

THE DEVELOPMENT OF AN EVALUATION MODEL FOR UNIVERSITIES AND INDUSTRY COLLABORATION IN OPEN INNOVATION

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Abstract:

Many government policies have encouraged collaboration between the three worlds that were once very separate: the private and public research, business and/or industrial partners (as a structure for wealth creation) and education. All three, can cover virtuous circles to produce successful innovations. In this context, universities have extend their traditional roles or primary functions of education and research, to new one; entrepreneurship university or the knowledge based university are new approaches that give a new meaning and content to the traditional education role. They has change also, their business models on doing research and valorising the related results. The research aims to present an evaluation model for the university-industry collaboration in open innovation. The approach's core consists of an ontology development based on reference review and creative common work of a research group of experts. The ontology dimensions and their characterization items were chosen based on university new role theory. Furthermore, the ontology structure and elements have contributed to the development of a questionnaire that could support a survey for the university-industry collaboration diagnosis (considering one university local, regional market) and it has been proofed as an effective support of the decision-making process when establishing a contract, project, or partnership with industrial or business organizations. The proposed evaluation model has been tested and validated through three practical case (universities) and the research results will be debated in this article.

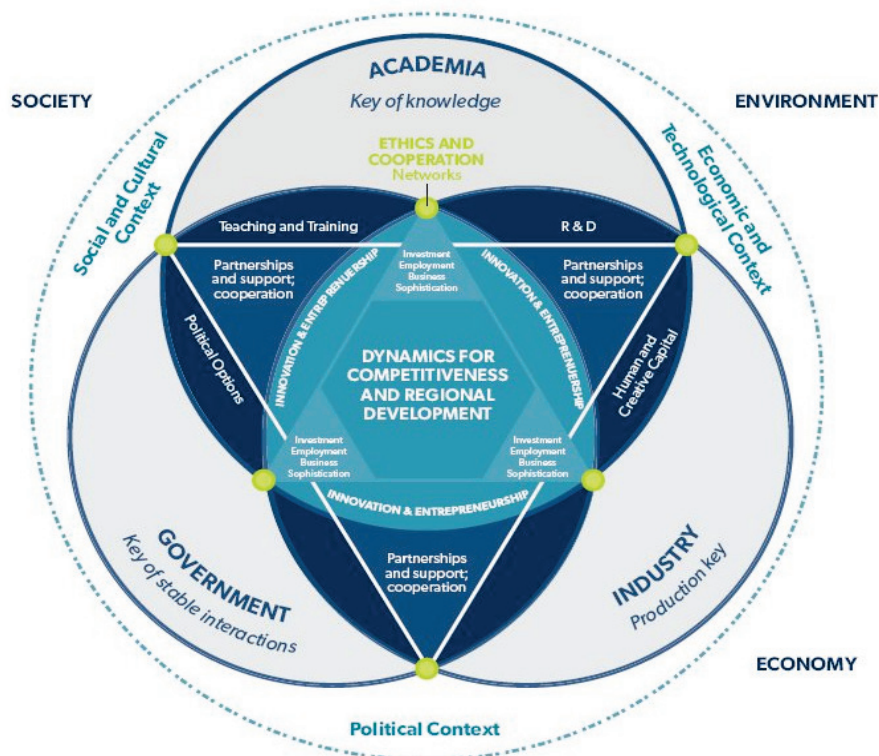
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1. INTRODUCTION

Today, universities (as public or private bodies) have extent their traditional roles (or primary functions) of education and research, to an integrative one, more related to society. Different approaches as the Entrepreneurship University and Knowledge-Based University were developed in order to explain the new meaning and content to the traditional role of these types of organizations (Draghici et al., 2015a; Draghici et al., 2015b; Draghici et al., 2015c) and to support development strategies formulation.

Based on the development shown by (Nonaka et al., 2000), there have been described the way university could be considered as a *Ba share space*¹ that interfere with other different actors' Ba, actors that are present on the local, regional, national or international market. Networking and involvement in different communities are important aspects of university BA space creation and development. This model could be seen as a generalized one and do not exclude the developments related to the dynamics of universities innovation models as the previous Model 2, Triple Helix of university-industry-government are (Etzkowitz & Leydesdorff, 2000). An overview of the Triple Helix model is presented in Picture 1.

Picture 1: Description of the Triple Helix model of university-industry-government



Source: extended from (Etzkowitz & Leydesdorff, 2000, p. 109)

Furthermore, European universities' third mission is focused on engagement with wider society. This third mission can be related to technology transfer (including knowledge and innovation) to industry or economic partners, participation in policy making or in public engagement and societal debate. There have been recognized that an important element of the universities third mission is their role in addressing societal challenges. The pillars of the Europe 2020 strategy reflect this fact (considered in

¹ According to (Nonaka & Konno, 1998), "Ba" is perceived as a shared place or space for emerging relationships. This can be explained or associated with a physical space (as an office or dispersed business space), a virtual space (as it is generated by web platforms or teleconference), but most appropriate it is associated with the action and interaction of mental energies interactions (usually for sharing ideas, experiences, ideas, ideals or harmonizing/disharmonizing human actions; positive and negative energies have to be considered) or any combination of them. It has been considered also, that Ba is a "share context in motion" which is described by the share "here-now" relationship and could support advancing individual and/or collective knowledge.

the European agenda for the next years), too. This agenda puts forward three mutually reinforcing priorities: Smart Growth, Sustainable Growth and Inclusive Growth, which are further divided into seven flagship initiatives to catalyse progress under each priority theme (Curaj et al., 2012). These are strongly related to the dynamics of the university Ba space and the way changes are managed in order to support the new business models that include strategies on how education and research are done, but also, how their results are valorised for the benefit of the entire society.

In this context, the article presents the research approach for defining an evaluation model, based on a related ontology, for the university-industry collaboration in open innovation. Furthermore, the proposed methodology has been tested and validated in the case of three Romanian universities and based on the experimental results a global overview or diagnosis was done. The following chapters will describe the research approach.

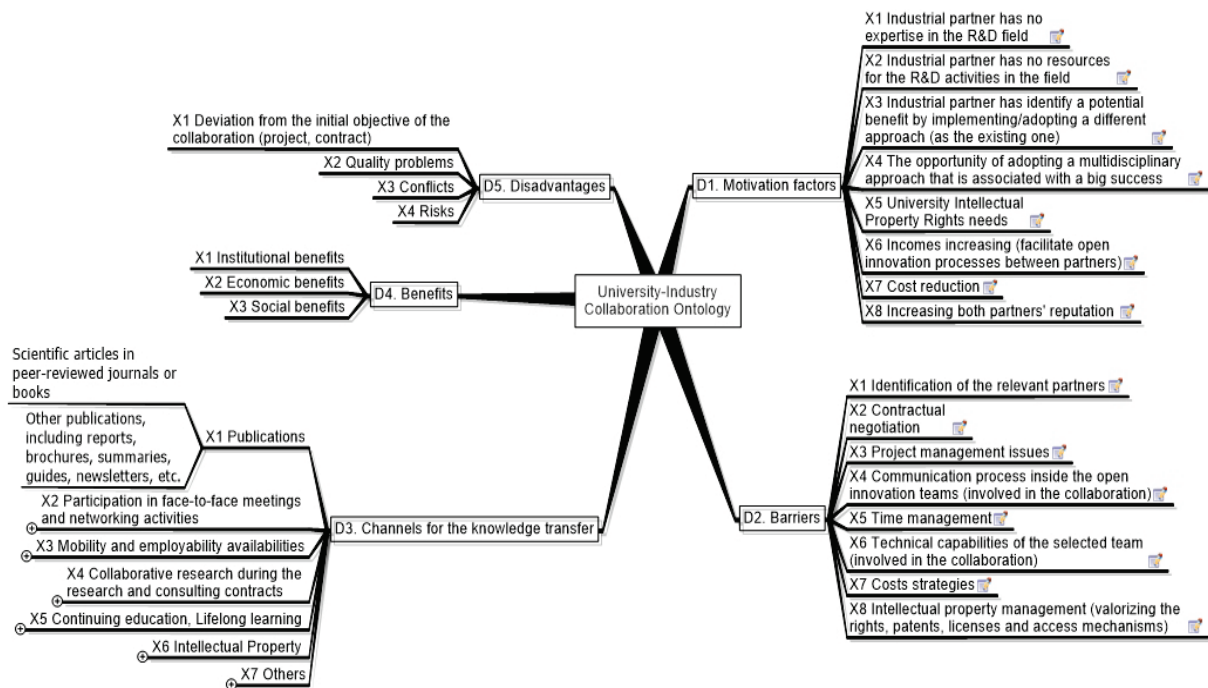
2. EVALUATION MODEL FOR UNIVERSITY-INDUSTRY COLLABORATION IN OPEN INNOVATION

It is observed that in the last years, universities have moved from a so call, “closed innovation system” to an “open innovation system” (Chesbrough, 2003). While the term “open” may include a number of factors as legal, economic etc., the process of supporting and encouraging networking (for innovation increasing) includes public-private partnerships or university-industry cooperation/collaboration (Geuna & Muscio, 2009; Larédo,(2003; Draghici et al., 2015a). This is considered a key element in order to be solve by the European universities (including their research entities for research, development and innovation or for the transfer of innovation or incubators etc.). It has been recognized that universities “play a leading global role in terms of top-level scientific output, but lag behind in the ability of converting this strength into wealth-generating innovations” (Massen & Stensaker, 2011). Based on these issues, the research approach was established in order to define an evaluation model for university-industry collaboration in open innovation.

2.1. The university-industry collaboration ontology definition

In order to define a coherent model, the first phase of the research was focused on the definition of a related ontology. The established framework consists of five dimensions described by 30 relevant items, which could be considered then for the evaluation model. The main issues of interest are (inspired mainly from (Ankrah, 2007) and analysed in (Draghici et al., 2015a)): 1) Identification of motivation factors, 8 items; 2) Barriers, 8 issues; 3) Channels for the knowledge transfer, 7 issues; 4) Benefits, 3 issues; 5) Disadvantages of the university-industry collaboration in the open innovation context, 4 issues (Picture 2).

Picture 2: The university-industry collaboration ontology general overview (knowledge map with codifications)



Source: extended from (Draghici et al., 2015a)

The ontology design is a result of a creative work developed in a collaborative manner with specialists from three universities in Romania, located in Timisoara, Cluj-Napoca and Oradea (West part of the country). Using their experience and expertise in university-industry collaborations, the ontology was used as a basis for the evaluation approach regarding the state of Romanian universities involvement in collaborative projects or contract with actors from the business environment (particularly with industrial actors).

2.2. Evaluation model development – methodological aspects

In the second phase of the research, the ontology has been transformed into a questionnaire, as a tool used for a survey to characterize the main dimensions of the university-industry collaboration in open innovation. The designed questionnaire was based on the ontology and the responses related to each question (with an adequate formulation) were evaluated based on the Likert scale with 5 points (1, totally disagree / unimportant, ..., 5, totally agree / very important). The dimensions considered for the analysis together with their items for characterization were codifying as shown in Picture 2. The questionnaire was distributed on-line to three universities research community (managers from different levels of the research domain and research staff were subjects of the survey). The collected responses were processes (using Excel software facilities) by each university responsible person and the global research result was presented as a university-industry collaboration foot print (radar graph) and by calculated a total score. The mathematical formulas used for the data processing are shown in Table 2. In the case of the dimension D₃ “channels for knowledge transfer”, there was included an open question that was not considered for the mathematical approach. Finally, the proposed model for evaluation of the university-industry collaboration in open innovation consists of 5 dimensions and 29 related items.

Table 2: The mathematical approach adopted for the university-industry collaboration foot print determination

Code	Dimension	Score / Item	Dimensions' score
D1	Motivation factors	$X_1 \dots X_8$ – absolute value of the score by each item of characterization $x_1 \dots x_5$ – number of responses (absolute values) related to the Likert scale points 1, ..., 5	_____

D2	Barriers	$X_1 \dots X_8$ – absolute value of the score by each item of characterization _____, $x_1 \dots x_5$ – number of responses (absolute values) related to the Likert scale points 1, ..., 5	_____
D3	Channels for the knowledge transfer	$X_1 \dots X_6$ (X_7 was transformed into an open question) – absolute value of the score by each item of characterization _____, $x_1 \dots x_5$ – number of responses (absolute values) related to the Likert scale points 1, ..., 5	_____
D4	Benefits	$X_1 \dots X_3$ – absolute value of the score by each item of characterization _____, $x_1 \dots x_5$ – number of responses (absolute values) related to the Likert scale points 1, ..., 5	_____
D5	Disadvantages	$X_1 \dots X_4$ – absolute value of the score by each item of characterization _____, $x_1 \dots x_5$ – number of responses (absolute values) related to the Likert scale points 1, ..., 5	_____
T	Total score	_____	_____

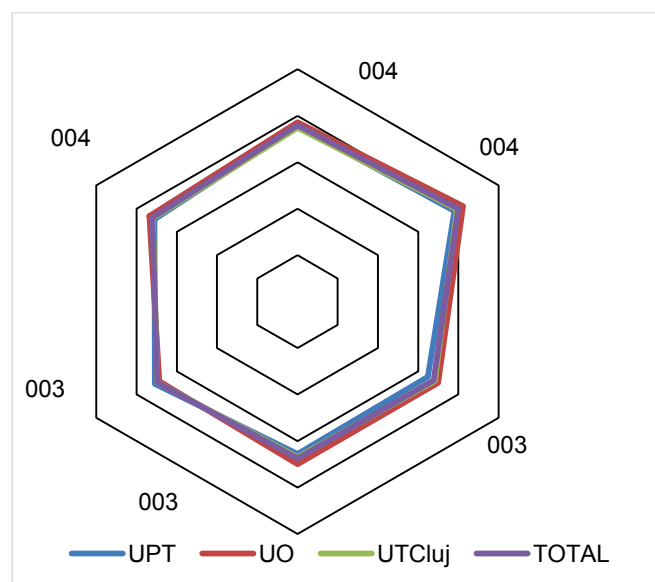
2.3. Experimental research results

Table 3 presents the research results gained after the responds were processed, for each university responsible. In Picture 3 are presented the university-industry collaboration foot print graphs for each universities involved in the research together with the global graph.

Table 3: Research results

University	Dimension D
Politehnica University of Timisoara - UPT (212 subjects)	D1 = 3.784788
	D2 = 3.898585
	D3 = 3.242138
	D4 = 3.281447
	D5 = 3.542453
Total/university	$T_{UPT} = 3.55$
University of Oradea - UO (154 in the subjects)	D1 = 3.857955
	D2 = 4.112825
	D3 = 3.494589
	D4 = 3.500000
	D5 = 3.435065
Total/university	$T_{UO} = 3.68$
Technical University of Cluj-Napoca - UTCluj (232 subjects)	D1 = 3.745151
	D2 = 3.967134
	D3 = 3.41822
	D4 = 3.346264
	D5 = 3.479526
Total/university	$T_{UTCluj} = 3.59$
TOTAL score	$T_{global} = 3.61$

Picture 3: The university-industry collaboration foot print



The research results show similar opinions and attitude of the subjects related to the university-industry collaboration in open innovation. The Total/university (3.55; 3.68 and 3.59) and the TOTAL

scores of 3.61 demonstrate the existing collaboration with difficulties of strategic and tactics related to complete attending of the universities objectives and in the field of knowledge, innovation transfer. Furthermore, Romanian universities do not have a coherent business model (definition, implementation in relation with the strategy) for their collaboration with industrial actors and this is a problem related to the top management. According to the responds given by the university researches, there have been observed that they understand well the D2, “barriers” dimension of the collaboration with industrial partners (the scores calculated for D2 are near the value 4, in the case of all investigated universities). Additional conclusions were elaborated per each university in order to explain the lower scores value for some dimensions:

1. UPT researchers do not understand and trust the exiting “channels for the knowledge management transfer” (D3) at the university level. This is an internal communication gap of the organization because UPT research responsible staff do not promote, internally, the facilities created in order to support D3 dimension (i.e. the Office for Innovation and Technological Transfer and the Office for Research Valorisation);
2. UO researchers have express less fear about the “disadvantages” (D5) in their collaboration with industrial partners. They do not consider that this type of collaboration could be in their disadvantage. This is a consequence of the fact that UO is well implicated in industrial collaboration, and the results of such collaborations are well known by the researchers community from academia and the economic environment;
3. UTCIuj researchers do not have a good perception (they do not realize) on the “benefits” (D4) gained because of their collaboration with industry. This fact is caused by the low perception of the organization benefit (people have low perception of their belonging to the organization). The considered items for the characterization of D4 dimension do not include personal benefits (extra salaries obtained by the researchers through their collaboration with industry).

According to the average profile determined for the three universities, there have been observed low scores for “channels for the knowledge management transfer” (D3 = 3.38) and “benefits” (D4 = 3.38) dimensions and the general causes could be similar with those presented earlier.

3. CONCLUSIONS AND FUTURE WORK

The described approach for the definition of an evaluation model for university-industry collaboration in open innovation. The research steps were: (1) definition of the university-industry collaboration ontology (five dimensions and 30 items of characterization); (2) definition of a questionnaire in order to support a survey developed with the universities researchers (including managers in the field); (3) experimental research (in the case of three Romanian universities) in order to test and validate the survey methodological approach that was assimilated with the evaluation model. The experimental research has proofed that the design evaluation model (considered also, as a diagnosis of the actual situation of the university-industry collaboration) could help to identify the strategic direction to be followed by the universities in order to better valorise their potential of innovation with the support and involvement of industrial partners. In addition, the evaluation model could be used to define the universities orientation for business, for profit generation through their research activities develop in partnership with industry.

The next priority of the research is the evaluation of the adoption level of the open innovation practices developed with universities by the industrial companies. Using a similar questionnaire there will be developed a survey with industrial subjects, by each university involved in the research. By this, there should be developed a comparative study between the opinion of the university staff and industry staff, for three distinguish areas in Romania. Furthermore, future researches will be focused on the development of a software product in order to evaluate the level of adoption of open innovation in the framework of university-industry collaboration projects.

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REFERENCE LIST

1. Ankrah, S.N. (2007). University-Industry Inter-organizational Relationships for Technology /Knowledge Transfer: A Systematic Literature Review, *Working Paper 1743-6796*, Leeds University Business School, Leeds, U.K, 1(4), 1-54.
2. Chesbrough, H. W. (2003). *Open innovation. The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.
3. Curaj, A., Scott, P., Vlasceanu, L., & Wilson L. (Eds.) (2012). *European higher education at the crossroads: between the Bologna Process and national reforms*. Springer.
4. Draghici A., Ivascu L. V., Baban C. F. & Bacali L. (2015a). University-Industry Collaboration in Open Innovation, *Proceedings of 9th annual International Technology, Education and Development Conference, INTED 2015*, 2nd – 4th of March 2015, Madrid, Spain, 6278 – 6287. Retrieved from <http://library.iated.org/view/DRAGHICI2015UNI>
5. Draghici A., Foldvary-Schramko H. K. & Baban C. F. (2015b). Comparative Study on Knowledge Management Dimensions That Support Education and New Learning in Romanian Universities, *Proceedings of EDULEARN 2015 Conference*, 6th -8th of July 2015, Barcelona, Spain, 6726 – 6735. Retrieved from <http://library.iated.org/view/DRAGHICI2015COM>
6. Draghici A., Baban C. F., Ivascu V. L. & Sarca I. (2015c). Key Success Factors for University - Industry Collaboration in Open Innovation, *Proceedings of ICERI 2015 Conference*, 16th – 18th of November 2015, Seville, Spain, 7357 – 7365. Retrieved from <https://iated.org/iceri/publications>
7. Etzkowitz, L., & Leydesdorff, M. (2000). The Dynamics of Innovation: from National Systems and “Model 2” to a Triple Helix of University-Industry-Government Relation. *Research Policy*, 29(2), p. 109.
8. Geuna, A., & Muscio, A. (2009). The governance of university knowledge transfer: A critical review of the literature. *Minerva*, 47(1), 93–114.
9. Larédo, P. (2003). Six major challenges facing public intervention in higher education, science, technology and innovation. *Science and Public Policy*, 30(1), 4–12.
10. Maassen, P., & Stensaker, B. (2011). The knowledge triangle, European higher education policy logics and policy implications. *Higher Education*, 61(6), 757-769.
11. Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, BA and leadership: a unified model of dynamic knowledge creation, *Long Range Planning*, vol 33.
12. Nonaka, I., & Konno, N. (1998). The concept of "ba": Building a foundation for knowledge creation. *California management review*, 40(3), 40-54.