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IZJAVA

Študent MIRAN KOVAČ izjavljam, da sem avtor tega magistrskega dela, ki sem ga napisal pod mentorstvom PROF. DR. BOGOMIR-ja KOVAČ-a ter somentorstvom PROF. DOMINIQUE-a FORAY-a in da v skladu s 1. odstavkom 21. člena Zakona o avtorskih in sorodnih pravicah dovolim njegovo objavo na fakultetnih spletnih straneh.

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INTRODUCTION

Slovenia is lagging behind the most developed economies in terms of knowledge transfer from academic research/educational institutions to the industry. To make Slovenian economy more competitive within the EU, there should be more knowledge transfer and cooperation between Slovene educational/research institutions and the business sector (Rebernik et al., 2003; Reynolds et al., 2002). This also applies to certain regions (e.g. Primorska) within Slovenia/EU and to research/educational institutions which are the sources of knowledge in those regions.

The theoretical underpinnings of such knowledge transfer are theories of coordination of social life, which include networks, markets and hierarchies. All these theories are in the realm of institutional economics, which, as opposed to the neoclassical economic theory, looks at the interactions between economic actors from a broader point of view. The underlying principle (coordination mechanism) of markets is the price system, the coordination mechanism of hierarchies are formal rules and the coordination mechanism of networks is trust, which is built by following informal norms of behaviour (Thompson et al., 1991).

Nation-states and different organisations, such as companies, are organised hierarchically. Organisations represent the means of achieving the benefits of collective action in situations where the price system (thus the market) fails. In my master thesis, I investigate what are the possible ways of enhancing collaboration between two traditionally separated and hierarchical types of institutions – educational/research institutions and companies, by using network and market means of coordination.

Through collaboration not only individual institutions increase their benefits, because new ideas in terms of products, services and processes are materialized and thus institutions are able to achieve greater visibility and/or additional revenues by marketing/delivering them, but the society as a whole benefits as well. Those benefits for the society come as constant improvements of people's everyday lives.

This is especially crucial in times of crisis, such as nowadays, when everyone is searching for ways to end it. Dealing with such economic crises is possible in many ways – one of them is the Schumpeterian approach, which, through the process of creative destruction, clears the market of existing goods and creates space for new ideas, which then fuel the renewed growth of the economy.

Collaboration and knowledge transfer enable such Schumpeterian processes and thus help the economy at all – global and local – levels to end the crisis, renewing the prosperity. And additionally, even more importantly, they also enable the long term transformation of societies across the globe towards their greater sustainability.

The thesis is structured as follows:
First is the introductory chapter in which I present the topic of the thesis and global implications of the knowledge transfer phenomena.

Then in Chapter 1 I analyze knowledge production as a prerequisite of knowledge transfer. I discuss different definitions of knowledge, its characteristics and measurement issues, and connections between different types of knowledge and its transfer, which is followed by description of the knowledge society and the role of universities and companies in it. Regarding companies, the influence of company characteristics on knowledge transfer and the idea of establishing corporate universities is additionally discussed.

Analysis of knowledge production and transfer issues in the knowledge society is followed in Chapter 2 by possible theoretical ways of coordination of knowledge transfer. The past and present ways of cooperation between institutions and knowledge transfer in the three most developed regions of the world – the U.S., Japan and the EU – are discussed. Presentation of some practical applications of knowledge transfer models as they currently exist at different research and educational institutions from those regions is also included.

The analysis of ways of knowledge transfer is followed in Chapter 3 by a survey (primary data) of companies (and also some public institutions) in Primorska region in Slovenia with a special emphasis on the University of Nova Gorica (UNG) as the chosen knowledge provider in that region. First of all, in the first part of Chapter 3, I present some hypotheses regarding knowledge transfer from UNG to the industry, based on theoretical analysis of the previous chapters.

Then I conduct an internal analysis of the University of Nova Gorica through interviews with heads of schools and laboratories who already have experience collaborating with the industry. Secondly, knowledge demand from companies from the Primorska region is being analyzed. The analysis of knowledge supply and demand at UNG forms the basis for the testing of hypotheses and proposal of new ideas/analysis of existing measures regarding knowledge transfer at UNG, which is described in the second part of the Chapter 3. Finally, the last chapter concludes the thesis.

1 DEFINITIONS OF KNOWLEDGE, POSSIBILITIES OF KNOWLEDGE PRODUCTION AND ITS TRANSFER

Even though the topic of my master thesis is knowledge transfer, there is no transfer possible without its production first, as is the case with any other goods in the economy/society.

1.1 Knowledge

1.1.1 Definitions of knowledge

Firestone and McElroy (2003, pg. 1-5) have put together many different definitions of what is knowledge from different authors of different studies. Some definitions of knowledge are:

- »justified true belief«;
- »information in context«;
- »understanding based on experience«;
- »experience or information that can be communicated or shared«;
- »made up of data and information, it can be thought of as much greater understanding of a situation, relationships, causal phenomena, and the theories and rules (both explicit and implicit) that underlie a given domain or problem«;
- »the body of understandings, generalizations and abstractions which we carry with us on a permanent or semi-permanent basis and apply to interpret and manage the world around us...we will consider knowledge to be the collection of mental units of all kinds that provides us with understanding and insights«;
- »it is composed of and grounded solely in potential acts and in those signs that refer to them«;
- »it is social acts«;
- »the capacity for effective action«;
- »a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experience and information; it originates and is applied in the minds of knowers; in organizations it often becomes embedded not only in documents or repositories, but also in organizational routines, processes, practices and norms«.

Even though there are no widely-accepted definitions of knowledge established, Firestone and McElroy propose a delineation, which is consistent with philosopher Karl Popper (1972) into three types of knowledge: World 1 knowledge, World 2 knowledge and World 3 knowledge. The evolution begins with World 1 (material)[1] knowledge. As a person evolves, it first achieves goals through limited adaptive and learning capabilities – it has brains (World 1 knowledge) but no mind. Mind (and consciousness) allows people to develop belief »shadows« for tracking reality and enhancing adaptation (this is subjective, or World 2 knowledge). Later on, people develop a sense for language and culture, which enable the creation of »shadows« that incorporate a more objective common (shared) perspective on reality (World 3 knowledge). Objectivity implies that knowledge is not agent specific and is shared among people as objects, whether or not they believe in it. All the people in the organization have access to it and it emerges from the interaction of a number of agents. It consists of models, theories, arguments, descriptions, problem statements, linguistic

[1] Knowledge which also includes a person's basic instincts – thesis author's comment.

formulations and expressions and they can all be discussed in terms of how close they are to the thruth (their thruthlikeness).

If we compare knowledge to data, information and wisdom, we can say that traditionally, data, information, knowledge and wisdom were assembled in a pyramid. However, Firestone and McElroy propose a knowledge life cycle concept (for examples of both see **Figure 1 and Figure 2 in Appendix 1**). In it, data, knowledge and wisdom are just a type of information. New data and knowledge are made through the knowledge life cycle from preexisting information, which includes wisdom, which is »just/righteous« information, data, knowledge and problems (Firestone & McElroy, 2003, pg. 5-20).

Another delineation of knowledge is between eksplicit (codified) and tacit knowledge. Whereas tacit or personal knowledge implies »commited beliefs«, which are contextual in character and difficult to express – thus the saying that »we can know more than we can tell«, explicit knowledge presents codified knowledge, which is explicit (Polanyi, 1958). In comparison with many-worlds delineation, World 3, objective, knowledge is all explicit and codified, while World 2 knowledge is implicit, in the sense that it represents beliefs and cognitions which are not explicitly stated, yet which can be verbally or in other way codified. Thus World 2 knowledge is tacit knowledge, which can be made explicit. However, there exists also tacit knowledge which can't be expressed and this knowledge is World 1 knowledge – physical procedures about how to handle material things, like cooking (Firestone & McElroy, 2003, pg. 20-23).

Codified and tacit knowledge are complementary and the border between them is in permanent state of flux – individual and organisational learning is a spiral process where tacit knowledge is transformed into codified knowledge, followed by a return to practice, where new kinds of tacit knowledge are developed, thus codification of knowledge is never complete, according to Nonaka (1991) (see also **Figure 3 in Appendix 1**).

Furthermore Nonaka (Nonaka et al., 2002) delineated knowledge into four different types – formal knowledge, intuitive knowledge, conceptual and routine knowledge[2], which can be graphically represented as in **Figure 4 of Appendix 1.**

According to the type of knowledge, Lundvall and Johnson (1994) distinguished between four different types:

- **know-what** – which refers to knowledge about »facts«; this knowledge is close to what has traditionally been called information – it can be broken down into bits – thus many practitioners operating in complex areas where experts must hold a great deal of

[2] Formal knowledge is purely explicit knowledge, intuitive knowledge is purely tacit knowledge, while conceptual and routine knowledge are a mix of explicit knowledge, which is kept in tacit form for the former and tacit knowledge, which can be made explicit (thus implicit knowledge) for the latter. And intuitive knowledge is purely implicit – thesis author's opinion.

such knowledge (e.g. medicine, law) belong to this category; these experts typically work in specialized consulting companies;

- **know-why** – refers to scientific knowledge of principles and laws, which can be extremely important in certain technological areas (e.g. chemical and electric/electronics industries); this type of knowledge is often organized in specialized organisations, such as universities; to access it, companies typically recruit scientifically trained labour or have direct contacts with university laboratories;
- **know-how** – refers to skills, which is a capability to do something; mostly this refers to practical people, who operate day-to-day tasks (being both managers and the supporting, administrative staff), yet also some very »theoretical« people, such as scientists, have to have know-how to conduct research experiments; these skills are usually kept within the borders of the individual companies, however, as the complexity of the knowledge-base increases, a mix of division of labour and cooperation between organisations is happening;
- **know-who** – refers to social skills and is becoming increasingly important; it is information about who knows what and who knows how to do what; this enables the transfer of knowledge among different practitioners and experts, since nowadays, because of the division of labour in modern economies, knowledge is dispersed among different people.[3]

Know-what and know-why can be learned by reading books, attending lectures and accessing databases, while know-how and know-who are mainly acquired through practical experience. Know-how is learned in apprenticeship relationships where the apprentice follows his master (e.g. natural science students following a teacher in laboratory work, management students learning through case studies, etc.). Know-how forms with years of experience through learning-by-doing and learning-by-interacting.

On the other hand, know-who is learned through social practice or specialized education environments, such as groups of students studying together in certain types of professional programs.[4] Alumnae clubs and professional societies also help colleauges from certain fields to keep in touch and network and enable participants a barter exchange of information (Foray & Lundvall, 1998, pg. 115-119).

According to Delanty the knowledge can be primarily defined as the knowledge as science and the knowledge as culture. Accordingly, the university[5] - as one of the knowledge producers – when shaping knowledge as culture, has become a major site of battles of cultural identity. However, in the area of knowledge as science, overrationalizing knowledge (overanalyzing) could cause the university rationalizing itself out of existence, if the

[3] Know-what can be compared to formal knowledge, know-why to conceptual knowledge, while know-how can be compared to routine knowledge and know-who to intuitive knowledge in Nonaka's afforementioned model --- thesis author's opinion.
[4] E.g. MBA – thesis author's comment.
[5] Please also see **Chapter 1.2.1** – thesis author's comment.

counterweight is not an increase in the reflexivity in the knowledge production. Reflexivity can be defined as a tendency for institutions and individuals, to increasingly monitor their behavior and actions by means of knowledge. This can be seen as an increase in expert systems, which offer interpretations of social reality for individuals. Reflexive application of knowledge to itself also generates new cognitive fields (Delanty, 2001, pg. 153).

Thus the knowledge is changing from Mode 1 to Mode 2 knowledge. In mode 1 knowledge, »problems are set and solved in a context governed by a small group of scientists, generally the academic community (Delanty, 2001, pg. 109)«. The university is the place where research is being carried out and where the results of research are disseminated. On the opposite, in Mode 2 knowledge, »knowledge is shaped in the context of its application, which is generally outside the university (Delanty, 2001, pg. 109)«. In Mode 1 knowledge is disciplinary and hierarchical, while in Mode 2 it is transdisciplinary and fluid. Mode 1 knowledge is also relatively autonomous and homogeneous, coherent, transcendent and self-referential while Mode 2 is more heterogeneous, socially accountable and reflexive. The theory of knowledge states that Mode 2 knowledge is more democratic, because knowledge users are more and more involved in the production of knowledge, making knowledge more relevant to concrete applications. In today's postmodern (postindustrial) society, knowledge is no longer something abstract (meta-narrative), but has entered the production process as a new production factor and is being generated in the context of application. To put it short – »knowledge for its own sake« is being replaced by »knowledge for use« (Delanty, 2001, pg. 102-110).

The four types of knowledge and their corresponding roles in the knowledge society are the following (Delanty, 2001, pg. 102-110):

1) **research**, which includes basic research and the accumulation of information; the knowledge role which fulfills this task is the expert;
2) **education**, which relates to human experience and the formation of personality; the role corresponding to this task is the role of the teacher;
3) **professional training**, which concerns itself with the practical vocational training; the according role in the knowledge »industry« is the professional trainer;
4) **intellectual inquiry and critique**, which deals with wider public issues of society and the intellectualization of society, with the corresponding role of the intellectual.

To summarize, knowledge can be defined in different ways, and the common definition is still being fiercely discussed and debated in both academic and other communities. However, with refinement and advances in definitions of knowledge, better knowledge management, including development of knowledge management models and cognitive mapping of knowledge management processes, will be enabled also.

1.1.2 Knowledge characteristics

Before being able to talk about knowledge transfer, we have to first look at knowledge – its characteristics and its measurement.

Knowledge, including technical knowledge, has the following distinctive characteristics (UNIDO, 1996, pg. 22 and Cefola, 1998, pg. 109-112):

- knowledge is intangible;
- it is cumulative;
- it cannot be consumed;
- it is easily transmitted;
- it is transnational in character;
- it enables increasing returns.

To discuss these properties in more detail, we can say that technology and all other knowledge are intellectual commodities (**intangibles**). In essence they are information which enables the production process. For ordinary goods, their structure and content determine the utility and thus, value, to the consumer, while for intellectual goods, the utility lays in an ever-increasing knowledge base, which enables the production of a continuous stream of new products and services.

Knowledge has a **cumulative** character, meaning that the present stock of knowledge in the world results from humanistic, scientific and technical developments of the past generations. However, because of cumulative properties, it is sometimes hard to link a discovery which extends our understanding of the world with a concrete innovation, which comes from a general idea.

Technology does not wear out physically. If we look at technical knowledge, which is a prerequisite for products and services, it wears out only economically, whereas material goods wear out both physically and economically. Because of **inconsumability**, knowledge can be bought and sold almost limitless number of times, without diminishing its value. Thus the law of diminishing returns, which applies to all other economic goods, does not apply to knowledge. Furthermore, the sales revenues are many times greater than the »costs« of technology production. The elasticity of supply of knowledge is thus close to infinity, which is not typical of any other good or service.

Knowledge is also very **mobile**, thus the lag-time between discovery of new knowledge and its dissemination around the world has, because of modern information-communication technologies (ICTs) shortened dramatically. There is a term being used for world becoming »a global village«, because the flow of information is so much faster, cheaper and easier than ever before in the history of the mankind, especially due to modern ICTs.

Knowledge (including technical knowledge) is particularly suited for globalizing forces of today's world. It's nature is **transnational**, and thus it flows around the world through many channels, both commercial (proprietary) and non-commercial (non-proprietary). Ideas created in one country are developed (appropriated) in other countries. Even though in the short run non-proprietary knowledge is accessible quicker and flows more freely (because it is not protected by patents and other means of intellectual property), in the long run both proprietary and non-proprietary knowledge are being diffused around the world (UNIDO, 1996, pg. 22).

With ordinary goods and services, the law of diminishing returns prevails in competition. However, with knowledge's different properties, the consumer's marginal utility increases as more of knowledge is consumed, thus **increasing returns** are the norm with knowledge rather than diminishing returns (Cefola, 1998, pg. 109-112).

1.1.3 Measurement of knowledge

Regarding measurement of knowledge, more and more companies (Institute of Management Accounting mentions even 70% of all) are experimenting with non-financial performance measurements (e.g. Balanced Scorecard), which are mostly focused on the productivity of human and intellectual capital. Nevertheless, knowledge measurement in the economy and at work is a whole new area of development and poses many issues.

One of them is measuring knowledge itself. Knowledge has three properties different from goods and services:

1. it is not separable – it stays with the one who sold it even after the sale;
2. additional »units« of the same knowledge yield no extra value to the person with the knowledge, thus new knowledge is better than more knowledge of the same kind;
3. value of knowledge is unknown until it is acquired and applied; thus the stock of knowledge cannot be evaluated, but the value of knowledge is in the flow; especially tacit knowledge value is hard to measure, because its value is unknown until tacit knowledge is gone.

Also, since knowledge is embedded in products and services, it undergoes significant changes over time, thus it is difficult to evaluate the level of output of knowledge. There is nowadays an increasing proportion of intangible to tangible value of products and services and some products/services emerging, which are knowledge-based, meaning that they are intelligent – adapting each time the product is used, thus being hard to define.

Another problem is that boundaries of producing units are changing, thus as connections between different economic actors are growing in the knowledge economy (e.g. suppliers codevelop products with manufacturers, manufacturers are conducting more and more customer surveys, etc.), or – to put it differently – the boundaries of companies and other organisations are becoming more permeable, and thus the connections are becoming more complex, it is harder to measure how much value each agent has added in the value chain.

Furthermore, knowledge causes spillover effect (externalities), meaning that learning something can enhance learning something new or it can interfere and thus the discovery of new knowledge is path dependent – where you look for knowledge is where you will find it, even though new knowledge does not have necessarily the properties which you expect to find. Thus the externality effects of knowledge may change and the change, which is caused by knowledge, causes externalities as well.

Problems arise also, because investments into knowledge are meta-investments, enabling companies/organisations to do things they had not been able to do before as opposed to direct investments into development of a certain product or service, and also, because it is hard to specify the timing of knowledge obsolescence. Some knowledge may last a long time while other may have a pretty short useful life, thus there are no exact schedules of depreciation. However, when knowledge becomes obsolete, the value of the stock of knowledge drops to zero immediately.

To summarize, knowledge is context dependent and has a different value to those who might acquire it, thus only the results of knowledge are meaningfully measured. Because knowledge causes humans to learn, measuring it causes those who measure it to learn, compromising the measurement itself (reflexivity), because new and better measurements are needed. Knowledge performance measures therefore have to be designed with the expected change in mind (flexibility of measures). In general, it is more informative to measure changes, which knowledge causes, rather than knowledge itself or the current performance of organisations. One such approach is real options approach, which alows managers of organisations to measure uncertainty and organisational flexibility, which knowledge brings with it (Siesfeld, 1998, pg. 193-202).

1.1.4 Knowledge and its transfer

Knowledge can primarily be transferred by means of a market system. Knowledge markets can, just like ordinary markets, consist of knowledge buyers, sellers and brokers, where knowledge buyers are those who are in search of knowledge, knowledge sellers sell it and brokers link buyers and sellers and facilitate knowledge exchange. What is specific for knowledge markets is that »communities of practice«, some sort of networks often form, which influence the transactions in the knowledge market. These communities are different from companies in that they do not have explicit goals, but they form around »a value-adding something that we are all doing« and develop spontaneously over time through shared experiences and social interaction and not some managerially imposed order.

Knowledge markets are especially known for its volatility – roles of participants of these markets are dynamic and thus often change. A knowledge seller in one exchange becomes a knowledge buyer in the other and the communities of practice, which are formed, often change. There are many externalities possible in these markets, which threaten the effectiveness of the knowledge transfer (Cefola, 1998, pg. 109-112).

This is especially true of codified knowledge. Codification of knowledge implies that knowledge is transformed into »information«, which can be easily transferred through modern information infrastructures by means of ICTs (information-communication technologies). Nevertheless, as mentioned before, many externalities exist, thus information and codified knowledge are not easily exchanged in the market. It is hard to exclude the buyer from reselling knowledge to others and hard to reach an agreement on the price of knowledge being transferred since buyers have a problem judging in advance what they are buying (the value is only known after the transaction has already been processed – ex post) (Foray & Lundvall, 1998, pg. 117-118).

However, not all knowledge can be transferred through markets. Tacit or hidden knowledge is usually not transferred by means of a market system. Reasons are manyfold. Because it is not stated in the explicit form, it cannot be easily transferred. Furthermore, because tacit knowledge is mostly formed of skills, a skilled person follows rules which are not recognized as rules by the skilled person itself. Tacit knowledge is also connected with implicit but shared beliefs and modes of interpretation. Thus the transfer of such knowledge is extremely sensitive to the social context and the only way to transfer it goes through a specific kind of social interaction similar to apprenticeship relationships, thus very personal and not possible to sell and buy it in the marketplace (Polanyi, 1958, pg. 212).

1.2 The knowledge society

There is a consensus among the public actors that we are entering a new phase in the history of mankind. Instead of capital it is knowledge that is becoming a primary resource in production and distribution of goods and services and in the organization of society.

Even though some authors claim that it is information society, for it is predominantly based on information, Delanty claims that it is knowledge society that we are entering, because knowledge is central to the information economy, to telecommunication systems, to technological systems, to politics and to everyday life, and there is nowadays even an extension of knowledge into the cultural domain (Delanty, 2001, pg. 152).

In the past, nation-states gained comparative advantage towards other nations through a unique combination of traditional production factors, such as land, labor and capital, while nowadays, in the context of a global, knowledge-based society, a nation's comparative advantage comes from a collective ability to leverage what its citizens know.

Because more and more knowledgeable people are being employed to solve problems and develop high-tech products (and being payed more to do it), the pace of change will continue to accelerate. Furthermore, because knowledge causes goods, services and knowledge itself to become obsolete quicker, volatility permeates the world economy today. Thus whole new products and industries can be developed within a fairly short time span and they can be eliminated also.

In this volatile world the main question becomes which technologies, innovations, etc. will lead the way into the future. The problem is that new science and technology do not have immediate usefulness (Delanty cites e.g. laser, whose invention enabled a multitude of applications, but whose usefulness at the very beginning was limited to a few fields of application[6] (Neef, 1998, pg. 8)).

Low and medium skilled workers will increasingly be moved away to low-cost labor markets or their work automatized and replaced by robots and other equipment, forcing a further shift towards »knowledge-based« industries and services. Knowledge based work causes two problems – 1. it is hard to measure; 2. it is resistant to productivity increases, because telling knowledge workers (e.g. doctors, laboratory researchers) to produce the same results in half the time either lowers the quality of results or is even impossible to do.[7]

There are many changes due to happen as we enter the knowledge-based society. One of the main changes is that ICT's – information and telecommunication technologies – are allowing ideas to flow instantaneously and coherently around the world. Thus, all this information is enabling developing economies to quickly build a highly competitive production infrastructure, capable of manufacturing high-quality products at the fraction of the labor costs of traditional »advanced« economies. Thus more and more production and sales is being relocated around the world towards the developing economies, while in the developed economies, there is an increasing drive towards »weightless« economy – based on services (including knowledge industries). What this shift towards »weightlessness« also implies is that productivity in developed economies is falling, primarily because of two reasons:

1. one reason is that some service industries (e.g. such as doctors and teachers) are resistant to productivity[8] increases, because their work requires enough time to accomplish the task;[9]
2. another reason is that as the primary (agriculture) and secondary (industry) sector is shrinking, workers' productivity levels are rising, while as the tertiary (services) and quartary (knowledge services) are rising, the workers' productivity levels in those two sectors of the economy are falling.

Behind all these national trends, there is a deeper shift in the world, which can be summarized in one sentence – the rise of the non-national organizations. New developing markets with low labour costs and many opportunities for development are the pull, while high tax rates and high labour costs of developed economies are the push for companies to relocate from their home bases. Also, with development of electronic communications, capital markets,

[6] The same goes for nanotechnology today – thesis author's comment.
[7] The possibility is to provide them with better equipment to increase their efficiency or to simplify their tasks or both – thesis author's suggestion.
[8] Productivity increase is defined as the time needed to accomplish a certain task or the quantity of a product – thesis author's comment.
[9] With the two possible solutions being the simplification of tasks and automation of the work processes as much as possible, as already mentioned; however, there is often general inertia towards changes (in productivity) present, caused by irrational behaviour of actors (thesis author's opinion).

advanced transportation and easily transferable technologies, companies are able to more freely operate around the world. All this will cause that businesses and other organizations will become members of non-national conglomerates (e.g. in telecommunications – World Partners includes American AT&T and 16 other companies in 31 countries around the world or Global One – Deutsche Telekom, France Telekom and (American) Sprint), and will be able to move their assets and skills around the world in order to avoid any legislated pressures that governments are trying to place on them.

Thus the knowledge-based economy with key characteristics of knowledge-based businesses, new technologies and unbounded globalization, will undermine the very nature of the nation state, where nation's comparative advantage was based upon a combination of natural resources, labour, capital and a balance of governmental, social and economic stability within its borders. Allegiance to the organisations rather than to nations will become paramount and comparative advantage for organisations will become access to ideas, human capital and the ability to create and deploy innovative new products and services (Neef, 1998, pg. 3-16).

1.2.1 Role of universities as knowledge producers in the knowledge society

Changes, described in the previous section, have impact on the universities as well – the universities should change the role which they are playing in the society. They cannot exist as ivory towers any longer, separated from the practical aspects of everyday life. The reason why they should change is twofold:

1. on the one hand the role of the national states is changing (as already mentioned, in a more and more globalized world, the nation states are losing their power), thus the implicit contract between the university and the state in terms of universities safeguarding the national interests of the state are changing; this fact is changing the university organisation into certain disciplinary fields (e.g. physics, mathematics, sociology, etc. – instead of specialized departments multi- and cross-disciplinarity is the norm) as well as the cultural role, which universities used to play as preserves of the national identity in collaboration with the state (the national aspects are giving way to cosmopolitan aspects); consensus on what constitutes knowledge has been replaced by dissensus and the national culture, preserved and reproduced in the university is being contested;
2. on the other hand knowledge is more and more produced by other social actors (e.g. companies and NGOs) and not just universities, thus there is an increasing competition in the market for knowledge; this fact is making universities more like other organisations (e.g. companies), and at the same time being reduced into the role played in technocratic consumerism by which students become mere consumers of knowledge and the university a transnational bureaucratic corporation which is trying to »excell« in its activities.

The loss of certainty which begun with 19th century cultural norms has extended into uncertainty in science today and thus a crisis of identity of the university and increased risk management. However, in the knowledge society, cognitive processes not only produce knowledge as content, but create new cognitive structures and identitites and, because the university occupies a space in which different discourses interconnect, the role of the university in the knowledge society is enhanced, not undermined (Delanty, 2001, pg. 152).

What Delanty states for universities as knowledge producers is that – as the state retreats from the role of provider to the role of a regulator – the state will no longer be the sole financier of knowledge and thus universities will have to look to other forms of financing. Furthermore, new knowledge producers are emerging and thus the site of knowledge production is being increasingly occupied by a range of non-university producers – e.g. industrial laboratories, research centres, think-tanks and consultancies.

In the era of modernity,[10] the modern university encompassed the Enlightenment ideal of the university being the »republic of science« - an autonomous institution, promoting the emancipation of scientific disciplines. The university, with its »caste« of intelectuals, played the role of the knowledge guardian, transmitting knowledge to society as indisputable laws. However, the postmodern role of the intellectual is more like that of an »interpreter«, trying to interpret the world around us, rather than impose universal thruths.

This is connected to the postmodern – risk – society, which is a self-critical society and in which the unquestioned belief in the rationality of science and the idea of neutrality of knowledge is no longer credible. There are new links being forged between society and knowledge as education is being more availabile to the masses, and ceases being an exclusive privilege of the elites. Information is becoming the most important resource and is sometimes even challenging the primacy of material security.

All this leads to the fact that the traditional roles of universities are in crisis and that the ivory tower is collapsing. The society is pushing for greater accountability of universities towards the society. Knowledge is being globalized and detached from its traditional reliance on the nation state and its custodians – intellectuals and university professors. Also, knowledge is becoming more fragmented – application of knowledge gives rise to specialization and thus the knowledge agents and the knowledge itself are becoming decoupled and recombined in new ways. Thus Mode 1 is more and more giving way to Mode 2 knowledge.[11]

There is a rise in managerial practices being implemented in universities. Universities are – because of globalisation and other changes in the society – forced to implement new regimes of management that more closely resemble businesses than the traditional sites of autonomous knowledge. Universities are increasingly competing for students, the best professors and their share of state's diminishing budgets. The humanistic intellectual has increasingly been overtaken by the administrator and the academic entrepreneur, the so-called »businessman of science«. Departments have to generate funding for research, thus funded research has

[10] The last 500 years (the new ages) – thesis author's comment.
[11] As defined in the **Chapter 1.1.1** – thesis author's comment.

priority over free and unbounded research and the highest mark of academic achievement is becoming entrepreneurship. Deans and heads of departments are starting to resemble managers rather than academic figures and thus they behave accordingly – they compartmentalize tasks, take full managerial control and systematically calculate costs for each step of the process. With one sentence – service delivery is being commodified and professional autonomy is being eliminated.

While this has as its aim greater efficiency and effectiveness, the results behind academic managerialism are often quite the opposite – because of the nature of knowledge production, academic self-governance is not time-efficient and often has a strong tendency[12] towards hierarchical structures, the very mode of managerial practice which has long been abandoned in the most successful companies. To put it short – by uncritically copying managerial practices from companies the universities are often doing more damage than good.[13]

On the other hand, the knowledge users – especially companies – are becoming more and more like universities – companies give employees study sabbaticals and other forms of training possibilities. The ultimate in this sense are American corporate universities, where large corporations establish their own universities[14] (e.g. General Motors university in Chicago) (Delanty, 2001, pg. 108).

Another large trend is becoming the separation of teaching and research in universities. Traditionally (the Enlightenment model) professors gave lectures which formed the core of their writings. As researchers are increasingly working on specific problems and are frequently condemned to obscurity in an ever-expanding publishing industry, researchers' knowledge is becoming overly specialized and thus irrelevant to the immediate needs of students. Besides, many academics have, because of specialization, lost a sense of the overall significance of their research (the big picture), thus they are losing themselves in endless details, while on the other hand academic standards among students have been falling, thus there are many academic communication gaps forming between students and teachers/researchers when conveying knowledge (Delanty, 2001, pg. 110-112).

The way in which universities should change – according to all the afforementioned by Delanty – should be the following:

a. a university should become a site for **interconnectivity** of different kinds of knowledge in the knowledge society (the reason for this is that today there are increased findings that there exist different types of knowledge (instead of one unified type as shown in the beginning of this chapter), however, there does

[12] Because of intellectuals' love of titles – thesis author's comment.

[13] Nevertheless, if the universities do copy such practices, they should learn from the best and most successful companies – thesis author's opinion.

[14] More on corporate universities is described in **Chapter 1.2.2.3**, with examples in **Chapters 2.4.1** and **2.4.4** – thesis author's comment.

not exist an institution which would open different avenues of communication between these different types of knowledge (NOT uniting them!));

b. in this manner, the universities should give expression to the new social bond which is emerging in postmodern society that is **communication** – the postmodern societies will not be integrated by national cultures or money or power, but instead by communication; complex modern societies are not based on values or roles but instead on differentiated systems of communication; and because the public sphere is being increasingly »colonized« by media under influence of money and power, universities should recover the public space of discourse that has been lost in the decline of the public sphere (Delanty, 2001, pg. 6-7.

Specifically, the universities can change according to the three types of communicative interconnecting:

1. new links between the university and society – as more communication occurs between expert systems and lay public, the university will become an important site of public debate between expert and lay cultures;
2. new links between the sciences – because there will be more and more cross-disciplinary communication between disciplines and the sciences as a whole, university will have to become a site of interconnectivity between the diverse forms of knowledge;
3. changing relations between the university and the state – as the state is becoming increasingly a regulatory agency and less exclusively a provider state, the university will be forced to negotiate with non-state actors regarding the provision and distribution of knowledge; one solution is the creation of diversity of universities, designed to fulfill different functions, and another solution is – according to Delanty – in creation of more and smaller universities rather than in the economies of scale.

However, there are many dangers looming ahead as well. One is that instead of multidisciplinarity, the university will embrace »postdisciplinarity« in the meaning that it will focus on bureaucratic or financial goals only – the result of such university would be purely managerial or entrepreneurial exercises in »academic capitalism«, as has already been mentioned before.[15]

Another risk is that the university has to open sites of communication in society, rather than become a self-referential bureaucratic organisation, forming a self-legitimating and autonomous society within the larger society (a kind of new age ivory tower, which is instead of being a totally non-profitable organization as in the age of modernity, becomes the other extreme – an exclusively profit driven organisation, without any recourse to non-profitable causes and actions).

[15] This danger is real due to external pressures of globalizing forces of the market system upon the academic freedom – thesis author's comment.

Thus the Delanty's idea is that university should become a place where there exists an idea of dissensus, while still unifying people together in a communicative interaction – a debate, instead of (political) consensus and the common identity (Delanty, 2001, pg. 1-11).

Therefore the university should be a place where people unite in a discussion and experimentation without imposing on them unifying ideas of the common culture and ways of behaviour and/or the common nation-states. If certain common ways of behaviour do want to be imposed, they have to be done through a process of communication, trying to find a win-win situation for both without one side or the other imposing strict rules upon each other – it's a dynamic process of negotiation, and not a specified order.

1.2.2 Role of companies in the knowledge society

1.2.2.1 Company aspects of knowledge creation and transfer

Market economies are being transformed into the knowledge-based society by three factors: knowledge, new technology and global strategies. Thus business strategies itself will have to adapt accordingly. Companies will have to develop new competitive advantages and corresponding strategies. In order to be able to do that, companies will have to learn how to do it in knowledge-based economies.

The characteristics of markets with increasing returns[16] are that those businesses, which compete in these markets, can either succeed substantialy or completely fail in the short run. Those who succeed, gain market share as all the consumers increase their utility by increasing their consumption (e.g. someone who buys a video phone increases his or hers utility as other people start purchasing video phones). Thus, such companies can become market leaders with products that become the industry standard.

Furthermore, what is more important, is that such market leaders can only be dethroned by anoher company, which develops such fundamental, high-impact, grand-scale innovation. The new product or service has to be substantially better (in price, speed or other features) so that customers will cease to purchase competitors' (old) products and services. However, to produce such major impact innovation, firms have to invest a lot of capital. Yet, because it is easier and much cheaper to copy than to develop such large innovations, those who copy are much better off than those who start anew, plus customers tend to put a lot of emphasis on the price, which can be substantially higher for new products. Thus companies tend to under-invest in knowledge (negative externality). This is the reason why there exists a clear need for government intervention when providing for basic/fundamental research and R&D infrastructure (Cefola, 1998, pg. 109-112).

[16] E.g. new technology markets – thesis author's comment.

Companies have to change their strategies in the knowledge society in order to improve the use of already existing knowledge by improving the internal processing of knowledge, and to be able to spur innovation and create new knowledge, thus expanding the organisation's existing knowledge base. Dr. Deming in his book on the system of profound knowledge mentions four critical components (first two how to systematize and use the knowledge transfer and second two to ensure continued innovation) for a well-functioning knowledge organisation (Deming, 1993, pg. 113-114):

1. business has to recognize that it exists as a composite of independent but networked parts – a system; it is like a jazz, rather than the classical band; in a jazz band, an initial theme starts the concert and everyone is like one big family, where everyone plays his part; however, later on they start to improvise and everyone delivers his own interpretation of the music; this is how companies in knowledge society should work to enable innovation: the company should remain a system unified by common goals and commitments, yet managers must also be flexible and adaptive to allow employees to improvise – use employees' individual talents and skills and let them reach the common goal and do it their – and not their bosses' – way;
2. companies and other knowledge organisations have to learn to distinguish between two forms of variations of performance from the goals – variation from special and common causes; special causes are the ones that cause upward and downward changes in quality of products and services and indicate that production processes are not predictable (are not in a stable state) and are thus not in control; in this case managers should identify what causes these deviations and create strategies to eliminate them; on the other hand, common causes are built into the system itself and cannot be changed unless the whole production system is entirely changed; thus good managers should be able to differentiate between different types of variations;
3. organisations should put in place strategies to enable continued innovation – define the knowledge creation process; in order to enable innovation, managers have to adopt a philosophy that the company is a living organism – a dynamic system with a collective goal and that in such a system all employees are considered knowledge workers, because all are capable of creating new knowledge; thus it is management's responsibility not only to spur the knowledge creating processes[17], but also to keep knowledge creation in line with broad (not narrow) strategic objectives;
4. lastly, new performance measures are needed to effectively measure the success of organisations in the knowledge-based society.

Companies therefore have to adapt to the coming knowledge society through developing new competitive advantages and strategies. However, these can only be achieved by improving internal processing of knowledge on one hand, and by enabling innovation and thus creation of new knowledge on the other.

[17] By allowing more freedom to workers to express their ideas on how to solve organisation's problems – thesis author's comment.

1.2.2.2 Influence of company characteristics on knowledge transfer

If we look at the studies which have analysed the effect of company characteristics (especially industry and size) on knowledge transfer we can see that the article on Links and Impacts: The Influence of Public Research on Industrial R&D, by Cohen, Nelson and Walsh is trying to research the contribution of public research – especially that which takes place in government and university labs – to company R&D activity. The authors of the article are interested in the key determinants of technological change and the impact of economic policy decisions regarding public research on technological development. At the same time such research gives insight into the innovation process itself.

Traditionally, Vannevar-Bush's »linear« model of innovation activity holds true, where innovation flows in the following way: basic research – applied research – development – commercialization (industrialization). University research is thus being conducted independent of technological development, and companies benefit from the »pool« of research results.

Lately, many researchers have developed the concept of interactive relationship among different parts of the innovation process, such as e.g. Gibbons and Johnston, Kline and Rosenberg, Nelson and von Hippel, whereas public research sometimes leads to the development of new technologies, and sometimes it focuses on problems, caused by past development or customer feedback. This way the innovation process becomes much more complex.

Since the 1980's the economic policy decision makers in the U.S. have turned down the linear model by encouraging government and university labs to start commercializing new technologies. Furthermore, the National Science Foundation (NSF) started creating centers for applied research and university-industry collaboration[18] and several U.S. states have started regional economic development programs.

A study by **Cohen, Nelson and Walsh** is based on data of Carnegie Mellon research from 1994 and among other is trying to find out what is the influence of different company characteristics (large vs. small companies and newly established vs. already existing companies) when bridging the differences between public and private R&D. The authors use LOGIT model to estimate the influence of company size and age on the percentage of company R&D projects using the findings from public research.

The results of the study show that large companies use public research results much more often than small and newly established (or start-up) companies. If we compare small and newly established companies, we can find out that start-up companies, in comparison with small companies – use such research more often. Because the reason for such results cannot

[18] Called university-industry research centers (UIRCs) – thesis author's comment.

be directly deducted from the study data, we can hypothesize that probably a number of start-up companies stem from university environment or are »spin-offs« from larger companies, thus they come into contact with university and other public research either directly or via the large company. Furthermore, R&D activities' yields of start-ups are higher than large company yields which implies a more efficient knowledge transfer from public research institutions into start-ups (Cohen et al., 2002, pg.1-2, 21-22).

According to the **Yale study** (Levin et al., 1986), companies benefit the most from public research in computer science, material science, mechanical engineering, electroengineering, metalurgy and chemical technology. The reason is in the applied nature of the mentioned research fields, whereas the least relevant fields for industry include public research in the field of basic sciences (physics, mathematics, medicine), with the exception of chemistry, where research results which can earn scientist a Nobel prize are equally useful in the industry.

Nevertheless, if we look at the total contribution of science to the development in the industry, the influence of basic sciences is equally important as the influence of applied sciences, because it is well understood that basic sciences represent the base for applied sciences. Research in the fields of basic sciences does not contribute directly to new or improved products and/or services, but it requires much more development work, which is mostly carried out in companies.

Another study – **GUIR study/roundtable** (GUIR, 1991) - which was based on discussions with 17 R&D managers from large companies, has shown that companies look for innovations among university research especially in the field of biotechnology, because it is a new industry, which is heavily dependent upon new scientific discoveries, which mostly take place in university and not company laboratories.

Similar findings go to pharmaceutical industry, where the GUIR study has contributed to the knowledge of processes in this industry. In the field of electronics the study has shown that companies differentiate between incremental improvements and true innovative ideas and that academic sphere is a source of radical new ideas whereas incremental improvements take place in company labs.

Similar to GUIR study, the **Ed Mansfield study** (Mansfield, 1991) on academic research work and industrial innovations, which included 76 large American companies, has analyzed how often academic research has contributed to the development of new products and processes, commercialized in the 1975-1985 era. The study shows the percentage of cases when products or processes would be developed with a substantial delay without academic research help and concludes that the percentage is greatest in pharmaceutical industry (almost 30 percent), in production of instruments and new materials and in the area of information technologies (10-15 % of all cases).

Accordingly, the percentage of new products and processes, where academic research is of great help is greatest in pharmaceutical industry, information technology and in the development of new materials. In the pharmaceutical industry academic researchers are not involved in the development of new drugs, but their research contributes to knowledge, which enables pharmaceutical industry to gain new approaches to development of drugs. In IT and instrumentation industry the percentage is, compared to pharmacy, half less, because academic research is important in the area of truly innovative products and processes and not just improvements. The least important is academic contribution in the fields of electronics, chemical and oil products.

Besides American there exist many European studies on the topic of cooperation between companies and universities or other public research institutions. There exists a paradox in Europe, because on one side we have high quality research results, and on the other side the competitiveness of European companies is falling. This paradox exists because there does not exist enough connections between the public and the private sphere.

Belgian study by Veugelers and Cassiman focuses on the demand side of connections between industry and science. It focuses on how cooperation contracts influence the willingness of companies to cooperate with the university and other public research institutions. The reason for this study is that other research studies show that the problem does not lay in too little research activity (thus on the side of knowledge supply), but rather the problem lies in a very low interest of companies for the results of scientific research (thus the problem represents the knowledge demand side, since only 10 % of innovative companies in the EU have connections with the universities). Despite a similar situation in the U.S., where 15 % of all research cooperation contracts involves a university, there exists a rising trend for the future.

The data apply to EUROSTAT/CIS-I study for Belgium. The probit model is specified as:

$$CPuniv = \alpha_1 + \alpha_2\,SIZE + \alpha_3\,FOR + \alpha_4\,COST + \alpha_5\,RISK + \alpha_6\,PROTstrat + \alpha_7\,IndPROTleg + \alpha_8\,IndCPuniv + \text{industry dummies} + v1$$

Where:
CPuniv – dependent variable which shows if companies cooperate (1) or not;
SIZE – size, expressed as a logarithm of the number of company employees;
FOR – dummy variable (1 – if the company has a seat abroad);
COST – aggregate measure for the importance of obstacles in the innovation process;
RISK – variable which measures the importance of high risk as an obstacle to innovation;
PROTstrat – average measure for the efficiency of the strategic protection (business secret, complexity, time advantage during development) of company products and processes;
IndPROTleg – average measure for the efficiency of patents / trademarks in the process of innovation;

IndCPuniv – mode for CPuniv at the industry level;
industry dummies – they are used for NACE-2 industry groups.

The results show that large companies have more signed contracts of cooperation with universities compared to small and medium companies. However, this does not hold true for those Belgian companies, which are part of foreign multinationals, because they do not have so many cooperation contracts signed. This points to the fact that multinationals and large companies have centralized basic research and development – which is crucial for the cooperation with universities – in countries where they have their headquarters.

In general, the main reason for the low level of university-industry cooperation in Belgium is a large number of small and medium enterprises, which are focused on development, rather than research activities, which contribute to connections between the industry and the university sphere. Also many large companies in Belgium are subsidiaries of foreign multinationals, therefore the extent of basic R&D activities and thus cooperation with universities is lower in those companies (Veugelers & Cassiman, 2004, pg. 2-4, 10-21).

The **Swiss study** of authors Arvanitis and Hollenstein focuses on innovativeness of Swiss industrial companies. It uses data from the analysis of 516 Swiss innovative private companies from the year 1996 (17 different industries and three different size classes). As the result of factor analysis, the study forms 5 different clusters, which have different characteristics regarding the indicators of innovative activity and 4 different clusters with different indicators of sources of knowledge for innovation.

The first cluster of sources of knowledge for innovation includes companies, which use external information from buyers, competitors, fairs, expositions, industry conferences and magazines – in one word market data – a lot in their innovative activities. They include the majority of small companies in the production of food, clothing and the production of plastic materials' industries.

The second cluster contains companies, which use all external sources of information, especially information from universities, technical faculties, other research institutions and government technology programs and knowledge transfer agencies (scientific knowledge). Those are especially medium and large sized companies from the industries of chemistry/pharma, production of metals and mineral products, electrical appliances and transport equipment.

The third cluster involves companies, which gain the majority of information from their suppliers of raw materials and other means of production. It consists of the majority of small Swiss companies from the industries of textiles, wood industry, paper, printing/publishing and metal treatment.

Finally, the fourth cluster consists of companies, which use information from institutes, patent announcements and specialized consultants (knowledge for specialized producers). This cluster includes especially large and also some small companies from production of machinery, electronics, precision instrumentation and watch industries (Arvanitis & Hollenstein, 1998, pg. 28).

1.2.2.3 Corporate universities

Nowadays, companies in the knowledge society are not just in charge of training their employees, but are more and more adopting wider functions of being strategic tools, tied directly to helping an organisation achieve its mission by being educational entities, which »conduct activities that cultivate individual and organisational learning, knowledge, and wisdom.« (Allen, 2007, pg. 4)

This means that corporate universities are in charge of developing people and growing organizational capabilities by conducting activities such as:

- needs assessments;
- designing and delivering training programs;
- designing and delivering managerial and executive development programs;
- assessing technology options;
- delivering e-learning or blended learning programs;
- hiring vendors and managing vendor relationships;
- marketing programs internally and externally;
- evaluating programs and the corporate university as a whole;
- executive coaching and mentoring;
- career and succession planning;
- strategic hiring and new employee orientation;
- managing strategic and culture change;
- managing library and electronic collections of information;
- research and development;
- managing university partnerships;
- knowledge and wisdom management.

Some companies (mostly larger ones, and especially regarding applicative research) do research and development in house and have a separate R&D department. And in some of those companies corporate university administers the areas of research that will benefit the company the most.

Managing university partnerships includes academic (accredited) programs and basic research, still predominantly executed at traditional universities – therefore companies usually form partnerships with local traditional universities; on the opposite, a whole different story is with executive development programs, where such programs at corporate universities represent a direct competition to traditional university-based programs; however, smart business schools usually cooperate with corporate universities to create customized degree and nondegree programs (Allen, 2007, pg. 3-9).

And regarding knowledge and wisdom management, most of the organisations agree that the most valuable asset is the knowledge in the heads of their employees - however, when it comes to acquisition, sharing and use of knowledge, most organisations admit that they perform poorly in managing that knowledge.

The problems with acquisition and storing of knowledge arise, because most of the databases can store only declarative (factual) knowledge and not procedural (how to do) knowledge, which – the latter – is usually more important to the organisation than the former. Regarding sharing of knowledge, the problems arise due to the fact that knowledge means power. And unless organisations properly reward workers for sharing knowledge, workers will tend to accumulate and not share it. After all, managing knowledge is not an IT, but rather human resources (HR) issue (Allen, 2007, pg. 13-15).

Regarding use of the knowledge, research shows that between 60-90% of the learned knowledge is not being implemented on the job (Allen, 2007, pg. 14). One solution to this is wisdom management, which is a planned and systematic process by which an organization manages how its employees use and apply their knowledge and skills in ways that benefit the organisation (Allen, 2007, pg. 391). In short, it is a process which ensures the return on investment in people development, instead of spending lots of money and time on this and, as is the case in most of the companies nowadays, seeing no or little return.

In order to be able to apply wisdom management successfully, an organisation should:

1.) specifically define, what are its' people development needs and goals; the goals should be as specific and measurable as possible, otherwise it is hard to say whether the goals of people development have been met or not;
2.) determine the optimum ways of delivering the required knowledge, skills and experience to the employees (choose from the possible activities of corporate universities, mentioned at the beginning of this chapter);
3.) ensure a method of translating development activities into employee behaviour which impacts an organisation's performance – no matter which activity an organisation chooses and in what way it is delivered, the goal should always be to achieve measurable results, but not in terms of e.g. how long the program lasted or similar, but more in terms of which organisation goals were achieved (e.g. sales increase by x %, employee errors reduced to zero or minimum, being able to use a marketing or an IT tool, etc.). Therefore the managers should in all steps of the learning process always ask themselves the question:»What do I need to do to ensure this developmental activity delivers the behaviours I want to see and the results we need to see?« (Allen, 2007, pg. 399-401).

2 ANALYSIS OF KNOWLEDGE TRANSFER POSSIBILITIES

2.1 Organisation of knowledge transfer

Knowledge transfer from universities to industry and vice-versa (one should not forget that knowledge transfer can go both ways) can be divided into two parts – commercial and non-commercial knowledge transfer, depending whether the aim is to make a profit (commercial means) or just cover the costs of operation of the university (non-commercial means).

In the following chapters I will focus primarily on the university to industry knowledge transfer. First of all, I will describe non-commercial means of knowledge transfer, which include publications and conferences, (non-commercial) consulting activities, employment of students (including student internships/cooperative education). Later on, I will research commercial means of knowledge transfer, including contract research, joint ventures and exchange of personnel, patenting and licensing, equity investments and the founding of start-up companies.

2.1.1 Non-commercial means of knowledge transfer (network type of collaboration between university and industry)

Non-commercial or traditional knowledge transfer mechanisms include publications, conferences, (non-commercial) consulting (of companies and other institutions) and employment of students by companies.

PUBLICATIONS AND CONFERENCES

Carnegie Mellon Survey of industrial R&D in the U.S. manufacturing sector (Cohen et al., 2002, pg. 14) shows that publications/reports are the dominant channel of information flow between public research institutions and industrial R&D labs. 41 % of respondents in the survey rated them as at least moderately important. Meetings and conferences are, together with other informal interactions the second most important way of knowledge transfer between educational/research institutions and industry (35 and 36 % of respondents, respectively).

These are, together with public meetings and conferences, channels of so called »open science«, which represent traditional longstanding ways of knowledge transfer between academia and industry. Typical of them, as well as of informal information exchange and consulting, is that they are relatively decentralized in the sense that they do not typically reflect formal institutional links and are not mediated through market exchange (Cohen et al., 2002, pg. 15-16).

(NON-COMMERCIAL) CONSULTING

Consulting represents a very important form of knowledge transfer. There exist many different forms of consulting, which can be of a commercial or a non-commercial nature. A special form are professor sabbaticals, which enable university lecturers to work in a company. This enables sharing of ideas both for the company and the university – a university researcher gains insight into relevant industrial research and activities, while at the same time a company gains expertise. The result could be joint research projects (Cooke & Mayes, pg. 68).

EMPLOYMENT OF STUDENTS[19] (INCLUDING STUDENT INTERNSHIPS / COOPERATIVE EDUCATION)

Many big companies are willing to employ graduate students as soon as they leave university, because certain jobs require the expertise of a person with a degree. However, regarding SMEs (small and medium companies) the picture is different. Graduate students are not always welcome by SMEs, because SMEs believe that they will not be able to pay them enough or that a graduate student will not be motivated enough by the work being done in SMEs. Nevertheless, SMEs can benefit from skills and the way of thinking (approach to problems) of a person that has finished university. Therefore – to attract graduate students to SMEs – the government should provide grants to companies or subsidize wages of graduates.

Another option of partnering university with a company is via teaching scheme, whereas a gradute student or several students work on a specific project of technology in the company for a specific duration (usually for a longer period). Some countries also have schemes to provide for collaborative postgraduate studentships, where a research, generally towards PhD is cofounded by a company and is in line with company needs (Cooke & Mayes, pg. 67-69).

2.1.2 Commercial means of knowledge transfer (market-type collaboration between university and industry)

Commercial knowledge transfer mechanisms include contract research, cooperative or joint ventures, personnel exchange, patenting, licensing, equity investments and founding of start-up companies.

CONTRACT RESEARCH, COOPERATIVE OR JOINT VENTURES, PERSONNEL EXCHANGE

Contract research and cooperative or joint ventures, toghether with exchange of personnel between university and industry laboratories represent possible vehicles of commercial knowledge transfer. Among them, contract research and cooperative/joint ventures are as

[19] Those students incorporate knowledge given through lectures and tutoring of students during their studies (thesis author's comment).

important as patents when transferring knowledge (17-21% of respondents in the afforementioned Carnegie Mellon survey), while personnel exchanges accounted for only 6 % (the least). Contract R&D and joint ventures can sometimes even become substitutes for industrial research and development (Cohen et al., 2002, pg. 16).

PATENTING

Patenting activities in the U.S. started to increase in the beginning of the 1980's, when a new legislation, entitled Bayh-Dole Act gave American universities freedom to be able to patent their inventions (Mowery & Shane, 2002, pg. vii).

A number of studies have been conducted researching the patenting activities at American universities after the enactment of the Bayh-Dole Act. One such study by Agrawal and Henderson (Agrawal & Henderson, 2002, pg. 44-60) focused on the MIT and tried to measure the university »output« or impact of university research by means of patents. There were three reasons why patents were used as a measuring stick:

1. patenting process requires that all the data is recorded – thus such systematically recorded innovation data is rarely availabile with other means of knowledge transfer;
2. innovations that are patented are expected to be commercially useful;
3. patent data is availabile in electronic form, thus it is easy to search it and extract useful knowledge out of it.

However, the study has shown that on average only 10-20 % of the MIT faculty patent in a specific year and that patents were responsible for as little as 7 % of the knowledge that was transferred from their labs to industry. Additionally, citations to academic papers far exceed citations to patents. Put in lay terms, MIT professors write far more papers than patents and many of them never patent at all.

Nevertheless, those professors who patent more write papers that are more highly cited and thus patenting volume may be correlated with research impact. Thus, patenting does not substitute for more fundamental research activity for the vast majority of the faculty. Patents represent a relatively small channel for the transfer of knowledge out of the university.

Another study by Mowery, Sampat and Ziedonis (Mowery et al., 2002, pg. 73-74; 88) has focused on institutional experience and learning regarding university patents after the enactment of the Bayh-Dole Act and found out that because of the act the internal research culture of U.S. universities did not change much, thus scientists and engineers did not start pursuing more applied research.

Therefore the increase in patenting can be attributed to the entry of new institutions (with little prior experience) into patenting after 1980. Moreover, the importance of entrant institutions' patents improved during the later 1980s and 1990s due to a broad process of institutional »learning«, which was based on spillovers between incumbents and entrant universities.

LICENSING

Licensing is a frequently used and efficient method for leveraging the value of technology. It is used to both enable companies and institutions to access the technology of others while at the same time provide access to their own technology. This will become crucial in the future as companies will strive to offer ever improving products and services to satisfy growing customer needs. Thus increasingly complex products for increasingly sophisticated markets will require more interdependent technologies and company relationships to develop them. Thus strategic technology management will become the key, with licensing as an integral or even a key component (Parr & Sullivan, 1996, pg. 8).

Authors of the article on growth in university licensing found out that licensing activity has increased with a larger willingness of faculty and administrators at universities to engage in this activity (Thursby & Thursby, 2002, pg. 90).

EQUITY INVESTMENTS

Equity investments relate to investments by universities in licensee firms. There are considerable differences among universities regarding this activity which depends upon licensing experience, past performance, organisation of universities' knowledge transfer operations and the organisational structure of the university (Mowery & Shane, 2002, pg. vii).

All the afforementioned behavioral factors influence the decisions of universities and other research organisations whether equity, which offers advantages for both generating revenue and aligning interests of universities, industry and faculty, will be used as a technology transfer mechanism or not (Feldman et al., 2002, pg. 105-120).

FOUNDING OF START-UP COMPANIES

Another vehicle for commercializing university inventions could be through the establishment of new companies. According to Shane's study (Movery & Shane, 2002, pg. vii), in which he analysed 1,397 patents, assigned to MIT during 1980-1996 period, university faculty, staff and students were more likely to found firms to commercialize their inventions when new technologies did not enjoy strong patent protection, while non-inventors were more likely to commercialize those inventions when patent protection was strong (effective) (regarding the effectiveness of patents please see **Appendix 2**) (Mowery & Shane, 2002, pg. vii-ix).

As for any start-up company, the size of venture capital invested is of a major importance, and not just for starting a new company, but bringing it to a successful IPO (initial public offering) as well. Thus it helps if a scientist-entrepreneur (founder) has connections (social ties) established with venture capitalists. These new start-up companies are an important source of growth in employment and economic activity (Mowery & Shane, 2002, pg. vii-ix).

More specifically, Shane and Stuart's study of 134 high technology companies, founded in the period from 1980 to 1996 in order to exploit MIT-assigned inventions analyzes how initial resource endowments – stocks of resources, including social and human capital, technical assets and industry attractiveness itself – affect a new venture's chances of survival and growth.

They find out that two measures of founder's social capital – the presence of direct and indirect ties to venture investors prior to firm founding – decrease the hazard of mortality and increase the likelihood that start-ups obtain external funding. And obtaining venture capital funding increases the likelihood that a start-up undergoes an IPO.

This study complements others in entrepreneurial finance, which focus more on how the use of explicit financial contracts minimize the information and agency problems. However, since financial contracts are more used in venture finance and not in business angel financing, network-based theories can better explain processes contributing to successful venture creation by scientists or entrepreneurs (Shane & Stuart, 2002, pg. 154-169).

2.2 Institutional forms of knowledge transfer

Regarding the ways of transfering the technology from universities to industry and vice-versa, there are a number of possibilities. However, they can be summarized into primarily two possibilities – either the transfer of knowledge goes directly from university to industry or there can be an intermediary.

When transfer of knowledge goes directly, there can be either local networks or virtual networks established, which are independent of the place, utilizing the newest information communication technology (ICT).

2.2.1 Direct transfer of knowledge

LOCALIZED/REGIONAL NETWORKS

- industry clubs (forums for the exchange of information)

One very useful way of sustaining university-industry partnerships once they are established is via industry clubs or forums for the exchange of information. A university can organize networks of companies to exchange knowledge via newsletters, workshops, seminars and short courses (Cooke & Mayes, pg. 65).

- clusters

Clusters represent a way of enhancing companies' competitive advantages on the market by pooling resources together to promote the development of new technologies, as well as develop new products/services or processes.

Slovenian government has encouraged the development of clusters since the year 2000. Examples of successful Slovenian clusters are: Slovenian automobile cluster, Transport-logistics cluster, Tool industry cluster, Plasttehnika cluster, etc. (Technology nets in Slovenia, 2004, pg. 5).

- technology nets/platforms

Technology nets/platforms represent a way to transfer new technologies into industry by stimulating the development of certain technological platforms with the aim of creating knowledge in specific technological areas, which are thought to be key areas for competitiveness of the country. Technology nets represent interactive processes of creating, transfering and using knowledge. They create synergies between different actors (organisations and individuals) through increased knowledge and information sharing.

Similar to clusters, they represent joint investment by public and private research organisations, companies and individuals. However, opposed to clusters, they do not serve solely company aims – they present common aim for a wider community of research and development organisations.

The difference between both can also be described in a way that clusters develop similar kinds of products using different availabile technologies, while technology nets focus on one technological platform which can serve as a basis for development of versatile products and services.

As of the middle of the decade, there existed four technology nets in Slovenia,[20] which have involved 48 companies and 24 support institutions (universities, institutes, other organisations) – Information-communication technologies, Intelligent polymer materials and technologies, Biotechnology and pharmacy and Process management technologies (Technology nets in Slovenia, 2004, pg. 1-21).

- R&D consortia

Similar concept to technology nets are R&D consortia. They are collaborative organisations, with a mission of advancing technologies in entire industries. They play important roles in the development and dissemination of technology, in economic growth and environmental

[20] They still exist as of 2009, and some are currently developing the so-called Centers of excellence, which include institutions both from the private sector and academia – thesis author's comment.

improvement and in the global competition. However, as opposed to an ordinary interfirm rivalry, R&D consortia represent a more sophisticated concept of global competition, where not individual companies/institutions, but whole networks compete among each other (Corey, 1997, pg. ix-xi).

Corey's book analysed six U.S. R&D consortia with different characteristics. Some, such as GRI (Gas Research Institute) and EPRI (Electric Power Research Institute) were formed to meet urgent energy needs at the industry and national levels in the 1970's, while others, such as MCC (Microelectronics and computer technology corporation) and SEMATECH were formed in the 80's as a response to Japan's rising dominance of world markets for semiconductors.

The later two consortia (MCC and SEMATECH) were both constrained by competitive rivalry among member companies, but they nevertheless succeded in establishing a base for semiconductor manufacturing and leading the technical advance in manufacturing technology, while at the same time enhancing the competitiveness of the member companies. On the other hand, EPRI and GRI were less constrained by rivalry and thus they served a broader range of its members' R&D needs – e.g. operations technology, supply industry infrastructure development, market development for new products, personnel training and environmental health and safety engineering – and accounted for a much larger percentage of the member's R&D budgets (Corey, 1997, pg. 24-27).

VIRTUAL/GLOBAL NETWORKS

One example of virtual/global networks is the so-called virtual enterprise. This was also one of the project topics of a research project entitled Data Mining and Decision Support for Business Competitiveness: A European Virtual Enterprise (SolEuNet) within the Fifth Framework program of research in the EU. Aim of this project was to propose a model of virtual collaboration for research projects and networks in general, which are typically performed in international consortia composed of expert teams from academia, business and industry. The analysed example was international collaboration in the data mining and decision support fields.

The proposed solution to the problem was the virtual enterprise - »a flexible association of academic institutions and business entities which share the main objective of promoting and selling advanced services offered by the pool of partners« (Jermol et al., 2004, pg. 2). Specifically, this was a model of self-organisational units (expert teams), geographically dispersed, yet connected by means of modern ICTs (information-communication technologies). However, for the virtual enterprise to work, some minimal guidelines, rules and standards had to be agreed upon among all the participating partners, which would also be used to accept new members into the network (Jermol et al., 2004, pg. 28-29).

2.2.2 Intermediary transfer of knowledge

When there is an intermediary, this usually takes the form of an office, which is either an internal office within a university or an external office, some sort of independent agent or knowledge broker.

INTERNAL OFFICE/UNIT AT THE UNIVERSITY

One successful way of transferring research to industry is via industry/university research units. Those units can be part of university housing. They provide companies with early access to applicable research results, ties to researchers and graduate students, joint research projects and a network of organisations with similar interest.

Another way is via university/industry liaison offices, which protects valuable new technologies and products and transfers them to companies. Benefits are income for the university and help with development of new products for the industry. One major factor in determining the success of such offices is what status the office and staff have within the university. The more important status it has, the more likely such office will be successful. Another important factor are the capabilities of people running the office – including communication skills, technical and marketing expertise, industrial experience and professionalism (Cooke & Mayes, pg. 65).

In order to establish an effective technology licensing office (TLO), an interested institution should adopt the following strategy:

- focus on technologies with the greatest possibility of success and capitalize on success quickly;
- provide TLO with adequate funding – both by outsourcing certain tasks to local services as well as finding additional local public funds – and effectively manage the relationship between staffing and resources;
- managing stakeholders of commercializations' expectations by establishing effective tools – in the form of a clear mission, measurable objectives, easy to follow guidelines and policy procedures – and communication systems, such as meetings, seminars and training sessions for inventors and staff;
- use Association of University Technology Managers (AUTM) meetings (in the U.S.) – or similar organisations elsewhere – and all other events to build your network (Allan, pg. 65-66);

INDEPENDENT AGENT OR KNOWLEDGE BROKER

Another possible way of transferring knowledge is by using an independent agent or a knowledge broker, which intermediates between universities and the industry from outside of university. This can take many institutional forms, such as e.g. university-industry research centres or UIRCs in the United States or a centralized governmental technology licensing organization (TLO) in Japan or innovation relay centres (IRCs) in Europe, all of which are described in more detail in **Appendix 3** for the U.S. and Japan and in the **Chapter 2.4.3** on knowledge transfer examples in Europe.

2.3 Obstacles to knowledge transfer

As with any activity, knowledge transfer from research and educational institutions to companies and vice versa, does not come without any strings attached. Besides benefits there are also potential costs.

2.3.1 Restrictions in the free flow of information and ideas

One of those costs come in terms of restrictions in the free flow of information and ideas between university and the general public, which was long held as the cornerstone of the university system and which was mentioned in UIRCs cases in the U.S. What are the short and long term implications of this is debatable, however.

2.3.2 Lawsuits

Another cost comes in terms of possibilities of lawsuits, which are more common in the private sector and thus public institutions have not been exposed to it in the past. This fenomena could especially be observed in the U.S., since the U.S. have the longest history and most experience with commercialization of university activities.

In 2002 there was a court process in the case of Madey versus Duke University, which was a process involving a university researcher and a private university. The result of this process was that the experimental use exception – a mechanism that provided a defense to patent infringement for private universities in the U.S. is no longer valid.

In the formal law language – »if the (patent) infringement furthered the university's legitimate business and was not solely for amusement, to satisfy idle curiosity, or for strict philosophical inquiry, the infringement would not qualify for the very narrow experimental use defence« (Hoorebeek, pg. 145). In lay terms – if a private university was using patented equipment or processes without paying the license fee to inventors for both – a) commercially oriented activities, as well as b) traditional activities of educating and enlightening students and faculty and carrying out research with no commercial application whatsoever, it could potentially be sued by the inventor of the patented product or process for the infringement of that patent. Public universities are exempt from patent infringement cases in the U.S. under the Eleventh Amendment of the constitution, which gives them sovereign immunity.

This has a major impact for university-industry relations and possibly even university-university interaction, especially in patent-oriented disciplines of biology, physics and chemistry and corresponding engineering sciences. The implications have a major impact in the U.S. However, elswhere around the world legal systems regarding patents are different, thus there will not be the same consequences. Nevertheless, all the universities around the world will probably be in one way or another involved in the debate and many voices are expected to sound the old belief that science and commerce shold not and must not mix.

Despite this, the line traditionally separating basic and applied research is dissappearing as universities are performing more and more basic research with commercial aim, especially in biotechnology sectors and thus commercial/non-commercial criterion is becoming more and more fuzzy and complex to decide upon.

2.3.3 Difference of expectations

Another major obstacle is the difference of expectations when researchers are engaged in non-commercial as opposed to commercial research activities. There should be a proper balance between the requirements of openess and autonomy of investigation regarding the former, and the need for delays and restrictions upon the full disclosure of new information concerning the latter, when designing university policies. Any movement from the two polar policy extremes (complete openness or unrestricted proprietary control) is expected to accelerate the rate of industrially applicable scientific findings.

Consistent with two aims of research, there are two different reward systems connected with it – when aiming at non-commercial research, university researchers are rewarded according to the number of articles written or similar non-commercial criteria, whereas achieved economic returns are a measuring stick for the success of commercially oriented research as a primary goal.

In line with the afforementioned differences of expectations there exists an invention disclosure problem in universities, because many innovative research methods or instruments, developed as part of »do-it-yourself« practice in the process of research are not protected, simply because the researchers do not feel the need (their focus is on the results more than the process of research). Thus if no incentive structures (technology audits, making notification of invention compulsory) are in place, many innovative opportunities are missed.

Those differences of expectations are actually differences between the academia and the industry, because industry is the main aim of the commercial research activities. Thus another issue is the »optimal quality of invention«. While academic researchers are »looking for the hyper-innovative solutions which can keep alive interesting and challenging discussions among colleagues« (Foray, 2004, pg.1) industry engineers focus on reliability and cost-effectiveness for the most part.

The solution could be a focus on »use-inspired« or »Pasteur-type« basic research, as opposed to a free-wheeling »curiosity-driven« research. However, how to achieve this is a different question. One idea is to have a specially designed institution, with a research mission distinctive from either the traditional academic science or profit-oriented R&D laboratories.

2.3.4 Post-invention process

Another thing, which must be taken into account when creating and transferring knowledge, is the importance of the post-invention process. Usually, a university invention is rarely applicable right away. Thus modifications and additional development is usually needed to commercialize the innovation, sometimes in the form of co-development activities – active participation of both sides in the development of the product/service/process. This co-development requirement further complicates the problem, because it makes the attribution of rights very complex and uncertain.

Sometimes the costs and risks connected with this process can be quite substantial, which, without proper instruments in place, can demotivate companies to deal with it. Therefore, the Bayh-Dole act in the U.S. had resolved the issue by enabling universities to grant patents and licenses, thus companies can gain exclusive rights, which preserve the profit incentives of companies (Foray, 2004, pg. 1-2).

2.4 Knowledge transfer examples

2.4.1 Knowledge transfer in the United States

From their inception, American universities were different than European,[21] because they provided immediate »hands-on« practical problem solving, while European universities distanced themselves from practical application. The reason behind American practical application focus can be explained through a culture which was strongly influenced by the need to tame the wilderness of the North American continent.

Only some schools were modelled after European institutions – such as Harvard and Yale – while others were moulded by the needs of the local communities. Thus they were more practically oriented and more widely accessible than universities in more class-rigid Europe. Yet it was not just the offering, but also the demand for university enrollment, which was very high in the U.S., since their high schools were perceived as not providing sufficient intellectual training.

Also much of the research at American universities was intended to help local industry and was thus highly specific. Their missions, styles and focus were based on the needs of the local environment. This type of research was especially strong in areas or industries, where

[21] This has to be always kept in mind when developing policy and strategy proposals in Europe as opposed to the U.S., because many people are unaware of the initial differences between the two continents and thus there is a risk of inappropriateness when »uncritically« copying each other's best practices – thesis author's comment.

industrial R&D was missing, such as areas/industries with many SMEs without R&D capabilities.

The primary activity of early American universities was the provision of vocational skills for a wide range of locally-important professions, thus many land grant colleges and agricultural experimental stations as well as mining experiment stations, etc., were established, all performing generic industrial research which, in some cases, still continues into the present.

One major accomplishment of American universities in the first half of the 20th century was to institutionalize engineering and applied science disciplines. Even though the afforementioned vocational education was widespread in the U.S., systematic training of professional engineers became widespread in the second half of the 19th century, with U.S. Military Academy at West Point – established already in 1802 – and Rensselaer Polytechnic Institute – est. in 1824 – being the first two engineering schools.

However, apart from Europe (namely Great Britain, France and Germany) where they were always taught at separate institutions, courses in applied science and engineering were introduced to elite institutions in the U.S., such as the Ivy League schools of Princeton, Columbia, Yale and Harvard (Rosenberg & Nelson, pg. 4-10).

If we move to contemporary time – in the last thirty years since the 1970s, there has been a major increase in industry funding of academic research and the rapid growth of UIRC's. And even though many see a continuation of this trend of industry funding of academia in the future, many obstacles should be overcome for this to become a reality – including different (and sometimes unrealistic) expectations from both sides; scepticism from the industrial side which lessens their receptiveness for academic research; the appropriateness of technology transfer for different industries, etc. (refer to the text on obstacles for technology transfer (in the **Chapter 2.3**)).

There should be explicit university research support programs established at American universities, which would foster university-industry knowledge transfer. They would require advisory committees, which are knowledgeable about industry needs and appropriate decision criteria and proposal evaluation systems, which are sensitive to those needs. It is important that close communication and interaction is established between both sides – those that perform research and those that deal with industrial design and development – if the university would like to take over some of the industrial R&D tasks.

However, a number of reasons go against university becoming too deeply involved into the R&D of the industry in the U.S.:

- the development of engineering and applied science disciplines in the U.S. has established a sensible division of labor between academic research institutions and companies – universities have trained young professionals who would go to work for the industry and

performed research, which has served as a basis for development of new products and processes, or which solved practical problems faced by companies;
- a further development of those products and processes, which would put academic researchers into position of making business decisions is questionable, because university researchers are not equipped with the knowledge of what would be the most acceptable solution to the problem according to the market needs, and furthermore, academia researchers are neither rewarded and nor highly regarded by their peers in academic circles for the research which deals with very practical »hands-on« applications;
- practical problem-solving from the early days of American universities is still there, yet it is performed for the most part in institutions, affiliated with universities, but not an integral part of them, which could exist just as well as separate organizations, such as e.g. Carnegie Mellon's Center for Iron and Steelmaking Research or the Forest Products laboratory at the University of Wisconsin or business »incubator« programs at Geogia Tech, all focusing on research which is undertaken to serve the needs of particular national industries.

Nevertheless, despite all the cons of narrowing the gap between universities/research institutes and companies, this trend can benefit both sides, if it is done the right way – this is to respect the division of labor between universities and companies, which was established with the development of engineering disciplines and applied sciences. Specifically, research in the sphere of academia has to stay of a »basic« nature, aiming for a long run understanding rather than short run monetary payoff, which is different from development work in the business world, where decisions need to be made according to commercial criteria (Rosenberg & Nelson, pg. 39-45).

Another important recent trend has been an increase of patenting and licensing activities and the establishment of technology licensing and transfer offices at American research universities since the late 1970s.

Most of these trends have been linked with the passage of Bayh-Dole Act in 1980, which provided the permission for performers of federally funded research to »file for patents on the results of such research and to grant licenses for these patents, including exclusive licenses, to other parties, and encouraged universities to develop technology transfer offices to market and manage their patentable inventions« (Colyvas et al., 2002, pg. 61).

The proponents of the Bayh-Dole Act argued that there was a significant informational divide between the world of academia and the world of industry, which made it difficult for university inventions to get into practice. Thus the goal of the Act was to spur more rapid and widespread university-industry collaboration by expecting that »allowing universities to share in the proceeds from faculty inventions would motivate universities to advertise these inventions to industry rather than leaving them on the shelf« (Colyvas et al., 2002, pg. 62).

However, study by Colyvas et al. has found out that besides Bayh-Dole Act there were other factors which contributed to the increase of patenting and licensing activities in the beginning of 1980s. Those factors were the rise and maturing of important new areas and techniques of university research, such as molecular biology with genetic engineering, computer science with ways of using computers in research and development of software, and similar. Bayh-Dole Act only accelerated and magnified those new trends that were already occuring.

Additionaly, according to the study, intellectual property rights (patents) are likely to be most important for embryonic inventions – inventions which licensee companies have to develop themselves much further in order to be able to transform them into commercially viable products. In this case protection is needed, because development of such new technologies is very risky. However, there exists a problem of choosing the »right« licensee ex ante which Bayh-Dole Act neglected.

On the other hand, if the invention is useful to industry »off the shelf« - thus a company can readily produce it, IP rights are not that important or may even hinder the development, especially if the license is non-exclusive, since in this case license represents a kind of taxation of the transfer of technology for the company. Regarding technology transfer offices, their marketing activities are most important for inventions in technological areas where existing links between academia and industry are weak.

The major findings of this study are:

1. an important goal of the Bayh-Dole Act was also to enhance university revenues, even though this was not an explicit goal for the policy makers when they instituted the act, but it became an important goal for the universities; also, when it comes to policies that maximize universities' revenues, they are not always aligned with those that maximize technology transfer;
2. patenting and technology transfer offices are important for the transfer of a subset of university developed technologies only; this was also historically so, as American universities have a long history in developing technologies of great use to industry and the public without patenting these or formally marketing them (Colyvas, 2002, pg. 67-68).

Another study by Richard Nelson and Paul Romer in the book (Neef et al., 1998) analyzes the position of the United States in the world economy and argues that the U.S. with increased focus on individual and direct R&D grants is underestimating the enormous indirect value of »open«, public-funded research, which it has on the society as a whole and furthermore – in its drive for efficiency, the U.S. may well be restricting, rather than encouraging, the free flow of knowledge and innovation.[22]

[22] Probably through patenting and other measures of hiding/protecting information and knowledge – thesis author's comment.

SPECIFIC EXAMPLES OF UNIVERSITY-INDUSTRY RELATIONSHIPS IN THE U.S.

M.I.T. (MASSACHUSSETTS INSTITUTE OF TECHNOLOGY)

Historical development of the relationships at MIT

The golden years of Massachussetts Institute of Technology (MIT) were between 1880 and 1920, when MIT became a »permeable« institution, closely connected to the industry. This happened in a process of competing programs of different faculty groups. Everything from MIT's curricula, research programs, relations with industry to institutional culture was a result of heterogeneous and often conflicting programs.

One group sought to centralize MIT and reform it through a merger with Harvard. Another, and predominant, group of practical engineers wanted to make MIT a very pragmatic institution, thus very much connected with the industry. A third group wanted to transform MIT into a science-based research university in accordance with the ideology of American industrial supremacy. It thought of engineering as a laboratory science and therefore it advocated science-centered engineering curricula. Additionally, it promoted collaboration between the faculty and the research laboratories of large science based corporations.

Another group shared the scientific view of the previous group, yet it focused more on small companies and it wanted to establish an MIT-centered network of industrial research laboratories, which would serve small companies and make American economy not just more scientific, but also more competitive. Lastly, there was a group which sought to »modernize« MIT without breaking with its tradition of preparing students for »immediate usefulness« in the industry. Thus this group supported both the establishment of research laboratories which would benefit small companies and the institutionalization of relations with big industrial corporations. Yet, whereas in the previous group these research laboratories were an instrument of making SMEs more competitive, this group focused on the internal benefits of MIT of keeping in touch with engineering practice and finding jobs for graduates.

At the end, the result of all these factions struggling for prevalence - with exception of the first group, which was turned down immediately - was that MIT was becoming more and more involved with both large and small companies and thus became a »permeable« school.

Lessons which can be drawn from the MIT and applied in general are the following:

- close university-industry relations in the U.S. existed since the 19. century already – specifically, at MIT the coalition of practical engineers encouraged them since the 1880's;
- despite the close connections with the industry, MIT faculty groups and administration took strategic decisions for the institute without much industrial interference; the only possible interference was that big corporate patrons were assigned patent rights and final say over the publication or that companies' support for a particular group tipped the balance within the MIT regarding the implementation of certain programs;

- even though there were pressures from big companies, MIT's engineering education did not become »a unit of the industrial system«; instead of integration and unification of MIT's research and educational programs, there was a complex process of adjustment and negotiation between academia and corporations, thus different types of university-industry collaboration can be distinguished:
  1. **practical engineers** were connected to local corporations to find jobs for the graduates and to educate students, which could be immediately useful to companies; praticing engineers were hired as lecturers and teaching staff consulted with local firms as a way of fostering their teaching competence; they sought corporate patronage, worked on problems which had immediate commercial applicability and connected education with corporate practices; their relationships with the industry were formalized and institutionalized through research laboratories and practice schools;
  2. **science group**, on the other hand, established more informal collaboration mostly with large companies and their laboratories; they trained industrial researchers and worked on issues which the industry was aiming to approach in the future, thus positioning their programs in advance of industrial laboratories (Lecuyer, pg. 28-32).

<u>Current example of knowledge transfer at MIT</u>

Nowadays, the **Technology Licensing Office (TLO)** manages the patenting, licensing, trademarking and copyrighting of intellectual property developed at M.I.T., Lincoln Laboratory and the Whitehead Institute and serves as an educational resource on intellectual property and licensing matters for the M.I.T. community. The core of this office is a group of technically trained and business oriented people. They work with industry, venture capital sources, and entrepreneurs to find the best way to commercialize new technologies.

TLO is one of the most active university patent and licensing offices in the U.S. M.I.T. has had over 1000 issued U.S. patents in its portfolio, many with foreign counterparts. In each of the past five years (1997-2002), they have had over 100 U.S. patents issued to them and they have signed 60-100 option and license agreements. Most of those licenses were exclusive. Under those licenses, companies were granted rights to their patents in return for their commitment to develop those inventions into products for the public good. Licenses to patents and copyrights have a twofold aim – firstly, to protect companies taking the risk of development, and secondly, royalties derived from licenses support further research and are shared with inventors to provide incentives for further innovation (Kovač & Urbančič, 2004, pg. 124-125).

STANFORD UNIVERSITY

Office of Technology Licensing (OTL) is responsible for managing the intellectual property assets of Stanford University. The OTL charter is to help turn scientific progress into tangible products, while returning income to the inventor and to the university to support further research and its mission is to promote the transfer of Stanford technology for society's use and benefit while generating unrestricted income to support research and education. In other words, OTL is helping planting seeds today for the products of tomorrow. The OTL can patent the licensed inventions or not. The non-patented technologies which the OTL licenses include software that is under copyright, as well as emblematic ware carrying Stanford logos and trademarked symbols for use on products such as t-shirts and baseball caps. On the other hand, a patent is intended to publicly disclose the best mode of practicing an invention and, in particular, to point out the features that distinguish the invention from prior art. Within the OTL, there is also the **Industrial Contracts Office (ICO)**, which is responsible for negotiating and signing sponsored research, collaboration, and material transfer agreements with industry except for clinical trial agreements, which are handled by the Office of Sponsored Research. ICO’s goal is to foster and maintain mutually beneficial relationships with industrial sponsors and provide high quality and timely service to Stanford faculty and staff, while maintaining a balance between Stanford and industry interests (Kovač & Urbančič, 2004, pg. 125).

UNIVERSITY OF TEXAS AT AUSTIN

The Office of Technology Licensing and Intellectual Property is responsible for Knowledge Transfer at the University of Texas at Austin. Its mission is to protect, market, and license proprietary rights to intellectual properties created by the faculty and staff of the university to private enterprises. Of course, the office assures the public that the discoveries and inventions of the university will benefit the public and be disseminated as broadly as possible and that the licensing of intellectual property creates an on-going revenue source (through royalties and continued sponsored research) for the university so that it may further improve the quality of its research and educational activities. Licensing of intellectual property also encourages creative research and provides a substantial incentive to its inventors through the sharing of royalty income.

The Office of Technology Licensing is also part of **the Texas Alliance for Technology Commercialization**, whose aim is to expand and strengthen cooperative and collaborative efforts between Texas Universities and the society in ways that result in faster and more efficient knowledge transfer from Texas universities (Kovač & Urbančič, 2004, pg. 124).

CARNEGIE MELLON UNIVERSITY

At Carnegie Mellon University in Pittsburgh, they started with the initiative on the **Carnegie Mellon Innovation Exchange**, which is a new approach for stimulating innovation across the Carnegie Mellon campus and facilitating the timely and effective transfer of new innovations to the outside community. It is designed to draw upon and support Carnegie Mellon's distinctive culture, which encourages interdisciplinary, problem solving, creativity (Gerson, 2003).

Innovation Transfer Center (ITC) at the Carnegie Mellon University takes care of the commercialization of new discoveries. Innovation transfer is one way the university disseminates knowledge, innovations, and discoveries back to the public. The ITC seeks the most competent partners to license and commercialize its innovations (Kovač & Urbančič, 2004, pg. 126).

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

University of Illinois at Urbana-Champaign's National Center for Supercomputing Applications (NCSA) has profited a lot from its PSP (Private Sector Program), where it is collaborating with numerous private sector companies.

One example is collaboration with the Caterpillar, Inc., which is the world's largest maker of construction and mining equipment, diesel and natural gas engines and industrial gas turbines. The company is a technology leader in construction, transportation, mining, forestry, energy, logistics, financing and electric power generation.

The history of collaboration started in 1989. The collaborative projects, which were awarded NCSA's 2002 Industrial Grand Challenge Award, include: use of virtual reality, immersive environments, computer engineering simulations for prototypes, and use of data-mining techniques to analyze warranty information and to pinpoint potential equipment problems. The award also recognizes Caterpillar's work with NCSA to develop a knowledge management system to encourage employee communication and collaborative problem solving, called **Caterpillar's Knowledge network** (NCSA, 2009).

Caterpillar's Knowledge network is both an example of university-industry collaboration as well as intra-industry collaborative network, and it is composed of the over four thousand communities of practice across its value chain. It has delivered over $ 14 million worth of value to community members in 2005 on a budget of $ 500.000 and operates within the Caterpillar University, a corporate university of the Caterpillar, Inc., which is also one of the main reasons for its success. Namely, the corporate university has presented a supportive framework for the network.

If it was not for the corporate university, research shows that such knowledge management initiatives as the Caterpillar Knowledge network tend to fall short on alignment to business initiatives, lack an effective approach to measurement, don't always operate with a clear strategy, and most importantly for this case, focus more on technology or procedures and taxonomies (thus on content), rather than connecting people.

The Caterpillar Knowledge network has provided its communities with flexible tools for developing their own resource libraries as they see fit, thus it has minimized overhead while ensuring that documents were relevant, useful and up-to-date. It is a good example of a philosophy that knowledge-sharing communities should be self-originating, self-managing and self-sustaining (Allen Mark W., 2007, pg. 371-375).

2.4.2 Knowledge creation and transfer in Japan

Innovations are determining the future competitiveness of companies and countries. Human resources employed in R&D represent a crucial part of the overall employment system and especially the innovation system in advanced countries as they incorporate the capabilities to achieve technological advances and diffuse them throughout the overall economy.

When compared with other OECD countries, the proportion of R&D workers among the whole workforce in Japan is higher than for any other advanced country. Nevertheless, there exist certain traits of Japanese R&D workers, which distinguish them from other developed economies and which are thought to represent impediments in an effort to create a more innovative Japanese society.

First such characteristic is the low degree of horizontal and vertical specialization of Japanese workers as opposed to American workers because of frequent moves of Japanese researchers and engineers between different units and departments (and thus different tasks) within the organization. However, there is a low degree of inter-organizational mobility of the Japanese R&D workforce, which is true both for the private and the public sector. Additionally, there exist a low degree of internationalization of the Japanese R&D workforce, as well as low numbers of foreign researchers and engineers coming to Japan.

As a result of these structural differences with the Western countries there were plans for restructuring established in the 1990's. Part of that plan was to double Japanese public R&D expenditures until the year 2001, with the result of increased government R&D expenditure from 17.9 % in 1990 to 22.9 % by the year 1995. Furthermore, to stimulate the arrival of foreign researchers to Japan, the number of fellowships to foreign researchers trippled by the year 2000, according to plan.

Another public policy was to establish research universities that are exclusively focusing on postgraduate courses and emphasize research activities in contrast to academic teaching, which was prevalent in Japanese universities. Also there was a removal of barriers for researchers operating under different Japanese ministry jurisdictions to join cooperative R&D projects, with specific MITI programs stimulating joint university-industry research.

Another move was to allow time-limited working contracts for researchers in public R&D institutions in 1997, which were contrary to the previous rule of unlimited contracts for the workers in academia, especially when it comes to inviting senior researchers and for young R&D workers. Lastly, evaluation of public R&D facilities by outside experts was established to encourage the R&D staff to take a more competitive and performance oriented attitude.

On the other hand – in the private sector, which accounts for the bulk of R&D efforts in Japan – other problems were present and plans were made to remove them. One such problem was that R&D spending of Japanese firms has been stagnating in the 1990s. Also, there was, as in the public sector, low inter-organizational mobility and low individual performance orientation of business researchers and engineers.

Thus, three priorities have emerged for Japanese firms:

1. active recruitement of R&D workers with working experience from other firms;
2. loosening of formal office presence rules for R&D workers, evaluating them instead of the number of their working hours or input performance on their output performance;
3. introduction of performance – rather than seniority – oriented compensation systems.

These three priorities were all aiming at increasing the inter-organizational fluidity (and thus knowledge transfer), while also trying to focus on stronger individual performance orientation of researchers and engineers. However, when one looks at the results of the plans in the private sector, one can observe that the pace of reforms in human resource management of R&D in that sector has been much lower than in the public sector – in one sentence – a lot has been talked about and discussed, yet very little implemented in reality (Dirks et al., 2000, pg. 546-550).

2.4.3 Knowledge transfer in Europe

Regarding the knowledge transfer in Europe, there are a number of European Union projects aimed at promoting innovation as part of the Lisbon agenda, signed in 2000, with the aim of making EU the most competitive and dynamic knowledge-based economy in the world.

One of those projects is the »European Innovation Scoreboard«, which measures the strenghts and weaknesses of each member country within EU and EU as a whole in terms of innovative capacity.

In addition, since the early 1980's, EU has implemented the so-called Framework Programmes to reach different research aims. The previous, sixth Framework Programme (2002-2006) had, as its main aim, development of a more coherent research landscape in Europe through establishment of a common European Research Area.

The three specific aims of this program were: »(1) to strengthen the technological capacity of small- and medium-sized enterprises by facilitating their access to the best research and technology, (2) to provide an international and global dimension to European research activities, and (3) to promote the mobility of researchers, with a view to the successful creation of the European Research Area.” (De Juan, 2002, pg. 37).

The current, seventh Framework Programme (2007-2013) consists of five major building blocks – cooperation, which fosters transnational consortia of industry and academia; ideas, which promotes frontier research; people, which supports researchers' career development and their mobility; capacity, in order to improve research infrastructure across Europe; and finally nuclear research program, which includes the establishment of the Joint Research Centre for nuclear research. The highest amount of funds is dedicated to the first initiative - cooperation in order to strenghten the European Research Area (FP7 in Brief, 2007, pg. 5-18).

In addition to the Framework Programmes, EU member countries are promoting direct and indirect measures to achieve knowledge transfer between research and educational institutions and companies. Direct measures include: (1) interface development between research institutes and companies; (2) promoting and enabling the creation of university startup companies; (3) co-financing university-industry cooperation; (4) stimulating the creation of forums, technology clubs, etc., to enable dialogue between the creators and the users of new technologies.

On the other hand, both national and EU institutions promote indirect measures, such as: (1) creation of technology parks; (2) regulations to achieve better cooperation among research institutes, universities, and businesses; (3) making intellectual property rights more easily understandable.

The most important institutions for transferring knowledge at the European level are Innovation Relay Centers (IRCs), which operate in numerous EU (including the new members), and non-EU countries (e.g. Norway, Switzerland).

The mission of IRCs is “to enable the transfer of innovative technologies to and from European companies or research departments.” (De Juan, 2002, pg. 40). More specifically, each IRC aims to enhance the ability of its clients to perform technology transfer, to audit their technological needs, to find suitable technologies and/or partners, and finally, to assist them in negotiation processes by advising them on intellectual property rights or innovation financing.

In addition, many EU countries have national technology/knowledge transfer programs in place – e.g. in Germany, EXIST (startups from colleges and universities) and INNoNet (cooperative R&D projects among research organizations and companies), POCTI (Operational Programme, Science, Technology, and Innovation) in Portugal, AKMON (Research Centers Development and Services Providing Projects with the User Participation) in Greece and national technological programs of National Technology Agency (TEKES) in Finland.

Despite all the aforementioned activities, Europe is facing two major issues, especially regarding its intellectual property rights:

1. European patent systems are underused, partly because of the non-existence of a European-wide patent law; thus despite a single patent-application process managed by the European Patent Office (EPO), each country has its own patent laws and the language requirements;
2. In the EU it is not possible to patent software-related inventions, while it is possible to do that in the U.S., thus the competition between EU and the U.S. is being distorted in favor of the U.S., because the companies prefer to protect their innovation as to keeping it as a trade secret.

Additionally, U.S. and EU use two very different systems of patenting. The U.S. have a "grace period" system, where an inventor is allowed to publish his or her innovation before patenting, because the lawyers look at research notes to see who was the "first to invent". On the other hand, in Europe, scientists are not allowed to publish before application for a patent has been made.[23] Thus Europe uses a so called "first-to-file" system.

Besides all the formal issues, there is an issue of culture, which is fundamentally different in the U.S. from EU. Whereas in the U.S. big companies would finance new research projects and see through to the establishment of new companies, in the EU the companies – partly also because of their smaller size – would preferably acquire an already developed technology, which suits their needs, rather than go through the hassle and a fuzzy process of creating new technologies and products.

The aforementioned differences between the two systems point to the fact that a global innovation policy has not been achieved, thus further steps and efforts are needed to create an international network of innovation, especially between the U.S., EU and Japan as three main drivers of innovation (De Juan, 2002, pg. 31-56).

SPECIFIC EXAMPLES OF UNIVERSITY-INDUSTRY RELATIONSHIPS IN THE EU

OXFORD UNIVERSITY, UK

Oxford is the leading UK university for knowledge transfer and commercial spin-outs and one of Europe's most innovative and entrepreneurial universities. The areas of knowledge transfer include: spin-out companies; patents, licenses and other forms of intellectual property transfer; Isis college fund for financing entrepreneurial ventures; business innovation and consulting group, and Venturefest – Oxford's international fair for entrepreneurs.

Isis Innovation is the technology transfer company of the University of Oxford, a wholly-owned subsidiary of the University of Oxford, commercializing the research generated by university researchers and owned by the university. Isis provides researchers with commercial advice, funds patent applications and legal costs, negotiates exploitation and spin-out company agreements and identifies and manages consultancy opportunities for university

[23] At least three months of waiting is needed before the publication, so that the lawyers can check if it is possible to patent the innovation – thesis author's comment.

researchers. Isis files, on average, one patent application each week and manages over 350 patent application families. It has assisted in the formation of more than 30 university spin-out companies since 1997, generating significant value in equity holdings for the university (Kovač & Urbančič, 2004, pg. 122-123).

CAMBRIDGE UNIVERSITY, UK

Cambridge University established the Research Services Division on March 1, 2000, which combines the Research Collaboration Office (formerly the Research Grants and Contracts Section) with the Technology Transfer Office (TTO – formerly the Wolfson Industrial Liaison Office) to create a single organisation dealing with technology transfer and the university's external research funding from industry, research councils, the European Union and from charitable trusts and foundations.

Within the Research Services Division, there is an organisation called **Cambridge Enterprise**, which has been established to enhance the University of Cambridge's contribution to society through knowledge transfer from the university to the community and brings the university's existing commercialisation activities (Cambridge Entrepreneurship Centre, Technology Transfer Office and University Challenge Fund) together in one new organisation, whose aim is more effective contribution to society, the UK economy, the inventors and the university.

The Technology Transfer Office (TTO) as part of Cambridge Enterprise manages the commercial development of the university intellectual property, and that arising from projects undertaken within the Cambridge-MIT Institute and the Cambridge Enterprise at Addenbrooke's initiative. The TTO helps with the formation of spin-out companies where the technology is sufficiently broad based or novel to form the basis of a new company; the TTO has helped form around 30 spin-outs based on university research in the last 5 years (Kovač & Urbančič, 2004, pg. 123-124).

IMPERIAL COLLEGE, LONDON, UK

Since the year 1907, Imperial College London is one of the leading research institutions in the world. It is also characterized by a very strong entrepreneurial culture – it's mission is to deliver world class scholarship, education and research in science, engineering and medicine, with particular regard to their application in industry, commerce and healthcare. **Imperial College London Innovations Ltd.**, established at the college, is responsible for the transfer of new knowledge. **Imperial Consultants Ltd.** takes care of all the consulting activities of the college, and in the year 2001 a third institution in knowledge transfer was established – **The Entrepreneurship Centre***,* which fosters business innovation among the 10,000 students enrolled in the Imperial College.

Imperial College London Innovations Ltd. takes a "hands-on" approach to commercialization, working closely with university researchers to protect intellectual property and maximize the exploitation of patents, either through licensing or the creation of spin-out companies with over 50 successful technology-based companies since 1997. The seed capital for the spin-out companies is provided by Imperial College's own investment fund (Kovač & Urbančič, 2004, pg. 124).

RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE (RWTH) AACHEN, GERMANY

At the RWTH Aachen, there are two institutions responsible for technology and innovation transfer: **Department for technology transfer and the advancement of research** ("Dezernat TechnologieTransfer und Forschungsförderung"), and **Entrepreneurship college** ("gründerkolleg").

The Department for technology transfer and the advancement of research offers personalized consulting, wealth of business contacts and financial help through the PFAU program – Program for safeguarding the successful entrepreneurial ventures at the university (Programm zur Absicherung von Unternehmensgründungen aus den Hochschulen).

The activities of the Department for technology transfer and the advancement of research include:

- information on the availabile public and private support programs for entrepreneurs;
- help with contacts in the industry and other institutions;
- offering the information material on the topic of establishing a new company;
- providing information on different programs, classes, workshops in entrepreneurship, knowledge transfer on campus of RWTH and outside.

The department is also part of a regional network, called the Entrepreneurship Region Aachen – "Gründer Region Aachen", which includes regional agencies, companies, banks, schools, research institutions and other interested institutions.

On the other hand, the entrepreneurship college offers both courses and individual training on how to think like an entrepreneur, how to write a business plan, what skills does a businessman need, and they also offer advice and contacts on finding the right business partner for the new venture (Kovač & Urbančič, 2004, pg. 126-127).

2.4.4 Knowledge creation and transfer in Slovenia

If Europe is in quite a dismal state when it comes to innovation, Slovenia is in a less fortunate position, still, because of its socialist system legacy. There is an appropriate entrepreneurship support environment missing, both regarding physical infrastructure, which includes all kind of incubators and technology parks and other office and production space, as well as intangible »infrastructure«, which includes appropriate tax systems and laws regarding intellectual property, etc.

And besides the infrastructural capital, Slovenia is missing adequate social capital, which requires certain changes in the value system of the people, where bigger responsibility for people's own professional development as well as self-realisation is missing[24] (Bavdaž, 2005).

These conclusions are very general. However, if we would like to get a more specific picture, we have to look at the national Strategy of Slovenia's development, which specifies the goals for the government in the introduction of the knowledge society as well as the **Development reports of UMAR**,[25] which compare the goals of the strategy with its results and thus monitor its implementation.

Thus if we look at the development reports for the years 2002[26]-2008, we can see in terms of **education and training** that Slovenia faced difficulties in the 1990s in terms of education of adults (low participation of adults in education, shown by the lifelong learning rate; low level of adults with acquired secondary/tertiary education, measured by the indicator of the share of population over 25 with a secondary or tertiary education; and low level of functional literacy). On the other hand, it has increased the number of young people in education at all levels, especially tertiary (Development report 2002, pg. 33; 2003, pg. 36).

In the beginning of the new decade (2000 and on), Slovenia is still increasing the enrollment of young students in the secondary and tertiary education. The number grew from 82% in 1995 to 94,3% in 2002 for the number of 16 to 19 years old participating in the secondary education (77,6 % for 15-19 years old in 2004/05 school year) and from 30,1% to 52,4% for 20-24 years old enrolling in the tertiary education between 1995 and 2002. However, among those enrolled in 1991/1992 only half of them completed their studies within 8 years. The efficiency of the studies in 2005 has improved somewhat, with average years of schooling being 6,3 years in higher education programs and 6,8 years in university programs (Development report 2003, pg. 36-37; Development report 2006, pg. 29; Development report 2007, pg. 37).

When we look at the young below 25 years of age, 68% of the target population is enrolled in the tertiary education; however, despite about 6% of GDP, alocated to the education in Slovenia, the efficiency of tertiary education is very low, since – as mentioned previously – only half of the students graduated within 8 years, while 44% never finished schooling. Another problem is the low functional literacy of both schooling and non-schooling population and the low educational attainments in mathematical and science skills of pupils.

[24] While assuming that intellectual capital is quite plentiful, at least when it comes to research – thesis author's comment.
[25] The Institute of macroeconomic analysis and development, which is a governmental body responsible for macroeconomic analyses and forecasts (thesis author's comment).
[26] The first year of publishing online (thesis author's comment).

Compared to the high expenditures on schooling, this points to Slovenia's education system's inefficient use of resources and insufficient quality of education (Development report 2004, pg. 30-31; 2005, pg. 31-33; 2006, pg. 29).

The high participation rate may reflect the postponement of entering the labour market, which increases the employment prospects of individuals. However, in Slovenia, the rising participation rates in tertiary education go hand in hand with the employment problem for young graduates. On one hand, demand for workers with a tertiary education is rising at a slower pace than the number of graduates, so there exists oversupply.

On the other hand, there exists the »matching problem« between supply and demand of graduates, which could explain the reasons for the difficulties of young people in their transition from school to work. In the structure of students enrolled in secondary schools, the share of those enrolled in grammar schools recorded the largest increase in the period 2000/2001–2007/2008. The share of students enrolled in four- or fiveyear technical programmes and other technical schools, which has been gradually increasing since the academic year 2001/2002, was also somewhat higher, whereas the percentage of students enrolled in two- and three-year secondary vocational programmes dropped significantly in 2000/2001–2007/2008.

These developments have translated into a deficit of certain occupation profiles on the labour market. The structure of enrolment at the level of tertiary education reveals the persistence of the long-term problem regarding insufficient interest in the study of science and technology subjects, where the percentage of enrolled students totalled 22.5% in the academic year 2000/2001, increased to 24.1% in 2007/2008, and at 21.1% fell short of the EU average (24.0%) in 2006 (Development report 2008, pg. 31-32).

The high share of tertiary education students is probably also linked to other factors, such as the absence of tuition fees for full-time students, the possibility of subsidised meals and work through student job agencies. In our estimate, all these factors reduce the efficiency of studying to some extent, since knowledge acquisition is not the only motive for participation in education.

Furthermore, the quality of education is also lower than the EU average. Among the factors, the ratio of students to teaching staff is high and reduces the possibility of a greater quality of studies. Greater international mobility of students and university teachers, which is currently still modest, would also contribute to higher quality of tertiary education.

The poor possibilities for a quality teaching process and other motives for participation in education, mentioned previously, affect the efficiency of studies, which remains low, as mentioned in the beginning. The share of undergraduate university graduates who needed more than five years from enrolment to graduation increased to 79.2% in 2006 (Development report 2008, pg. 29-30).

Over the last few years, Slovenia has already made certain steps to improve the quality of education in line with SRS. The Resolution on the National Programme of Higher Education of the Republic of Slovenia 2007–2010 was adopted in November 2007. A reform of vocational college programmes was carried out as well, and the credit point system introduced. Decentralisation of higher education is already underway. The network of higher education institutions is expanding, yet for now most new universities specialise in social sciences rather than natural and physical sciences, as was envisaged in SRS. Changes in the financing of higher education, aimed at rewarding research work that has a link to the users of research results, were also foreseen for 2006 according to the SRS action plan, although they have not been implemented yet.

Furthermore, the number of students enrolled in natural science and technology programmes is increasing. These problems were also identified in the Resolution on the National Programme of Higher Education, adopted in 2007, which foresees certain policies and measures to further increase interest in science and technology programmes (Development report 2008, pg. 32).

The involvement in education and training by adults is improving, which is shown by the enrolment data from the year 2003, where 15,1% of adults were involved in education and training (in 2005 there were 15,3%), which is higher than EU average of 9% and the Lisbon strategy average of 12,5%. However, the share of adults with tertiary education at 20% in 2005 is still below EU-15 average (24 %) and almost half of the highest shares in north-European countries and the U.S. (Development report 2004, pg. 30-31; 2005, pg. 31-33; 2006, pg. 29).

Another problem is the financing, especially of the large increases in tertiary education, since even though public expenditure on education, which amounts to 5,5-5,9% of GDP for the 1995-2002 period is more than the average of the OECD and EU-15 countries, the financing is mostly concentrated on primary and secondary education, while tertiary education is lacking both finance and educational staff. This holds true also in the more recent years (Development report 2003, pg. 36-37; Development report 2006, pg. 29; Development report 2007, pg. 38; Development report 2008, pg. 31).

In terms of **research and technological development** we can say that in the 90s, Slovenia was stagnating in investment in research and technological development, as its share in the GDP did not change significantly. It totaled 1,51% in 1999, while the EU-15 average was 1,92% in that same year. In the 90s there was reduction or even total abolition of R&D activity in Slovenian companies, which led to a decrease in the number of researchers in companies. By the end of the decade the picture started to change slowly as the number of researchers in companies and the R&D expenditure by the companies started to increase (Development report 2002, pg.33-34).

However, there still remained the problem with financing, as most of the investment for R&D by companies stayed in the private domain, while most of the state investment was in the public sector, so there was no transfer of knowledge and the efficiency of (public) investments remained low. And to further worsen the situation, only a quarter of government R&D expenditure went to applied research and experimental work (Development report 2002, pg.34; 2003, pg. 37).

The situation started to improve somewhat with the beginning of the new decade, as the investment in R&D stepped up, following the goal of two percent by 2006 and the Lisbon goal of 3% by 2010. However, after the initial increases at the beginning of the new decade, the investment in R&D as a share of GDP first experienced a drop in 2003 and then a slight increase. As of 2004, the investment in R&D stood at 1,61 %, while in 2005 it stood at 1,49 % of GDP. The greatest progress was made in 2006, when the share reached 1.59% of GDP. Such slow pace of increase (or even slight drops) in both Slovenia and similarly in the most of the EU[27] is not conducive to achieving the Lisbon objectives (Development report 2004, pg.31; 2005, pg. 33; 2006, pg. 30; 2007, pg. 39; 2008, pg. 32).

However, the pace of increase by the business sector of the economy is still very slow (in 2002, the private sector accounted for 60% of all R&D expenditure, but the share was still lower than EU-15 average), lacking enough qualified researchers, partly because the availability and mobility of researchers between the public and the private sector is very low. In 2004, 38 % of all researchers were employed by the business sector, which is still much lower than the EU-25 (49,5 %).

On the other hand, positive changes were recorded recently in the structure of R&D funding in favour of the business sector, partly as a result of economic policy measures. The business sector posted the largest real increase in R&D expenditure in 2006 (22.6%), after its R&D spending largely stagnated in 2003–2005. Nevertheless, in terms of gross domestic expenditure on R&D and the number of researchers per 1000 inhabitants, Slovenia is already ahead of the new members of the EU (Development report 2004, pg.31; 2005, pg. 33; 2006, pg. 30; 2008, pg. 33).

Additionally, the capacity of the country to introduce new products, technologies and processes depends on the availability of appropriate human resources, especially upon the sufficient number of natural science and technically trained students. In 2003 in Slovenia, the number of those students with a degree fell to 8,7 ‰[28] (compared to 12,3 ‰ in the EU-25 in that same year). Furthermore, the share of Slovenian graduates with natural science and technical degrees in the total number of graduates fell from 23,8 to 18,6 % between 1998 and 2003, while in the EU it stayed about equal at 26 % in that same period. Thus Slovenia is

[27] With e.g. Austria, the Czech Republic, Finland, Lithuania and Spain, being exceptions in terms of increasing the R&D expenditure as a share of GDP consistently since the year 2000.
[28] 8,7 graduates per 1000 inhabitants (thesis author's comment).

falling behind in adapting the structure of the workforce to the needs of innovative enterprises, which may worsen its long term position in terms of the global competitiveness.

Another negative fact is that many natural science and technical faculties have not started to implement the Bologna program. Yet, on the other hand, the responsible state bodies are aware of the enrolment problem and are starting to take steps to improve enrolment numbers, as already mentioned in the previous pages (Development report 2006, pg.30). Thus the situation in this area has been improving, albeit relatively slowly. The number of science and technology graduates increased in 2000–2007, but the increase was smaller than in most other European countries (Development report 2008, pg. 34).

Regarding **innovation activity**, studies show that R&D expenditure accounts for about half of the expenditure for innovation, while the other factors for increased innovation are mechanisms of knowledge transfer, qualified research staff in companies, support services for knowledge transfer and supportive environment for innovation in general. The term innovation includes not just new products and services, but also new processes through changes in organisation, company philosophy and culture, new business and marketing models and distribution methods. In the 90s – between 1994 and 1998, 1/3 of all manufacturing companies were innovative enterprises (compared with 50% in the EU-15), while the number is three times lower for service companies – all these dismal figures are the result of the lack of appropriate financing of innovation activity and entrepreneurship (Development report 2002, pg.34; 2003, pg. 37-38; 2005, pg. 33).

Even in the beginning of the new century, the innovation activity remained negligible, especially regarding services and the innovation activity of small enterprises. However, innovation activity of companies increased significantly in 2004–2006 compared to the previous period, particularly in services. The latest available data for 2004–2006 show that 35.1% of Slovenian companies were innovation-active. According to the latest figures for the EU, which are available for the period 2002–2004, the share of innovation-active companies averaged 39.5%. The greatest progress regarding innovation activity was recorded in services, where the share of innovation-active companies rose from 16% in 2002–2004 to 26.8% in 2004–2006 (Development report 2008, pg.33).

Nevertheless, there is still considerable room for improvement in this area, as the understanding of innovation in Slovenia is primarily focused on technological changes, whereas innovation processes in the service sector are less known. The solution could come from decisive action, coordinated mix of policy measures in different fields of science and from transparent funding, which should not be dispersed, but focused on key priorities.

Put in other words, the institutional reform and reorganisation of R&D activities should be finished, which includes the establishment of two new government agencies – Science agency and Agency for technological development – and adopting the newest national R&D

document.[29] Additionally, new programs of the Ministry of the Economy for 2007-2013, which include measures aimed at increasing innovation in services, should be implemented[30] (Development report 2004, pg.31; 2005, pg. 33-34; 2007, pg. 40-41; 2008, pg. 33-34).

In general, Slovenia has established a good foundation regarding the mechanisms of knowledge creation, yet it does not sufficiently use its innovation potential to increase the competitiveness of its economy. It has still not sufficiently developed intellectual property protection mechanisms, it has a low share of companies which innovate, its marketing of new products and services is weak (the process of transforming inventions into market successful innovations), it has a low share of high-tech products among its export revenues, low number of patent applications at the European Patent Office, few ties developed between public research institutions and the private sector, few financial incentives for SMEs to innovate and a lack of systematic evaluation of the effects of various support instruments[31] (Development report 2006, pg. 30-31).

And finally, regarding the **use of information-communication technologies or ICTs' infrastructure**, which forms the basis for the establishment of a knowledge-based society, Slovenia faced improvement in terms of the number of active Internet users, especially towards the end of the 1990s. However, regarding electronic commerce, Slovenia lagged behind developed EU countries significantly (Development report, 2002, pg. 35).

In Slovenia, the use of the mobile telephony is very high, while the use of the Internet with 35 % of the population lagged behind EU average of 51 % in 2002. This could partly be attributable to a lower share of the population with finished tertiary education. The situation is better in the number of secure servers, which has an impact on enabling e-commerce through secure transactions. However, Slovenia is still facing a big gap compared to EU regarding the use of computers in primary and secondary schools (Development report 2003, pg. 38-39).

After the year 2000, especially in 2002-03 period, there was significant progress made in terms of Internet use in the total population and households, where Slovenia has reached the same level as EU-15. However, regarding individual use, there was still disparity with the EU figure, due to less educated and elderly people using the Internet to a much lesser extent than in the EU (Development report 2004, pg. 31; 2005, pg. 34-35; 2008, pg. 34).

In 2005, Slovenia has already reached a 47% share of the Internet use among the whole population, while in the first quarter of 2006 it exceeded 50 %, which is just slightly behind EU-25 average with 53 %. And in the first quarter of 2007, 53% of people in Slovenia aged 16–74 were using the Internet, 2 p.p. more than the year before. Among individual users, the

[29] Called National research and development programme (NRRP), which is explained later in this chapter – thesis author's comment.

[30] This is what different Development reports suggest, opposite to the free market thinking, where government should not interfere too much and just focus on removing bureaucratic obstacles in the innovation system (thesis author's comment).

[31] In one word, the entrepreneurial culture is missing (thesis author's comment).

share is much higher for households with children (64 %) than those without (41 %). Also, regarding the broadband Internet access, there was continuing improvement through the years, which is the result of both raising customer expectations and increased number of Internet providers, with tougher competition among them. More specifically, Slovenia, with 34 % of households having broadband Internet access in the first quarter 2006, exceeded the EU-25 average by 2 percentage points, and in 2007 already 44 % of households were using a broadband access to the Internet (Development report 2006, pg. 31; 2007, pg. 41; 2008, pg. 34-35).

Furthermore, regarding e-commerce, the numbers are very slowly increasing, with somewhat greater increase being made in the provision of e-government services for citizens. Nevertheless, the citizens of Slovenia use those service on average much less than citizens in the EU as a whole. The same gap persists with Slovenian firms, which utilize the possibility of electronic commerce much less than their counterparts in the EU.

On top of that, the indicator of investment in ICT as a share of GDP has decreased and the legislation regarding the introduction of competition to the electronic communications market has not been implemented yet. Therefore the overall potential of ICTs has been exploited to a limited degree only (Development report 2004, pg. 31; 2005, pg. 34-35; 2007, pg. 41-42).

In general, Slovenia does not lag behind most developed EU countries in terms of human resources and the production of knowledge, but more in terms of the transfer and use of knowledge, and the financing mechanisms to enhance that transfer (Development report, 2002, pg. 32).

And despite improvements in the recent years in higher enrolment levels in tertiary education, the increases in R&D expenditure by the business sector and in the access to the Internet, the development is still progressing very slowly, which shows itself as a large gap between innovative activity in Slovenian and top performing EU countries' enterprises, especially when measured in terms of patent applications. The factors of the knowledge-based society are interlinked – thus a lack of high-qualified researchers in the private sector contributes to a low level of overall innovative activity in the private sector and the wider economy and the increase in the education levels[32] in the economy will be crucial for more widespread use of information and communication technologies (Development report, 2005, pg. 31).

To improve all this, Slovenia has created a new national **Strategy of Slovenia's development (SRS)** for the years 2006-2013, which, in comparison with the previous strategy of 2001-2006 (Strategy of Slovenia's economic development – SGRS), puts special emphasis on the implementation of its measures and upgrading and possibility of amending the whole or parts of the strategy at regular intervals. This way the inoperability of the previous strategy would

[32] Especially in technical and (natural) science fields (thesis author's comment).

be avoided and the strategy would be flexible enough to incorporate the changes in the society.

In the area of measures regarding the successful transition to a knowledge-based society, Slovenia has set two main goals for the 2006-2013 period to enhance effective generation, two-way flow and application of the knowledge needed for economic development and quality jobs. The first is to raise economic efficiency and the level of investment in research and technological development and the second is to improve the quality of education and encourage lifelong learning, both with numerous actions envisaged.

Thus, the current strategy should solve the difficulties regarding the establishment of the knowledge society in Slovenia (regarding creation and transfer of knowledge) and be efficiently and fully implemented with the goal of enabling Slovenia to catch the upper third of the EU countries in terms of economic development by the end of the year 2013 (SRS, pg. 29-33).

Furthermore, Slovenia has developed the **National research and development programme – NRRP**,[33] which defines foundations, goals, size and financing, and indicators for measuring the efficiency of national policies in terms of implementation and enhancement of the knowledge creation and knowledge transfer activity in the Slovenian economy in the period 2006-2010[34] and thus complements the proposed Strategy of Slovenia's development (SRS).

Regarding the previous program, which covered the period 1995-2000, it was not implemented as planned – on the opposite, sometimes the results were even contradictory to the plan. In between (2001-2005) there even was a gap with no program accepted by the state bodies at all.

The main goals of the new program are to increase investment into knowledge by both the public sector (to 1% GDP) and the private sector (to 2 % GDP). However, just increasing the R&D expenditure without changes in the way of financing and monitoring those changes and its efficient use will not bring positive results.

Part of those funds has to be devoted to encouraging the private sector to contribute 2 % of GDP to R&D, according to the Lisbon agenda goals of 3 % of GDP (1 % public and 2 % private), which should be devoted to R&D by 2010.

Also, all of basic science (with maybe the exception of humanities) should become part of the European-wide programs which would help its financing and raise its level of quality by giving it the access to European-wide resources and exposing it to European-wide debates.

[33] Proposed to be called national research, technological development and innovation programme – NRTRIP in the future (see GZS, 2005).
[34] At first it was thought that the programme should cover the period 2004-2013, however, due to the delay in its adoption, the new proposal covers the period 2006-2010 (thesis author's comment).

This way domestic funds could be diverted to applied basic science, other applied science, technology development and innovation.

The most important criteria in financing R&D, technological development and innovation have to be quality and priority areas, irrelevant of who conducts it (preferred treatment of certain individuals or institutions must not be allowed). Furthermore, Slovene research and development is split into many small units, thus collaboration and connection into larger groups and achieving the critical mass is necessary.

All the fields of science should be financed, and companies should be able to attract enough qualified professionals, which would apply to EU funds (currently public research institutions are much more successful in getting the funding than companies – especially small and medium enterprises). What is more, those students in natural science and technical fields should be motivated by different means to stay in Slovenia (especially means which would attract them to work for Slovenian companies), thus to minimize brain drain.

Slovenia should also motivate its researchers to think more entrepreneurially and to help create new workplaces. Innovative entrepreneurship should become more appreciated in the society. Besides that, leadership role should go to the most experienced, or at least those who have taken project management or general management courses and show adequate capabilities for leadership.

The program should be implemented at the national level and all the state agencies and institutions (including ministries, chambers of commerce, state development agencies, etc.) should cooperate and work in the same direction, just like in e.g. Finland. Accordingly, tasks and their execution have to be as specific as possible and responsibility should be delegated to all the involved actors.

Besides the afforementioned, all government actors should simplify laws regarding domestic and foreign investment, especially into technology and innovation intensive projects. And in general all laws regarding innovation, research and development and protection of rights should be respected by all government actors and the law should be interpreted in the same way by everyone, and not arbitrarily, as is often the case now.

For program implementation, special board should be formed. The documentation regarding the program's activities should be short, concise and simple, so that researchers will not waste time on the bureaucratic procedures – their task is to research. In general, public administration should become more transparent and consistent in carrying out the program and the public should be given a chance to track the progress of the program in a concise and simple enough manner of reports.

To summarize, in order for the program to be successful:

1. the investment into knowledge has to be accompanied with its successful use and innovation;
2. increased public spending on R&D has to be accompanied with other structural reforms;
3. some of the public funds have to be explicitly aimed at encouraging the private sector to increase its investments into R&D;
4. researchers need to be motivated to behave entrepreneurially (innovative entrepreneurship has to become an asset);
5. the implementation of the NRRP (NRTRIP) needs to be carried out by experienced managers, both at the research and company levels;
6. there needs to be a change in the decision making process of allocation of R&D funds;
7. science also has to take responsibility for the development of the country.

Regarding the knowledge transfer of research results into the commercial domain, five explicit goals were set:

1. Establishment of the competitiveness council, which is led by the prime minister and is in charge of efficient interministerial reconciliation of measures regarding the rise of competitiveness of Slovene economy, technological development and innovativeness.
2. Increase in the size of public funds for encouraging technological development and innovation to 0,5 % of GDP by the year 2008.
3. Increase in the number of researchers (developers) in the industrial sector by 40 % or – in nominal terms – 700 researchers by the year 2010.
4. Increase in the number of innovative enterprises by 35 %, of those 300 to 500 new high tech companies by the year 2010.
5. Establishment of the technology agency – TIA, which should oversee the implementation of the programs and measures regarding technology development and innovation.
6. Additional idea is to spin-off natural science and technical faculties from current universities and group them into new universities while at the same time encourage the establishment of private universities in these fields.

Through successful implementation of all the afforementioned measures Slovenia will be able to catch the upper third of the EU countries and contribute to EU becoming a more competitive and knowledge-oriented economy in the world.

<u>SPECIFIC EXAMPLES OF UNIVERSITY-INDUSTRY RELATIONSHIPS IN SLOVENIA</u>

CENTER FOR KNOWLEDGE TRANSFER IN IT AT THE JOZEF STEFAN INSTITUTE IN SLOVENIA

Jozef Stefan Institute, the largest Slovenian research institute and one of the co-founders of the University of Nova Gorica, introduced a model of continuous technical education in information technologies by establishing the Center for knowledge transfer in information technologies in 1996. This was part of the strategy for additional professional and specialist education of experts from Slovene companies and institutions. The main activity of the Center is the development of educational programs, organisation of seminars and workshops and development of the support infrastructure of the center (databases, procedures, repositories and an up-to-date homepage).

Center developed a model of workshops, which are based on learning through problemsolving in small groups and are being conducted following a carefully designed scenario in order to maximize efficiency. The Center also develops and organizes specialized seminars, which are based on advanced research and development, and thus offer more potential to attract end-users. Workshops and seminars are highly specialised and are targeted for experts in different fields, such as ecology, medicine, marketing, etc. and have proved to be very successful. However, there are negative sides to these workshops and seminars – development of such programs is time-consuming and costly, while the audience is limited in a small country like Slovenia.

Because of the above mentioned limitations the Center for knowledge transfer had to find other sources of income by using other ways of knowledge transfer – e.g. long-term engagements between businesses and the institute and expansion into the European market. That is why it has initiated the SolEuNet project (Mladenić et al., 2003), a 5th framework EU project with 12 partner institutions from 7 countries – 8 from the academia and 4 from the business world. The project was concerned also with the modern organisation forms of cooperation between academic and business communities (Kovač & Urbančič, 2004, pg. 121-122 and Lavrač & Urbančič, 2003).

LJUBLJANA UNIVERSITY INCUBATOR

As stated on their website, Ljubljana university incubator (LUI) gives complete support to newly developed enterprises by undergraduate students, postgraduate students, teachers, assistants and other employees of University of Ljubljana as well as external bearers of technological entrepreneurship ideas.

LUI helps them to overcome all the difficulties at the beginning, which includes business infrastructure, counselling and providing knowledge base necessary for entrepreneurship in the form of organized workshops and links to qualified consultants. Regarding the infrastructure, LUI offers equipped working places, where groups can meet and work on their business projects, including laboratories and research equipment. All these facilities and equipment are availabile at subsidized rates at different faculties and premises of the University of Ljubljana.

LUI also helps with preparation of a business plan, helps at organizing marketing activities for the companies, helps with development of the organizational structure and the information system of a company and provides general business consulting. Furthermore, regarding workshops, participants can learn about marketing, finance, etc. and useful practical business advice (Ljubljanski univerzitetni inkubator, 2005).

TOVARNA PODJEMOV (ENTREPRENEURSHIP FACTORY)

In Maribor, the second largest town in Slovenia, entrepreneurship factory (a university incubator) has been established to help University of Maribor students and other interested entrepreneurs with their business undertakings. The entrepreneurship factory offers consulting and mentoring, business facilities, workshops and connections via the network of partners of the entrepreneurship factory.

Basic consulting and mentoring services are offered via the staff at the incubator, while more specialized in depth consulting activities are offered via government subsidized external consultants on the topics of marketing, finance, management, internationalization, accounting, innovation, technology and law. Business facilities include subsidized office space and administrative support.

On top of that, Entrepreneurship factory offers educational seminars and workshops, which can be a few hours or even a few days long. Finally, the incubator offers entrepreneurs the connections to formal and non-formal investors, to university professors/researchers and facilities, and connections to young and dynamic employees, know-how partners, public administration and other government institutions.

Besides incubator facilities and services, entrepreneurship factory offers students career services, within which it offers students help with career planning, career consulting, with finding a job, gives answers to regulatory questions and different documentation formulars. Furthermore, company consultants from Entrepreneurship factory together with professors and assistants of the University of Maribor and company experts offer services of mentored student projects, within which students, alone or in a team, solve participating companies' problems.

Furthermore, Entrepreneurship factory organizes a competition for the best business idea of the year together with the leading Slovene business newspaper »Finance«. It is a competition with the aim of identifying best innovative new and existing companies and entrepreneurs behind them and to offer their companies a financial prize and professional help and promotion in Slovenia. This competition is also a way to promote innovative entrepreneurship.

Next service is the market, which represents a crossroad of ideas, ambitious people, finance and challenges. Along with that the Entrepreneurship factory organizes »Mladi um« - an entrepreneurship fair and education event, which is aimed at connecting the young, researchers and businesspeople; and events like »Podjem: Tehnologija«, where the main topic of the event is the question how to bring innovative new technical ideas to the market and is taking place at the technical faculties of the University of Maribor (Tovarna podjemov, 2005).

MERKUR GROUP

As a successful trading company, Merkur d.d. (after reorganization known as a holding company Merkur Group (MG), with three divisions – Merkur, Mersteel and Big Bang), organizes many educational activities for their employees, with some activites involving external instutions, including universities.

Among educational and other »corporate university« activities, managed by the HR department, one can find:

1) **strategic programs**- e.g. MOKL, a strategic program of managing organisational culture in the direction of fulfilment of strategic goals of the company, where MG uses external advisers (including academia); previous program MOKL-1 had as its aim the development of two key HRM concepts- 1. knowledge (competency) and 2. efficiency (work sucessfulness); the results of the program were many improvements in the work (HRM) processes: flexible sistemization of workplaces based on competences, more efficient Merkur yearly employee interview, renewed awards system, goal directed system of education, improved system of leadership, academy for perspective employees, dynamic intranet, improved results of organisational climate, improved standards of work, etc.; however, with intense investment activity in the last years, reorganisation of company into divisional structure, and with increased internationalization, a need for a new program has emerged – thus MOKL 2, which focuses on two key elements: 1. affiliation to the company, which includes those that work with passion and feel deeply connected with the company and 2. inovativeness (creativity and innovation); those two elements are aimed at building an organisational culture based on entrepreneurial behaviour of employees under the slogan »the ambassadors of a trademark«; the goals of MOKL-2 include: 1. attainment and development of key – perspective – employees; 2. search and attainment of operational employees; 3. new HRM information system KADIS; 4. adaptation of HRM function to the internationalisation of the company and to its divisional organisation; 5. internal marketing to establish corporatewide culture and strengthen affiliation; 6. enhancement of the educational system;
2) **meetings of management people** – a once a year weekend gathering of management (top and middle managers), with both internal and guest (external) speakers (usually on the high business/academia/government level);
3) **conferences and meetings** – on different business topics; e.g. »Merkurjevi dnevi«, so-called Merkur days, which are organised by the Faculty of Organisation in Kranj – it is a yearly meeting of academia, government and company representatives on the topic of e-initiatives, such as e-region, e-company, e-business, e-government, etc., hosted by MG; it has started in 1999 and thus in 2008 the 10th meeting was organised, which has, among others, focused on e-payments within the e-region of Central European countries; MG also participated at the Student Business Conference at Faculty of Economics, University

of Ljubljana in March 2009 with student theses and projects on different MG interesting topics; additionally, many educational meetings are organised on the topic of knowledge of goods and services, together with suppliers and other business partners, and take part either in MG facilities or elsewhere;

4) **education for perspective managers (sMPA academy)** – started in 2006, and currently the second generation is enrolled; around 10 people from the whole MG is selected every 2-3 years to take part at round tables and seminars; round tables are a chance that new ideas on certain company important topics are presented, while seminars are led by external collaborators (including academia), with different, company interesting topics; the aim of the academy is to sistematically manage talented individuals with managerial potential; it encourages creativity, innovativity, team work, knowledge sharing and other managerial skills and competencies, and the selected individuals codevelop the company's vision and mission; the three most successful program participants of the first generation were awarded a one week trip in June 2008 to the London Business School to attend a course on marketing;
5) **»business schools«** - the so-called – twice a year and usually lasting two days – gatherings for perspective employees, who were not yet included in other programs; gatherings mostly outside Merkur Group facilities with mostly internal lecturers; their aim is to present business results in the previous period and plans for the future; they include presentations on the current company-interesting projects and topics and discussions regarding the current issues facing the company;
6) **Sales academy** – first introduced in 2008, and started as coaching seminars for managers, while later introduced to both wholesale and retail departments; »wholesale« Sales academy was a top-down approach, where a group of selected perspective wholesale people would later spread its knowledge to other colleagues around them, while »retail« Sales academy used a bottom-up approach, where ideas from all the employees would shape trainings later on; both academies included a mix of internal and external coaches/advisers (including academia); the goal of both programs was to develop practical abilities in key sales activities when being directly or indirectly in contact with customers; the contents of the wholesale Sales academy was how to direct the sales process more successfully, while the retail Sales academy focused on three major themes: 1. monetary and non-monetary rewards, 2. workplaces and roles, 3. improvement of the sales processes;
7) **preparatory periods** – they are obligatory (by Slovenian law) for all those employees, who are employed for the first time after finishing school; usually they last between six months and one year during which a program is composed between the preparatory employee and his/her mentor (usually the superintendent); the employee keeps a diary and orally defends his/her preparatory work in front of an exam comission;
8) **on the job trainings (preparatory trainings)** – most of them are required by law or some external organisation (e.g. Slovene railways) – courses include operating certain equipment (e.g. forklifts, lifts, etc.), safety precautions (e.g. fire safety, handling toxic materials, etc.), language courses (e.g. Slovene, English, German and other languages)

and computer classes (company internal software courses and external, mostly Microsoft software, courses);

9) **internal seminars** – other seminars (courses) according to needs (usually those needs are formed from the company yearly discussions with employees); examples include financial and law »update« courses, marketing, sales, management, logistics, and above all, material knowledge courses (the latter include all the sales programs of Merkur Group);
10) **entry seminars for new colleagues** – they take a form of a whole day meeting with the members of the management board, who give overall company presentations to the new recruits; furthermore, topics on work and fire safety, including obligatory tests, are included;
11) **part-time studies** – (co)financing of employees' formal studies at universities, where employees are then employed for the same period of time; or part-time studies organized by Merkur Group, which involves 200 employees per year on average; the two most common forms are the educational program for a salesperson (6th level, associate degree study), performed in Naklo in collaboration with IRC Institute and the 7th level, bachelor degree study, for the profession of an economist, in collaboration with IRC Institute and Nottingham Trent University;
12) **scholarships** – in 2008 Merkur has delivered 59 scholarships, while for 2009 it plans 79 scholarships, mostly for sales people with finished secondary school and also a few for other areas, such as informatics and logistics;
13) **work practice and summer jobs** – each year MG temporarily employs its scholarship students and other students to carry out their obligatory or non-obligatory work either during the year or during summer vacations.

MG is a recipient of numerous Top 10 awards for being one of the 10 Slovenian companies, which dedicate the most resources to their employee development by a Slovenian business newspaper GV. This award is given for a systematic investment into knowledge and for educating and developing company employees. It has been MG's sixth award in the last seven years. Additionally, MG has also received numerous awards for its HRM projects (e.g. the sMPA academy was awarded third place at the annual awards for the best Slovenian HRM projects in 2007 and the Sales academy was also awarded third place in 2008). MG was also awarded a Golden thread award in 2009, for becoming the top 7 employer in the category of large companies, among the 101 top employers chosen each year by the Slovenia-wide newspaper Dnevnik (Merkur Group, March 2009).

3 ANALYSIS OF KNOWLEDGE SUPPLY AND DEMAND AT THE UNIVERSITY OF NOVA GORICA[35]

In the previous chapters knowledge society and the abstract issues of the production and transfer of knowledge have been presented together with examples from the developed world. In the following chapters of the thesis analysis of a concrete example, which is University of Nova Gorica, will be presented.

However, before analyzing it, some hypotheses will be presented, based on the theory of the previous chapters or on thesis author's own assumptions regarding the questions posed in the questionnaires for the employees of UNG and the company questionnaires.

The hypotheses are:
Hypothesis 1: At the University of Nova Gorica, as most of the universities elswhere, non-commercial means of knowledge transfer prevail.

Hypothesis 2: Most of the companies from the research study invest in education, yet they do not educate their employees by themselves.

Hypothesis 3: Companies from the research study, because of their practical, results oriented activities prefer customized, shorter, programs, with lower educational attainments rather than high educational attainments preferable.

Hypothesis 4: Companies from the research study in different industries have different needs regarding education.

Hypothesis 5: There is a difference in educational needs and wants between micro/small and medium-sized/large companies from the research study.

Hypothesis 6: There exist differences in educational needs between profitable and unprofitable companies.

Hypothesis 7: Adequate finances represent an important motivational factor for enhancing the collaboration between University of Nova Gorica and the industry.

Hypothesis 8: Most of the profitable companies from the research study would be willing to financially support their research at the external collaborator.

[35] Previously it was called Nova Gorica Polytechnic, however, it has changed its name and status during the year 2006 (thesis author's comment).

Hypothesis 9: Most of the companies from the research study have needs for new technologies and thus perform R&D themselves within their own department of R&D, financed by internal assets.

Hypothesis 10: Most companies from the research study benefit the most from university research results in the area of applied research (especially pharma, biotech, new materials' science and IT – information technologies) while basic research is not so useful, with the exception of chemistry.

Hypothesis 11: Companies in different industries have different needs regarding research and thus behave differently.

Hypothesis 12: Medium-sized/large companies from the research study are more willing to cooperate with universities and other external institutions regarding research than micro/small companies.

Hypothesis 13: There exist differences in research needs and wants between profitable and unprofitable companies from the research study.

These hypotheses are tested in the proceeding analysis and their acception or rejection discussed in **Chapter 3.3**.

3.1 Knowledge supply analysis

According to its vision, University of Nova Gorica (UNG) is becoming a place where knowledge is produced in a harmonious relationship between students and researchers and transferred to younger generations as well as to the business environment of the institution. Cooperation with the industry and the business environment is expected from all UNG employees. This way the conditions for knowledge transfer from an academic institution into the business environment are set, recognition of the institution is being enhanced and job opportunities for UNG alumni are increased.

A whole range of activities complement and enhance each other in achieving these objectives: applied research projects, a track of seminars for postgraduates which is open to public, seminars of continuous education, visits of experts in companies in the region, etc. UNG is also a co-founder of the Primorska region technology park, which should – among other things – contribute in creating a business opportunities environment for the bachelors', masters' and PhD students.

Research activity at UNG is being currently conducted in 5 laboratories, 3 centers and 1 institute:

- **Laboratory for Environmental Research**, which conducts research in different areas of environmental sciences (e.g. basic research in new instrumentation and methodologies for measuring environmental pollution, applied research in the application of photothermal and bioanalytical techniques for food quality control and development of expertise in the area of environmental impact assessment, frequently requested by the public and private sector);

- **Laboratory for Astroparticle Physics**, which conducts research in the area of experimental cosmic ray physics and elementary particle physics and is strongly connected to international collaborations and laboratories, such as the Pierre Auger collaboration and Belle collaboration. Part of the activity is dedicated to the synchrotron radiation research of new materials at the synchrotron radiation facilities of HASYLAB at DESY in Hamburg, ESRF in Grenoble, ELETTRA Sincrotrone in Trieste and SRS Daresbury. Besides basic research it develops R&D activity which is oriented towards the development of new detector techniques in astroparticle physics and environmental sciences particularly in the field of superconductive strip detectors and remote sensing of air pollution and atmospheric properties;
- **Laboratory of Organic Matter Physics**, where research activities are carried out in two fields: in the field of organic electronics the main topic are electronic properties of materials that are interesting as components of organic solar cells and organic thin film transistors; in the field of biophysics one of the goals is integration of protein molecules and electronic elements that function on the basis of organic semiconductors. Such hybrid electronic elements will act as biosensors;
- **Laboratory for Multiphase Processes**, which conducts fundamental research towards the development of advanced numerical methods for multiphase systems and development of physical models for solid-liquid processes, applied research in numerical modeling of a wide variety of processes with metallic, polymer or ceramic materials and their composites and expertise in computer simulation of the Slovenian low and intermediate nuclear waste repository, which is being developed together with Slovenian state agencies and regulatory bodies. And, in addition to that, the laboratory is working towards the enhancement of simulation capabilities for the assessment of the transport of radionuclides and other pollutants in different natural and technological systems;
- **Materials research laboratory**, which covers research topics from fields of electronic and environmental materials. Both fields are complementary with respect to a type of materials (semiconducting oxides) and physical effects (electron transfer). New electronic materials are strategic materials for advanced information and telecommunication technologies. Research of environmental materials currently focuses on the area of photocatalytic materials for hydrogen generation by water splitting. The laboratory's high international research reputation opens doors for collaboration with the most prestigious international academic and industrial laboratories;
- **Centre for Atmospheric Research**, which conducts research regarding the atmosphere, especially in terms of pollution; center conducts basic research in the field of remote sensing of atmospheric properties, using LIDAR (light detection and ranging), and atmospheric impact on the performance of satellite navigation systems;

its' applied research, using Lidar measurements at Otlica observatory, is a part of the national network for environmental monitoring; these measurements, together with regional climate change studies and impact studies of these changes contribute to the development of strategies for adaptation to climate change in Slovenia;

- **Centre for Systems and Information Technologies**, which has been established in March 2007 to connect researchers in the field of systems and IT- at the beginning, the center is focusing its activites in two areas – 1. IT for support of activities in medicine and public health system; 2. theory of systems and system engineering; however, numerous other areas connected with systems and IT are also the topic of research; the center's coworkers include people both from industry and academia;
- **Wine Research Centre**, which has been operating since November 2008, unites researchers connected to the fields of viticulture, enology and wine marketing. The Centre is located in the middle of the wine growing region and is therefore strongly connected with local winegrowers and winemakers. However, one of the main goals of the new Centre is also the establishment of active cooperation with similar institutions abroad. The research work and plans of the newly established Centre are focused on applicative and expert activities in the following fields: analyses of grape and wine secondary metabolites, analyses of various plant origin samples quality, optimization of viticulture technologies in accordance with wine quality, optimisation of wine-making technologies in correlation with wine composition and wine sensory characteristics, microbiology of vines and wine diseases of vines, grape and yeast metabolomics, economics and wine marketing;
- **Institute for Cultural Studies**, which conducts research in two fields – cultural studies and cognitive science; cultural studies research group tries to understand culture in a very broad way, because culture is not a monolithic and coherent concept in space and time; researchers, which include historians, linguists, philosophers and anthropologists, analyze manifestations of culture using various research approaches and methodologies from different social sciences; on the other hand, cognitive science research group studies human cognition or more generally, the way human brains work from a formal linguistics perspective, and the group cooperates with other researchers around the world.

Research topics as well as successful projects for end-users indicate great potential for even more intensive and systematic knowledge transfer. These projects can serve as good sources of interesting problems to be tackled by students' diploma theses. Besides, UNG believes that being an educational institution helps also in the opposite direction: contacts established through work placement and diploma thesis projects can, if managed properly, lead also to bigger projects.

On the other hand, regarding **teaching**, UNG currently consists of seven schools:

- School of Engineering and Management
- School of Environmental Sciences

- School of Humanities[36]
- School of Applied Sciences
- School for Viticulture and Enology
- School of Arts[37]
- Graduate school.

The following study programs are currently being conducted at UNG:

➢ **Undergraduate programmes and I. and II. level programmes**:

- Bachelor's programme in Viticulture and Enology at the School for Viticulture and Enology;
- Bachelor's programme in Engineering physics and Master in Experimental physics at the School of Applied Sciences;
- Bachelor's programme in Engineering and Management (I. Level), Bachelor's programme in Industrial Engineering Management and Economics and Master in Engineering and Management at the School of Engineering and Management;
- Bachelor's programme in Environment, Bachelor's programme in Environment (I. Level) and Master's study programme ENVIRONMENT (2nd level) at the School of Environmental Sciences;
- Bachelor's programme in Slovene Studies, Bachelor's programme in Cultural history, Bachelor's programme in Slovene Studies (I. Level), Joint Master in Migration and Intercultural Relations and Master in SL studies - Linguistics at the School of Humanities;
- Bachelor's programme in Digital Arts and Practices is being established at the School of Arts.

➢ **Graduate programmes and III. level programmes** (all conducted at the Graduate school):

- Economics and Techniques for the Conservation of the Architectural and Environmental Heritage graduate study programme;
- Environmental Sciences graduate study programme;
- Graduate study programe Environmental Sciences (3rd level);
- Intercultural Studies - Comparative Studies of Ideas and Cultures graduate study programme;
- Karstology (III. Level);
- Karstology graduate study programme;
- Material Characterization graduate study programme;
- Molecular Genetics and Biotechnology graduate study programme (III. Level);
- Physics;
- The Graduate Program Comparative Studies of Ideas and Cultures.

[36] Previously called the Stanislav Škrabec School of Slovenian Studies – thesis author's comment.
[37] Which is just being established in the spring of 2009 (thesis author's comment).

UNG has signed agreements for work placement with many companies and cares a lot about the quality of work placement sessions that are obligatory for students of the School of Engineering and Management. Every work placement is defined as a project in cooperation with two mentors, one at the school and one in the company. Projects tackle problems interesting for the company. Most of them are prolonged into bachelor's degree theses. As a rule, all theses of the School of Engineering and Management are practically oriented and solve real life problems of companies. Since the study program is very interdisciplinary, most of them cover technological as well as business aspects. Basically, they can be divided into two groups:

- Bachelors' degree theses, where the main topic is ex-ante planning or modelling of certain products, services or processes – e.g. planning the purchase of raw materials in the company; modelling the organisation of the purchasing function; planning the information system; introducing the ISO 9001 and ISO 14001 standards; making a waste disposal strategy; producing a business plan; designing production automatization; developing products and services marketing plan; etc.;
- Bachelors' degree theses, where the topic is an analysis of a certain business situation or ex-post evaluation of certain business or technical decisions – e.g. evaluating the investment efficiency; economic evaluation of an investment into a certain product or service or a production closure; analyzing production maintenance; analyzing business environment of a company; optimizing inventories; workplace arrangements; valuing the investment into automatization of production; technological, ecological and economic analyses of production; waste management planning; etc.

As seen from the topics mentioned above, students are expected to demonstrate their acquired knowledge by solving interesting problems in companies. This typically requires interdisciplinary approach and cooperation of experts from different fields. Cross-disciplinary and cross-institutional cooperation fosters creativity and results in solutions that have proved to be useful in practice. We can also report about a very high percentage of students being later employed by the organization of their work placement, which is currently 24%. Although this figure will probably decrease with the increasing number of students, it has some value as a reflection of satisfaction in companies.

Of course, at masters' and doctoral level, there is much more emphasis on research novelties and scientific contributions. Nevertheless, theses obtained at the School of Environmental Sciences at these two levels also provide results that can be applied for the benefit of companies or society, as shown by some examples:

- identification of wastes and preparation of waste disposal and treatment strategy at Iskra – Avtoelektrika company;
- fault detection of industrial processes;
- analysis of changes of cultural mountain landscape (case study of Sv. Anton na Pohorju cadastral community);
- biological factors which influence the habitation of fish in the shallow coastal areas;

- environmental impact assessment – validity of long term predictions (a case study: radioactive waste disposal in Slovenia);
- development and application of photothermal biosensor for detection of organophosphate and carbamate pesticides;
- development of laser spectroscopic techniques for characterisation and studies of phytoplankton pigments.

Regarding the analysis of primary data, interviews have been conducted with four professors, which are also heads of schools and laboratories at the University of Nova Gorica. The aim of interviewing heads of schools and laboratories was to get a grasp of as much tacit (hidden) knowledge as possible (besides formalized knowledge, gained from the previous secondary data sources analysis). The questions and replies are given in **Appendix 4**. Nevertheless, there still exists a lot of knowledge at the University of Nova Gorica among its numerous researchers/teachers and other staff at the UNG.

Therefore, in the forthcoming years, a repository of expertise availabile at the institution will be gathered and presented in an electronic form easy to be searched out along different dimensions. This will serve as a knowledge management tool that will help in approaching companies when discussing new possibilities of cooperation and designing new knowledge transfer activities such as continuous education seminars (Kovač & Urbančič, 2004, pg. 120-121).

3.2 Knowledge demand analysis

The aim of demand analysis was to find out what were the needs and wishes of the other side of the equation – namely, companies – regarding knowledge. What kind of knowledge were they looking for – both in terms of education of their employees as well as research which they are currently performing or would like to perform in the future. Therefore a further aim was to discover whether collaboration could be established between University of Nova Gorica and analysed companies and in what way.

3.2.1 Research methodology

I have conducted a research of companies in the Primorska region in Slovenia (which further consists of three different statistical regions – Goriška with the center in Nova Gorica, Notranjsko-kraška with the center in Postojna and Obalno-kraška with the center in Koper (Capodistria)). And in Italy I contacted companies in Friuli-Venezia-Giulia region (which further consists of Trieste province with the seat in Trieste, Gorizia province with the seat in Gorizia, Udine province with the seat in Udine and Pordenone province with the seat in Pordenone).

I have contacted 300 companies in Slovenia and 150 companies in Italy.[38] I have created a questionnaire (see **Appendix 6**) and used both regular mail and e-mail in order to contact the companies.

The companies, which were contacted in **Slovenia,** come from all industries (from letter A through Q) of the standard classification of industries according to United Nation's ISIC Rev.3.1. (ISIC, 2004). Specifically, I have chosen companies in Slovenia according to the following criteria:

- 38 companies, which University of Nova Gorica already collaborates with through student internships;
- 100 fast growing companies from Primorska region (GV, 2002a);
- 36 companies from Goriška region, which have received some type of ISO certificate (e.g. 9001, 9002, 14001) (GZS, 2002);
- 14 companies from Goriška region, 8 from Notranjsko-kraška region and 20 companies from Obalno-kraška region, which had the largest total revenues in 2001 (GV, 2002b);
- 18 companies from Goriška region, 5 from Notranjsko-kraška region and 20 companies from Obalno-kraška region, which had the largest net profit in 2001 (GV, 2002c);
- 41 LLC (small-medium) and Inc. (large) companies, which Regional development agency (RRA) from Vrtojba collaborates with.

A list of almost 30.000 companies from **Italy**, which have more than 20 employees, was compiled from Camera di Commercio, Industria, Artigianato e Agricoltura di Gorizia. From this list:

- 80 largest companies regarding invested capital were chosen and contacted at first (numbers 1-300 in the table, with a lot of large companies having subunits in Friuli-Venezia-Giulia which were counted among those 300 companies – thus only 80 companies out of 300 on the list were left at the end);
- another 70 were chosen in the following way:
    1. all the companies, which have their seat in the Gorizia province were chosen from number 300 to 1000 in the afforementioned list;
    2. all the companies, which have their seat in Trieste, Udine and Pordenone province (in that order) were chosen from number 300 to 500 until 70 companies were reached in total.

The companies in Italy were chosen from the following industries (including a corresponding letter from the standard classification of activities ISIC, Rev. 3.1.): D – Manufacturing, E – Electricity, gas and water supply, I – Transport, storage and communications, K – Real estate, renting and business activities.

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[38] Research was carried out end of 2004/beginning 2005 – thesis author's comment.

Number of companies that have answered my questionnaire: **73 in Slovenia and 3 in Italy** (one explanation behind disappointing turnout of the questionnaires from Italy could be wrong/changed addresses, while another could be the general lack of trust in giving out company internal information or not enough visibility of University of Nova Gorica in Friuli-Venezia-Giulia region, yet). For the research results – analysis of all Slovenian questionnaires – please see **Appendix 5**.

3.3 Testing of hypotheses

Hypothesis 1, stating that at the University of Nova Gorica, as most of the universities elswhere, non-commercial means of knowledge transfer prevail, is based on the theory from the chapter on non-commercial means of knowledge transfer (**Chapter 2.1.1**). It can be concluded that it holds true, since student lectures, tutoring, publications, conferences and workshops, which are all non-commercial means of knowledge transfer, represent the bulk of UNG activities, while patents, license agreements and formal commercial contracts (commercial means) represent less important means of knowledge transfer (please refer to knowledge supply analysis in **Appendix 4**).

If we look at **hypothesis 2**, which stated that most of the companies from the research study invest in education, yet they do not educate their employees by themselves and was based on author's own opinion,[39] we can say that indeed, most of the companies (almost 90 %, as can be inferred from Question 1 in the **knowledge demand analysis – k.d.a.**[40]) invest in additional education of their employees. However, regarding who should offer additional education – both external practitioners and the company internal practitioners offering education together is the most optimal solution, while none of the questioned companies gave internal only as an answer (please refer to Question 3 in k.d.a.).

Hypothesis 3, which thesis author has expressed as: companies from the research study, because of their practical, results oriented activities prefer customized, shorter, programs, with lower educational attainments rather than high educational attainments preferable. The results, inferred from Question 5 in k.d.a., confirms the hypothesis in the sense that both very short courses of a few hours or days and lower formal educational attainments – undergraduate associate and bachelor degree studies rather than graduate levels – are desirable by companies; additionally important is the strong need of companies for customized programs (e.g. consortia or similar studies, tailored to suit the specific knowledge needs of companies).

If we look at **hypothesis 4**: Companies from the research study in different industries have different needs regarding education, we can infer the proof of the hypothesis from the comparative analysis of questions. This analysis shows that when looking at specific industries, it can be seen that manufacturing companies provide additional education to their

[39] The hypotheses are based on thesis author's personal opinions if not stated otherwise.
[40] For the knowledge demand analysis see **Appendix 5** – thesis author's comment.

employees in the majority of cases, yet service companies are not far behind either (Question 1 in k.d.a.); manufacturing companies have an already existing program of education in the company for the most part, while the majority of companies in service industries leave their decision regarding education to employees themselves (Question 2 in k.d.a.); with the exception of trading companies, which prefer external educators only, manufacturing and other service industries prefer both external and internal educators teaching (Question 3 in k.d.a.); but when it comes to the type of preferred courses, both are unanimously in favour of shorter courses/programs and customized programs (Question 5 in k.d.a.).

Hypothesis 5: There is a difference in educational needs and wants between micro/small and medium-sized/large companies from the research study. Again, the comparative analysis of questions shows that there exists a difference between micro/small companies and medium-sized/large companies; this is not so much in terms of additional education, which is offered by all (Question 1 in k.d.a.), but more in terms of giving freedom to employees in their choice of educational programs by micro and small companies, while medium-sized and large companies have already established programs within their facilities (Question 2 in k.d.a.); when it comes to the type of practitioners (Question 3 in k.d.a.), all companies prefer external and internal practitioners offering education, with the exception of small companies, which give preference to external practitioners only; as for types of courses, the answer is consistent with afforementioned hypotheses, regardless of the size of companies.

The only difference from the above findings in terms of **hypothesis 6**, which states that there exist differences in educational needs between profitable and unprofitable companies, is that profitable companies have applied equal importance to having additional programs offered by themselves as to giving employees the possibility to choose either internal or external programs by themselves (Question 2 in k.d.a.), while unprofitable companies leave their decisions to employees for the most part. Furthermore, profitable companies find it twice as good if educational programs are offered by both external and internal practitioners rather than just external ones, while unprofitable companies are almost indifferent.

Hypothesis 7 presumed that adequate finances represent an important motivational factor for enhancing collaboration between University of Nova Gorica and the industry. From the knowledge supply analysis we can see that Question 4 stresses that researchers expect stronger financial support from companies and public sector institutions in the future collaborative projects. Furthermore, Question 7 mentions that low finances were the obstacle for greater collaboration. And especially Question 9 from the supply analysis explicitly confirms that money is an important motivational factor for enhancing the academia-industry cooperation.

Hypothesis 8 stated that most of the profitable companies from the research study would be willing to financially support their research at the external collaborator.[41] However, when we

[41] Since they are profitable and have the need for new technologies (thesis author's comment).

look at the results, we can see that despite most of the companies making profits in their last financial year (according to the general question on profitability), less than half would be willing to financially support their research at the external collaborator (educational & research institution) (Question 12 in k.d.a.).

Hypothesis 9: Most of the companies from the research study have needs for new technologies and thus perform R&D themselves within their own department of R&D, financed by internal assets. Even though majority of all analysed companies have needs for new technologies (Question 20 in k.d.a.), most do not perform R&D within their company (Question 7 in k.d.a.); among those that do perform their R&D themselves, 2/3 have their own department of R&D[42] (Question 8 in k.d.a.), and ¾ finance their research with internal assets only, as can be inferred from the knowledge demand analysis.

Hypothesis 10 (based on theoretical findings in **Chapter 1.2.2.2**): Most companies from the research study benefit the most from university research results in the area of applied research (especially pharma, biotech, new materials' science and IT – information technologies) while basic research is not so useful, with the exception of chemistry. Looking at Question 9 in k.d.a., we can observe that those fields of science and technology, where a majority of research is being performed at companies, are development of new products and production processes, mechanical engineering, telecommunications and – among services – market research. This can hint at the areas, where companies would be willing to collaborate with the universities.

Furthermore, Question 20 in k.d.a., which is asking about new technology fields that are the most useful for companies today or which could be the most interesting in the future are mostly applied science and technology fields. However, a number of technologies, such as e.g. new materials regarding textiles and plastics, plastic and hybrid materials and custom-made color granules are based on basic research in chemistry. Thus these findings confirm the hypothesis.

Hypothesis 11 claims that companies in different industries have different needs regarding research and thus behave differently. When we look at specific industries in the knowledge demand analysis, we can see that manufacturers (ISIC classification D), which includes pharmaceutical, biotech, new materials and IT hardware companies (from the previous hypothesis), are the most in need of new technologies (Question 20 in k.d.a.), they also perform the most R&D among all analysed companies (Question 7 in k.d.a.), would be willing to collaborate with external institutions regarding research (Question 11 in k.d.a.) and also financially support that research (Question 12 in k.d.a.). Thus these findings confirm our hypothesis.

[42] The rest (1/3), probably do not have a separate R&D department, but conduct their R&D within other departments – thesis author's comment.

On the other hand, companies in service industries (regardless of the type of services, thus also including the software part of IT) would also have needs for new technologies (albeit not as strong as manufacturing companies), yet they do not perform their own R&D for the most part – as opposed to medium-sized and large companies, are not willing to partner with external institutions regarding research or are at least indifferent about it and would also not be willing to financially support that research (even though the question on profitability shows that they are profitable (for the most part)); the same picture goes for the afforementioned industries regarding applying to different EU/national or local research programs (Question 13 in k.d.a.); additional analysis shows that companies in service industries do not have as much experience collaborating with academia as manufacturing companies (Question 14 in k.d.a.) and that the major reason behind it is that they do not have the need to do so (Question 16 in k.d.a.).

Hypothesis 12 (based on findings in **Chapter 1.2.2.2**): Medium-sized/large companies from the research study are more willing to cooperate with universities and other external institutions regarding research than micro/small companies. Analysis confirms that as with questions regarding education there is a difference between micro/small companies and medium-sized/large companies; the difference is not so much regarding profitability (for the most part they are all profitable, regardless of the size, according to general question on profitability) or the need for new technologies (they all have needs, regardless of the size, as can be inferred from Question 20 in k.d.a.), but regarding the research characteristics and willingness to cooperate; namely, micro and small companies – for the most part – do not perform R&D (Question 7 in k.d.a.); they are also not willing to perform research activities in partnership with an external collaborator (with small companies breaking even; Question 11 in k.d.a.); they would also not be willing to financially support their research at an external institution (even though they are among the most profitable companies according to the question on profitability – micro are tied with medium-sized, while small companies are in the lead; Question 12 in k.d.a.); however, when it comes to applying for local/regional/national/EU research support programs (Question 13 in k.d.a.), micro companies would not be willing to do it while small would. Thus overall, this confirms the hypothesis that medium-sized and large companies are (on average) more willing than micro/small companies to cooperate with universities and other external institutions regarding research.

Finally, the last **hypothesis, no. 13,** presumed that there exist differences in research needs and wants between profitable and unprofitable companies from the research study. From analysis we can find out that majority of profitable companies do not perform R&D activities, thus we can infer that knowledge-intensive activities are not the source of their profits (Question 7 in k.d.a.); this finding is the same with unprofitable companies. Furthermore, even if profitable companies do perform R&D, they do not have their own department for the most part (Question 8 in k.d.a.); on the other hand, unprofitable companies do have their own department. Since most of the analysed companies are profitable this explains why most of the companies finance R&D exclusively with internal assets (Question 10 in k.d.a.);

nevertheless, the same goes for unprofitable as well. Profitable companies are also willing to enter partnerships (Question 11 in k.d.a.) and apply for external funds to programs together with an external institution (Question 13 in k.d.a.), while unprofitable would not; and, when it comes to financial support of research, profitable would support it (albeit they are almost tied – a little bit more than half in favour, a little less than half against; Question 12 in k.d.a.), and unprofitable would not, which is expected.

Yet, such narrow result for profitable companies shows a very rational behaviour of profitable companies (of course the profitability criteria is quite limited, because companies were asked for their last financial year only, when a track record of profitability for more than one year would have been more significant). Nevertheless, all the above analysis could prove the differences between profitable and unprofitable companies (albeit the sample of unprofitable companies is almost too small to draw any conclusions).

3.4 Suggestions for University of Nova Gorica from hypotheses and the supply and demand analysis

3.4.1 What could University of Nova Gorica offer[43]

3.4.1.1 Regarding education

From Question 3 in k.d.a. can be inferred that there exists an opportunity for University of Nova Gorica to create educational programs with involvement from both company internal practitioners as well as its own staff (e.g. UNG staff lecturing on theory while company staff giving practical real-life examples) or at least bring company practitioners to enhance student lectures (according to Question 15 in k.d.a.).

Regarding topics of education which would be most interesting for companies to be offered by UNG (inferred from Question 4 in k.d.a.), they would be (in the following order): knowledge of how to sell products/offer services, courses on project management, courses regarding the quality of products, services and processes (in connection with standards), courses on production optimization, on informatics, marketing and logistics, finance, procurement, R&D, general management skills, environmental knowledge and company specific topics.

Regarding the duration and type of educational programs, UNG could expand its offering with very short – a few hours or days – courses, while longer courses on specific topic are not so popular; regarding more formal programs (as opposed to courses), UNG could introduce programs tailored to the needs of companies (consortia studies or similar).

[43] Inferred from demand analysis (thesis author's comment).

If UNG will introduce courses, it should follow the specific propositions given as answer to Questions 5 and 6 in k.d.a. The study topics for longer courses should include i.a. topics in mechanical engineering, electrotechnics, chemistry, environmental science, construction, energy, computers and informatics, informatics and telecommunications, economics, business process optimization, business, international business, marketing, sales, finance, management and law.

3.4.1.2 Regarding research

Regarding research activities in general, UNG could consider collaborating with manufacturing companies in particular, which have the greatest need for new technologies and are also willing to financially support that research; of course, it could also collaborate with service companies (e.g. IT and telecommunications), if they would like to perform R&D activities (since they – for the most part – do not have their own R&D facilities) and – most importantly – if they would be willing to financially support those activities.

Regarding size of companies, collaboration with medium-sized and large companies, which perform research and are also able to finance it, would be the most meaningful; nevertheless, micro and small companies should not be neglected, especially those which are willing to do R&D, since many of them are very profitable; especially those micro and small companies, which have a high growth potential should not be neglected!).

UNG should complement companies' existing research rather than trying to get exclusive contracts on research topics, as can be inferred from both subparts of Questions 11 in k.d.a. In case that companies are not willing to cofinance research (Question 12 in k.d.a.), UNG should involve them in the application process for local/regional/national/EU programs (Question 13 in k.d.a.), especially those companies, which are willing to apply to such programs together with external institutions.

When deciding upon the form of collaboration (Question 15 in k.d.a.), UNG should look primarily to go into joint R&D projects and direct orders, whereas it should pay attention to getting feedback on collaboration and try to adapt to companies' needs and requests; however, enough human resources need to be availabile at UNG to work on company projects.

Despite most of the companies replying to Question 16 in k.d.a. that the major reason behind their non-cooperation with academia was because of no need felt, this is probably due to change in the future with rising competition in the EU;[44] again, since – for the most part – there is not enough human resources and financial resources availabile for collaboration at companies themselves, UNG should counterweigh that by applying to different programs within EU which provide financing for research projects.

[44] Additionally, the current global crisis in 2009 will probably increase the need of companies to collaborate with academia and vice versa in order to survive, as can also be inferred from current articles (e.g. Kontler – Salamon, 2009) – thesis author's comment.

Regarding Question 17 in k.d.a., most of the companies do not perform R&D for which they would need specialized equipment; on the other hand, among those that do, 85 % own their equipment (Question 18 in k.d.a.), yet there is still a possibility for collaboration with UNG, because many companies have declared that they would be willing to use the equipment at research/educational institutions such as UNG to complement their own research equipment (Question 19 in k.d.a.).

If UNG would think about expanding into new innovative technologies' fields, it should follow the technologies mentioned under answers to Question 20 in k.d.a. Those technologies include i.a. final construction using specific technologies, e-education, new materials regarding textiles and plastics, leadfree welding, chip bonding, welding of SMD elements, holtmelt procedures for textile materials, technologies for enhancement of textiles, communications, plastic and hybrid materials, quick optical prototypes, radiofrequency electronics, digital processing of signals, communications, custom-made color granules and heating and cooling. Yet, because each company is different, it is worth signing individual contracts before proceeding into new research fields.

3.4.2 What UNG already offers and to what extent[45]

3.4.2.1 Regarding possibilities of university-industry collaboration in general

Regarding possibilities of collaboration according to theory (theoretical chapters at the beginning), UNG already uses a number of non-commercial knowledge transfer mechanisms, such as publications, conferences, non-commercial consulting and student internships; of course the frequency of usage of these channels could be increased further; however, when it comes to commercial means of knowledge transfer, such as cooperative/joint ventures, personnel exchange, patenting, licensing, equity investments or founding of start-up companies, UNG has a potential to do much more; the exception is contract research, where a number of research contracts have already been signed with companies and other public sector organisations.

When it comes to different possibilities regarding institutional forms of knowledge transfer, UNG has been involved in direct transfer of knowledge from university to industry by being part of local/regional networks – specifically, IN-PRIME network; furthermore, some professors/researchers who work at UNG have also been involved in virtual/global networks.

3.4.2.2 Regarding education

With regards to education, knowledge about product sales and services, project management techniques, production optimization, informatics, as well as courses in marketing, logistics, procurement and environmental science are all parts of formal undergraduate study programs;

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[45] According to supply analysis and theoretical options, mentioned in **Chapter 2** – thesis author's comment.

regarding R&D education, this is dependent upon the individual company, but in general, environmental R&D education is covered by the School of Environmental Sciences while material and other applied science R&D education is covered by the School of Applied Sciences.

3.4.2.3 Regarding research

Regarding research, UNG has already collaborated with medium-sized and large manufacturing companies and some service companies; additionally, some research has been done for the public sector institutions. If we look at the type of research, which is currently carried out, many different areas from the company »wish list« of the future (second part of Question 20 in k.d.a.) are already covered within UNG laboratories and centers.

UNG has already applied for/collaborated in a number of research support programs, especially programs within the 5th, 6th and 7th EU research framework. Additionally, UNG has used its equipment when performing research for companies or even used equipment, availabile in companies; furthermore, a number of students have worked in laboratories who, in connection with companies' mentors, prepared bachelor and master degree theses.

3.4.3 What could UNG offer which it does not offer yet[46]

3.4.3.1 Ideas from university-industry collaboration possibilities in general

In my opinion, University of Nova Gorica could extend and/or expand existing commercial mechanisms of knowledge transfer of contract research, cooperative/joint ventures, personnel exchange, patenting, licensing, helping to create start-up companies and equity investments in those start-ups or other companies.

In order to stimulate commercialization of technology, involvement in different networks usually helps, not hinders that, because certain commercialization mechanisms, especially creation of new companies, require a wide network of different actors to ensure the success of new ventures – from university laboratories and educational/consulting institutions to financial institutions and headhunting companies; thus UNG could extend its collaboration in different networks, especially those that provide access to high-technology knowledge (e.g. technological nets or high-tech industry clusters).

Additionally, since the tasks of commercialization of new technologies are quite formidable regarding time and other resources needed, UNG could think about cooperating with an external knowledge broker, especially when it comes to patenting and licensing research findings; however, later on, when a critical mass of research that could lead to new products or processes will exist (UNG is still a young institution, developing new schools and

[46] According to demand analysis and theoretical options – thesis author's comment.

laboratories), UNG could think about establishing its own office of technology transfer (this, however, depends on the comparison of costs of performing technology transfer in-house versus outsourcing it to external brokers).

3.4.3.2 Ideas regarding education

Courses on quality and standards should be offered depending on company specific needs. Furthermore, even though management skills are offered in the bachelor's and masters programme in (Industrial) Engineering, Management (and Economics) at the School of Engineering and Management, there is not an explicit course offered on managerial skills; this would preferably be an obligatory course, yet it could also be offered as an elective during studies.

Another idea regarding education, which is not offered at UNG yet, could be short courses and seminars on different topics mentioned as answer to Question 5 in k.d.a. – these could either last one or few days. Furthermore, UNG could maybe think about offering customized longer formal programs, suited to the specific needs of companies (e.g. consorita studies or similar), which would include topics agreed upon among all the participating companies (some clues as to which topics would be interesting gives the answer to Question 6 in k.d.a.).

3.4.3.3 Ideas regarding research

Even though some research involving companies has already been done, this could be extended to involve many more companies, especially if those companies would be willing to finance research in order to provide enough financial means to be able to employ new researchers at UNG who could tackle company problems, thus not to overburden existing researchers.

This is so much more important, because even though UNG has already received support funds from different programs (besides local especially those from the EU's 5th, 6th and 7th Framework programs), those funds were not enough to cover the planned costs for research; thus companies who would be willing to channel their surplus profits into research and not just luxury perks, need to be approached (if they are willing to collaborate according to Question 11 in k.d.a. and if they have needs for new technologies, according to Question 20 in k.d.a., of course). And since companies are looking for collaboration rather than exclusivity of research, UNG could look into which research areas are already being carried out and try to align them with those of the companies (according to Question 9 in k.d.a.) if possible.

Finally, with regard to specialized research equipment, UNG could sign more contracts with companies to come to UNG to perform their research or borrow equipment from UNG labs, because a majority of companies have expressed their wish to do so, according to Question 19 in k.d.a.; however, because most of the companies that perform R&D use their own equipment, UNG could entice companies through promotional activities to collaboration even before companies would buy their own equipment.

CONCLUSIONS

My masters thesis begun – after an introductory chapter – with a discussion of knowledge production in Chapter 1. First of all, I have analyzed numerous definitions of knowledge, which is followed by description of the main characteristics of knowledge that, unlike other goods in the economy, possesses particular properties and thus poses many problems with its measurement using current tools. I also discussed the era of knowledge society, which we are now entering and how this will affect the role which universities play and the appropriate strategies and possible ideas (e.g. corporate universities) for companies in the changing society.

Secondly, I analyzed knowledge transfer. I began already in the chapter on knowledge production (Chapter 1) by analyzing the different types of knowledge and possibility of its transfer via market/non-market means. Furthermore, I analyzed the influence of company characteristics such as industry and size on knowledge transfer. I looked at the studies in the U.S. and in Europe, with the latter including Belgium and Switzerland.

Then I continued in Chapter 2 by analyzing different possibilities of knowledge transfer. I have analyzed both commercial means (using market coordination system or - put in other words - price mechanism) to transfer knowledge, as well as non-commercial means (network coordination mechanisms, based on trust) of coordination of knowledge transfer between two more or less hierarchically organised institutions – universities and companies.

Among the non-commercial means, I have analyzed publications and conferences, consultation work and hiring of students, including those that have already been involved with companies through internship projects or cooperative teaching schemes. On the other hand, I have analysed contract research, cooperative or joint ventures, personnel exchange, patents, licenses, equity investments and founding of start-up companies as commercial means of knowledge transfer.

Then I focused on the institutions which perform knowledge transfer. Those institutions can either be local/regional or global/virtual networks, which transfer knowledge directly or they can be intermediary institutions, such as internal technology transfer offices at universities or independent agents/technology brokers.

The theoretical analysis of ways and institutions of technology transfer is followed by analysis of possible obstacles to knowledge transfer as well as examples of that transfer. I compared all three major geographical areas of technological advance – the U.S., Japan and the EU and provided specific examples of technology transfer from all three of them.

The next chapter (Chapter 3) starts by presenting hypotheses, based on the beginning three chapters, to be tested using the findings of the analysis of supply and demand at the University of Nova Gorica (UNG) and companies and institutions in the Primorska region of Slovenia. First, the analysis researches the supply side, using secondary data availabile at UNG, followed by primary data, collected through interviews with heads of schools and laboratories at the UNG.

Then, the analysis of knowledge demand by the companies follows, based on data, collected from an extensive research of companies and institutions in Primorska region. The aim of the study was also to perform the same analysis on the companies of Friuli-Venezia-Giulia in Italy, however, there was not enough questionnaires returned (too small a sample) to include data from that analysis as statistically significant and draw any generalizations based on it.

If I look at the hypotheses first, hypothesis no. 1 is based on the supply side analysis of UNG regarding education, while hypotheses 2 through 6 are based on educational needs of companies and institutions in Primorska region.

The first hypothesis states that non-commercial means of knowledge transfer prevail over commercial means at UNG, which is consistent with theoretical findings, and was confirmed through the analysis. Hypothesis 2 was partly confirmed, since the majority of the companies do invest into education, yet they prefer a mix of external and internal educators, as opposed to external educators only, as stated in the hypothesis. Hypothesis 3, which stated that companies prefer shorter and more focused courses, where students attain a lower educational degree has been confirmed. Thus we can infer that companies prefer practical, focused, problemsolving courses to educational degrees and titles.

Furthermore, hypothesis 4 states that the needs regarding education differ between manufacturing and service companies, and this can indeed be confirmed in terms of provision of additional education and in terms of internal company education programs. However, when it comes to the preference of external or internal educators teaching and to the type of preferred courses, the differences between both types of companies vanish.

Similarly to hypothesis 4, hypothesis 5 tests the differences between micro, small, medium-sized and large companies. Findings show that micro and small companies have similar views regarding additional education being left to individuals, while medium-sized and large companies have established internal programs of additional education for the most part. Other issues are more or less independent of the size of companies, with one exception for small companies, which give preference to external practitioners only offering education. Regarding the profitability (hypothesis 6), there exist differences between both in terms of unprofitable companies leaving their decision regarding additional education to employees and in terms of profitable companies finding it better if educational programs are offered by both types of practitioners.

On the other hand, regarding research, hypothesis 7 is, as with educational hypotheses, again based on the supply side (UNG) analysis, while hypotheses 8 through 13 are based on the demand side, consisting of companies and institutions.

Regarding hypothesis 7 from the analysis of knowledge supply at UNG, one can infer from different questions that hypothesis holds true – that money is indeed one of the motivational factors enabling university-industry cooperation. On the other hand, hypothesis 8, which stated that most of the profitable companies would be willing to finance research collaboration, has not been proven, since many companies in the study were profitable, yet only a minority would be willing to financially support their R&D collaboration at external institutions.

Hypothesis 9, which stated that most of the companies from the research study have needs for new technologies and thus perform R&D themselves within their own department of R&D, financed by internal assets, has been partly confirmed. The part that companies have needs for new technologies and that those companies, which perform R&D themselves, have their own department for it and finance it with their own assets, has been confirmed. However, the part that the majority of the companies perform R&D by themselves, has not been confirmed. Furthermore, hypothesis 10, which claimed that most of the companies from the research study benefit the most from university research results in the area of applied research while basic research is not so useful, with the exception of chemistry, has been fully confirmed.

Hypothesis 11 stated that companies in different industries (manufacturers and service companies) have different needs regarding research and thus behave differently. It has been confirmed in terms of the need for new technologies, performance of R&D, willingness of collaboration with external institutions and in terms of financial support of the research. Additionally, hypothesis 12 stated that medium-sized/large companies from the research study are more willing to cooperate with universities and other external institutions regarding research than micro/small companies. The differences and thus the hypothesis have been confirmed in terms of research characteristics – performance of R&D, partnership with an external collaborator and financial support. Lastly, hypothesis 13, which assumed the differences in research needs and wants between profitable and unprofitable companies, has also been confirmed in terms of company's own department for R&D, partnerships and applications to programs together with external institutions and in terms of financial support of that collaboration.

Secondly, I researched the knowledge transfer issues from the university point of view, and the findings show that there is still a lot of room where University of Nova Gorica could expand its educational and research programs. In general more promotion is needed at UNG (e.g. promotional letters, organisation of workshops and other events, such as »open door«

events (access of public to lectures and laboratory visits), public announcements of new theses, attendance at different industry conferences and fairs, etc.) in order to inform companies about all the possibilities which UNG offers.

Furthermore, in order to stimulate UNG researchers, they need to be informed about potential benefits of collaboration with companies (and not just from the UNG as a whole, point of view, but what is in there for researchers themselves – e.g. profit sharing from patents and licenses, possibility of publications, etc.). One must never forget that one is dealing with people, who, unlike machines, need to be somehow motivated to perform (usually, when one deals with basic research, intrinsic motivation prevails, however, when you deal with research that is interesting for companies, but not necessarily for university researchers, more explicit forms of motivation of researchers, such as points for promotion, money, etc., and more favourable climate towards applicative research and development, in general, are needed).

On the other hand, even though that was not the original focus of my research, it can be said that companies could also be more proactive in seeking necessary knowledge at the university or at least respond to university efforts. The low number of questionnaires returned as well as companies present at the UNG organised meetings regarding student internships, shows that there is still a lot of managerial myopia regarding the future trends of competition and needs of customers and that so publicized knowledge society is still quite distanced from the Primorska region's everyday business reality.

One must not forget that only mutual efforts from both sides can bridge the gap that currently exists between academia and industry and that anything else will lead to a zero sum game, where both sides will be left at a disadvantage. And this holds true not just for Primorska region, but for Slovenia as a whole and also for any other society looking to bridge that gap. And bridging the gap is becoming ever more important when faced with global challenges of today's world.

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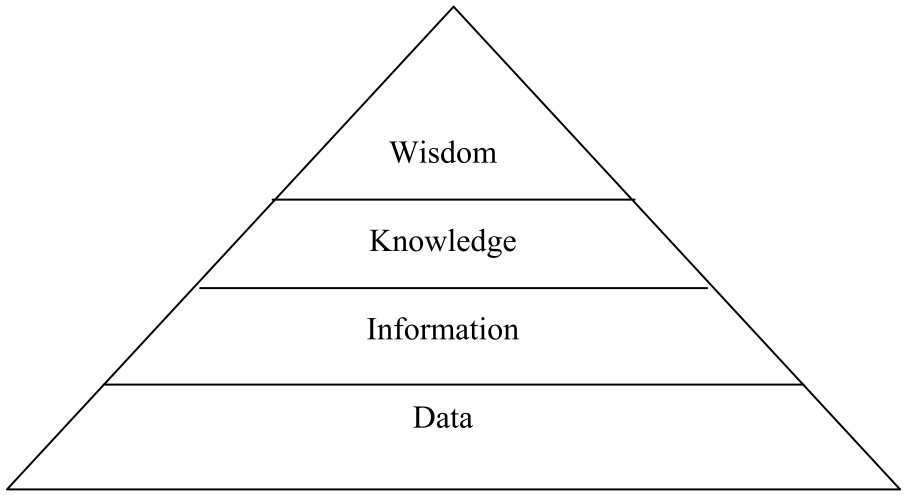
TABLE OF APPENDICES

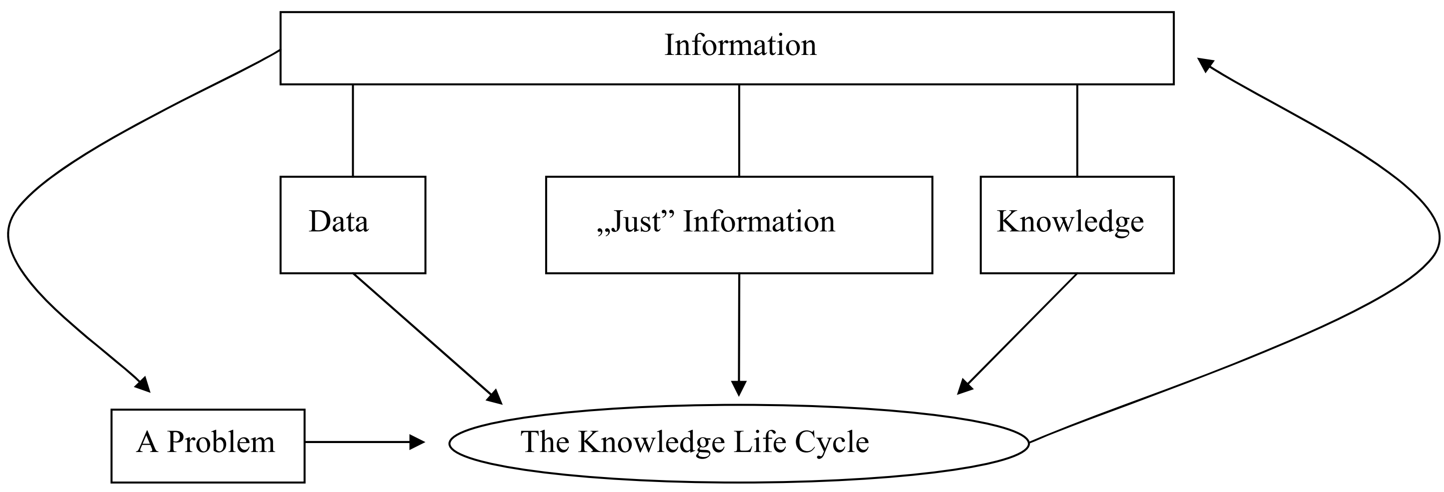
APPENDIX 1: Classifications of knowledge

Figure 1: Traditional distinction between data, information, knowledge and wisdom – the pyramid



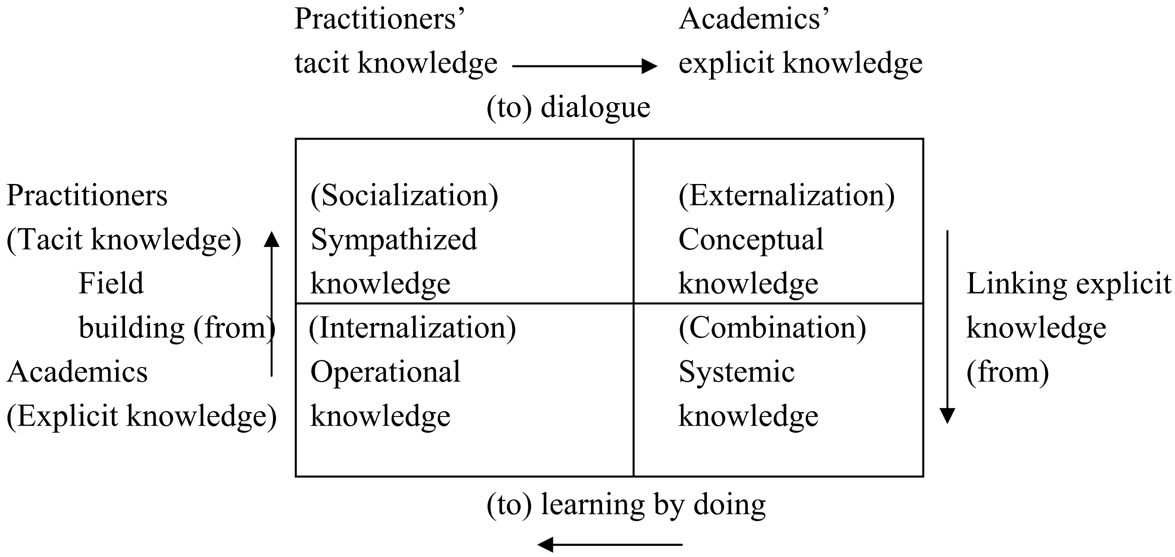
Source: Firestone & McElroy, Key Issues in the New Knowledge Management, 2003, pg. 18

Figure 2: The knowledge life cycle concept



Source: Firestone & McElroy, Key Issues in the New Knowledge Management, 2003, pg. 19

Figure 3: Continuous knowledge creation and transfer according to Nonaka and Takeuchi (1995)



Source: Nicolaidis & Michalopoulos, Education, industry and the knowing-doing gap. A knowledge management perspective of business education, 2004, pg. 106

Figure 4: Knowledge classification according to Nonaka (2002)

Intuitive knowledge	**Conceptual knowledge**
Knowledge, which is based upon common experience: - skills and experience of individuals; - zeal, affiliation, trust and security; - energy, passion and tension.	Knowledge, which is based upon pictures, symbols and language: - ways of development of new products; - design; - registered trademarks.
Routine knowledge	**Formal knowledge**
Knowledge, which became routine based on repetitiveness: - knowledge, which is being performed in daily tasks; - knowledge, which is being encouraged in the whole organisation; - organisational culture.	Knowledge, which is systematized: - documents, specifications, handbooks; - databases; - patents and licenses.

Source: Bernik, Florjančič & Rajkovič, Upravljanje z znanjem in uporaba informacijskih tehnologij, 2002, pg. 474

APPENDIX 2: On patents and their effectiveness

The effectiveness of patents depends on whether it is likely that a patent will be held valid if challenged, if patents are enforcable, if competitors cannot legally invent around them, if technological advance does not move too fast so that patents stay relevant, if patent documents do not require disclosure of too much proprietary information, if licensing is not required by court decisions and if companies do not participate in cross-licensing agreements with competitors.

Specifically, results of the study (Shane, 2002, pg. 122) show that:

- university inventions are more likely to be licensed when patents are an effective mechanism for appropriating the returns to innovation, since the patent system reduces the transaction costs of technology transfer; additionally, licensing to non-inventors is perceived to be the best solution for technology commercialization, since inventors usually do not posses comparative advantage in technology commercialization, which requires a set of skills, such as identifying customer needs, developing product concepts, designing products and processes, prototyping and manufacturing;
- when patents are ineffective, university technology is likely to be licensed back to inventors, because inventor commercialization mitigates the information problems in the markets for inventions/knowledge (adverse selection, moral hazard, hold-up);
- consistent with the first two conclusions, when patents are effective, licensing back to inventors increases the likelihood of license termination and reduces the likelihood of invention commercialization;
- finally, the efectiveness of patents increases royalties earned by research institutions for inventions licensed to non-inventors, because, this way, commercialization is undertaken by economic actors who posses a comparative advantage in that activity.

The results have implications for two research policy fields in particular – one is innovation strategy and management and the other is technology entrepreneurship. Regarding the former, results provide insights into Schumpeterian dynamics in high tech industries. The process of creative destruction through which innovators replace incumbent firms when innovation is being conducted outside of incumbents depends on the industry in question. In many high tech industries, such as biotechnology, even though innovations are performed by outside smaller players, the process does not result in creative destruction.

One reason for variation between industries for incumbents to withstand external innovation lies in the effectiveness of markets for knowledge. Where markets for knowledge are effective (thus patents provide strong protection), nonincumbent innovators can license their technologies to established companies, because patents allow them to earn returns to innovation without competing with incumbents in product markets.

Regarding technology entrepreneurship, the results suggest that university inventors become entrepreneurs because of failures in the markets for knowledge, thus inventor-entrepreneurship is the second best option to commercialization being conducted by specialized external actors. Thus independent entrepreneurship is not necessarily a better option than commercialization by established companies. Additionally, it can be argued that who becomes an entrepreneur, depends not just on certain human traits, such as tolerance of uncertainty, need for achievement, wealth creation, but also upon information and opportunities.

All these factors regarding effectiveness of patents and the nature of technological opportunities provide decision criteria for whether opportunities should be exploited by inventor-entrepreneurs (internalized) or should be contracted out (outsourced) to other specialized actors and institutions dealing with technology commercialization (Shane, 2002, pg.122-136).

APPENDIX 3: Examples of independent agents/knowledge brokers

In Japan, the famous MITI (Ministry of International Trade and Industry) is promoting an idea of setting up a centralized government organisation for transferring technologies from academia to industry. The rationale behind this idea is that individual technology licensing offices, which would be set up by Japanese universities themselves, would, according to American experience, need at least 10 years to become financially feasible.

Therefore a **technology licensing organisation (TLO)** would bring together universities (national, public and private) and business corporations (prospective licensees that can utilize the results of research), which would both participate in the management of a TLO. Additionally, venture capitalists, financial institutions and other consulting firms would participate in management of a TLO as well.

Universities would provide results of research, with intellectual property rights attached, and TLO would do technology appraisals. Then TLO would file an application for a domestic patent with a Japanese patent office and take care of the preservation of patent rights. In case an international patent protection would be needed, TLO would file an application with foreign patent agencies. Additionally, TLO would warn and litigate any domestic or foreign pirates and provide feedback regarding the patenting process to universities. Furthermore, TLO would negotiate with business corporations for marketing and licensing of a certain patent. Finally, the revenues collected from business corporations will be redistributed to universities via TLO (Hashimoto, 1998, pg. 22-25).

On the oposite side of the Pacific – **in United States** – a different form of organisations has existed since 1880 already. They are called **university-industry research centers (UIRCs)**. Their number has particularly increased since 1970s, when the National Science Foundation created a series of programs to stimulate their formation and in 1980s, when state governments in the U.S. created such programs.

Federal and state governments are the major sources of finance for the UIRCs, providing half of the funds, with roughly 30 % coming from industry and 20 % coming from universities themselves. UIRCs are the major institutions for direct industry support of academic science and engineering R&D. Besides industry funding, companies provide universities and UIRCs with equipment, access to industrial facilities and practical experience for students.

Most UIRCs (75%) were initiated by university faculty members and not by industrialists. This may not be surprising if we take into account that the reason behind the establishment were shortfals in federal research support or explicit government programs that tied university research support to industry participation.

Thus most UIRCs pursue more traditional academic objectives and do not perform research regarding improvement of companies' products and processes. Nevertheless, those that do commercial technology development and thus help increase efficiency of private R&D efforts, create substantially more inventions, prototypes, patents and licenses than those that are more concerned with traditional academic research. Besides research, UIRCs provide education and training to both undergraduate and graduate students and delivering trained employees to industry. This educational function of UIRCs is very important.

In general, there exists a tradeoff between industrial orientation of UIRCs and their traditional academic orientation. Industrial orientation has its costs and benefits. Benefits come in terms of immersion in real world problems, access to industrial facilities and data. Costs, imposed by industrial partners, come in terms of restrictions in communication flow and information sharing, delays in publications or not publishing certain findings at all, etc. Nevertheless, benefits for the society in terms of more effective mechanisms for advancing commercial technology, outweigh the costs and UIRCs still generate significant academic results, which are publicized (Cohen et al., 1994, pg. 1-6).

Another example of an independent agent or knowledge broker is the **Long Island Research Institute**, which was set up in 1992. The aim of the institute was to create and nurture enterprises based on technologies, which were developed in its sponsoring institutions: the University at Stony Brook, Brookhaven Laboratories and Cold Spring Harbor Laboratories, and North Shore University Hospital.

The experience from this example shows that for success of such an organisation:
- it is necessary to have professionals who combine professional and business know-how;
- managers need to have extensive contacts with local business and research communities, because commercialization of technology entails interplay among scientists, managers, civil servants and financiers;
- there needs to be a variable company assistance, because each company and each commercialization project is different, plus it needs to be on an ongoing basis, because a new venture is an ongoing concern;
- venture capital is beneficial for any commercialization project, yet, public and institutional funding is welcome to provide support in tech transfer as well;
- if the needs of companies are known, this can quicken the commercialization process, because, apart from »push factors« from R&D institutions, a powerful motivational force is fulfilment of the needs of the companies, which is a »pull factor« from the company side;
- there should be an entrepreneurial champion for each project – no matter how great the efforts of university technology managers are, if there does not exist a person with the drive, energy and determination to bring new technologies to the market, the project will hardly succeed (Dempster & Goldberg, 1996).

APPENDIX 4: Analysis of primary data – interviews at the University of Nova Gorica

Four full-time professors at UNG were interviewed regarding the knowledge which is »deposited« at UNG and which UNG could offer to companies. Those professors represent the main three schools at UNG – School of Engineering and Management, the School of Environmental Sciences and the School of Applied Sciences.

Two professors come from the School of Engineering and Management – one is the head of the Center for Criptography and Computer Security,[47] and the other is the head of the Laboratory for Multiphase Processes. The third professor is both the head of the School of Environmental Sciences and the Laboratory for Environmental research, while the fourth is both the head of the School of Applied Sciences and the Laboratory of Organic Matter Physics.

Question 1: ***Do you already cooperate with <u>companies</u> and <u>institutions in the public sector</u>?***

All four interviewed professors have answered positively, meaning that they currently cooperate or have already cooperated with companies and the institutions in the public sector.

Question 2: ***If YES – in what way and how much do you <u>currently cooperate/have you so far cooperated with industry</u> (with private and public[48] companies) <u>and the public sector institutions</u> (institutes, faculties, universities, schools, hospitals, centers, etc.)?***

PERFORMING RESEARCH FOR:

- Fructal, Tekstina Ajdovščina, Salonit, Iskra Avtoelektrika, Meblo, Vinska klet (wine cellar) Dobrovo, Komunalno podjetje (public utility company) Nova Gorica, Zavod za zdravstveno varstvo (Public health institute) Nova Gorica, Zavod za kmetijstvo in gozdarstvo (Agriculture and forestry institute) Nova Gorica, Inštitut za biologijo (Biology institute) Ljubljana (students are responsible for collaboration with some institutions and companies);
- a company in Slovenia (development of a flexible display); a company in Italy, with whom UNG is currently collaborating as part of the EU's 6th Framework Programme of research;
- Project with MORS (Ministry of defense of the Republic of Slovenia) and SOVA (Security agency of the Republic of Slovenia) and E-government project with the Municipality of Nova Gorica;
- Goriške opekarne (brick producers) project from the year 2002, Impol Slovenska Bistrica, ARAO agency; and a 10-year collaboration with aluminum (Talum Kidričevo) and steelworks industries (Jeklo Štore, Acroni Jesenice).

[47] This center has ceased to exist at the University of Nova Gorica at the time of publishing of this master thesis, thesis author's comment.
[48] It means government owned (and NOT that it is trading on the stock market), thesis author's comment.

OTHER FORMS OF COLLABORATION (e.g. workshops, consulting, etc.):

- lectures (undergraduate and graduate studies) and consulting activity;
- tutoring (internships, theses – bachelors, masters, doctorate);
- workshops as part of obligations regarding international exchanges – e.g. workshop on environmental epidemiology, on environmental impact assessment, radioactivity and radiological protection (usually 20-40 people participate in these workshops);
- presentation of possibilities for joint collaboration with the hospital of »Franc Derganc« in Šempeter pri Gorici; ADACTA – smart cards for the Social security agency of Slovenia, student internships in companies;
- conferences.

Question 3: ***If you have COOPERATED with companies and public institutions, how satisfied are you with this cooperation? What was positive/negative according to your opinion?***

- for the development of a flexible display there was not enough resources availabile (Nova Gorica municipality was able to give much less than what is needed for commercialization of research; unfortunately EU does not give resources for commercialization of research either, but only for research itself (this is due to change, however, with the EU promotion of the so-called Centers of excellence, thesis author's comment));
- good thing is that it is possible to get student placements in those companies, so that students are offered jobs after finishing projects with certain companies.

Question 4: ***What would you like to see more and which things would you like to avoid regarding future collaboration?***

Problem of weak financial support from companies and public sector institutions (with some companies being a notable exception).

Question 5: ***Was previous cooperation more of a formal (contractual) or informal type?***

FORMAL – which forms of cooperation?
when cooperation includes monetary transactions and payments, when dealing with companies, when dealing with the Ministry of defense and similar government institutions and when doing research projects

INFORMAL - which forms?
student diplomas

Question 6: ***Have you applied for/acquired any patents and have you signed any license agreements with other companies; have you created any companies by yourself?***

- YES – two patents have been granted after five applications during one of the professors' stint at Certicom Corp. (encryption technologies) in Canada;
- YES – two patents are currently in the procedure to be granted.

Question 7: ***If you did not collaborate (or collaborate less than expected), please tell me what was the reason behind non-cooperation?***

- I do not have contacts with external institutions (outside University of Nova Gorica) (no answers)

- no money for cooperation (1)

- no time for cooperation (no answers)

- no willingness for cooperation from companies/institutions (2): companies or government institutions already buy developed solutions from abroad

Question 8: ***Have you used technical aids/laboratory equipment during collaboration and which one?***

YES – we have used it ourselves (4)
YES – we have lent it to a company/public institution (no answers)
NO (no answers)

Equipment: UNG's own equipment (2); companies could sign contracts to come to work at UNG, but usually there are students working in laboratories who, in connection with companies, prepare bachelors and masters theses; sometimes we have also used equipment, availabile in companies; equipment, used so far in collaboration – e.g. computer code or computers and our own computer programs, financed on behalf of the interested companies

Question 9: ***Suggestions and complaints regarding collaboration in the future (what could be offered to companies and other public institutions in the future):***

- in Slovenian scientific policy there exists a conflict between patenting research results and publicizing the results, which is – the latter – necessary for an academic career – if something would like to be patented, research results are not allowed to be publicized, and the patenting process itself is long and researchers usually do not have time to do it;
- if there was more money from companies, young researchers could give less lectures and do more research; additional researchers could also be employed;
- it would be great if companies themselves would come to University of Nova Gorica, however, because this is not the case, more promotional activities are needed;
- money is a problem, always, because companies in the Primorska region are not willing to invest their financial surpluses into research & development (R&D), but they usually spend it on luxury goods; on the other hand – banks are not willing to invest into start-ups – thus more venture capital is needed (there is a potential, though, of contacting Italian financial institutions, which are already more advanced in terms of financial instruments – author's comment);

- another problem are human resources – gaining enough students to study natural sciences and enough researchers willing to come to Nova Gorica to perform their research (there exists a potential of introducing interesting/useful new programs and projects which would attract them to Nova Gorica – thesis author's comment);
- when cooperating with companies, it is necessary that companies provide enough financial resources for applied research – for the needed equipment and for employing new researchers, because current researchers are full time occupied with their doctoral research;
- in general, organised forum, where the state/local government, companies and UNG would discuss joint development and its implementation is needed (a new forum, called IN-Prime -Primorska enterprise, whose aim is to do just that (In-Prime, 2004) has come into existence and UNG is a part of it – thesis author's comment);
- we could program smart cards – however, there is not enough smart cards to be able to program them – idea for a new company which would import smart cards into Slovenia from its producers in the U.S., France (Gemplus) and Germany (Siemens);
- three main motivational factors for academia to collaborate with the industry are:

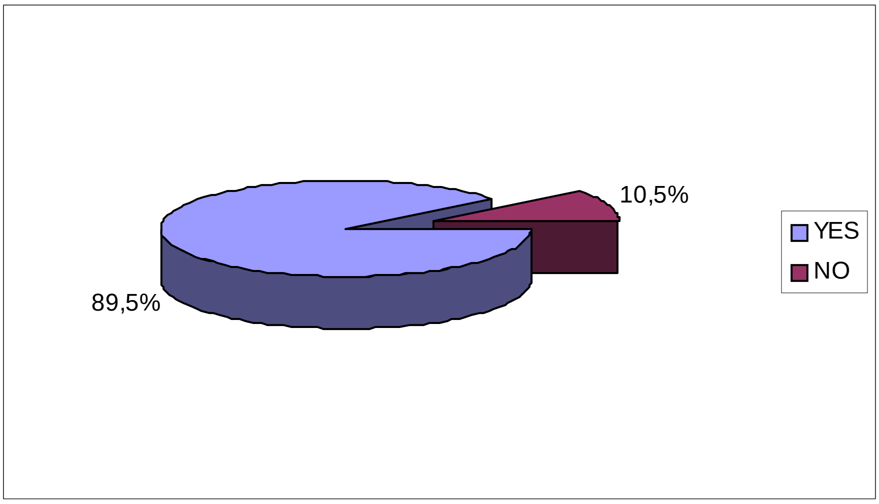
1. financial resources – if there does not exist enough money to finance research (or a research group) from the government, the academia is willing to collaborate with the industry;
2. financial resources – researcher's personal gains prompt them to collaborate with the industry;
3. evaluation criteria – if the government would include collaboration with the industry among criteria to promote a professor to a part-time or a full-time status, there would be more willingness to collaboration.

APPENDIX 5: Analysis of primary data - company questionnaires

Since the sample of Italian companies is very small (only three respondents), I have focused my analysis on Slovenian companies only.

Question 1: ***Do you ADDITIONALLY EDUCATE your employees?***
YES: 68
NO: 8

Figure 1:



As shown in Figure 1, a large majority of surveyed enterprises (almost 9 out of every 10) additionally educates its employees.

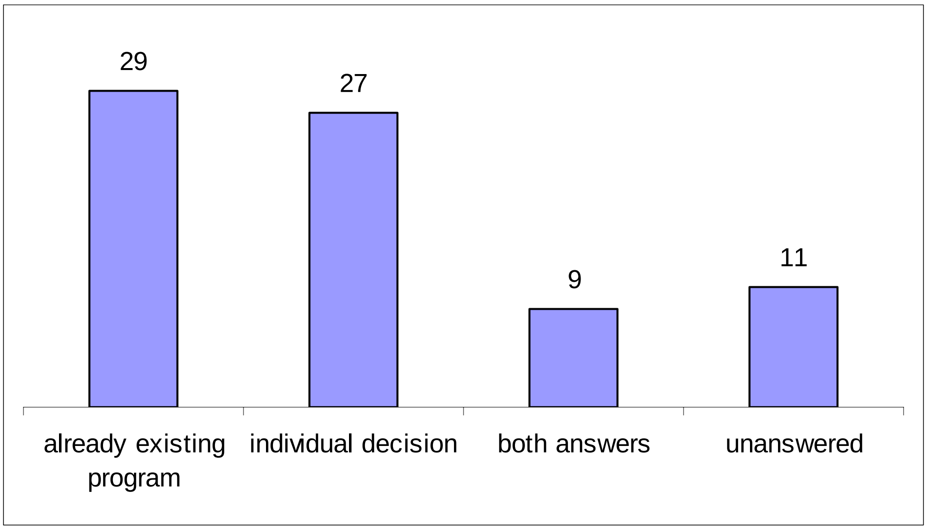
Question 2: ***If YES, in what way do you offer additional education?*** [49]

- ***we have an already existing program of additional education in the company*** (29)
- ***a decision regarding additional education is left to individual employee*** (27)
- both answers: 9, unanswered: 11

38 % of the surveyed companies have an already existing program of additional education in the company, while 36 % of companies leaves the choice of additional education to individual employee; in 12 % of all cases both possibilities are being offered.

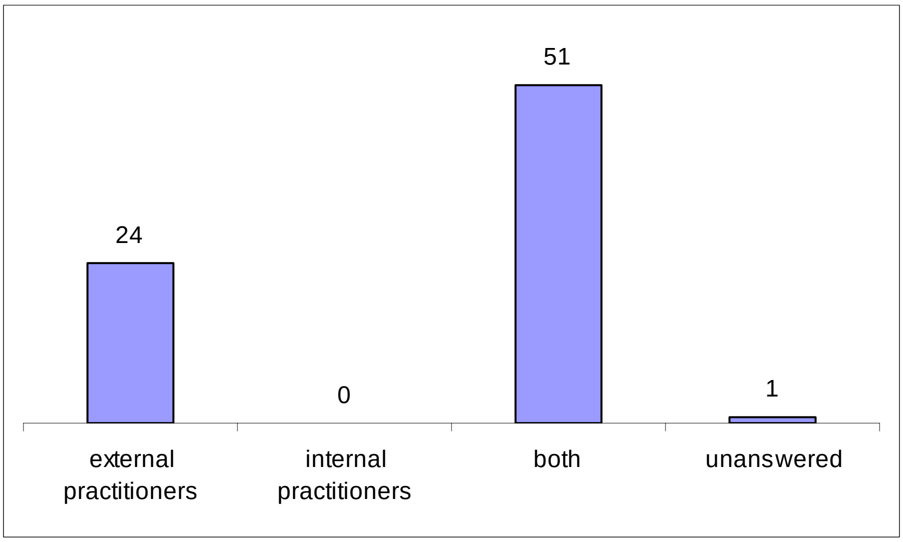
[49] The numbers next to answers or in brackets correspond to the number of respondents who answered the same.

Figure 2:



Question 3: ***Do you find it better – regarding preferences and your experience – if the program of additional education is being offered by company's internal practicioners, external practitioners or both and why?***
External: 24
Internal: 0
Both: 51
Unanswered: 1

Figure 3:



In 67 % of analysed cases the best possibility is to offer a program of additional education both by company's external and internal practicioners, while 32 % of companies think that external practitioners (individuals or educational institutions outside the company) are better than internal ones. Surprisingly, none of the companies would like to see education programs delivered by internal practitioners only – thus either external practitioner only or both – external and internal – together should offer educational programs to companies.

Reasons for external practicioners:

- no internal educators employed;
- new knowledge in different areas, which is missing in the company (2);
- gaining knowledge, which is independent of the known experience;
- greater professionalism;
- small company (no resources);
- more competencies;
- a view outside the company (the big picture) / new approaches to problemsolving;
- professionalism and objectivity (greater independence);
- employees take them more seriously;
- they are educated for it (they are specialized for it);
- their experience in different fields (soft knowledge);
- some posts within the company require formal external education;
- more general educational programs;
- more formal (theoretical) and complex programs;
- specific knowledge regarding standards;
- time constraints within the company

Reasons for internal practicioners:

- more economical;
- more concrete (specific) knowledge and programs, depending on the specificities of the organisation and the work tasks within the company (4);
- applying external knowledge for solving internal problems;
- they know company specific environment, possibilities and needs (2);
- showing concrete examples, concentrated contents, concrete topics and usually a more relaxing atmosphere;
- educating employees about specific internal matters;
- internal practicioners have tacit knowledge;
- for computers / IT education, languages and all matters, connected with company internal systems;
- internal knowledge transfer (among employees);
- educating employees for production tasks

Reasons for both types offering education:

- a combination of both is better than just one or the other;
- achieving the optimal form (this way theoretical knowledge could be better adapted to the real situation);
- a combination of professional theoretical knowledge and practical experience at work (going from problems to solutions);
- adaptable topics, dynamics, rationality;

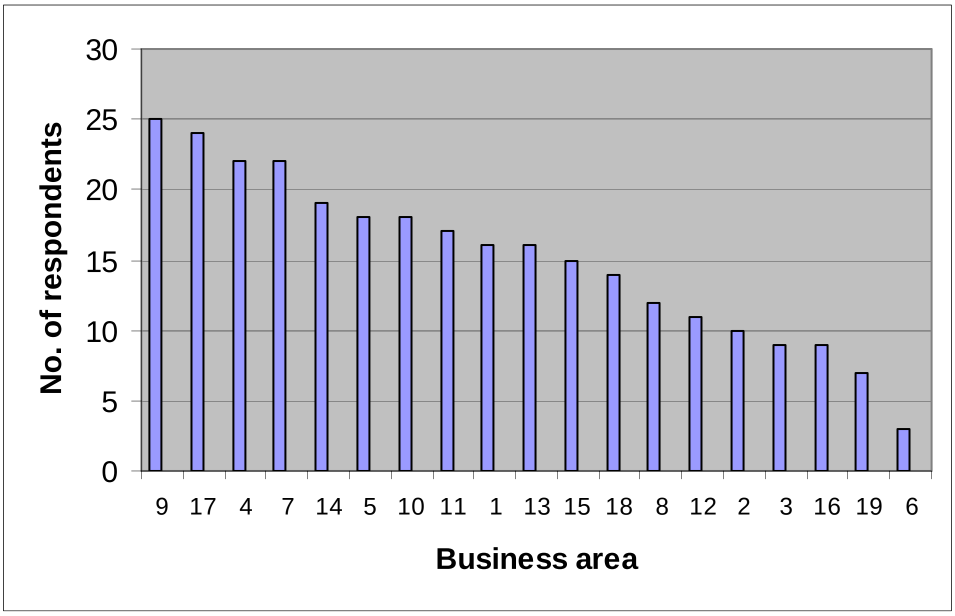
- more sources of information helps you form your own opinion;
- more knowledge gained;
- different approaches to education and knowledge transfer, depending on previous experience;
- in general it depends on the topic (contents/area) and type of education, the structure of employees and needs; and who can more efficiently fulfill needs;

Question 4: ***In which area of business do your employees mostly lack knowledge/expertise?***

- ***1 - procurement*** (16)
- ***2 - production technologies*** (10)
- ***3 - production automatization*** (9)
- ***4 - production optimization*** (**22**),
- ***5 - logistics*** (18)
- ***6 - energy supply*** (3)
- ***7 - quality of products, services and processes (standards)*** (**22**)
- ***8 - environmental knowledge*** (12)
- ***9 - product sales (or offering of services)*** (**25**)
- ***10 - marketing (if it is separated from sales)*** (18)
- ***11 - finance*** (17)
- ***12 - accounting*** (11)
- ***13 - human resources*** (16)
- ***14 - informatics*** (19)
- ***15 - R&D (research & development)*** (15)
- ***16 - management of new technologies*** (9)
- ***17 - project management*** (**24**)
- ***18 - overall company management (leadership) skills and tasks*** (14)
- ***19-other:*** new knowledge regarding EU (logistics, sales); knowledge of foreign languages, internal company organisation, general rules of behaviour, interpersonal relations – cooperation among different groups, teamwork, human resource management

Majority of companies lack knowledge in sales of products or offering of services. This is followed by project management techniques and skills. Another highly sought after area is the quality of products, services and processes (achieving certain quality standards) and optimization of production.

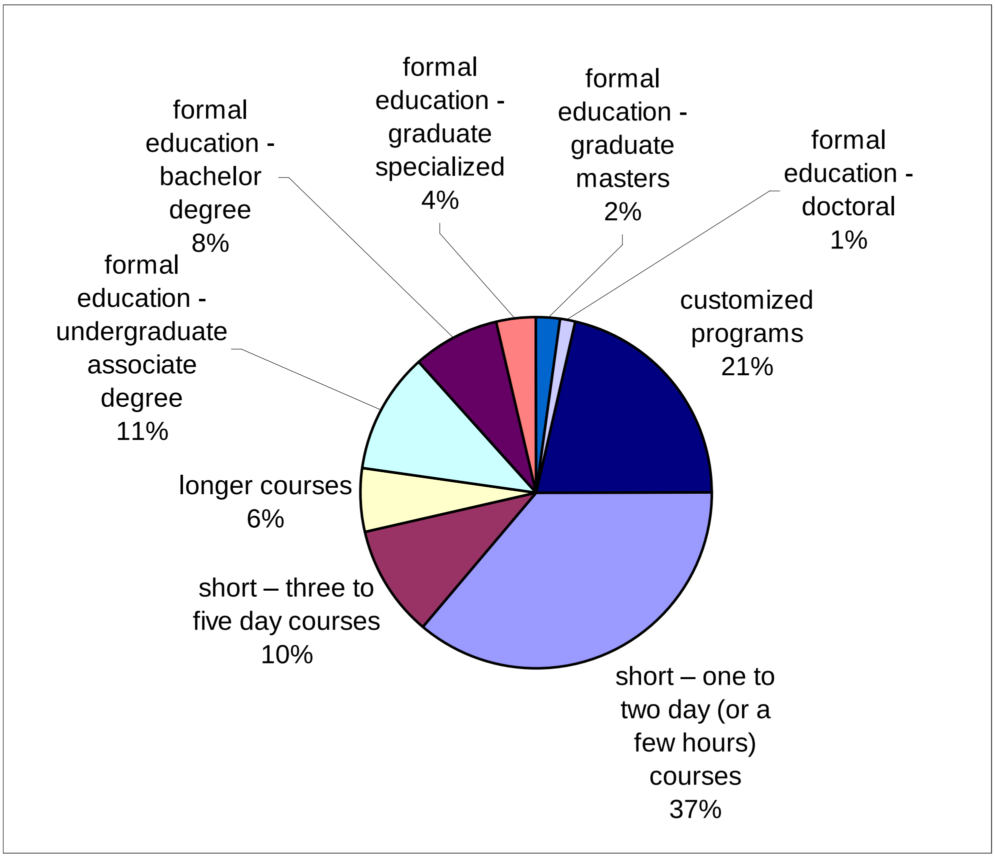
Figure 4:



Question 5: *What educational programs would you find the most useful for the enhancement of knowledge of your employees?*

- ***short – one to two day (or a few hours) courses on the following topic*** (49): accounting (2), finance, taxes, sales, marketing, procurement, HRM (human resource management), leadership skills & motivation, interpersonal relations within and outside of a team, marketing, internal & external communication, informatics (2), production technologies & automatization & optimization, castings technology, management of technology, project management, quality of services, logistics, standards (ISO certificates), informatics, quality, new products
- ***short – three to five day courses on the following topic*** (14): project leadership, marketing and foreign languages, sales, accounting, finance, technologies, R&D, quality, informatics, planning, logistics, change of law and business environment, working with production machines, plastics
- ***longer courses (please specify the preferred duration)*** (8): 1-2 month courses on marketing and foreign languages, specialized studies on Fridays/Saturdays on general computer knowledge; 1-2 week courses abroad with suppliers involved, specialized knowledge regarding marketing and high tech;
- ***formal forms of education – which ones:***
    - ➢ ***undergraduate associate degree studies*** (15)
    - ➢ ***undergraduate bachelor of science/arts degree studies*** (11)
    - ➢ ***graduate specialized studies*** (5)
    - ➢ ***graduate masters degree studies*** (3)
    - ➢ ***doctoral program*** (2)
- ***customized programs, which are tailored to the needs of the company (e.g. consortia studies)*** (29)

Figure 5:



Regarding courses, short – one to two day courses are prefered to three to five day courses, with 36 % and 10,3 %, respectively, while only 5 % of respondents prefers longer courses - few weeks or months courses.

Regarding formal educational programs – customized programs, tailored to suit the needs of companies (e.g. »consortia« studies, where a »consortia« of companies is formed with programs adapted just for them) are majorly sought after with 21,3 % before associate undergraduate studies and bachelor degree studies).

Overall, really short programs predate individually tailored programs, while both predate formal forms of education.

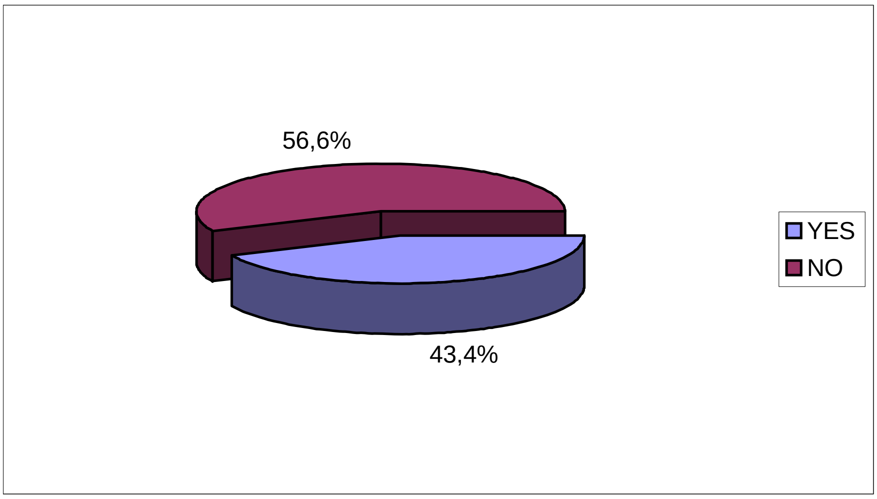
Question 6: ***If you are interested in longer forms of education, which study topic would you be most interested in?***

Mechanical engineering (2), electrotechnics (2), chemistry, environmental science, construction, energy, computers and informatics (2), informatics and telecommunications, economics, business process optimization, business, international business, marketing, sales, finance, management (2), law.

Question 7: ***Do you perform R&D (RESEARCH AND DEVELOPMENT) in your company?***

YES: 33
NO: 43

Figure 6:

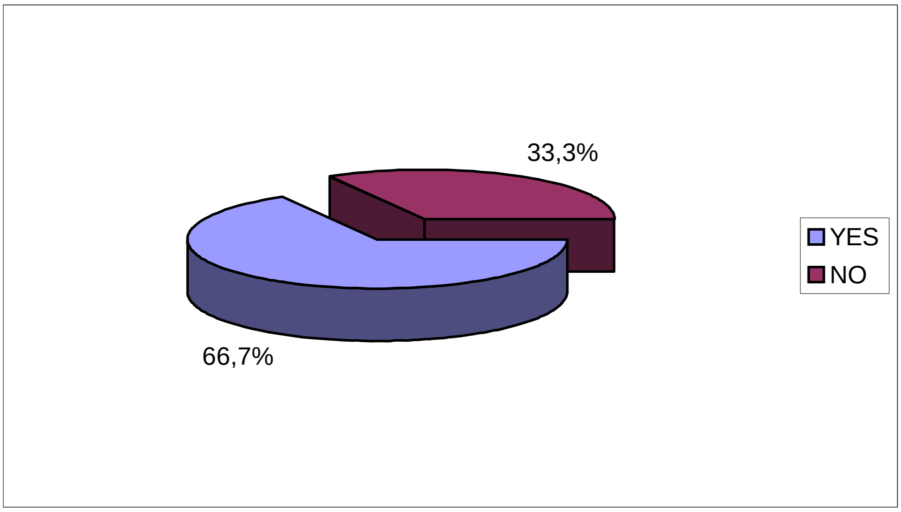


Majority – almost 57 % of companies do not perform R&D in their company, while 43 % do.

Question 8: ***If you have answered to the previous question with YES, do you have your own department of R&D?***

YES: 22
NO: 11

Figure 7:



Out of those that do perform R&D (positive answer to question no. 7), 66,7 % have their own department of R&D, while 33,3% do not have that.

Question 9: ***In which fields of science/technology do you perform your research?***

- development of new products (both regarding materials and design) and processes (4);
- food/nutrition; meat products;
- alloys& plastics, kryogenics;
- chemistry, special poliuretan foams; chemistry (dispersions and glues); colourings;
- protection of environment;
- metalurgy (castings) (2);
- mechanical engineering (3);
- products for automobile and cable industry; hydraulics and pneumatics;
- physics, electrotechnics/electronics;
- electrotechnics, electric motor controls;
- furniture frames, tools and composition systems;
- floor tiles; lighting system; overcharging protection (energy and telecommunications);
- telecommunications (2); business informatics; information technology; other informatics: heterogeneous information systems, e-government, computer graphics, grid, semantic web;
- quality, organisational culture;
- market research (2).

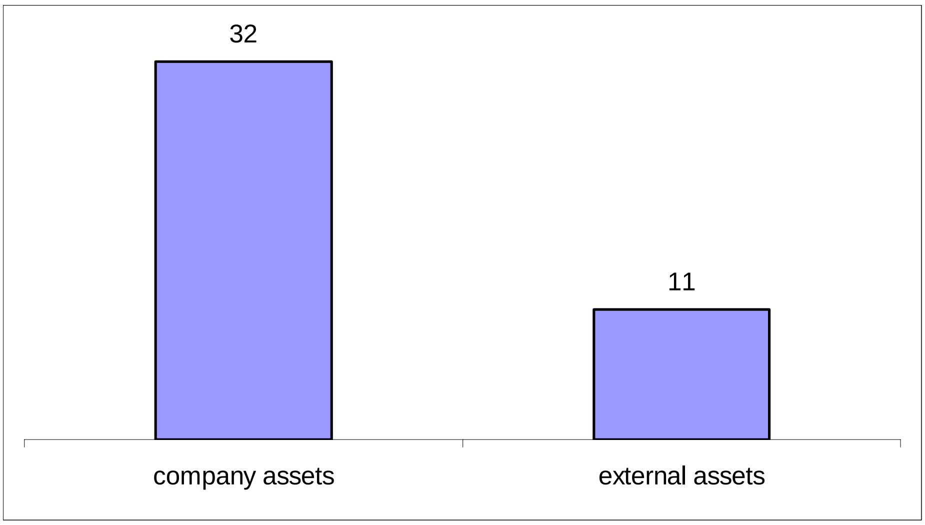
The fields of science and technology that a majority of research is being performed in, are development of new products and production processes, mechanical engineering, telecommunications and – among services – market research.

Question 10: ***In which way do you finance the afforementioned research (company resources/external resources)?***

Company resources: 32

External resources: 11

Figure 8:

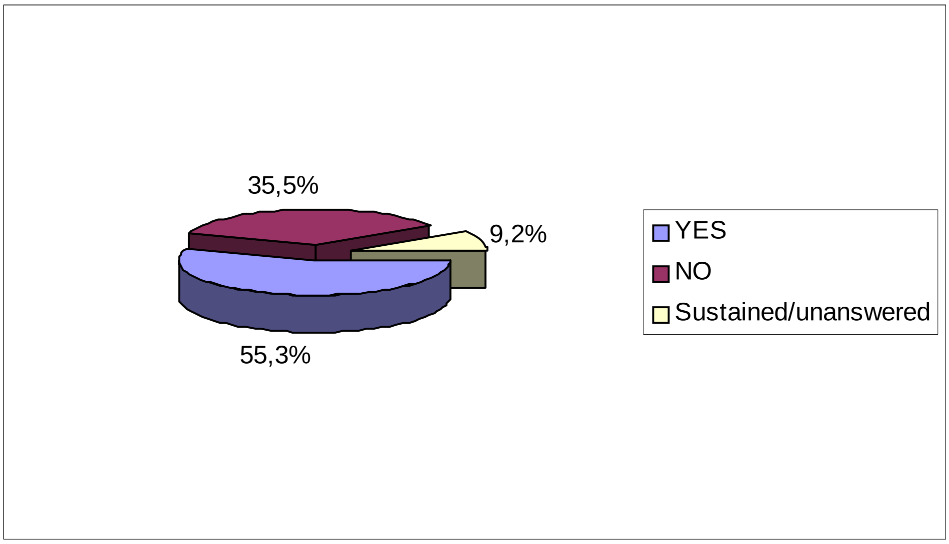


The afforementioned research is being primarily funded through company resources (74 % of the cases), while external resources, which include Ministry of economic affairs, Ministry of education, science and sport, Technology park of Primorska in Nova Gorica, interested investors and three public tenders, have been important in 26 % of the cases.

Question 11: ***Would you be willing to conduct research activities <u>in partnership with an external collaborator</u> (complementing your own research with an external research institution)?***

YES: 42
NO: 27
Sustained/unanswered: 7

Figure 9:



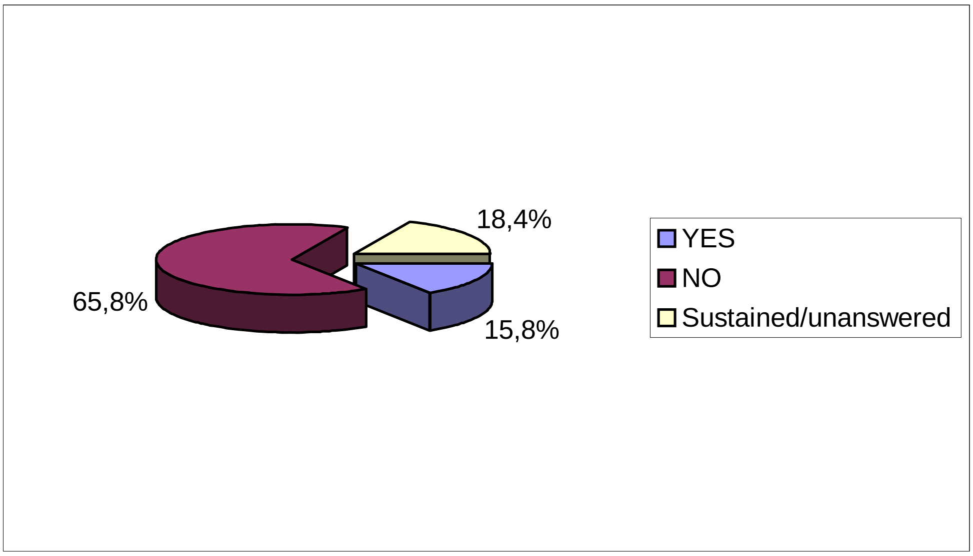
Majority of the companies would be willing to complement their research activities in partnership with an external research institution, while more than a third of companies (35,5 %) would not be willing to do that.

Would you be willing to conduct your research via an external collaborator ONLY (scientific-research organisation)?

YES: 12
NO: 50
Sustained/unanswered: 14

When asked if the chosen companies would allow an external collaborator to conduct their research, without their direct participation, companies would not be willing to do that in almost 66 % of analysed companies.

Figure 10:

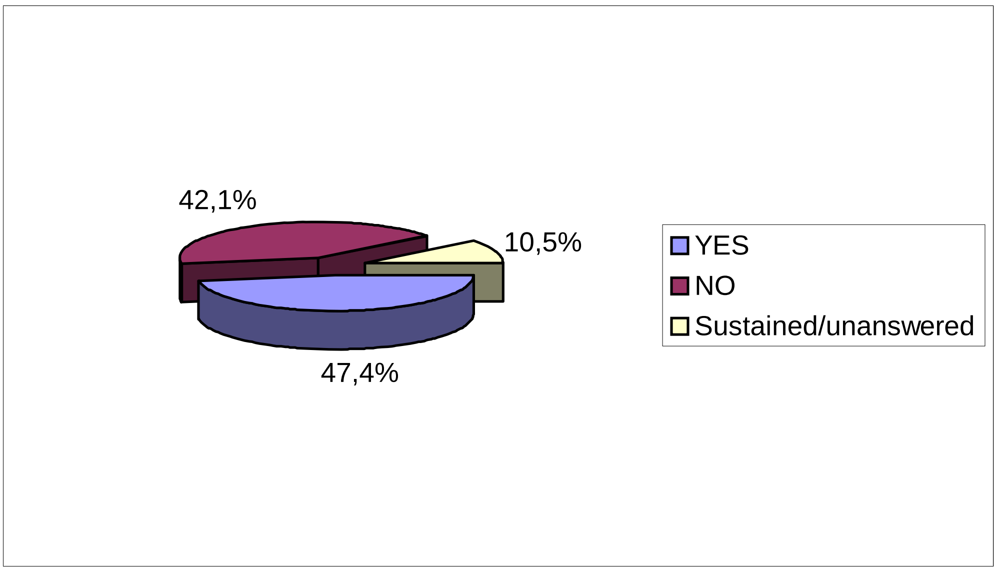


Question 12: ***Would you be willing to financially support your research at the external collaborator (educational & research institution)?***

YES: 36
NO: 32
Sustained/unanswered: 8

The analysed companies are almost indifferent whether to financially support their research at the external educational & research institution or not. 36 companies or 47,4 % would be willing to do that, while 32 companies or 42,1 % would not, with 10,5 % of the companies sustaining themselves from answering.

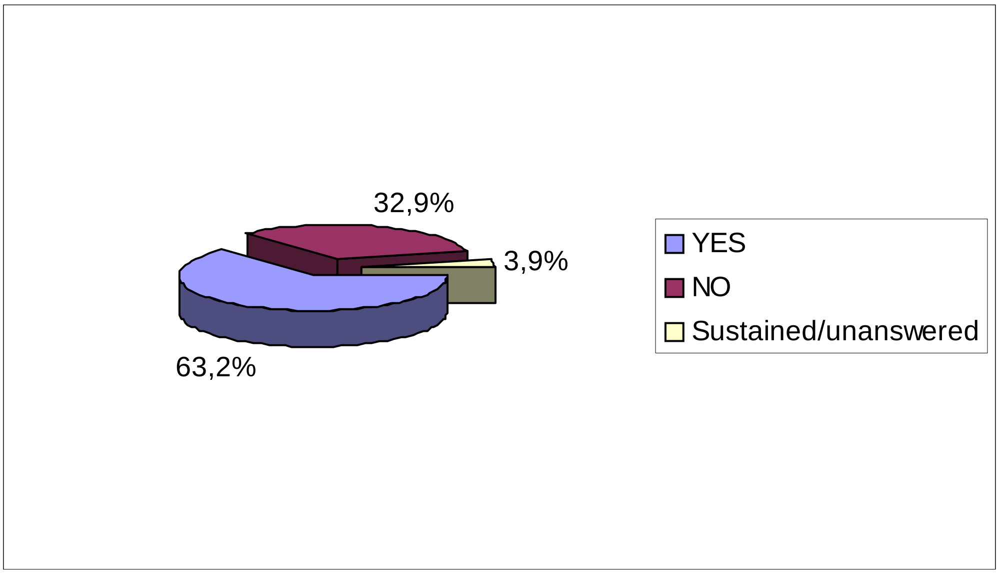
Figure 11:



Question 13: ***Would you be willing to apply for local/regional, national and EU research programs together with an external institution?***

YES: 48
NO: 25
Sustained/unanswered: 3

Figure 12:



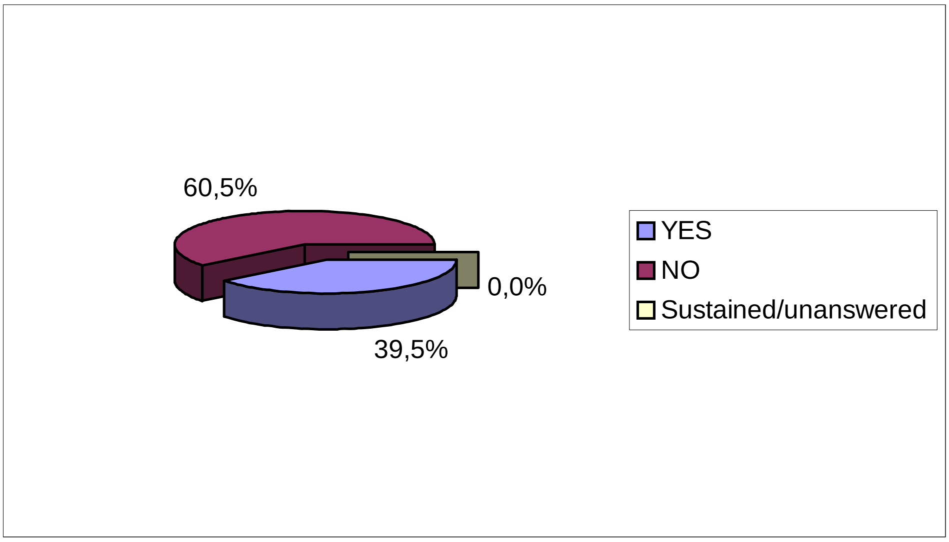
When asked about applying for local/regional/national or EU research programs together with an external institution, the situation was similar to the first part of question 11, in terms that a majority – 63,2 % of the companies would be willing to do that, while 32,9 % would not.

Question 14: ***Have you so far collaborated with any educational/scientific institutions?***

YES: 30
NO: 46
Sustained/unanswered: /

As can be inferred from figure 13, 60,5 % of companies has not collaborated with any educational/scientific institutions yet, while almost 40 % has.

Figure 13:



Question 15: ***If YES:***

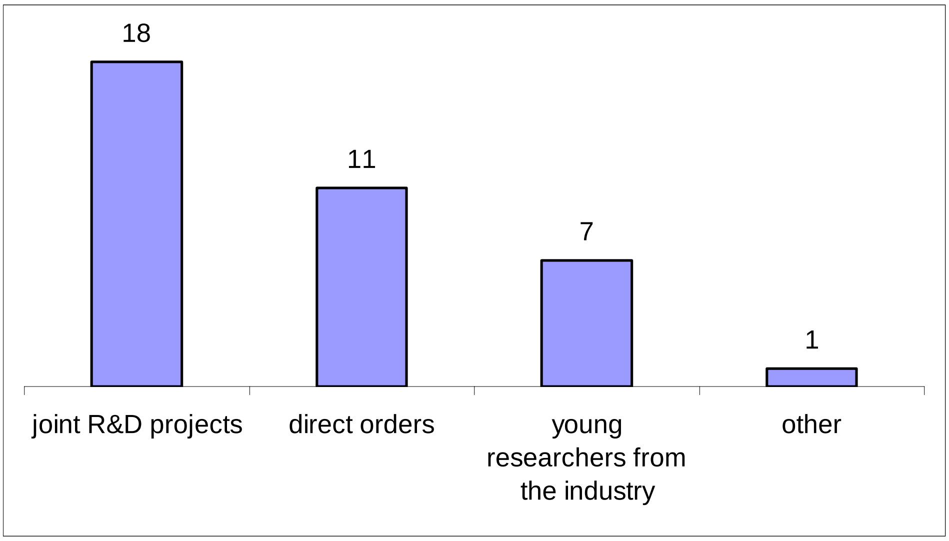
a) ***with which institutions?*** Faculty of Electrical Engineering Ljubljana (7) – Laboratory for lighting technologies; Faculty of Mechanical Engineering Ljubljana (6), »Jozef Stefan« Institute Ljubljana (4), Biotechnical Faculty (3), University of Nova Gorica (3)– School of environmental sciences, School of applied sciences; Faculty of Economics Ljubljana (FELU) (2), Faculty of Natural Sciences and Engineering (2), School of design (design academy) (2), School of management, university institutions, »Milan Vidmar« Institute Ljubljana, Mass media faculty, ZRMK, Faculty of Mechanical Engineering Maribor, Faculty of Computer and Information Science, Paul Scherrer Institute (Switzerland), EBRD, Institute for Work Relations, Institute for Business Law, Faculty of Chemistry and Chemical technology, Textile institute Maribor, Management research institute of the Faculty of Management Koper, Institute of metalurgy, ENAIP

b) what form of collaboration:

- ***joint R&D projects:*** 18
- ***direct orders:*** 11
- ***young researchers from the industry:*** 7
- ***other:*** consultations between a company and a research institution

Out of 37 answered questionnaires, 18 or 48,6 % of respondents has already done joint R&D projects with educational/scientific institutions, 11 were direct orders, while in 7 cases collaboration was about CEOs sending young researchers from their respective companies to work in research settings at research/educational institutions, which is clearly shown in Figure 14.

Figure 14:



c) what was your experience regarding this collaboration (good/bad)? – please elaborate on your answer: good (20) – description regarding collaboration: development projects, student internships, exchange and transfer of knowledge, measurements, education of employees, new experience, tests being made;

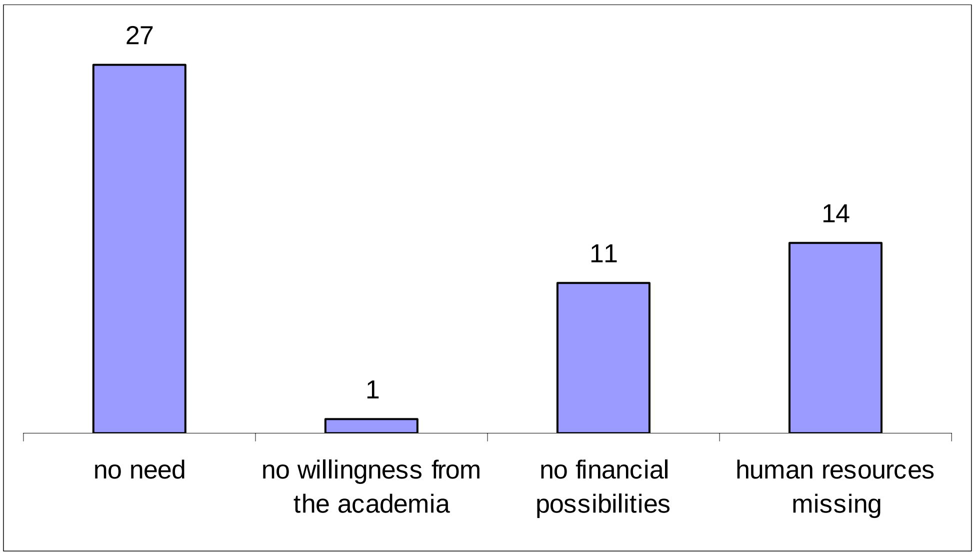
- remarks regarding collaboration: feedback on the needs of the market is increasing (institutions are adapting to companies), one project was not chosen from the ministry, natural science faculties in Ljubljana are lacking human resources (they are already busy with too many projects), students were eager to learn from the people who work in companies (who have practical experience); the institute did not do what they were specifically asked to do

Question 16: ***If you answered NO to question no. 14, what was the reason:***

- ***there was no need*** (27)
- ***there was no willingness from the educational/research institution side*** (1)
- ***we do not have financial possibilities*** (11)
- ***we do not have human resources possibilities*** (14)
- ***other (please specify):*** for such collaboration you need time, money and a person who will work on that – right now we cannot afford this due to full employment of assets and employees; specificity of our production programs; high prices of services; we cannot decide on our own (100 % foreign ownership); no possibilities; we do not feel the need (retail industry); we did not contact anyone; always running out of time for such projects (office equipment industry).

Regarding non-collaboration, the major reason behind it – 51 % of respondents – was that there was no need felt from the industry. Many companies (26%) also do not have adequate human resources possibilities, while some (21 %) do not have financial possibilities to enter into such a collaboration with educational/research institutions. All this is represented in Figure 15. While there was also one case when a research/educational institution was not willing to collaborate, other reasons are mentioned above.

Figure 15:

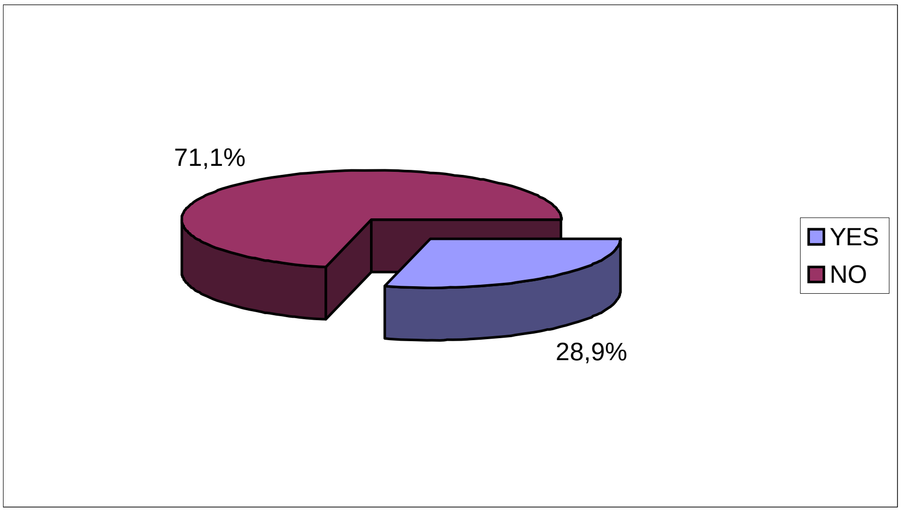


Question 17: ***Do you perform tasks within your company for which you need specialized technical or lab equipment?***

YES: 22
NO: 54

Most of the companies do not perform tasks for which one would need specialized technical or lab equipment.

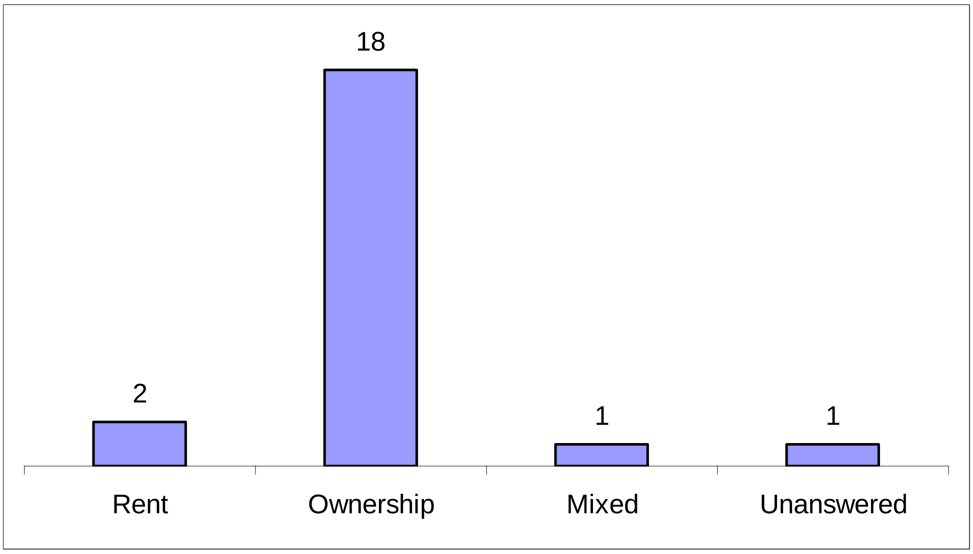
Figure 16:



Question 18: ***If you answered the previous question with YES: do you rent this equipment or do you own it?***

RENT: 2
OWNERSHIP: 18
Mixed: 1
Unanswered: 1

Figure 17:

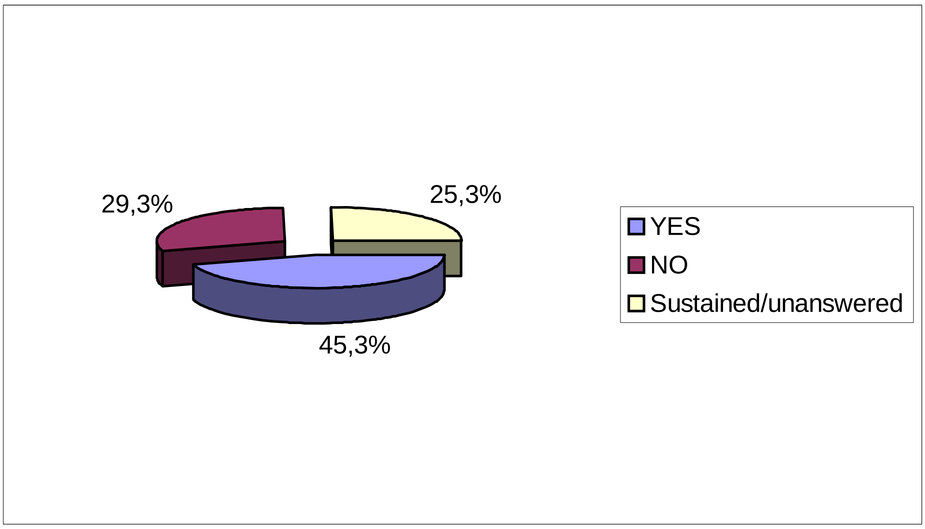


Those that do perform those tasks mostly own this equipment. Only in two cases do the companies rent it.

Question 19: ***Would you be willing to use the equipment, which is availabile in the laboratories of science/research institutions, if those institutions would have free capacities?***

YES: 34
NO: 22
Sustained/unanswered: 19

Figure 18:

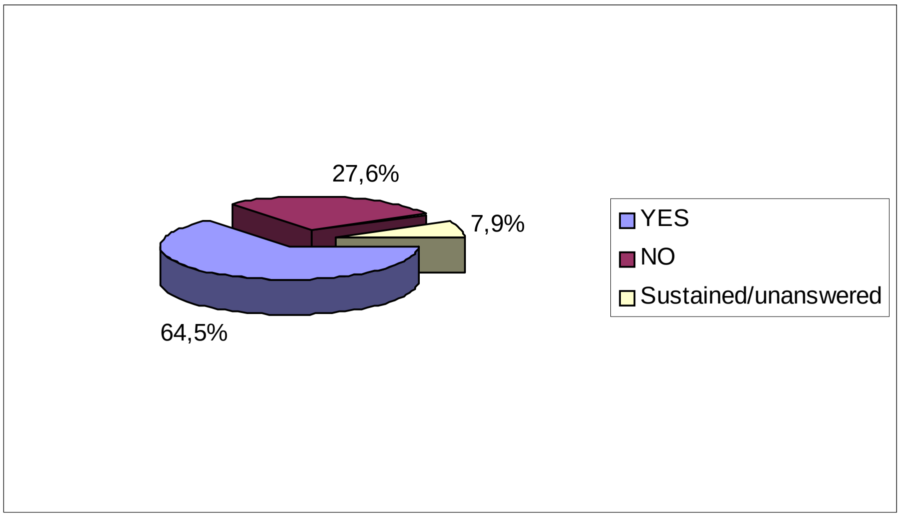


45,3 % of the respondents would be willing to use the equipment, which would be availabile at external institutions, almost a third (29,3 %) would not and a quarter (25,3 %) have not answered to the question.

Question 20: ***Do you have needs in your company for new technologies?***

YES: 49
NO: 21
Unanswered: 6

Figure 19:



While 27,6 % does not perform research and development (R&D) within their company (Question 7), a majority of companies, 64,5 % have needs for new technologies in their company, which could mean that they outsource R&D or simply buy already developed solutions on the market.

If YES, which new technology fields are the most useful for you today or will be the most interesting in the future?

Final construction using specific technologies, e-education, new materials regarding textiles and plastics, leadfree welding, chip bonding, welding of SMD elements, holtmelt procedures for textile materials, technologies for enhancement of textiles, communications, plastic and hybrid materials, quick optical prototypes, radiofrequency electronics, digital processing of signals, communications, custom-made color granules; heating and cooling.

General questions:

- **What is your company's main field of activity?**

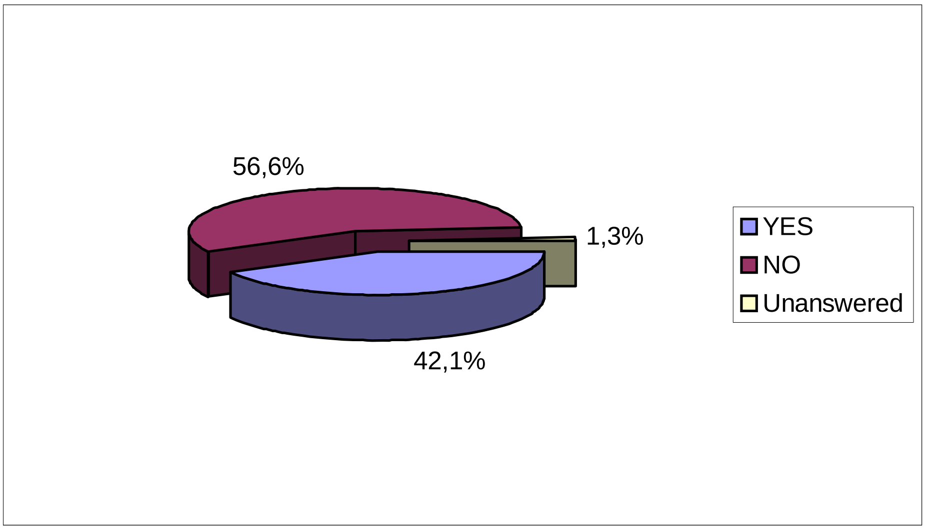
- food industry, industrial chicken farm, engineering – food and chemical industry, processing of meat and production of meat products, chemistry + food production;
- production of dispersions and glues (chemistry), kryogenics;
- processing of plastical parts, chemistry – processing and production of plastics, electronic production and processing of plastics;
- textile industry (2);
- production of iron castings, metal processing industry, metallic industry, steel technologies;
- development and production of mechanical equipment;
- automobile industry, processing of automobiles and planning, hydraulics and pneumatics (2);
- production of electrical equipment for machines and cars, production of protective electronical components, development and production of electronics, production of electrical cables and wires, production of electrical energy;
- production of furniture parts, tools and automatization of furniture machines; production and sales of office furniture (2), production of wooden parts of furniture, production of furniture – kitchens, massive parts furniture, surface furniture, processing and production of wooden products and its movement and warehousing;
- energy procurement and roofing, production of cheramical tiles, production of window blinds/shades, production and implementation of lighting systems;
- building construction (2), building projects and engineering;
- restaurants and lodging, hotel and recreational services;
- information systems, telecommunications (2), computers and informatics, computer services, informatics, radio, informatics (web technologies);
- international road transport of goods + logistics, traffic, export-import of inox materials;
- retail (11), wholesale (3) – car sales, medical equipment sales;
- accounting services (3), financial leasing, financial consulting and marketing;

- education, consulting (2), projects and technical consulting.

- **Have you received any certificates of quality (e.g. ISO 9001, ISO 14001, etc.)?**

YES: 32 – type of certificate: 9001 (29), 14001 (8), TS 16949 (3), UDA 6.1. (2), QS9000, EAQF, OHSAS 8000, TÜF, Business excellence, Learning Company
No: 43
Unanswered: 1

Figure 20:

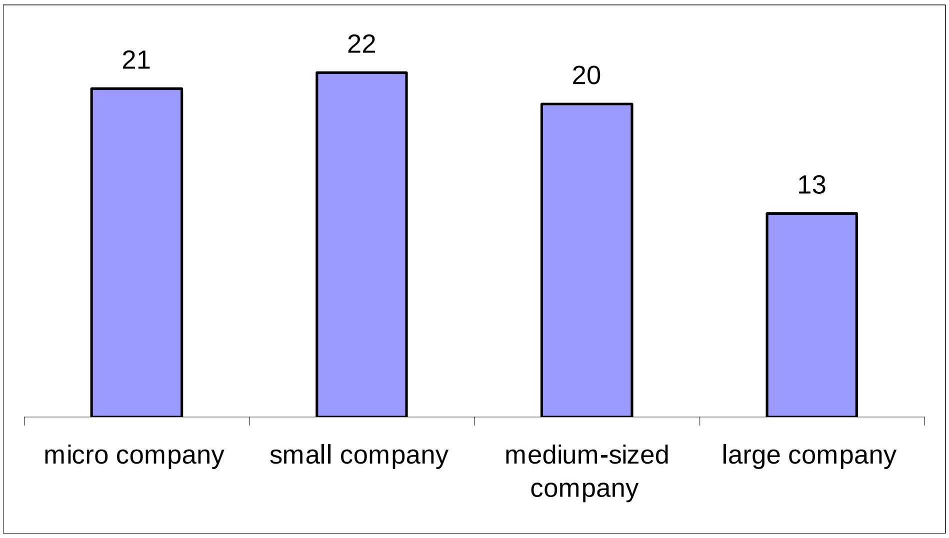


While 56,6 % of analyzed companies (43 out of 76 respondents) do not own a certificate of quality, 42,1 % (or 32) of them do.

- **Size of the company (in terms of number of employees):**
- ***micro company (up to 9 employees)*** (21)
- ***small company (from 10-49 employees)*** (22)
- ***medium-sized company (from 50-249 employees)*** (20)
- ***large company (250 or more employees)*** (13)

Out of 76 companies, which replied to the questionnaire, 21 were micro companies, meaning that they employ less than 10 people, 22 were small companies, employing from 10 to 49 people, 20 were medium-sized companies with a number of employees being less than 250 and 13 were large companies, with a number of employees of 250 or more. The definitions of the size brackets were according to Slovenian standards.

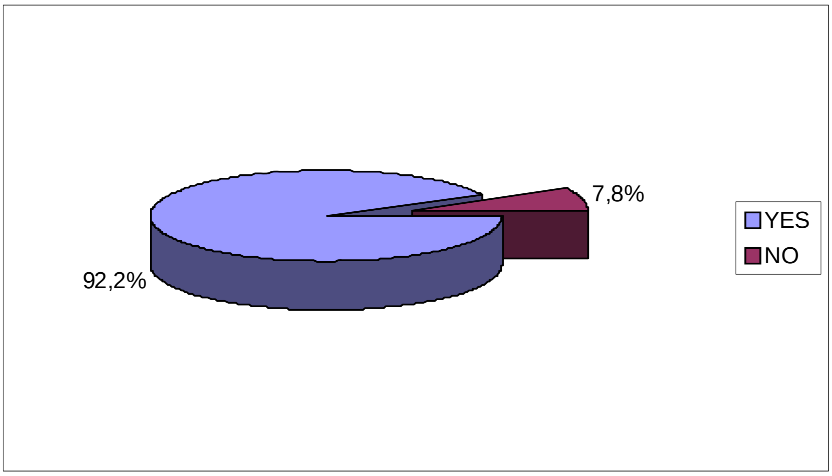
Figure 21:



- **Have you made any profits in the last financial year?**

YES: 59
NO: 5
Unanswered: 12

Figure 22:



Almost all the analyzed companies were profitable in their last financial year.

APPENDIX 6: Questionnaires in original languages – Slovenian/Italian

VPRAŠALNIK

1. Ali v vašem podjetju DODATNO IZOBRAŽUJETE zaposlene?

DA **NE**

2. Če da, na kakšen način ponujate dodatno izobraževanje?

- ☐ **v podjetju imamo že utečen program dodatnega izobraževanja**
- ☐ **možnost dodatnega izobraževanja je prepuščena posameznim zaposlenim**

3. Ali se vam – glede na preference ter dosedanje izkušnje – zdi bolje, če programe dodatnega izobraževanja izvajajo zunanji izvajalci, notranji izvajalci ali oboji ter zakaj?

ZUNANJI **NOTRANJI** **OBOJI**

Utemeljitev: ____

____

4. Na katerih področjih poslovanja primanjkuje vašim zaposlenim največ znanja oz. strokovnih sposobnosti - po vašem mnenju:

- ☐ **nabava**
- ☐ **proizvodne tehnologije**
- ☐ **avtomatizacija proizvodnje**
- ☐ **optimizacija proizvodnje**
- ☐ **logistika**
- ☐ **energetika**
- ☐ **kakovost izdelkov, storitev in procesov (standardi)**
- ☐ **okoljevarstvo**
- ☐ **prodaja izdelkov (oz. ponudba storitev)**
- ☐ **trženje (če je v vašem podjetju ločeno od prodaje)**
- ☐ **finance**
- ☐ **računovodstvo**
- ☐ **kadri (človeški viri)**
- ☐ **informatika**
- ☐ **raziskave & razvoj**
- ☐ **management tehnologij**
- ☐ **vodenje projektov**
- ☐ **vodstvene naloge**
- ☐ **drugo:** ____

5. Kakšni izobraževalni programi bi se vam zdeli najbolj ustrezni za dopolnitev znanj vaših zaposlenih?

- **krajši, eno- do dvodnevni tečaji na temo:**

  ____

- **krajši, tri- do petdnevni tečaji na temo:**

  ____

- **daljši (prosim, navedite trajanje):**

  ____

- **formalne oblike izobraževanja - katere:**
  - **dodiplomski visoki strokovni študij**
  - **dodiplomski univerzitetni študij**
  - **podiplomski specialistični študij**
  - **podiplomski magistrski študij**
  - **doktorski študij**
- **individualni programi za konkretne potrebe podjetja (t.i. konzorcijski študij)**

6. Če vas zanimajo daljše oblike izobraževanja, katera študijska smer bi vas najbolj zanimala?

____

____

____

7. Ali se v podjetju ukvarjate z RAZISKOVALNO-RAZVOJNO DEJAVNOSTJO?

DA **NE**

8. Če ste na prejšnje vprašanje odgovorili z DA: Ali imate v podjetju svoj lasten oddelek raziskav in razvoja?

DA **NE**

9. Na katerih področjih oz. na področju katerih znanosti oz. tehnologij izvajate raziskave?

____

____

____

10. Na kakšen način financirate omenjene raziskave (sredstva v podjetju, zunanja sredstva)?

____

11. Bi bili pripravljeni izvajati raziskovalno dejavnost <u>v partnerstvu z zunanjim izvajalcem</u> (poleg lastne raziskovalne dejavnosti partnerstvo z raziskovalno institucijo)?

DA **NE**

Ali pa bi bili pripravljeni izvajati <u>raziskave zgolj preko zunanjega izvajalca</u> (znanstveno-raziskovalne institucije)?

DA **NE**

12. Bi bili pripravljeni raziskave pri zunanjem izvajalcu (izobraževalno-raziskovalni instituciji) tudi finančno podpreti?

DA **NE**

13. Bi se bili z zunanjo institucijo pripravljeni prijavljati na razpise za raziskovalna sredstva na lokalni, državni oz. evropski ravni?

DA **NE**

14. Ali ste dosedaj že kdaj sodelovali s kakšno visokošolsko institucijo ali znanstvenim inštitutom?

DA **NE**

15. Če ste na prejšnje vprašanje odgovorili z DA:

a) s katerimi institucijami? ____

____

b) za kakšne oblike sodelovanja je šlo?

- ☐ **skupni raziskovalno-razvojni projekti**
- ☐ **direktna naročila**
- ☐ **mladi raziskovalci (MR-ji) iz gospodarstva**
- ☐ **drugo (prosim navedite):** ______________________________

c) kakšne so bile vaše izkušnje s tem sodelovanjem (dobre, slabe)? – prosim za kratko obrazložitev

____

____

16. Če ste na vprašanje št. 14 odgovorili z NE, kakšen je bil razlog:

- ☐ **ni bilo potrebe**
- ☐ **ni bilo pripravljenosti s strani visokošolske inštitucije**
- ☐ **nimamo finančnih možnosti**
- ☐ **nimamo kadrovskih možnosti**
- ☐ **drugo:** ____

17. Ali v podjetju izvajate naloge, za katere potrebujete specializirano tehnično oz. laboratorijsko opremo in katero?

DA **NE**

Tip oz. vrsta opreme: ____

18. Če ste na prejšnje vprašanje odgovorili z DA: ali to opremo najemate ali je v vaši lasti?

NAJEM **LASTNIŠTVO**

19. Bi bili pripravljeni uporabljati opremo, ki je dostopna v laboratorijih znanstveno-raziskovalnih institucij, v kolikor bi te imele proste kapacitete?

DA **NE**

20. Ali obstajajo v vašem podjetju potrebe po novih tehnologijah?

DA **NE**

Če DA, katera tehnološka področja oz. nove tehnologije so za vas najbolj aktualne danes oz. bodo najbolj aktualne v prihodnosti?

____

____

____

....

Na koncu vas naprošam še za nekaj splošnih podatkov:

Naziv podjetja: ____

Katera je vaša osnovna dejavnost (oz. v katero panogo spadate glede na osnovno dejavnost)?

____

Ali ste prejeli katerega od certifikatov kakovosti (npr. ISO 9001, ISO 14001, ipd.)?

DA – kateri: ____

NE

Velikost podjetja glede na število zaposlenih:

- ☐ **mikro podjetje (do 10 zaposlenih)**
- ☐ **malo podjetje (od 10-50 zaposlenih)**
- ☐ **srednje-veliko podjetje (od 50 do 250 zaposlenih)**
- ☐ **veliko podjetje (nad 250 zaposlenih)**

Vaš promet (skupni prihodki) v letu 2003 (neobvezno): _________________________

Ali ste v preteklem poslovnem letu (2003) ustvarili dobiček? (neobvezno) **DA** **NE**

Želite, da vas obveščamo o programih izobraževanja ter o možnostih raziskovalnega dela na Politehniki Nova Gorica in se strinjate, da vas s tem namenom vključimo v našo bazo podatkov?

DA **NE**

Prosim še za nekaj splošnih podatkov:

Ime direktorja: ____

Ime in delovno mesto kontaktne osebe v podjetju (če vprašalnika ni izpolnjeval direktor):

____

Naslov vašega podjetja oz. institucije:

____

Telefon: ____

E-pošta: ____

Domača stran: ____

QUESTIONARIO

1. Nella Sua impresa si fa formazione degli impiegati?

SI **NO**

2. Se sì, in che modo offrite formazione?

- ❑ **In azienda abbiamo già in corso un programma di formazione.**
- ❑ **La possibilità di formazione è lasciata al singolo impiegato.**

3. Per Lei – con riguardo alle preferenze e alle esperienze maturate – sarebbe meglio se i programmi di formazione venissero eseguiti da operatori esterni, interni, entrambi e perché?

INTERNI **ESTERNI** **ENTRAMBI**

Motivazione:____

____

4. In quali aree aziendali manca maggiormente ai Suoi impiegati competenza ed esperienza personale – a Suo giudizio:

- ❑ **Acquisti**
- ❑ **Tecnologie produttive**
- ❑ **Automazione della produzione**
- ❑ **Ottimizzazione della produzione**
- ❑ **Logistica**
- ❑ **Energia**
- ❑ **Standard qualitativi dei prodotti, dei materiali e dei processi**
- ❑ **Sicurezza ambientale**
- ❑ **Vendita di prodotti (o offerta di materiali)**
- ❑ **Marketing (se nella Sua azienda è separato dalle vendite)**
- ❑ **Finanza**
- ❑ **Contabilità**
- ❑ **Quadri aziendali (risorse umane)**
- ❑ **Informatica**
- ❑ **Ricerca & sviluppo**
- ❑ **Gestione della tecnologia**
- ❑ **Direzione dei progetti**
- ❑ **Gestione dei task**
- ❑ **Altro:**____

5. Che tipologia di programmi formativi sarebbero maggiormente utili per il completamento della competenza dei Suoi impiegati?

- ❑ **Brevi, una o due settimane di corso per tema specifico:**

____

- ❑ **Brevi, da tre a cinque settimane di corso per tema specifico:**

____

- **Lunghi (specificare la durata)**

- **Quali tipologie istituzionali di formazione:**
- **Istruzione superiore professionale**
- **Laurea di primo livello**
- **Laurea di secondo livello**
- **Dottorato di ricerca**
- **Programmi individuali per le esigenze concrete d'impresa**

6. Se Le interessano forme prolungate di formazione, quale orientamento di studi Le interessa di più?

---

7. Nella Sua azienda si fa attività di RICERCA & SVILUPPO?

SI **NO**

8. Se alla domanda precedente ha risposto SI: la vostra azienda ha un suo proprio ufficio per ricerca & sviluppo?

SI **NO**

9. In quale settore o in quale area di competenza o di tecnologia state eseguendo ricerca?

---

10. In che modo finanziate la ricerca specifica? (fonti interne o esterne)

---

11. Sarebbe disposto a praticare attività di ricerca <u>in partenariato con operatori esterni</u>? (in collaborazione con un istituto di ricerca)

SI **NO**

Sarebbe disposto a fare ricerca <u>solo per mezzo di un operatore esterno</u>? (istituti di analisi e ricerca)

SI **NO**

12. Sarebbe disposto a sostenere il finanziamento di tale ricerca presso un terzo operatore? (istituti di ricerca e formazione)

SI **NO**

13. Sarebbe disposto a partecipare con istituzioni esterne a concorsi per fondi di ricerca a livello locale, nazionale o europeo?

SI **NO**

14. Finora ha già collaborato con qualche istituto post diploma o di analisi?

SI NO

15. Se alla precedente domanda ha risposto SI:

a) Con quali istituti?

____

____

b) In che forme collaborative si è svolto?
- ❑ **Progetti comuni di ricerca & sviluppo**
- ❑ **Task specifici**
- ❑ **Con giovani ricercatori in campo economico**

c) come sono state le vostre esperienze in tale ambito? (positive o negative) – se possibile dare una breve spiegazione

____

____

____

16. Se alla domanda 14 ha risposto NO, per quale motivo:
- ❑ **Non vi era necessità**
- ❑ **Non vi era predisposizione da parte degli istituti post diploma?**
- ❑ **Non vi sono possibilità finanziarie**
- ❑ **Non si dispone di quadri aziendali adeguati**
- ❑ **Altro:**____

17. In azienda eseguite task per i quali necessitate di tecnologie specifiche o di attrezzature da laboratorio?

SI NO

Tipologia di attrezzature:

____

____

18. Se alla precedente domanda ha risposto SI: avete in locazione tali attrezzature o sono di vostra proprietà?

LOCAZIONE PROPRIETà

19. Sarebbe disposto ad utilizzare attrezzature messe a disposizione in un laboratorio di un istituto di analisi e ricerca, qualora ce ne posse il libero utilizzo?

SI NO

20. Nella Sua azienda c'è necessità di nuove tecnologie?

SI NO

Se sì, quali campi tecnologici o quali nuove tecnologie sono a Suo avviso più attuali oggi o saranno più attuali nel futuro?

____
____
____
____

In conclusione Le domando ancora qualche dato generale:

Denominazione aziendale:

____

Quali sono le vostre attuali attività(o in quale settore siete collocati nell'attuale attività)?

____

Avete già dei certificati di qualità? (es.: ISO 9001, ISO 14001)?

SI – quali:

____

NO

In sostanza l'impresa ha il seguente numero di dipendenti:

- □ **Micro imprese (fino a 10)**
- □ **Piccole imprese (da 10 a 50)**
- □ **Medie imprese (da 50 a 250)**
- □ **Grandi imprese (oltre i 250)**

Il vostro fatturato nell'anno 2003 (facoltativo):

____

Avete prodotto utile nell'anno 2003 (facoltativo):

____

Desidera essere informato sui programmi di formazione o sulle possibilità di lavori di ricerca nel Politecnico di Nova Gorica e permette che a tal scopo inseriamo la Sua azienda nella nostra base di dati?

SI **NO**

Nome del direttore:

____

Nome e categoria lavorativa della persona da contattarsi in azienda (se il questionario non è stato compilato dal direttore):

____

Indirizzo della Sua azienda o istituto:

____

____

Recapito telefonico:

____

Indirizzo di posta elettronica:

____

Eventuale sito internet aziendale:

____