

Research on the valorization of technology transfer in view of sustainable increase in the competitiveness of  
research – development – innovation organizations



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**Abstract of doctoral dissertation**

**RESEARCH ON THE VALORIZATION OF TECHNOLOGY TRANSFER IN VIEW  
OF SUSTAINABLE INCREASE IN THE COMPETITIVENESS OF  
RESEARCH - DEVELOPMENT - INNOVATION ORGANIZATIONS**

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**Keywords:** national research and development institutes (NRDI), evaluation of the global performance indicator of technology/knowledge transfer (GPI), measuring the contribution of different technology / knowledge transfer mechanisms to the fulfillment of its mission.

## **INTRODUCTION**

### **Formulation of the research item**

The transfer of technology, by linear dissemination methods often has a limited economic impact. In the absence of some stimulants to engage in complex transfer mechanisms with a wider impact on the local economy development, the clear distancing between the public research organizations (universities/ national research-development institutes) and specialized industrial units is often present in countries/regions that have not managed to modernize the innovation systems. In contrast with these ones, there are the countries that have aligned stimulants for the technological transfer and that invest in changing the culture and the infrastructure associated to the technological transfer.

The subject area, addressed to within the doctoral thesis aims to take over and develop an assessment instrument of the technological/knowledge activity within the academic environment, instrument that can be used by the managers of the component units of the national RDI system, especially national research-development institutes (NRDI).

The idea of this thesis is to answer one of the questions raised by the scholarly literature with regard to the assessment of the technology transfer (TT) mechanisms efficiency: "Can be developed a measure of technology efficiency transfer for the RDI system in Romania?"

### **Importance and topical issue of the theme**

The knowledge of technological transfer mechanisms is of interest both for the public research organizations (universities/NRDI), and for the industrial ones, as the knowledge created by these ones, as result of research funded from the state budget for the research-development activity, have the potential of bringing benefits to economy, society and to the environment.

By choosing this innovative theme, my aim is to present an overview of the academic knowledge, in order to fully explain the impact of research and of technology-knowledge transfer in a new approach that of assessing the efficiency of broken technology transfer within a well structured hierarchy of the specific transfer objectives and mechanisms, and of the relationships among them. This new approach of valuating the efficiency of technology transfer from universities to industry examines a comprehensive list of university technology transfer mechanisms that contributes to its mission achievement.

### **Motivation for choosing the research topic**

The motivation for choosing this theme has a triple signification. Firstly, by this thesis I have tried to take an important step in my life and can be considered a feedback of the motto "Start where you are. Use what you have. Do what you can".

Secondly, I have intuited the need of using a managerial instrument within the field of valuating the efficiency of technology transfer for another category of knowledge-based organization, respectively from the national research-development institutes to industry.

Thirdly, it is about the desire of creating an interest theme/a managerial instrument for the national research-development institutes, in accordance with the current tendencies regarding the use of the managerial instruments.

### **Objective of the thesis**

The specialized literature is very rich in assessing the efficiency of the technology transfer from universities to industry. Thus, Thien Anh Tran (2013) presents the elaborated extended hierarchical decisional model by which he suggested a methodology for assessing the performance of technological/knowledge transfer activity applicable to the academic/university environment. This model was adopted by UPB (2015) and Hadăr (2018) and optimized for the technical university environment in Romania, adapted for the Romanian academic entrepreneurial environment. The purpose of assessing the technological transfer activities carried out within the technological transfer centers within the research universities and institutes, the business models applied by these under the conditions specific for the transition economy they carry out their activity in, aim to support their competitive advantage increase.

Within this context, the conducted research aimed to: (i) analyze the component elements of MOGSA model (model designed with five levels labeled: Mission, Objectives, Goals, Strategies and Actions) for the organizational efficiency of the TT technological transfer and of the relationships among the component elements; (ii) analyze the types of strategies undertaken by the technological transfer centers (CTT) within the academic environment in order to best match the environments they operate in.

In accordance with the objective of the thesis, I have outlined the operational frame of research by using different research methods (quantitative and qualitative), on one hand for achieving an analysis having the purpose of highlighting a series of elements specific for the academic model, and, on the other hand, by using these methodological instruments, I have considered them in developing an instrument for the assessment of the

technological/knowledge transfer activity applicable to the national research-development institutes (NRDI).

This thesis carried out the: (i) identification of the elements and indicators of the competitive advantage, as specifically applied for NRDI; (ii) defining and validation of the model by real measurements within the context of the NRDI from Romania, through an empirical analysis of assessing the institutional efficiency of TT.

In accordance with the above mentioned research objective, I have set up the general and specific objectives both from the theoretical and methodological point of view.

### **General objective of the research**

The general objective of the research is to study, to take over an instrument for the assessment of the technological/knowledge transfer activity from the academic/university environment, and to develop it such way to be used within other knowledge-based organizations, components of the RDI national system, especially the national research-development institutes (NRDI). The testing/validation of the instrument aims to demonstrate if the conceptual model is able to produce an analysis with real data to achieve the research objectives. Depending on the obtained results, the beneficiary NRDI of the analyses may change the shares of the parameters according to the problems approached at the level of their management. Nevertheless, the developed model does not intend to make comparisons between the NRDI within a field/different fields, but only assesses their efficiency to demonstrate the applicability of the model.

### **Specific objectives of the research with theoretical and methodological character**

The specific objectives of the research are:

- *Objective 1.* Identification of the main factors that facilitate the technology transfer (TT) from NRDI to industry, as well as the common problems, barriers occurring within the TT process between NRDI and the enterprises;
- *Objective 2.* Characterization of the technological transfer innovating activity of the national research-development institutes (NRDI);
- *Objective 3.* Identification of a conceptual model for the assessment of the technological/knowledge transfer activity within the knowledge-based organizations (within the academic/university environment), for calculating the Global Performance Indicator (GPI);
- *Objective 4.* Development of a conceptual model for the assessment of the technological/knowledge transfer activity within NRDI, for calculating the global performance



Indicator (GPI) of an NRDI, by defining the individual TT mechanisms and of the adherent performance indicators;

- *Objective 5.* Identification of some economic models specific for TT within knowledge-based organizations (within the academic/university environment) used in their development strategies;

- *Objective 6.* Validation of the conceptual model for the assessment of the technological/knowledge transfer activity by case study.

### **Working hypotheses**

The following hypotheses are subject to valuation in this paper:

*Hypothesis 1.* The C-D personnel within the CD national system can identify the main factors, as well as their influence degree on the performance recorded by NRDI with regard to the valorization of the technological transfer;

*Hypothesis 2.* The measurement of the efficiency of the technology transfer for the RDI ecosystem in Romania, respectively NRDI, may be performed based on a scientific model;

*Hypothesis 3.* The use of a managerial instrument regarding the Global Performance Indicator (GPI) of TT activities within some NRDI is of interest due to the benefits and advantages that are brought in taking decisions, appropriate for the problems addressed by their management;

*Hypothesis 4.* The used technical/metrical data are significant in the case of quantitative studies.

### **Applied research methodology**

The research methodology applied within the theme involved the use of:

- scientific research instruments: bibliographic research; quantitative research (questionnaire based survey) and an qualitative research (focus group interview) on a representative sample that involving researchers working in national research-development institutes.

- used software instruments: IBM SPSS Statistics.

### **Contributions of the work**

The study addresses to NRDI management within the CDI national system frame that can be interested in this managerial instrument regarding the Global Performance Indicator (GPI) of TT activities within them.

I have to highlight a few contributions of the thesis that can be useful to potential

beneficiaries interested in using a certain method, but also for the obtained results:

Firstly, an overview of the universities' specific framework referring to the model of assessing the technology/knowledge transfers activity within the academic/university environment.

Secondly, the achievement of an empirical study (with quantitative and qualitative component) on the characterization of the innovating and technological transfer activity of the national research-development institutes (NRDI), which provide information and opinions of the respondents regarding the cooperation between NRDI and enterprises, the way the transfer of knowledge from NRDI to industry is achieved, the common problems they confront with, possible measures and recommendations for the improvement of this activity.

Thirdly, the development of a model for the assessment of technological/knowledge transfer activity within the national research-development institutes (NRDI) – The calculation process of the Global Performance Indicator (GPI) of a national research-development institute (NRDI), which represents a specific management instrument within the CDI field it activates in.

Fourthly, by validating the model for the assessment of the technology/knowledge transfer activity within the national research-development institutes (NRDI), by auditing the technologic/knowledge transfer and the interpretation of the results obtained by performing empirical analysis surveys with regard to the evolution of the global performance Indicator of the technological transfer activities within 5 NRDI for a determined period of time, the thesis formulates a series of recommendations that can adequately contribute to the problems addressed at the level of their specific management. This allowed both the construction of the "knowledge maps" based on the collected technical data for the reference periods, and for the following-up of the evolution of the Global Performance Indicator of the analyzed NRDI, which in supporting the execution of an audit program, be able to concentrate on the performance of the technological/knowledge transfer carried out by NRDI.

By these contributions, the thesis highlights the importance of using this managerial instrument within the CDI field and underlines the fact that this can be periodically used by NRDI management that desires to use such approaches.

## **STRUCTURE OF THE PhD THESIS**

In accordance with the proposed objectives, the paper is structured on three parts, followed by general conclusions, and by the annexes and the bibliographical references.

In Part I, consisting in chapters 1-2, there are general aspects that can be found in the specialized literature "Current stage of research with regard to the transfer of

technology/knowledge and the competitive advantage".

In Chapter 1, entitled "General aspects regarding the intellectual property rights and the transfer of technology/knowledge in research - development – innovation organizations in the academic/university environment", I have considered an analysis of the specialized literature regarding the intellectual property and the technology/knowledge transfer.

At the same time, I have highlighted the fact that the academic/university environment uses advanced scientific methods for assessing the performance within the technology/knowledge transfer field. Thus, I have created an overview of the academic specific framework from the USA referring to:

- business models of university technological transfer (identified by Baglieri) accepted in the specialized literature, which are used in making decisions in order to achieve their mission and strategic objectives, in order to achieve some services specific for the customer segment/market needs;
- "model for assessing the technology/knowledge transfer activity within the academic/university environment – Methodology for calculating the Global Performance Indicator (GPI) within the academic/university environment" (suggested by Saaty & Tran). This extended/explicit decisional model is accompanied by an assessment methodology of the technology/knowledge transfer activity within the academic/university environment.

In Chapter 2, first part, there are presented a series of "Aspects regarding competitiveness and sustainability at microeconomic level within the knowledge-based organizations – the case of the national research-development institutes". In continuation of this chapter there are presented a series of particularities of the CDI activity organizing - the case of the national research-development institutes (NRDI) with reference to the: mechanisms of their organizing, functioning and financing; the innovation and technological transfer infrastructure; proposals for public policies oriented to the increase of competitiveness of their organizing and management way. In the end of this chapter I have made a "SWOT analysis of the national research-development institutes (NRDI) resulting from the public information contained in the annual activity reports from 2014-2017". All the elements mentioned in this chapter, at microeconomic level, show the relevance of competitiveness measuring in terms of the resources used to achieve and maintain the competitive advantage of the knowledge-based organizations – the case of the national research-development institutes (NRDI).

Part II, consisting in chapters 3-4, focuses on the presentation of the specific results obtained in this thesis with regard to the "Proposed method and model for the development / design of a system of institutional performance assessment indicators regarding the valorization of technology transfer and application of applications to organizations".

Thus, in Chapter 3, I have achieved an empirical survey regarding the characterization of the technological innovation and transfer of the national research-development institutes (NRDI) by using:

- a quantitative component – denominated "Quantitative survey on innovation and technological transfer of the national research-development institutes", a survey based on a questionnaire addressed to the research personnel within NRDI that provides information and opinions on the cooperation between NRDI and enterprises, the way the knowledge from NRDI to industry is achieved, the common problems they confront with, possible measures for improving this activity;
- a qualitative component – denominated "Qualitative survey on innovation activity and technology transfer in order to increase the competitiveness of national research-development institutes" to gather in-depth information from the decisional factors/the personnel employed within NRDI.

In the end of the empirical survey, the correlations resulting from the comparative analysis of the two components (quantitative and qualitative) regarding the characterization of the innovation and technological transfer of the national research-development institutes (NRDI) are presented in order to increase their competitiveness, through which I intended to draw conclusions from the perspective of the researcher involved in the CD activity. Through their personal approaches, presented in the empirical survey, there were identified the influence spheres on the technological transfer mechanisms in the fulfillment of a NRDI mission.

In Chapter 4, I have achieved the development a model for the assessment of the technological/knowledge transfer activity within the national research-development institutes (NRDI) – The calculation process of the global performance Indicator (GPI) of a national research-development institute (NRDI) by adapting the decisional model for the assessment of technology/knowledge transfer activity within the academic environment, with the related calculation relations, to the specific of a public research – development – innovation organization, respectively for a NRDI.

In this model developed for the national research-development institutes (NRDI) the contribution of the technological transfer mechanisms to its general performance is highlighted, and there are introduced a series of specific elements, as follows:

- the specific mission of a NRDI has been defined;
- the specific 5 objectives of a NRDI to the fulfillment of the Mission (M) have been formulated;
- a new group of 6 technology/knowledge transfer mechanisms has been formulated to meet the Objectives (O) and the Mission (M) of a NRDI;
- 15 individual technology/knowledge transfer mechanisms have been formulated to meet the Objectives (O) and the Mission (M) of a NRDI;
- 34 performance indicators of technology/knowledge transfer for the fulfillment of the Objectives (O) and of the Mission of a NRDI have been selected;
- the weights of these objectives/groups of individual mechanisms and respectively, technology/knowledge transfer indicators based on a rational correlation regarding the spheres of influence on each group of technological (G) transfer mechanisms groups in the fulfillment of the Objectives (O) and of the Mission (M) of a NRDI.

By the developed model it was aimed the relevance of technology/knowledge transfer activity, considering the contribution of the individual indicators to the Global Performance Indicator (GPI) of a NRDI.

In Part III, consisting only in Chapter 5, there are presented the original results regarding the validation of the model for the assessment of technology/knowledge transfer activity within the national research-development institutes (NRDI) through case surveys, the audit of the technological/knowledge transfer and the interpretation of the obtained results. The validity of the model regarding the assessment of the technology/knowledge transfer activity within the national research-development institutes (NRDI) aims the degree this management instrument covers the interest field regarding the Global Performance Indicator (GPI).

Thus, in Chapter 5, in a first stage I have planned to identify a representative sample of 5 NRDI with competitive potential whose field of activity correlates with the 5 areas of intelligent specialization set up by the National Strategy for Research, Development and Innovation RDI for the period 2014-2020. Also, at this stage, as a data collecting instrument there were used the public data contained in the annual activity reports for the period 2014-2017, whose processing allowed obtaining information that has been used to achieve the analysis and decisional support matrices – the spreadsheet for the global performance Indicator (GPI) of NRDI for the reference periods (respectively for the periods 2015/2014, 2016/2015, 2017/2016).

In the second stage, I have achieved the piloting the model for the assessment of the technological/knowledge transfer activity within the national research-development institutes – the calculation process of the global performance Indicator (GPI) of a NRDI. Consequently,

for each NRD I have performed the calculation of the global performance indicator (GPI) of the TT activities within them and the interpretation of the empirical results validly and relevantly obtained, in terms of these indicators. The analysis and interpretation of this information permitted to follow-up the evolution of the contributions of the mechanisms groups to the achievement of the global performance Indicator (GPI). Considering the fact that the specific of the analyzed NRDs is the applicative research, this allowed the formulation of some conclusions/recommendations specific for each institute in order to concentrate the efforts for increasing their performance within the mechanisms groups.

The achieved case surveys are interesting as a novelty element regarding the management instruments, available to the management through which it is intended the functioning/fulfillment of the NRDs mission from the technological/knowledge transfer point of view, or may be also used by the coordinating body as support for piloting some policies regarding the basic/complementary funding within the NRDs, based on the global performance Indicator (GPI) of TT activities.

Reflecting on the stages completed through the piloting of the model for the assessment of technological/knowledge transfer activity within the national research-development institutes – the calculation process of the global performance Indicator (GPI) of NRDs, I found out the possibility of using different methods (questionnaire, interview, analysis of the annual reports) for the construction of the "knowledge maps" of NRDs. It comes to the aid of executing an audit program that focuses on the technological/knowledge transfer performance carried out by NRDs.

Therefore, in the third stage, I also developed an auditing methodology of the technological/knowledge transfer performance carried out within the NRDs, which, by interpreting the obtained results with the proposed ones (under economical, efficiency and effectiveness) be able to allow adapting the organizational framework of these ones according to their business environment.

Finally, Part IV consists only in Chapter 6, and contains the general conclusions of the research, the original contributions and the perspectives for its subsequent development. In the end of this chapter, I presented the references I used and the articles published in specialized journals or within some national scientific manifestations.

## SYNTHESIS OF THE EMPIRICAL RESULTS

Study	Hypothesis	Method	Empirical results
Quantitative Survey	Hypothesis 1	Introduction of the questionnaire on a specialized platform SurveyGizmo®	The obtained data together with the answers to the questions regarding the study, have been captured on an Excel calculation spreadsheet and then analyzed by using SPSS (Statistical Package in the Social Sciences), and Amos (software statistic, which is a SPSS module). The preliminary analysis for the identification of the main factors, as well as their influence degree on NRDIs performance regarding the valorization of the technological transfer highlighted both strengths (access to multiple financing sources, varied RDI results that are applied, permissiveness to collaborative and multidisciplinary research) but also a series of weaknesses (disturbances with regard to the financing mechanisms, moderate attractiveness of the researcher career, varied barriers that do not allow the technology transfer in the economy/society).
	Hypothesis 4	ISS method for data processing	The quantitative survey allowed the identification of the: - Important factors ( $F_i$ ) that facilitate the transfer of new technologies/knowledge from the NRDIs to industry; - Their major and common problems ( $MP_i$ ) that occur in the new technologies/knowledge transfer process; - Communication barriers ( $B_i$ ) existent among the NRDIs (as provider of technology/knowledge) and the enterprises (as beneficiary of technology/knowledge).
Qualitative Survey	Hypothesis 1	Interview/ focus group	The qualitative survey allowed a sufficient collection of information resulted from the respondents' opinions referring to: - the most frequently mentioned/important indicators for performances' assessment; - the major and common, in the same time, problems that occur during the new technologies/knowledge transfer process within their organizations towards industry; - the important factors that facilitate the transfer of new technologies/knowledge from NRDIs to industry; - recommendations for a better cooperation between NRDIs and companies/SMEs to overcome the existing problems that occur during the new technologies/knowledge transfer process; - presenting some success stories they directly participated in, which highlights the collaboration with national or international companies; In order to optimize the new technologies/knowledge transfer process, the recommendations formulated by the respondents are necessary to overcome the existent communication barriers between the technology beneficiary and the technology provider.
Study for the development of a model for the assessment of technology/kno	Hypothesis 2	Adapting the model for the assessment of the technology /knowledge	Development of a model for the assessment of technological/knowledge transfer activity within the national research-development institutes (NRDIs) – the methodology for calculating the Global Performance Indicator (GPI) specific for a national research-development institute by adapting the decisional model for the assessment of the technology/knowledge transfer activity within the academic environment, with the adherent calculation relations, to the specific of another research – development – innovation public organization, respectively, for

<p>wledge transfer activity for NRDI.</p>		<p>transfer activity within the academic/university environment</p>	<p>a NRDI.                  The model developed for NRDI highlights the contribution of TT mechanisms to its general performance. A series of specific elements have been introduced in this model, such as:                  - the specific mission of a NRDI has been defined;                  - the specific 5 objectives of a NRDI for the accomplishment of the Mission (M) have been formulated;                  - a new group of 6 technology/knowledge transfer mechanisms for the fulfillment of the Objectives (O) and of the Mission (M) of NRDI has been formulated;                  - 15 individual technology/knowledge transfer mechanisms for the fulfillment of the Objectives (O) and of the Mission (M) of a NRDI have been formulated;                  - there have been selected 34 performance indicators of technology/knowledge transfer for the fulfillment of the Objectives (O) and of the Mission (M) of a NRDI;                  - there have been argued the weights of these objectives/groups of individual mechanisms and respectively, technology/knowledge transfer indicators based on a rational correlation regarding the influence spheres on each group of technology/knowledge transfer mechanisms (G) in the fulfillment of the Objectives (O) and of the Mission (M) of a NRDI.                  There was followed up the relevance of technology/knowledge transfer activity by considering the contribution of the individual indicators to the Global Performance Indicator (GPI) of a NRDI.</p>
<p>Survey for the validation of the model for the assessment of technology/knowledge transfer activity for NRDI.</p>	<p>Hypothesis 2                  Hypothesis 3                  Hypothesis 4</p>	<p>Collecting the technical data from the annual reports of the NRDI, adherent to the reference period.                  Achievement of the analysis and decisional support matrices – spreadsheet of the Global Performance Indicator (GPI) of NRDI for the reference periods.</p>	<p>The carrying out of the 5 case surveys with regard to the evolution of the Global Performance Indicator (GPI) of TT activities within some NRDI within a certain analyzed period.                  The individual assessment of each contribution of TT mechanisms or of those TT groups of mechanisms to its general performance.                  Identification of all TT activities that are effective or where it is recommended to pay increased attention in order to correct the found non-conformities.                  The obtained results are useful for the decisional factors within a NRDI for efficiently planning and managing the technology/knowledge transfer activities within their institution.</p>



## **GENERAL CONCLUSIONS**

The specific of the thesis allowed, on one hand, the highlighting and need to use a structure for tracing the framework elements of a methodology for the assessment of technology/knowledge transfer activity for NRDI and, on the other hand, the validation of the model for the assessment of technology/knowledge transfer activity for NRDI.

In order to respond to the challenge of developing a methodology in the perspective of its integration within a managerial instrument, it was taken into account the fact that for achieving the mission and the objectives specific for a NRDI, 4 empirical surveys have been achieved.

Through the first survey (quantitative survey), through the questionnaire, it was aimed to analyze and assess the opinion of the respondents regarding the important factors that facilitate the new technologies/knowledge transfer from NRDI to industry, the major problems and the common barriers that occur during the new technologies/knowledge transfer process.

Through the second survey (qualitative survey), through the interview, it was aimed to analyze and assess the opinion of the respondents within the RDI field with regard to the most frequently mentioned/important indicators for the assessment of performances, the important factors that facilitate the transfer of new technologies/knowledge from NRDI to industry.

In order to optimize the new technologies/knowledge transfer process, the recommendations formulated by the respondents are necessary to overcome the major and common problems that occur during the new technologies/knowledge transfer process from their organizations towards industry.

The two surveys are complemented by the connections coming from the assembly made up of objective elements – hypotheses - results.

The third survey represents the development of a model for the assessment of the technological/knowledge transfer activity within the national research-development institutes (NRDI) – the methodology for calculating the global performance Indicator (GPI) specific for a national research-development institute (NRDI). This survey is related to the setting up of the mission (M) and of the objectives (O) specific for a NRDI, the formulation of some groups of mechanisms deemed to be necessary for the fulfillment of the Objectives (O) and of the Mission (M) of a NRDI, the setting up of the individual TT mechanisms and the performance indicators adherent to them on one hand, checked through the results of the quantitative and qualitative surveys, and, on the other hand, the connection between them being made by weights that have been taken over either from the specialized literature (for objectives), or deduced from the qualitative survey (for the mechanisms groups, TT individual mechanisms, performance

indicators, etc.).

This survey also highlights the fact that the same influence spheres, determinant for the fulfillment of the Objectives ( $O_i$ ) and of the Mission ( $M$ ) of a NRDI, also act on each group of technological transfer mechanism ( $G_k$ ), are determined by the Major problems ( $PM_i$ ), the Influence factors ( $F_i$ ) and, respectively by the Communication barriers ( $B_i$ ) expressed by the respondents that participated in the survey and are presented in the end of the sub-chapter through which I have performed the correlations resulted from the comparative analysis of the two components (quantitative and qualitative) of the empirical survey regarding the characterization of the technological transfer and innovation activity of the national research-development institutes.

The fourth empirical survey, consisted in the validation of the model for the assessment of technology/knowledge transfer activity for the NRDI, with the valuation of the results obtained in the RD activity carried out during the analyzed period, through the calculation of the global performance Indicator (GPI). This survey was derived from the general framework of the research (provided by the elaboration of the third survey), which practically validates the elaborated methodology. The carrying out of the case surveys/analysis responds to the specific objectives and hypotheses of this thesis. Therefore, in a first stage, there are described the profiles of the NRDI by presenting the research field, as well as a series of characteristics. In the second stage, based on the centralization of the data adherent to the period 2014-2017, there are identified and collected the monitoring indicators, the analysis and decisional support matrices have been developed – the spreadsheet of the global performance Indicator (GPI) of NRDI for the reference periods, interpretation of the obtained results and finally a few conclusions and general recommendations could be drawn.

The empirical results obtained within the thesis are confirmed as follows:

Firstly, by the methodology used for calculating the GPI which is recommended by the specialized literature, and the achieved methodology is a dominantly quantitative methodology, with the possibility of using the public data taken over from the annual reports of NRDI, consequently, this aspect assuring the data quality criterion.

Secondly, the empirical results obtained in connection with the global performance Indicator (GPI) of NRDI for the reference periods, reflect the tendency of integrating innovative methods within the set of analysis instruments in management.

Thirdly, the empirical results integrate research methodologies used in analyses that report to certain current themes with regard to the technological transfer (TT), which indicates a change of perspective on approaching some more complex assessment analyses of the NRDI.

### **Limits of research**

Considering the complexity of the model for the assessment of technology/knowledge transfer activity, limitations at this stage of research are inevitable. A series of limits can be set both methodological, and empirical. From the methodological point of view, there have been analyzed only 2 methods that can be integrated into more complex audit strategies.

From the empirical point of view, a first important limit of this research was to establish the sample of analyzed NRDI from the 43 NRDI accredited at present, conform to the provisions in force, by restricting the area to the NRDI that mainly conduct applicative research.

With regard to the quantitative survey, the sample may also constitute a limit of the research as the research-development personnel within the NRDI who carries out fundamental research has not been interviewed.

On the other hand, some aspects regarding the selection of the second analyzes sample cannot be mentioned. In this regard, it is about: the relative small volume of NRDI sample, the inclusion of the global performance Indicator (GPI) analysis only on three reference consecutive periods, but also the accuracy of the existent technical data.

### **Future research directions**

Starting from the identified limitations, I have to point out the following development perspectives opened by this thesis.

Taking into account those I have presented, for the extension of the research direction in the future, there are necessary a series of activities that should be considered in connection with the assessment of the technology transfer efficiency within the NRDI, as follows:

1. In order to further develop the Model for the assessment of the technological/knowledge transfer activity within the national research-development institutes, it is necessary to extend the analysis, consequently, to increase the sample to all those 38 NRDI, components of the national interest research system, which are, at present, under the coordination of the Ministry of Research, Innovation and Digitalization, for calculating the global performance Indicator (GPI).

2. It is necessary to further carry out a survey regarding the application of 4th stage of the audit to the technology/knowledge transfer for the representative sample of 5 NRDI, with the possibility of performing the audit of the technology/knowledge transfer for the whole sample

of NRDI that are under the coordination of the Ministry of Research, Innovation and Digitalization.

3. It is also necessary to focus on the streamlining of the Technological Transfer Entities (TTE) within ReNITT in order to improve the performances of the NRDI. In this regard it is necessary to develop a hierarchical model of decision support, through a simulation performed on TTE from the perspective of the technology/knowledge transfer model on the scenarios from the academic environment.

From the perspective of the business organization models for the technological transfer centers (TTC) within the academic environment, the survey will allow the correlation of the indicators of the TT individual mechanisms of a NRDI with the activities carried out within its own TTE. For the fulfillment of the NRDI mission, considering the available resources within it, the strategic decision regarding the business model within the technology transfer field will be finalized: revenue center or profit/value center.

4. As I have previously mentioned, future research based on this survey may also include an assessment and a comparison of a group of NRDI/TTEs. This survey will be of a special interest for the management of a NRDI/TTEs in order to improve the effectiveness of NRDI/TTEs activity, as it is in their interest to better settle the available resources.

5. Another possibility is to implement a survey in order to examine the effectiveness of an organization for a longer period of time (for example 10 years). This survey identified the strategic mechanisms for a NRDI, which could be a first step for a survey regarding the settling of resources from the state budget (providing the basic financing and respectively, of the complementary financing).

6. Another research direction, a very challenging one, is to assess the economic efficiency of all knowledge and technological mechanisms that have been identified in this survey, the profitability of research investments and expenditures at a NRDI. The survey underlined the fact that the revenues obtained from the valorization of RD results (by licensing/transfer) are not sufficiently profitable revenues to provide the financial sustainability of a NRDI.

The doctoral dissertation includes 47 tables, 36 images, 23 annexes, 117 bibliographical indications, 213 pages, and the results from the performed research are published in 14 articles, as first or co-author.

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