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# Universities as knowledge providers in the technological innovation. Romania's situation

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## Abstract

In its first part, the present paper demonstrates the relation between innovation and knowledge using a literature review. Concepts such as technology, technological innovation, knowledge and knowledge flow are defined and described. The Newman model of knowledge flows is then used as a starting point for the analysis of the innovative potential in the Romanian academic sector. The paper also identifies the characteristics of the knowledge actors, transformation and knowledge artefacts at the level of the Romanian universities. In the conclusions part, starting from the characteristics we discovered, we drew a series of recommendations for changing the knowledge web in the academic environment into innovation.

**Keywords**: technological innovation, knowledge, knowledge flows

## 1. Innovation is knowledge

*1.1 (Re)defining technology and technological innovation. Calibrating the concept in agreement with the knowledge contained*

In the normal language, using the word "innovation" (many times in an excessive and overstated way) exploits its common meaning referring to a "new thing, making, change, modification", confirmed by the Romanian Dictionary – DEXOnline (1998) as well. Besides, we can notice that both the dictionaries and the current use of the word in the nowadays information media acknowledges, either directly or implicitly, its relation with technology – for example, the second meaning of the word mentioned in DEX is the one referring to "solving a technical issue or an issue related to organizing the work in order to improve it (its productivity), technical improving or rationalizing the applied solutions". The meaning referring to the technical (technological) progress visible in this definition is naturally attached in the nowadays world to the word "innovation".

Thus, we can say that innovation and technology are two distinct, though related, concepts. In order to clarify the differences and relationship between them, we will study a series of definitions extracted from the specialty literature, approaching the two concepts both at an organizational and at a macro-economic level.

From an organisational perspective, according to White and Bruton (2007, p. 16), **technology** is defined as the practical implementation of individuals' and organisations' learning and knowledge in order to support the human endeavours and it consists in the knowledge, products, processes, instruments and systems used to create goods and provide services. Another definition, belonging to Northcraft and Neale (1994, p. 34), gives technology the same meaning – that is, "knowledge, tools and techniques", but this time regarding, in a systemic manner, the way it serves the organisation – that is, "to transform input into output". It is regarded as a transformation process that can be rendered by something abstract (such as a formula, a recipe or a method) or that can be developed by very material elements (machines and equipment). Malik (2004) considers that it is more important to regard technology as knowledge rather than as artefacts or processes. The meaning derived from using technology within organisations is a particularisation of the term's broader meaning, that appeared through the juxtaposition of the Greek words "techne" (craft, technique, ability) and "logos" (knowledge, science). Starting from its roots, Nahar (2001, p. 28) translates it literally, as "knowledge of techniques" or "crafts science", and regards it as being formed both from "bodiless" components (knowledge, human abilities), as well as from material, "bodily" elements (equipment, tools etc.).

From the definitions enumerated we can identify a series of unifying elements regarding the studied object, relevant for the subject of our research: *technology is knowledge applied systematically, with transformation abilities, that supports organisations/society in meeting their/its goals*. At the same time, we would like to emphasize, making an anticipation, that, when it comes to the developing

countries necessities in the technology area, the immaterial elements, such as abilities, expertise, procedures, the way to solve things, as well as management, can prove to be more valuable once they have been assimilated and applied, as compared to up-to-date machines, tools or equipment purchased and used improperly.

Going back to **innovation**, the term that interests us, and without assuming that understanding its meaning is an easy thing to do, we can notice that, generally speaking, it is defined as *invention* („solving or technical implementation in a knowledge field that represents novelty and progress as compared to the previous situation", according to DexOnline, 1998) + *its exploitation*. The distinction between invention and innovation has been emphasized ever since 1934, by Schumpeter, who defined invention as the birth of a new thing at a conceptual level, whereas innovation was defined as the implementation, the use of that specific novelty (Nahar, 2011). According to Miller, Miller and Dismukes (2005-2006), especially at an organisational level, innovation is more complex than that, including the process of development and implementation of the invention. Synthetically, according to Rubenstein (1989), it is a process by which new and improved products, processes, materials and services are developed and transferred into a factory or market which they are adequate for, and it emerges only when the idea of a new product or process (invention) is sold and becomes a source of potential benefits – see also Sánchez and Rodríguez (2009, p. 391). At a macro-economic level, we can notice that, in the Green Paper on Innovation (European Commission, 1995, p.1), innovation is considered the same thing as the successful production, assimilation and exploitation of the new in the economic and social environment, addressing both individual and social needs, as a whole. Rogers (1983, p.11) draws attention to the fact that the novelty element depends on the perception, meaning that a thing that may seem old to an observer can be absolutely new for another one – and this element is also true when it comes to technologies. In order to highlight the content of knowledge in innovation, which is so important for the research subject hereby, we bring a few definitions to support our opinion: innovation is a process by means of which knowledge is achieved, shared and assimilated, in order to create new knowledge, incorporated in products and services – Nahar (2011), a process that includes technical, physical and knowledge-based activities – Cardinal et al. (2001), a process by means of which knowledge is achieved, shared and assimilated in order to create new knowledge that will later become products and services – Herkema (2003), the creation of new knowledge and ideas to the organisation's interest, in order to improve the business' internal processes and structures and to obtain products and services required by the market – Du Plessis (2007).

The connotation given to innovation, both at an organisational and at a national or global level, is an imperatively-positive one. In the terms used by Sánchez and Rodríguez (2009, p. 384), "it has become a compulsory reference both in the economic analysis manuals, as well as in justifying various programs and actions in the public policy of promoting innovation and research, in referring to the positive effects they have on the economic growth and development of societies (the increase in the income, new and improved products that increase the level of life, a higher accessibility to these products, etc.) and on the welfare growth". The authors draw attention to the fact that, ever since the Green Paper, the social character of the innovation process has been emphasized (seen as a mechanism for expressing creativity and necessities that needs to respond to the most important current problems and, most of all, that needs to allow us to improve the life conditions and to determine a sustained development) and, to their support, they quote Mokyr (1990), according to whom innovation increases the total volume of the society's knowledge and, implicitly, its productive capacity (both quantitatively and qualitatively), that is, its economic growth and capacity to generate welfare. Du Plessis (2007) draws attention to the increasing complexity of innovation as a phenomenon that changed the nature of the economic growth itself, as well as to the fact that chasing the new seems to be one of the constant things of the contemporary economic life. The positive impact of innovation on the economic development of a nation or region (or on the competitive advantage or on the market quota or the dimension of an organisation), the complexity and rhythm that characterize the innovative processes, are considered by Markatou (2011) the reasons why general business papers that approach the subject are so abundant in scientific papers and articles.

In the light of what has been stated above, we define technological innovation as the *new applied knowledge, with transformation abilities, that supports organisations/society in meeting their/its goals.* Innovation freshens technology and we consider that it functions as an engine, weak or powerful, able to support the progress of an organisation or country. We would like to emphasize that

novelty does not need to be absolute, meaning that an element considered old in an organisation or nation can be regarded as new in another one, becoming able to substantially improve its situation.

*1.2 Knowledge, shortly*

Starting from what has been mentioned above and including it in the Romanian business environment, which is many times immature and not familiarized with the role of the knowledge, in this sub-chapter we will study the elements we consider essential for understanding knowledge and its typologies, as well as for the way in which they are likely to change into innovation and, implicitly, into the so much wanted economic growth.

According to the contemporary classics of the knowledge management, Davenport and Prusak (1998, p. 5), knowledge is a fluid mixture of assumed experiences, values, contextual information, understanding and expertise, that ensure a framework for the assessment and incorporation of new experiences and information. They originate in and are applied to the individual's mind. Rolf (1991) considers that at the lowest level of the human being lay the talent, skills and habits of the individual (who is directly controlled by them). They are followed by the know-how – that represents the way in which persons respond to certain rules derived from the social context they act in. Competence or expertise is at the upper level and it reflects the way people are capable to judge rules and change them. In organisations, knowledge is many times incorporated not only in documents, but also in the organisational procedures, processes, practices and norms, as well as in the organisations' culture and identity, according to Fotache (2002). Nonaka, Toyama and Konno (2000, p. 7) consider knowledge the result of a dynamic process, based on interactions between individuals, which depends, at the same time, on a certain spacial and temporal context. Nonaka made famous one of the best known knowledge taxonomies, used by Polyani ever since the 60's, the one dividing it into explicit and tacit. Explicit or encoded knowledge is expressed in a formal, systematic language, and can be shared (as data, scientific formulas, or specifications), easily transmitted and stored. Tacit knowledge has a highly customized character and is not easy to formalize. This includes the understanding of various situations, intuitions and presentiments; it is difficult to communicate because it is specific to a certain context and is deeply rooted in actions, routines, ideas, values and emotions, according to the interpretation given by Homocianu (2009, p. 15). In other words, tacit knowledge is the collection of data and rules used to manipulate non-explicit data and rules. Tacit knowledge has cognitive and technical components (Alavi and Leidner, 2001). The cognitive components are non-structured mental models used by people and that cannot be expressed directly as data or information (mental maps, beliefs, paradigms, points of view), whereas technical components are concepts that can be expressed (by means of the know-how and abilities used in a certain context) and that are known as structured knowledge. Explicit knowledge consists of these technical components, as well, that can be expressed directly in the knowledge representation process. According to Jennex (2007, pp. 2-3), the transfer of knowledge in an organisation appears when its members make tacit and explicit knowledge pass from one to another, and an invention appears when a person succeeds in transforming an undiscovered part of his/her tacit knowledge into explicit knowledge. The obtaining, use and sharing of tacit knowledge is considered essential for an organisation's innovating capacity (Du Plessis, 2007).

As we can see up to now, the complex character of both concepts described makes the relation between them not so easy to define. On the contrary, the relation seems to take the shape of a sophisticated and even chaotic picture, such as the ones painted by Jackson Pollock.

*1.3 The role played by knowledge in the technological innovation process. Knowledge flows*

As it has been shown in the above-presented definitions, technology represents knowledge, whereas innovation represents new and applied knowledge. The success of innovation depends on the way the knowledge it relies on is obtained and administered – in other words, it depends on an efficient knowledge management. This relation has been noticed and supported by various authors. Hurmelinna-Laukkanen (2011) states that the success of the innovative activities management highly depends on the effectiveness, with which the company (or nation n.n.) can create, achieve and transfer knowledge both within its borders and abroad. As a result of the high level of technological change and complexity, the ability to successfully access and use values based on knowledge from complementary sources is essential. Du Plessis (2007) notices that the fusion of the knowledge

management system with other key resources and competences in companies is the element that can result in the development and support of a competitive advantage sustained by product and process innovation. Alavi and Leidner (2001) add that the competitive advantage does not depend on the knowledge itself that can be found at a certain moment in a certain system, but on the ability to obtain new knowledge from the available one. Starting from Nonaka's observation that "in an economy in which the only certainty is that there is no certainty, an important source of competitive advantage is its knowledge and manipulation", the authors Holsapple, Jones and Singh (2007, pp. 54-55) suggest a "knowledge value chain" that identifies five main activities and four secondary activities regarding knowledge management, able to guarantee higher achievements in an organisation. The main activities are the generation, procurement, selection, assimilation and production of knowledge, and the secondary activities refer to its measuring, controlling, coordinating and leadership. These activities influence an organisation's capacity to innovate, and also its productivity, promptness and reputation. We can transfer the model suggested by Holsapple at a national level as well, where one can find the same problems and the same relation between knowledge and achievement. Preiss (1999) declares that, currently, the competitive advantage does not consist in the rapid access to capital, but in the adequate access to knowledge and innovation, and shows that, if, in the past, companies were different according to their access to markets, nowadays, due to the democratization of technologies, the hierarchy of companies is established according to the speed with which they answer to the changes in their environment, which highly depends on the knowledge resource, considered the main resource that maintains an organisation's competitively. According to him, the necessary knowledge is not obtained, however, from an injection made at a certain moment, but from a necessary knowledge flow which should always be available, knowledge flow which the author considers synonym with innovation, emphasizing that it should always be new knowledge. This knowledge flow has ups and downs and is related to the other two flows present in the enterprise network nowadays – the money flow and the flow of goods and services. The core competence of a company is given by the company's access to a knowledge flow or to the strategic know-how, as Gupta and Govindarajan (1991, 2000) call it, by its capacity to assimilate the new knowledge flow, as well as by the rate with which it can create new and useful knowledge (in other words, its capacity to innovate).

The conventional vision according to which organisations are regarded as input – processing – output systems is not enough when it comes to describing knowledge processes. Modern organisations' characteristics, highly based on knowledge – that is, the intangible character of input and output, the constant interaction with customers and various types of partners, the strong independence of experts and of their individual judgement, innovation meaning a constant renewal and a continuous amplification of the products and services portfolio, the informational asymmetry – all these increased both the needs and possibilities for a rapid informational and knowledge transfer, both representing the essential success factors in the dynamic and global business environment nowadays. Therefore, the knowledge flow problem seems to become accessible using the means of the complexity theory. Although the knowledge flow regarded separately can be considered a linear element, from a transmitter to a receiver, the complexity at the system (organisational) level appears due to the connectivity and multiple transfer relations.

Starting from the fundamental assumption that knowledge allows actions and decisions, Newman (2004) defines knowledge flows as sequences of the transformation made by agents on the knowledge artefacts in order to support certain specific actions or decisions. The author divides the agents into individual (human) agents, automatic (non-human) agents, collective agents (a specific collection of individual and/or automatic agents). The artefacts are documents, memories, norms, values and other such elements that represent the input and products of the agents' knowledge activities. Transformations are agents' behaviours on artefacts, grouped by the author into four major categories common to all the systems based on knowledge: the knowledge creation, retention, transfer and use. The creation of knowledge refers to all the behaviours that make new knowledge penetrate a knowledge-based system. It can come from two main sources: it can be either created inside the system or it can come from the outer environment. Knowledge transfer refers to those operations by means of which agents share knowledge information and artefacts. The retention of knowledge refers to the way in which previously-developed knowledge is stored, maintained and recovered. The last category, knowledge use, is the essential element, the fundament of knowledge-based behaviours, because it refers to the way in which knowledge responds to the purposes of the analysed system.

Remembering from the above-mentioned that knowledge flows are alive, dynamic elements, relevant to the study of the contribution brought by knowledge to innovation, we consider them useful when analysing one of the most important actors of the national innovative system, that is, universities. In order to make things simple and structured, we will choose the Newman model as a basis for assessing the situation of the Romanian universities as knowledge providers in the innovative process. However, we will not ignore the background drawn by Pollock, since knowledge flows are very varied and complex, and can be detailed and characterized or not by self-similarity.

## 2. Universities – the nest and knot of knowledge flows

Romania is not a country with outstanding achievements in the innovation area. The internal perception that presents it as a country which "values the general knowledge rather than technical specialisation" (Patapievici, 2007) and which is not "updated regarding technology" (Gheo, 2011) is supported by the non-impressive numbers – the 24th position from the countries of the European Union in the European classification of innovation in 2010 (Money Channel, 2010). In the Innovation Union Scoreboard 2010 (INU 2010) report we find the statement that "Romania is one of the modest innovators, with a performance below average". Since the production or services area does not excel in innovation, we will focus on the high-education sector, starting from the assumption that universities are the lungs able to transmit the necessary knowledge in order to obtain nation-wide achievements in innovation and we will analyse the Newman model (2004) regarding the knowledge flows, taking into account the global example of Romanian universities.

The figure 1 contains our opinions regarding the knowledge agents, transformations and artefacts noticed in the local academic environment.

## 3. Conclusions

From the dashboard below we can conclude that the Romanian academic environment is a nest of knowledge flows (that are born synergistically from the transformation actions of knowledge workers on knowledge assets), as well as a knot able to drive them towards their practical use in the business environment. The knowledge web created in universities represents a creative and innovative potential not to be neglected, which, if Romania values, can help us obtain a higher position in the international specialised classifications. In order to increase the role played by universities as providers of knowledge capable to be transformed into innovation, we identified the following necessary elements:

a. **Financing.** One of the recommendations made by the Digital Agenda for Europe (European Commision, 2010), according to which "activities involving knowledge transfer should be managed efficiently and supported by adequate financial instruments, whereas the research financed from public funds should be disseminated as widely as possible by publishing scientific data and papers and giving free access to them" is reiterated and developed in reunions of various national bodies (informatia.ro, 2010), which, for the current period (2007-2013), emphasize the need to attract and absorb EU funding for research, simultaneously with a better participation in research projects at the European level. The degree of absorption of the financing in Romanian universities is satisfying, but the process needs to be a continuous and fruitful one.

b. **A sustained, coherent and self-consistent process of knowledge flow management**, so that knowledge becomes sustained innovation. A famous observation made by Thomas Alva Edison says that the real challenge in the innovation field is not invention (having totally new ideas), but rather making it work, making it find a technical and commercial use. Innovation is much more than the simple fact of having good ideas: it is a process that means developing them in order to find a practical use. Paraphrasing this and adapting it to our study, new knowledge should be developed, structured and exploited, not only created. Moreover, in such an insecure and complex step as innovation, chance plays a very important part. Sometimes chance emerges accidentally – and sometimes the benefits resulted from such a lucky strike are enough to finance the subsequent failures. But the real success resides in the capacity to make it happen again, to manage this process thoroughly, so that the success is likely to emerge, even if it is not guaranteed. This depends on the understanding and management of this process so that very little of it is left to happen accidentally. The reality proves that success is based on the capacity to assimilate, learn and repeat these actions (Leuca, 2008, p. 20).

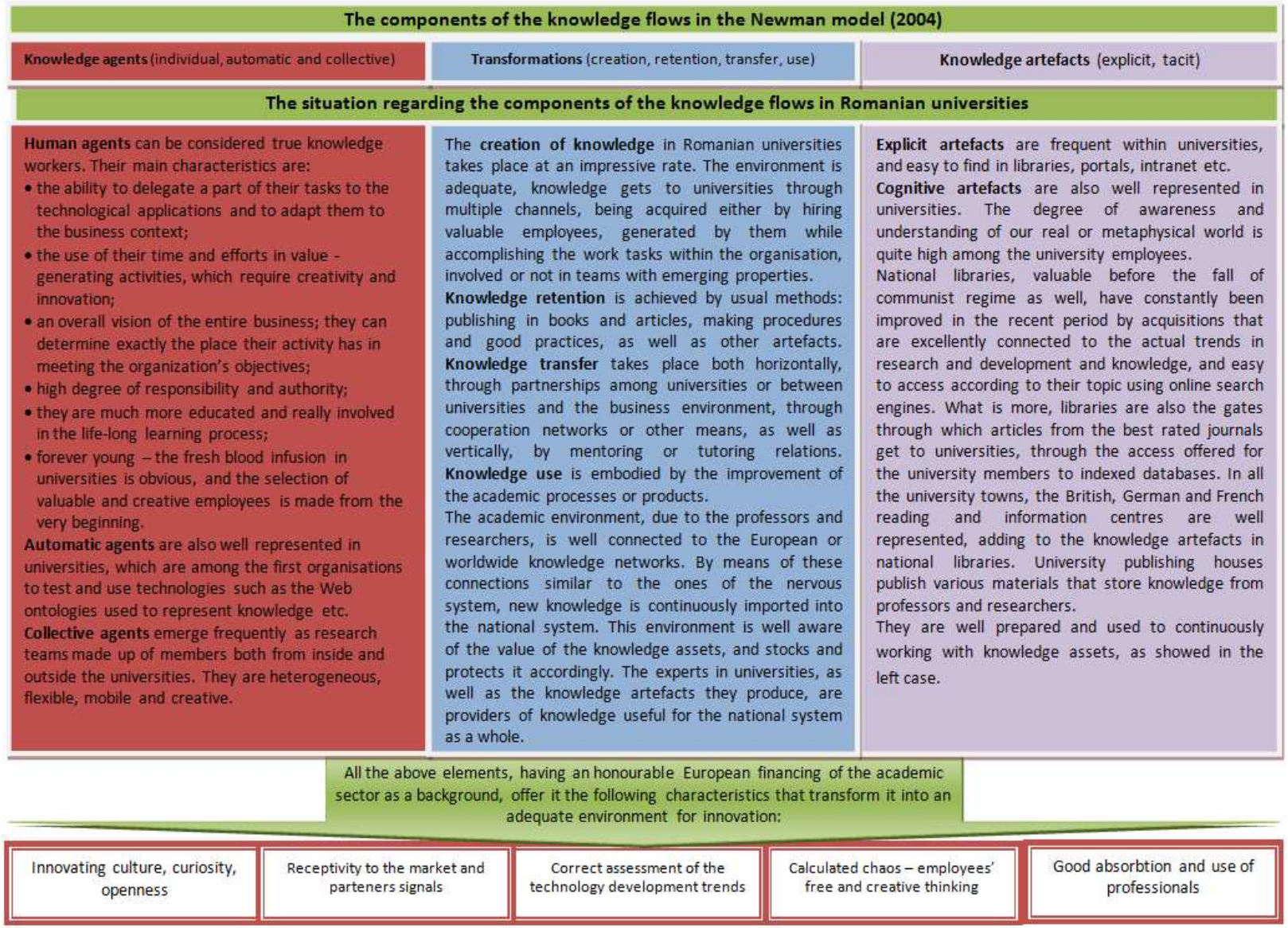


Fig 1. A dashboard of knowledge flows in the Romanian universities

c. **The involvement of universities in partnerships with the private sector**. Although the role played by the Romanian system in the creation of technological innovations can be indirectly seen both in the results obtained by the national IT&C sector - see, for example, Bârligă, G., Ardelean, A. (2011), and in the Romanian graduates' involvement in the R&D laboratories abroad, the formal internal partnerships with the productive sector are scarce, and the so-called corporate universities are completely missing.

d. **Transformation of universities from an ivory tower into collaborative networks, in which to maintain a balance between knowledge dissemination and property**. The degree of adherence of old knowledge in an organisation cannot be neglected – the innovative process involves giving up existent knowledge and developing several series of new and different knowledge (Leuca, 2008, p. 11), and this is not an easy thing to do, especially in the context of reminiscences of the communist, centralized system, reminiscences that can still be noticed in the Romanian universities regarded by some as ivory towers. Nowadays, the cooperation and interconnectivity become more and more important in the research-development and innovation areas. However, the management of the innovation collaborative activities is difficult. Since innovation involves the exchange of knowledge, it also implies important risks, such as the failure in cooperation, but also the loss of the competitive advantage if flows of core knowledge get to the competitor. On the one hand, the creation and maintaining of a viable environment that allows innovation imply encouraging the knowledge transfer, but, on the other hand, knowledge and innovation should be kept away from imitations, in order not to get to rivals. The knowledge security issue, from the perspective of its contribution to innovation, has been widely discussed in Popescul (2011). Most innovations do not derive from inventions, but from borrowings – this fact emphasizes the role of valuable knowledge: it is represented by those surprising combinations of ideas that succeed in making a difference. Knowledge flows should be bi-directional, and universities need to "promote" their own knowledge fortune, on the one hand, and, at the same time, they need to acquire knowledge from other universities and from companies in the private sector. Sharing knowledge allows the combination of various knowledge bases of the individual actors, so that the innovation appears as an emergent property.

To conclude, we esteem that the observations made at the Romanian universities level demonstrate the observation made in 2010 by Innovation Union Scoreboard, stating that Romania's situation regarding the financing is above the European average, but it can be improved in areas such as the excellence in research and innovation, or the relation between public-private and intellectual assets. We can assume that, through the infusion of European funds accessed at a satisfactory level by the analyzed universities, we created the necessary context, the mycelium of knowledge flows that will result in valuable technological innovations, as soon as possible and as frequently as the mushroom cultures emerge.

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