications, 1995-1999



Source: Benchmarking, 2002, page 23

App - Figure 5: Number of scientific publications and number of researchers (FTE) - average annual growth, 1995-1998



D, E, P: 1995-99;
B, EL, IRL, I, FIN, S, US: 1995-97;
SI: 1996-99

Sources:
Key Figures 2001;
CWTS (data for SI);
Statistical Office of the RS (data for SI)

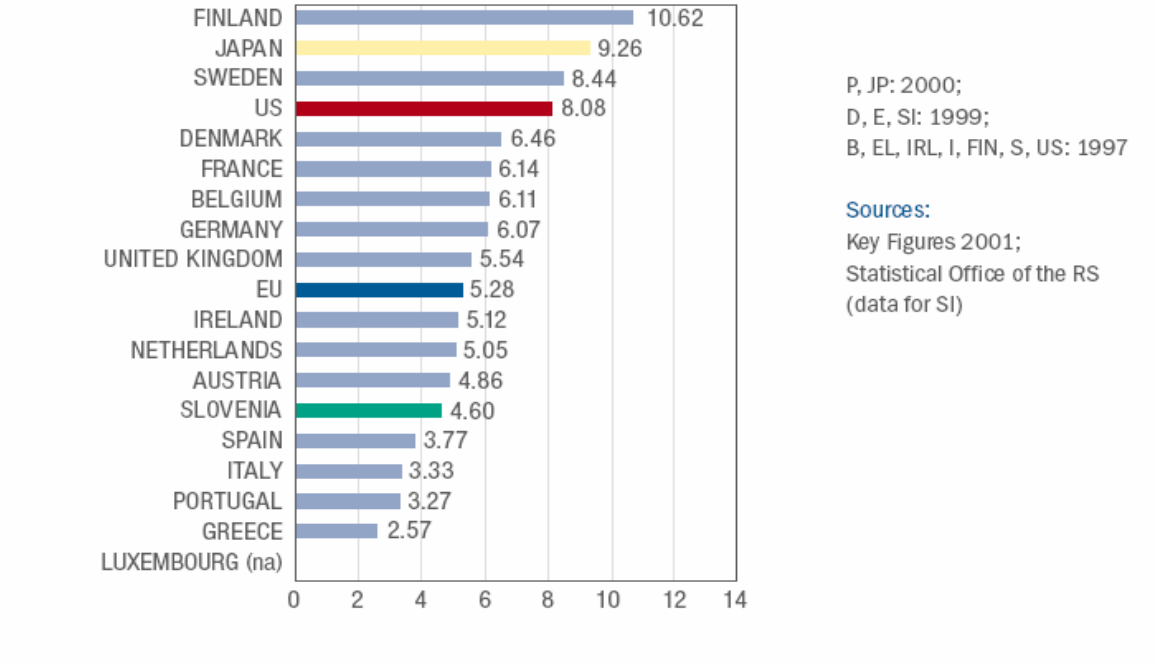
Note:
Since the Slovenian 1995 data for researchers is overestimated the time-span applicable to both indicators shown in the graph is 1996-1999.

25 THEME 3: SCIENTIFIC AND TECHNOLOGICAL PRODUCTIVITY

Source: Benchmarking, 2002, page 25

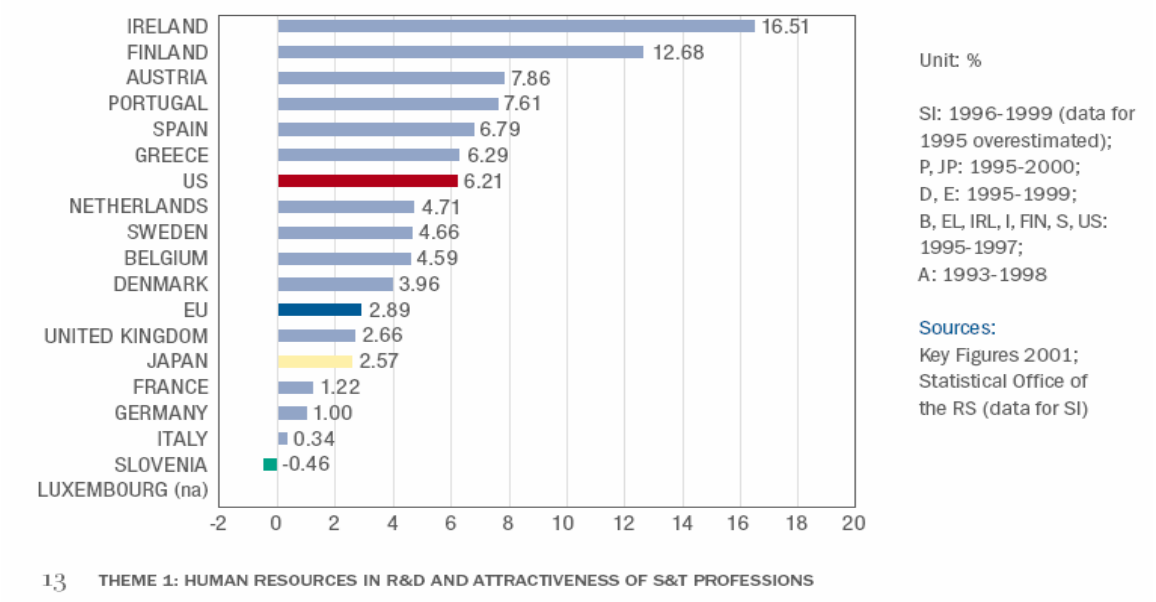
Appendix 2: Research Institutes - figures EU vs Slovenia

App - Figure 6: Total researchers (FTE) per 000 workforce, 1998



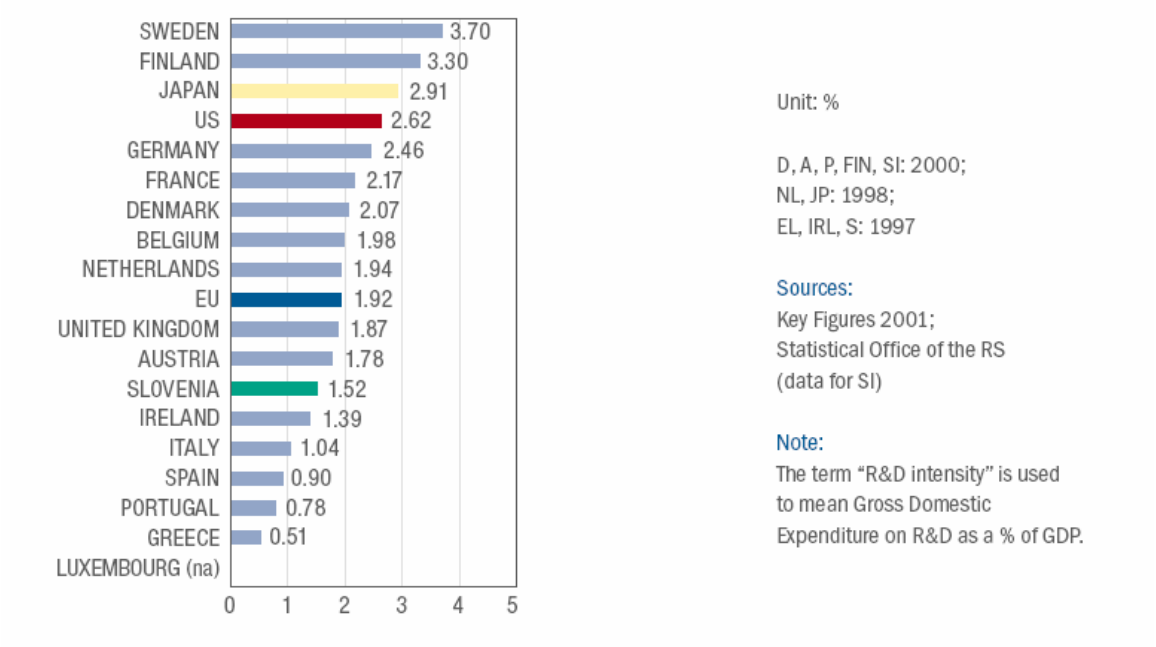
Source: Benchmarking, 2002, page 13

App - Figure 7: Average annual growth in total researchers (FTE), 1995 -1998



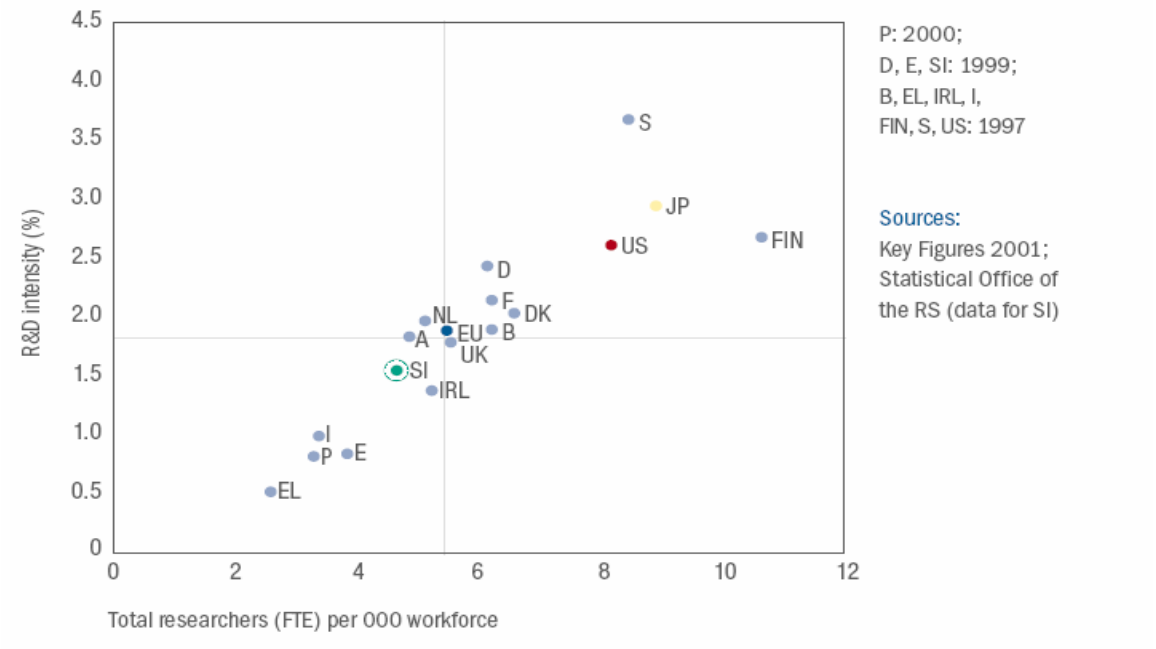
Source: Benchmarking, 2002, page 13

App - Figure 8: R&D intensity, 1999



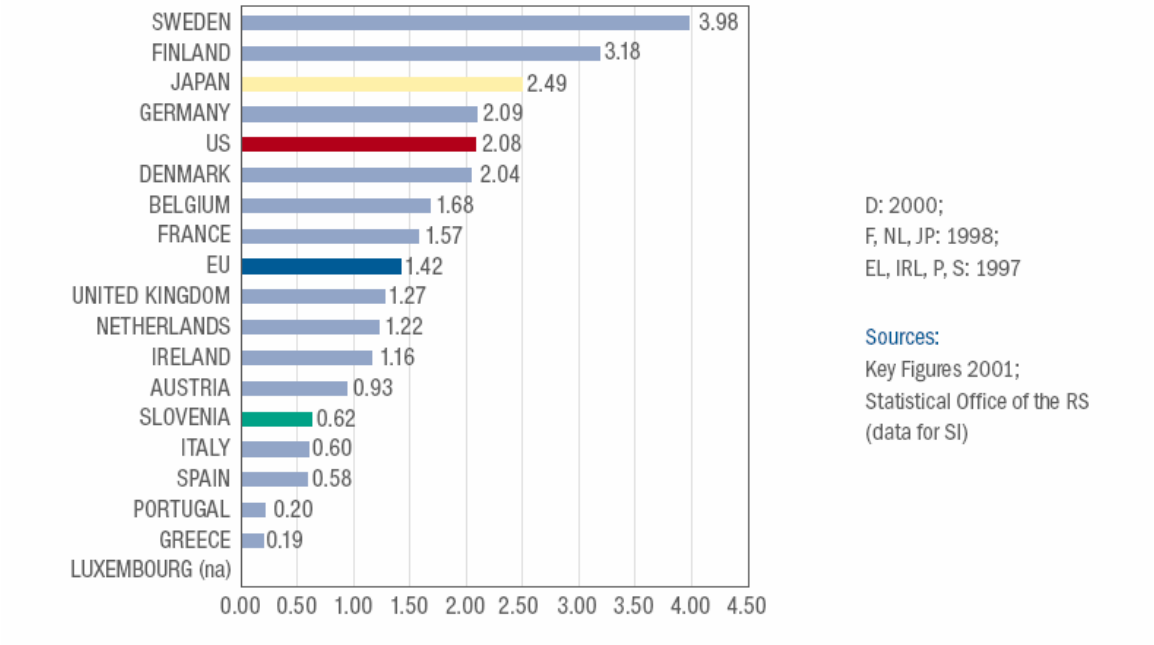
Source: Benchmarking, 2002, page 16

App - Figure 9: Total researchers (FTE) per 000 workforce and R&D intensity, 1998



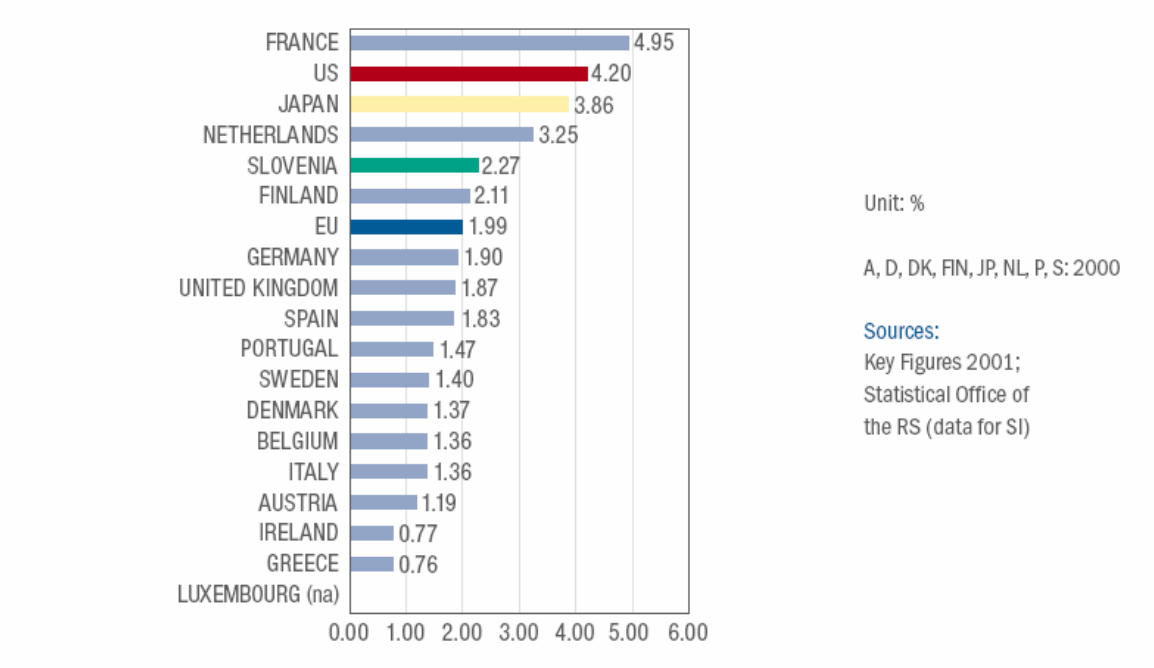
Source: Benchmarking, 2002, page 14

App - Figure 10: Industry-financed R&D as a % of industrial output, 1999



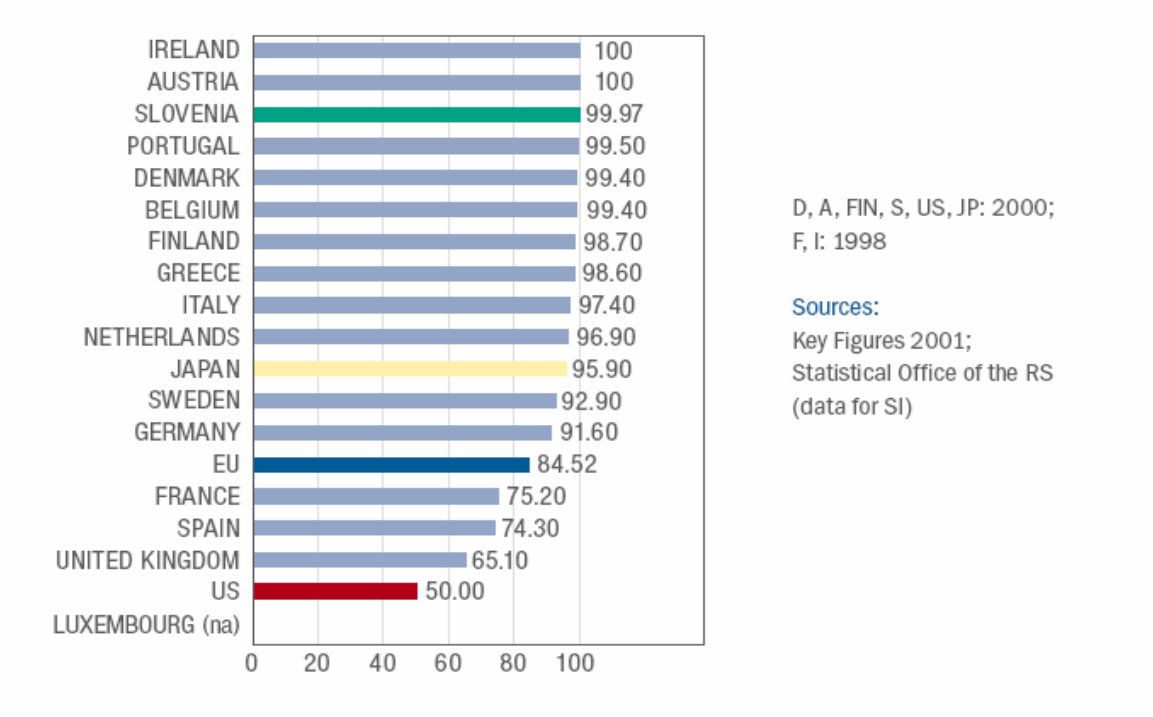
Source: Benchmarking, 2002, page 17

App - Figure 11: Share of government budget allocated to R&D, 1999



Source: Benchmarking, 2002, page 18

App - Figure 12: Civil R&D as a % of total government R&D budget, 1999



Source: Benchmarking, 2002, page 19

Appendix 3: Other research organisations in Slovenia

Other research organisations, which do not posses a status of public research institute, include:

- ✓ Institutes:
  - Austrian Institute for Eastern and South-Eastern Europe
  - EIMV (The Milan Vidmar Electro-institute)
  - EIPF (The Institute of Economy within the Faculty of Law)
  - ERICO (Institute for Ecological Research)
  - Institute of Philosophy
  - The Anton Melik Institute of Geography
  - GI ZRMK (the ZRMK Building and Civil engineering Institute)
  - IMFM (Institute of Mathematics, Physics and Mechanics)
  - The Institute of the Republic of Slovenia for Rehabilitation
  - The Institute for Cellulose and Paper
  - IPMIT (The Institute for Project Management and Information Technology)
  - IRMA (The Institute for Research of Materials and Applications)
  - IRM (The Institute for Media Research)
  - ISR (The Institute for Systemic Research)
  - ITK (The Institute for Textile Chemistry)
  - ITPO (The Institute for Surface Engineering and Optoelectronics)
  - IVZ (The National Institute for Public Health of the Republic of Slovenia)
  - The Institute of Oncology of Ljubljana
  - SIQ (The Slovene Institute for Quality and Metrics)
  - Slovene Institute for Revision and Auditing
  - And others.

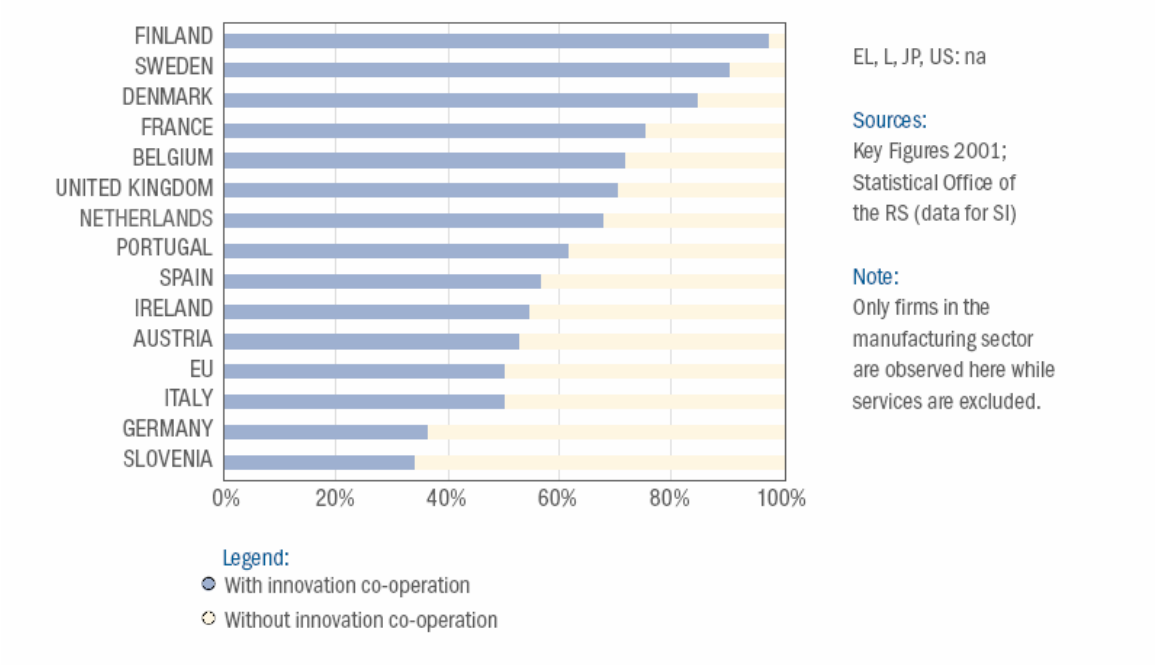
- ✓ Institutions:
  - NUK National and University Library
  - Institutes for Public Health

- The Institute of the Republic of Slovenia for Blood Transfusion
- The National Museum
- The Regional Museum
- The Museum of Natural History
- The Slovene Etnographic Museum

and others.

Appendix 4: Knowledge Transfer - figures EU vs Slovenia

App - Figure 13: Share of turnover linked to new or improved products from innovators by engagement in innovation co-operation, 1996



Source: Benchmarking, 2002, page 26

Appendix 5: Questionnaire "The transfer of knowledge from research institutions into practice – institutes"

The following questionnaire was designed for researchers and scientists from research institutes.

1. **The transfer of new knowledge from research institutions into industry:**
How much new knowledge (inventions, innovations, novelties, discoveries suggestions) form your area of expertise do you transfer into practice? Please circle the appropriate value on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

2. **The interest of researchers and scientists in the transfer of new knowledge into practice:**

Please state the degree of your personal interest in the transfer of new knowledge into enterprises? Please circle the appropriate degree of your interest on a scale from 1 to 5.

1 – not interested
2 – slightly interested
3 – averagely interested
4 – interested
5 – very interested

3. **Contacts between research institutes and enterprises:**

Please state the frequency of your contacts with enterprises in terms of knowledge transfer? Please circle the appropriate frequency on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

4. The ways and methods of knowledge transfer:

How do you transfer new knowledge into enterprises?

a) Directly, through e.g. agreements, orders, contracts and similar.

Please circle the appropriate frequency on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

b) Other: articles, lectures, notices, seminars and similar.

Please circle the appropriate frequency on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

5. The applicability of transferred knowledge for enterprises:

Do you believe that transferred knowledge is useful for enterprises? Please circle the appropriate degree of applicability of new knowledge on a scale from 1 to 5.

1 – not useful
2 – slightly useful
3 – averagely useful
4 – considerably useful
5 –very useful

6. In your opinion which are the most important factors in the transfer of new knowledge from research institutions into practice?

(Please mark the following statements according to their importance on a scale from 1-5, where 1 denotes the least important and 5 denotes the most important factor)

a) Research institutes should become more open. _____
b) Cooperation should be based on a long-term basis. _____
c) The methods of presenting new knowledge should be more adapted to the needs of enterprises. _____
d) Research institutes should provide more useful knowledge. _____
e) Communication should be “market-oriented”. _____
f) Other:_____ _____

7. How much do you agree with the following statements?
(Please circle the appropriate number from 1-5, where 1 denotes your disagreement and 5 denotes your full agreement.)

		disagree				fully agree
a)	Slovene enterprises lack market-orientation.	1	2	3	4	5
b)	Institutes do not provide enough encouragement for researchers to focus on applicative research.	1	2	3	4	5
c)	New knowledge is too expensive for enterprises.	1	2	3	4	5
d)	State should provide more support for investments into development and education with appropriate tax-relief.	1	2	3	4	5
e)	The attitude of management in enterprises towards the cooperation with research institutes is negative.	1	2	3	4	5
f)	Cooperation is often established on the basis of personal acquaintances.	1	2	3	4	5
g)	There is no coordination between main actors within institutes.	1	2	3	4	5
h)	There are not enough contracts between research institutes and industry (apart from regular cooperation).	1	2	3	4	5
i)	Researchers and scientists from institutes are not present enough in enterprises.	1	2	3	4	5
j)	Researchers and scientists from institutes are not familiar with industry's actual needs.	1	2	3	4	5
k)	Researchers from enterprises cannot get in contact with contact persons at institutes.	1	2	3	4	5
l)	There are too few formal and informal contacts between researchers and scientists from research institutes and enterprises.	1	2	3	4	5

8. Please choose 5 of the following statements which, in your opinion, denote major issues regarding the transfer of knowledge between research institutions and enterprises.
(Please mark with X or circle the appropriate statement)

m) Slovene enterprises lack market-orientation. _____
n) Institutes do not provide enough encouragement for researchers to focus on applicative research. _____
o) New knowledge is too expensive for enterprises. _____
p) State should provide more support for investments into development and education with appropriate tax-relief. _____
q) The attitude of management in enterprises towards the cooperation with research institutes is negative. _____

r) Cooperation is often established on the basis of personal acquaintances. _____

s) There is no coordination between main actors within institutes. _____

t) There are not enough contacts between research institutes and industry (apart from regular cooperation). _____

u) Researchers and scientists from institutes are not present enough in enterprises. _____

v) Researchers and scientists from institutes are not familiar with industry's actual needs. _____

w) Researchers from enterprises cannot get in contact with contact persons at institutes. _____

x) There are too few formal and informal contacts between researchers and scientists from research institutes and enterprises. _____

9. State assistance in the transfer of new knowledge into industry

In your opinion whom should the state provide more financial funds intended for the transfer of new knowledge, to enterprises or to research institutes (RI)? Please circle your answers on a scale from 1 to 5. If you believe that the state should provide more financial assistance to enterprises, please circle 1; if you believe that the state should provide mere funds for research institutes, circle 5.

1 – entirely to enterprises
2 – 75% to enterprises and 25% to RI
3 – 50% to enterprises and 50% to RI
4 – 25% to enterprises and 75% to RI
5 – entirely to RI

10. What do you suggest for an even more successful cooperation between research institutes and enterprises or for the overcoming of existing problems occurring during the process of knowledge transfer from research institutes into enterprises?

_____
_____
_____
_____
_____

Appendix 5a: Anketni vprašalnik »Prenos znanja iz raziskovalnih inštitucij v prakso - inštituti«

Vprašalnik namenjen raziskovalcem in znanstvenikom iz raziskovalnih institucij.

1. **Prenos novega znanja iz raziskovalnih institucij v industrijo**

Koliko novega znanja (izumi, inovacije, novosti, izsledki, predlogi) z vašega področja prenašate v prakso? Vrednost označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

2. **Zainteresiranost raziskovalcev in znanstvenikov za prenos novega znanja v prakso**

Navedite, koliko ste zainteresirani za prenos novega znanja v podjetje? Zainteresiranost označite s krožcem na lestvici od 1 do 5.

1 – nisem zainteresiran
2 – malo zainteresiran
3 – srednje zainteresiran
4 - zainteresiran
5 – zelo zainteresiran

3. **Stiki med raziskovalnimi institucijami in industrijo:**

Koliko stikov imate z industrijo v smislu prenosa novega znanja? Vrednost označite s s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

4. **Način prenosa novih znanj:**

Na kakšen način prenašate novo znanje v podjetja?
a) na neposredni način, kot npr. dogovori, naročili, pogodbe in podobno.

Vrednost označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

b) drugo: članki, predavanja, obvestila, seminarji in podobno.

Vrednost označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

5. Uporabnost prenešenega znanja za podjetje:

Koliko mislite, da je prenešeno novo znanje v podjetju uporabno? Uporabnost označite z krožcem na lestvici od 1 do 5.

1 – ni uporabno
2 – malo uporabno
3 – srednje uporabno
4 – precej uporabno
5 –zelo uporabno

6. Kaj je po vašem mnenju ključnega pomena pri prenosu novega znanja iz raziskovalnih inštitucij v prakso?

(Spodnje trditve označite po pomembnosti z ustrezno številko od 1-5, pri čemer 1 pomeni najmanj pomembno, 5 - najbolj pomembno.)

a) Raziskovalni inštituti se morajo odpreti navzven. _____
b) Sodelovanje naj bo dolgoročno. _____
c) Način podajanja snovi s strani raziskovalnih inštitutov mora biti prilagojen industriji. _____
d) Raziskovalni inštituti morajo ponuditi koristno znanje. _____
e) Komunikacija mora biti »prodajno usmerjena«. _____
f) Drugo:_____ _____

7. Koliko se strinjate s spodaj navedenimi trditvami?

(Obkrožite ustrezno številko od 1-5, pri čemer 1 pomeni se ne strinjam, 5 - se zelo strinjam.)

		se ne strinjam				se zelo strinjam
a)	Slovenska podjetja so premalo razvojno usmerjena.	1	2	3	4	5
b)	Inštituti premalo stimulirajo raziskovalce k aplikativnim raziskavam.	1	2	3	4	5
c)	Nova znanja so za podjetja predraga.	1	2	3	4	5
d)	Država bi morala v večji meri spodbujati vlaganje v razvoj in izobraževanje z ustreznimi davčnimi olajšavami.	1	2	3	4	5
e)	Odnos vodstvenih delavcev v podjetjih do sodelovanja z raziskovalnimi inštituti je negativen.	1	2	3	4	5
f)	Do sodelovanja pride najpogosteje na Osnovi osebnih poznanstev	1	2	3	4	5
g)	Obstaja nepovezanost med glavnimi akterji znotraj inštitutov.	1	2	3	4	5
h)	Premalo kontaktov med raziskovalnimi inštituti in industrijo (v primeru ko ne gre za sodelovanje).	1	2	3	4	5
i)	Raziskovalci in znanstveniki iz inštitutov so fizično premalo prisotni v industriji.	1	2	3	4	5
j)	Raziskovalci in znanstveniki iz inštitutov ne poznajo dejanskih potreb industrije.	1	2	3	4	5
k)	Raziskovalci iz industrije težko pridejo do kontaktne osebe na inštitutih.	1	2	3	4	5
l)	Med raziskovalci in znanstveniki iz raziskovalnih inštitucij in raziskovalci iz industrije je premalo formalnih in neformalnih kontaktov.	1	2	3	4	5

8. Od spodaj naštetih trditev jih izberite 5, ki po vašem mnenju predstavljajo največje težave pri prenosu znanja med raziskovalnimi inštitucijami in industrijo.

(Označite z X ali obkrožite.)

a) Slovenska podjetja so premalo razvojno usmerjena. _____
b) Inštituti premalo stimulirajo raziskovalce k aplikativnim raziskavam. _____
c) Nova znanja so za podjetja predraga. _____

d) Država bi morala v večji meri spodbujati vlaganje v razvoj in izobraževanje z ustreznimi davčnimi olajšavami. _____
e) Odnos vodstvenih delavcev v podjetjih do sodelovanja z raziskovalnimi inštituti je negativen. _____
f) Do sodelovanja pride najpogosteje na osnovi osebnih poznanstev. _____
g) Obstaja nepovezanost med glavnimi akterji znotraj inštitutov. _____
h) Premalo kontaktov med raziskovalnimi inštituti in industrijo (v primeru ko ne gre za sodelovanje). _____
i) Raziskovalci in znanstveniki iz inštitutov so fizično premalo prisotni v industriji. _____
j) Raziskovalci in znanstveniki iz inštitutov ne poznajo dejanskih potreb industrije. _____
k) Raziskovalci iz industrije težko pridejo do kontaktne osebe na inštitutih. _____
l) Med raziskovalci in znanstveniki iz raziskovalnih inštitucij in raziskovalci iz industrije je premalo formalnih in neformalnih kontaktov. _____

9. Pomoč države pri prenosu novega znanja v industrijo

Komu bi po vašem mnenju država morala nameniti več finančnih sredstev za prenos novega znanja, industriji ali raziskovalnim inštitutom (RI)? Ustrezno obkrožite nalestvici od 1 do 5. V kolikor menite, da bi država morala podpirati samo industrijo, obkrožite številko 1, v kolikor pa menite, da bi morala podpirati samo RI, obkrožite številko 5.

1 – v celoti podpreti industrijo
2 – 75% industriji in 25% RI
3 – 50% industriji in 50% RI
4 – 25% industriji in 75% RI
5 – v celoti podpreti RI

10. Kaj predlagate za še bolj uspešno sodelovanje med raziskovalnimi inštituti in industrijo oz. za premagovanje obstoječih težav pri prenosu znanja iz raziskovalnih inštitutov v industrijo?

_____
_____
_____
_____
_____

Appendix 6: Questionnaire "The transfer of knowledge from research institutions into practice – industry"

The following questionnaire was designed for researchers and scientists from industry.

1. The transfer of new knowledge from research institutions into industry

How much new knowledge (inventions, innovations, novelties, discoveries, suggestions) do you obtain from research institutes? Please circle the appropriate value on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

1a. The acquisition of new knowledge from other sources

How much new knowledge (inventions, innovations, novelties, discoveries, suggestions) do you acquire from other sources?
Please circle the appropriate value on a scale from 1 to 5.

1 - nothing
2 - little
3 - average
4 – enough
5 – a lot

	nothing	little	average	enough	a lot
bibliography	1	2	3	4	5
development within enterprises	1	2	3	4	5
employees	1	2	3	4	5
competition	1	2	3	4	5
trade fairs, visits, exhibitions	1	2	3	4	5
internet	1	2	3	4	5
other.	1	2	3	4	5

2. The interest of researchers and scientists in the transfer of new knowledge into practice

Please state the degree of your personal interest in the transfer of new knowledge from research institutes? Please circle the appropriate degree of your interest on a scale from 1 to 5.

1 – not interested
2 – slightly interested
3 – averagely interested
4 – interested
5 – very interested

3. Contacts between research institutes and enterprises

Please state the frequency of your contacts with research institutions in terms of knowledge transfer? Please circle the appropriate frequency on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

4. The ways and methods of knowledge transfer

How do you obtain new knowledge from research institutes?

a) Directly, through e.g. agreements, orders, contracts and similar.

Please circle the appropriate frequency on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

b) Other: articles, lectures, notices, seminars and similar.

Please circle the appropriate frequency on a scale from 1 to 5.

1 – nothing
2 – little
3 – average
4 – enough
5 – a lot

5. The applicability of transferred knowledge for enterprises

In your opinion, how much is knowledge transferred from research institutes useful for your enterprises? Please circle the appropriate degree of applicability of new knowledge on a scale from 1 to 5.

1 – not useful
2 – slightly useful
3 – averagely useful
4 – considerably useful
5 –very useful

6. In your opinion which are the most important factors in the transfer of new knowledge from research institutions into practice?

(Please mark the following statements according to their importance on a scale from 1-5, where 1 denotes the least important and 5 denotes the most important factor)

a) Research institutes should become more open. _____
b) Cooperation should be based on a long-term basis. _____
c) The methods of presenting new knowledge should be more adapted to the needs of enterprises. _____
d) Research institutes should provide more useful knowledge. _____
e) Communication should be "market-oriented". _____
f) Other:_____ _____

7. How much do you agree with the following statements?

(Please circle the appropriate number from 1-5, where 1 denotes your disagreement and 5 denotes your full agreement.)

		disagree				fully agree
a)	Slovene enterprises lack market-orientation.	1	2	3	4	5
b)	Institutes do not provide enough encouragement for researchers to focus on applicative research.	1	2	3	4	5
c)	New knowledge is too expensive for enterprises.	1	2	3	4	5
d)	State should provide more support for investments into development and education with appropriate tax-relief.	1	2	3	4	5
e)	The attitude of management in enterprises towards the cooperation with research institutes is negative.	1	2	3	4	5
f)	Cooperation is often established on the basis of personal acquaintances.	1	2	3	4	5
g)	There is no coordination between main actors within institutes.	1	2	3	4	5
h)	There are not enough contracts between research institutes and industry (apart from regular cooperation).	1	2	3	4	5
i)	Researchers and scientists from institutes are not present enough in enterprises.	1	2	3	4	5
j)	Researchers and scientists from institutes are not familiar with industry's actual needs.	1	2	3	4	5
k)	Researchers from enterprises cannot get in contact with contact persons at institutes.	1	2	3	4	5
l)	There are too few formal and informal contacts between researchers and scientists from research institutes and enterprises.	1	2	3	4	5

8. Please choose 5 of the following statements which, in your opinion, denote major issues regarding the transfer of knowledge between research institutions and enterprises.

(Please mark with X or circle the appropriate statement)

a) Slovene enterprises lack market-orientation. _____
b) Institutes do not provide enough encouragement for researchers to focus on applicative research. _____
c) New knowledge is too expensive for enterprises. _____
d) State should provide more support for investments into development and education with appropriate tax-relief. _____
e) The attitude of management in enterprises towards the cooperation with research institutes is negative. _____
f) Cooperation is often established on the basis of personal acquaintances. _____
g) There is no coordination between main actors within institutes. _____
h) There are not enough contacts between research institutes and industry (apart from regular cooperation). _____
i) Researchers and scientists from institutes are not present enough in enterprises. _____
j) Researchers and scientists from institutes are not familiar with industry's actual needs. _____
k) Researchers from enterprises cannot get in contact with contact persons at institutes. _____
l) There are too few formal and informal contacts between researchers and scientists from research institutes and enterprises. _____

9. State assistance in the transfer of new knowledge into industry

In your opinion whom should the state provide more financial funds intended for the transfer of new knowledge, to enterprises or to research institutes (RI)? Please circle your answers on a scale from 1 to 5. If you believe that the state should provide more financial assistance to enterprises, please circle 1; if you believe that the state should provide mere funds for research institutes, circle 5.

1 – entirely to enterprises
2 – 75% to enterprises and 25% to RI
3 – 50% to enterprises and 50% to RI
4 – 25% to enterprises and 75% to RI
5 – entirely to RI

10. **What do you suggest for an even more successful cooperation between research institutes and enterprises or for the overcoming of existing problems occurring during the process of knowledge transfer from research institutes into enterprises?**

_____
_____
_____
_____
_____

Appendix 6a: Anketni vprašalnik »Prenos znanja iz raziskovalnih inštitucij v prakso - industrija«

Vprašalnik namenjen raziskovalcem iz R&D oddelkov iz industrije.

1. Prenos novega znanja iz raziskovalnih inštitucij v industrijo

Koliko novega znanja (izumi, inovacije, novosti, izsledki, predlogi) dobite od raziskovalnih inštitucij? Vrednost označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - precej
5 - veliko

1a. Prenos znanja iz raziskovalnih inštitucij v industrijo

Koliko novega znanja (izumi, inovacije, novosti, izsledki, predlogi) pridobite iz drugih virov? Vrednosti označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

	nič	malo	srednje	dosti	vse
literature	1	2	3	4	5
razvoj v podjetju	1	2	3	4	5
zaposleni	1	2	3	4	5
konkurenca	1	2	3	4	5
sejmi, obiski, razstave	1	2	3	4	5
internet	1	2	3	4	5
drugo	1	2	3	4	5

2. Zainteresiranost raziskovalcev in znanstvenikov za prenos novega znanja v prakso

Navedite, koliko ste zainteresirani za prenos novega znanja z raziskovalnih inštitucij? Zainteresiranost označite s krožcem na lestvici od 1 do 5.

1 – nisem zainteresiran
2 – malo zainteresiran
3 – srednje zainteresiran
4 – dosti zainteresiran
5 – zelo zainteresiran

3. Stiki med raziskovalnimi inštitucijami in industrijo

Koliko stikov imate z raziskovalnimi inštituti v smislu prenosa novega znanja? Vrednost označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

4. Način prenosa novih znanj

Na kakšen način dobite novo znanje z raziskovalnih inštitucij?

a) na neposredni način, kot npr. dogovori, naročili, pogodbe in podobno.

Vrednost označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

b) drugo: članki, predavanja, obvestila, seminarji in podobno.

Vrednost označite s krožcem na lestvici od 1 do 5.

1 - nič
2 - malo
3 - srednje
4 - dosti
5 - veliko

5. Uporabnost prenešenega znanja za podjetje

Koliko mislite, da je uporabno prenešeno novo znanje z raziskovalnih inštitucij za vas? Uporabnost označite z krožcem na lestvici od 1 do 5.

1 – ni uporabno
2 – malo uporabno
3 – srednje uporabno
4 – precej uporabno
5 –zelo uporabno

6. Kaj je po vašem mnenju ključnega pomena pri prenosu novega znanja iz raziskovalnih inštitucij v prakso?

(Spodnje trditve označite po pomembnosti z ustrezno številko od 1-5, pri čemer 1 pomeni najmanj pomembno, 5 - najbolj pomembno.)

a) Raziskovalni inštituti se morajo odpreti navzven. _____
b) Sodelovanje naj bo dolgoročno. _____
c) Način podajanja snovi s strani raziskovalnih inštitutov mora biti prilagojen industriji. _____
d) Raziskovalni inštituti morajo ponuditi koristno znanje. _____
e) Komunikacija mora biti »prodajno usmerjena«. _____
f) Drugo:_____ _____

7. V kolikšni meri se strinjate z naslednjimi trditvami v zvezi s težavami pri prenosu novih znanj v industrijo?

(Obkrožite ustrezno številko od 1-5, pri čemer 1 pomeni se ne strinjam, 5 - se zelo strinjam)

	se ne strinjam				se zelo strinjam
a) Slovenska podjetja so premalo razvojno usmerjena.	1	2	3	4	5
b) Inštituti premalo stimulirajo raziskovalce k aplikativnim raziskavam.	1	2	3	4	5
c) Nova znanja so za podjetja predraga.	1	2	3	4	5
d) Država bi morala v večji meri spodbujati vlaganje v razvoj in izobraževanje z ustreznimi davčnimi olajšavami.	1	2	3	4	5
e) Odnos vodstvenih delavcev v industriji do sodelovanja z raziskovalnimi inštituti je negativen.	1	2	3	4	5
f) Do sodelovanja pride najpogosteje na osnovi osebnih poznanstev.	1	2	3	4	5
g) Obstaja nepovezanost med glavnimi akterji znotraj inštitutov.	1	2	3	4	5
h) Premalo kontaktov med raziskovalnimi inštituti in industrijo (v primeru ko ne gre za sodelovanje).	1	2	3	4	5
i) Raziskovalci in znanstveniki iz inštitutov so fizično premalo prisotni v industriji.	1	2	3	4	5
j) Raziskovalci in znanstveniki iz inštitutov ne poznajo dejanskih potreb industrije.	1	2	3	4	5
k) Raziskovalci iz industrije težko pridejo do kontaktne osebe na inštitutih.	1	2	3	4	5
l) Med raziskovalci in znanstveniki iz raziskovalnih inštitucij in raziskovalci iz industrije je premalo formalnih in neformalnih kontaktov.	1	2	3	4	5

8. Od spodaj naštetih trditev jih izberite 5, ki po vašem mnenju predstavljajo največje težave pri prenosu znanja med raziskovalnimi inštitucijami in industrijo

(Označite z X ali obkrožite)

a) Slovenska podjetja so premalo razvojno usmerjena. _____
b) Inštituti premalo stimulirajo raziskovalce k aplikativnim raziskavam. _____
c) Nova znanja so za podjetja predraga. _____
d) Država bi morala v večji meri spodbujati vlaganje v razvoj in izobraževanje z ustreznimi davčnimi olajšavami. _____
e) Odnos vodstvenih delavcev v podjetjih do sodelovanja z raziskovalnimi inštituti je negativen. _____
f) Do sodelovanja pride najpogosteje na osnovi osebnih poznanstev. _____
g) Obstaja nepovezanost med glavnimi akterji znotraj inštitutov. _____
h) Premalo kontaktov med raziskovalnimi inštituti in industrijo (v primeru ko ne gre za sodelovanje). _____
i) Raziskovalci in znanstveniki iz inštitutov so fizično premalo prisotni v industriji. _____
j) Raziskovalci in znanstveniki iz inštitutov ne poznajo dejanskih potreb industrije. _____
k) Raziskovalci iz industrije težko pridejo do kontaktne osebe na inštitutih. _____
l) Med raziskovalci in znanstveniki iz raziskovalnih inštitucij in raziskovalci iz industrije je premalo formalnih in neformalnih kontaktov. _____

9. Pomoč države pri prenosu novega znanja v industrijo

Komu bi po vašem mnenju država morala nameniti več finančnih sredstev za prenos novega znanja, industriji ali raziskovalnim inštitutom (RI)? Ustrezno obkrožite nalestvici od 1 do 5. V kolikor menite, da bi država morala podpirati samo industrijo, obkrožite številko 1, v kolikor pa menite, da bi morala podpirati samo RI, obkrožite številko 5.

1 – v celoti podpreti industrijo
2 – 75% industriji in 25% RI
3 – 50% industriji in 50% RI
4 – 25% industriji in 75% RI
5 – v celoti podpreti RI

10. Kaj predlagate za še bolj uspešno sodelovanje med raziskovalnimi inštituti in industrijo oz. za premagovanje obstoječih težav pri prenosu znanja iz raziskovalnih inštitutov v industrijo?

_____
_____
_____
_____
_____

Appendix 7: T - tests

Question 1: T-test

	Odkod prihaja	N	Mean	Std. Deviation	Std. Error Mean
Koliko novega znanja dobite od raziskovalnih inštitucij/prenašate v prakso	inštitut	30	3,1667	,87428	,15962
	industrija	20	2,2500	,55012	,12301

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Koliko novega znanja dobite od raziskovalnih inštitucij/prenašate v prakso	Equal variances assumed	1,636	,207	4,164	48	,000
	Equal variances not assumed			4,549	47,892	,000

Question 1a: Paired Samples T-test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Koliko novega znanja pridobite iz razvoja v podjetju	1,5102	49	1,93781	,27683
	Koliko novega znanja pridobite od zaposelnih	1,3061	49	1,71031	,24433

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Koliko novega znanja pridobite iz razvoja v podjetju - Koliko novega znanja pridobite od zaposelnih	,2041	,45550	,06507	,0732	,3349	3,136	48	,003

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Koliko novega znanja pridobite iz literature	1,2449	49	1,65240	,23606
	Koliko novega znanja pridobite od zaposelnih	1,3061	49	1,71031	,24433

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Koliko novega znanja pridobite iz literature - Koliko novega znanja pridobite od zaposelnih	-,0612	,74744	,10678	-,2759	,1535	-,573	48	,569

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Koliko novega znanja pridobite od zaposelnih	1,3061	49	1,71031	,24433
	Koliko novega znanja pridobite iz sejmov, obiskov, razstav	1,1224	49	1,56302	,22329

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Koliko novega znanja pridobite od zaposelnih - Koliko novega znanja pridobite iz sejmov, obiskov, razstav	,1837	,66688	,09527	-,0079	,3752	1,928	48	,060

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Koliko novega znanja pridobite od zaposelnih	1,3061	49	1,71031	,24433
	Koliko novega znanja pridobite od konkerence	1,1837	49	1,60304	,22901

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Koliko novega znanja pridobite od zaposelnih - Koliko novega znanja pridobite od konkerence	,1224	,56394	,08056	-,0395	,2844	1,520	48	,135

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Koliko novega znanja dobite od raziskovalnih inštitucij	2,8000	50	,88063	,12454
	Koliko novega znanja pridobite z interneta	1,0800	50	1,42628	,20171

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Koliko novega znanja dobite od raziskovalnih inštitucij - Koliko novega znanja pridobite z interneta	1,7200	2,04081	,28861	1,1400	2,3000	5,960	49	,000

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Koliko novega znanja dobite od raziskovalnih inštitucij	2,8163	49	,88208	,12601
	Koliko novega znanja pridobite od drugod	,7347	49	1,25458	,17923

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Koliko novega znanja dobite od raziskovalnih inštitucij - Koliko novega znanja pridobite od drugod	2,0816	1,77760	,25394	1,5710	2,5922	8,197	48	,000

Question 2: T – test

	Odkod prihaja	N	Mean	Std. Deviation	Std. Error Mean
Koliko ste zainteresirani za prenos novega znanja v podjetja?	inštitut	30	4,4333	,62606	,11430
	industrija	20	4,1000	,85224	,19057

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Koliko ste zainteresirani za prenos novega znanja v podjetja?	Equal variances assumed	,304	,584	1,595	48	,117
	Equal variances not assumed			1,500	32,384	,143

Question 3: T – test

Group Statistics

	Odkod prihaja	N	Mean	Std. Deviation	Std. Error Mean
Koliko stikov imate z raziskovalnimi inštitucijami v smislu prenašanja novega znanja/z industrijo?	inštitut	30	3,1333	1,04166	,19018
	industrija	20	3,1500	1,03999	,23255

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Koliko stikov imate z raziskovalnimi inštitucijami v smislu prenašanja novega znanja/z industrijo?	Equal variances assumed	,018	,893	-,055	48	,956
	Equal variances not assumed			-,055	40,921	,956

Question 4: T-test

	Odkod prihaja	N	Mean	Std. Deviation	Std. Error Mean
Na kakšen način pridobite/prenašate novo znanje **neposredno**	inštitut	30	3,0000	1,25945	,22994
	industrija	20	3,7000	1,08094	,24170
Na kakšen način pridobite/prenašate novo znanje **preko člankov, predavanj, obvestil**...	inštitut	30	2,6333	,88992	,16248
	industrija	20	2,1000	,96791	,21643

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Na kakšen način pridobite/prenašate novo znanje **neposredno**	Equal variances assumed	,453	,504	-2,034	48	,047
	Equal variances not assumed			-2,098	44,873	,042
Na kakšen način pridobite/prenašate novo znanje **preko člankov, predavanj, obvestil...**	Equal variances assumed	,193	,663	2,005	48	,051
	Equal variances not assumed			1,971	38,449	,056

Question 5: T-test

	Odkod prihaja	N	Mean	Std. Deviation	Std. Error Mean
Kako uporabno je preneseno novo znanje	inštitut	30	4,0000	,78784	,14384
	industrija	20	3,2500	,91047	,20359

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Kako uporabno je preneseno novo znanje	Equal variances assumed	1,439	,236	3,098	48	,003
	Equal variances not assumed			3,009	36,710	,005

Question 6: T - test

Group Statistics

	Odkod prihaja	N	Mean	Std. Deviation	Std. Error Mean
Raziskovalni inštituti se morajo odpreti navzven	inštitut	30	3,5667	1,52414	,27827
	industrija	20	3,8500	1,26803	,28354
Sodelovanje naj bo dolgoroèno	inštitut	30	3,833	1,3412	,2449
	industrija	20	3,450	1,3945	,3118
Naèin podajanja snovi naj bo prilagojen industriji	inštitut	30	3,3667	1,47352	,26903
	industrija	20	3,6500	1,22582	,27410
Raziskovalni inštituti morajo ponuditi koristno znanje	inštitut	30	4,3667	,96431	,17606
	industrija	20	4,5000	,60698	,13572
Komunikacija mora biti "prodajno usmerjena"	inštitut	30	3,1333	1,59164	,29059
	industrija	20	3,6000	1,23117	,27530
Drugo	inštitut	26	1,3846	2,24636	,44055
	industrija	16	1,2500	2,23607	,55902

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
Raziskovalni inštituti se morajo odpreti navzven	Equal variances assumed	1,167	,285	-,687	48	,495	-,2833	,41230	-1,11233	,54566
	Equal variances not assumed			-,713	45,545	,479	-,2833	,39728	-1,08322	,51656
Sodelovanje naj bo dolgoroèno	Equal variances assumed	,528	,471	,975	48	,335	,383	,3933	-,4075	1,1742
	Equal variances not assumed			,967	39,754	,339	,383	,3965	-,4181	1,1848
Naèin podajanja snovi naj bo prilagojen industriji	Equal variances assumed	,591	,446	-,711	48	,481	-,2833	,39860	-1,08478	,51811
	Equal variances not assumed			-,738	45,546	,464	-,2833	,38407	-1,05663	,48996
Raziskovalni inštituti morajo ponuditi koristno znanje	Equal variances assumed	2,399	,128	-,549	48	,586	-,1333	,24284	-,62159	,35492
	Equal variances not assumed			-,600	47,893	,551	-,1333	,22230	-,58032	,31366
Komunikacija mora biti "prodajno usmerjena"	Equal variances assumed	,565	,456	-1,108	48	,274	-,4667	,42136	-1,31387	,38054
	Equal variances not assumed			-1,166	46,834	,250	-,4667	,40029	-1,27203	,33869
Drugo	Equal variances assumed	,044	,835	,189	40	,851	,1346	,71254	-1,30549	1,57472
	Equal variances not assumed			,189	32,010	,851	,1346	,71175	-1,31515	1,58438

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Raziskovalni inštituti se morajo odpreti navzven	3,6800	50	1,42055	,20090
	Raziskovalni inštituti morajo ponuditi koristno znanje	4,4200	50	,83520	,11811

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Raziskovalni inštituti se morajo odpreti navzven - Raziskovalni inštituti morajo ponuditi koristno znanje	-,7400	1,62644	,23001	-1,2022	-,2778	-3,217	49	,002

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sodelovanje naj bo dolgoroèno	3,680	50	1,3619	,1926
	Naèin podajanja snovi naj bo prilagojen industriji	3,4800	50	1,37381	,19429

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Sodelovanje naj bo dolgoroèno - Naèin podajanja snovi naj bo prilagojen industriji	,2000	1,56492	,22131	-,2447	,6447	,904	49	,371

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sodelovanje naj bo dolgoroèno	3,680	50	1,3619	,1926
	Komunikacija mora biti "prodajno usmerjena"	3,3200	50	1,46301	,20690

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Sodelovanje naj bo dolgoroèno - Komunikacija mora biti "prodajno usmerjena"	,3600	1,61321	,22814	-,0985	,8185	1,578	49	,121

Question 7: T - test

	N	Minimum	Maximum	Mean	Std. Deviation
Država bi morala v večji meri spodbujati vlaganje v razvoj in izobraževanje z ustreznimi davčnimi olajšavami	50	2,00	5,00	4,2800	,83397
Raziskovalci in znanstveniki iz inštitutov ne poznajo dejanskih potreb industrije	50	1,00	5,00	4,2200	,84007
Raziskovalci in znanstveniki iz inštitutov so fizično premalo prisotni v industriji	50	2,00	5,00	4,2200	,81541
Premalo kontaktov med raziskovalnimi inštituti in industrijo (v primeru, ko ne gre za sodelovanje)	50	2,00	5,00	4,1800	,80026
Inštituti premalo stimulirajo raziskovalce k aplikativnim raziskavam	50	2,00	5,00	3,9800	,93656
Do sodelovanja pride najpogosteje na osnovi osebnih poznanstev	50	2,00	5,00	3,9600	,92494
Slovenska podjetja so premalo razvojno usmerjena	50	2,00	5,00	3,7800	,81541
Med raziskovalci in znanstveniki iz inštitutov in industrije je premalo formalnih in neformalnih kontaktov	50	1,00	5,00	3,6800	,97813
Obstaja nepovezanost med glavnimi akterji znotraj inštitutov	50	1,00	5,00	3,6600	1,02240
Nova znanja so za podjetja predraga	50	1,00	5,00	3,1800	1,13731
Odnos vodstvenih delavcev v industriji do sodelovanja z razisk. inštituti je negativen	50	1,00	5,00	2,9600	,87970
Raziskovalci iz industrije težko pridejo do kontaktne osebe na inštitutih	50	1,00	5,00	2,3800	1,10454

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Slovenska podjetja so premalo razvojno usmerjena	Equal variances assumed	5,216	,027	1,657	48	,104
	Equal variances not assumed			1,558	32,302	,129
Inštituti premalo stimulirajo raziskovalce k aplikativnim raziskavam	Equal variances assumed	5,377	,025	-1,696	48	,096
	Equal variances not assumed			-1,867	47,601	,068
Nova znanja so za podjetja predraga	Equal variances assumed	3,134	,083	1,437	48	,157
	Equal variances not assumed			1,482	44,857	,145
Država bi morala v ve?ji meri spodbujati vlaganje v razvoj in izobraževanje z ustreznimi davčnimi olajšavami	Equal variances assumed	3,952	,053	,550	48	,585
	Equal variances not assumed			,582	47,173	,564
Odnos vodstvenih delavcev v industriji do sodelovanja z razisk. inštituti je negativen	Equal variances assumed	,369	,547	3,312	48	,002
	Equal variances not assumed			3,277	39,364	,002
Do sodelovanja pride najpogosteje na osnovi osebnih poznanstev	Equal variances assumed	1,769	,190	,371	48	,712
	Equal variances not assumed			,359	36,313	,721
Obstaja nepovezanost med glavnimi akterji znotraj inštitutov	Equal variances assumed	,722	,400	,056	48	,956
	Equal variances not assumed			,053	33,892	,958
Premalo kontaktov med raziskovalnimi inštituti in industrijo (v primeru, ko ne gre za sodelovanje)	Equal variances assumed	,523	,473	-,501	48	,619
	Equal variances not assumed			-,520	45,529	,606
Raziskovalci in znanstveniki iz inštitutov so fizično premalo prisotni v industriji	Equal variances assumed	4,584	,037	,140	48	,889
	Equal variances not assumed			,148	46,802	,883
Raziskovalci in znanstveniki iz inštitutov ne poznajo dejanskih potreb industrije	Equal variances assumed	1,220	,275	-,892	48	,377
	Equal variances not assumed			-,981	47,637	,332
Raziskovalci iz industrije težko pridejo do kontaktne osebe na inštitutih	Equal variances assumed	1,426	,238	-,363	48	,718
	Equal variances not assumed			-,381	46,734	,705
Med raziskovalci in znanstveniki iz inštitutov in industrije je premalo formalnih in neformalnih kontaktov	Equal variances assumed	,533	,469	,468	48	,642
	Equal variances not assumed			,485	45,295	,630

Question 9: T – test

	Odkod prihaja	N	Mean	Std. Deviation	Std. Error Mean
Komu bi po vašem mnenju država morala nameniti več finančnih sredstev za prenos novega znanja	inštitut	30	3,0333	,92786	,16940
	industrija	20	2,2500	1,33278	,29802

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Komu bi po vašem mnenju država morala nameniti več finančnih sredstev za prenos novega znanja	Equal variances assumed	8,663	,005	2,453	48	,018