KNOWLEDGE MANAGEMENT AND RESEARCH PRODUCTIVITY: MEASURING AT THE UNIVERSITY

Svetlana Panikarova – Maxim Vlasov

Abstract

The aim of the research is to formulate the methodological approach to evaluating knowledge generation efficacy at universities based on the assumption that higher education institution knowledge generation is defined by the knowledge generation transaction costs. To evaluate knowledge generation efficacy at the University, authors suggest the following performance criterion: transaction efficacy of knowledge generation, which is a quantitative characteristic of knowledge generation efficacy demonstrating the share of knowledge increase in the context of transaction costs increase. To test these method authors conducted the evaluation of knowledge generation transaction efficacy at several Russian universities. The theoretical importance of this research is in formulating and testing university performance efficacy criteria allowing for the further formulation of methodological recommendations on improving academic activities at higher educational institutions. The practical importance of obtained results is that they can be used in analysis and design of institutional knowledge generation environment at the University. Knowledge Generation Efficacy Ratio can be used for making a decision concerning which research activities of students and university staff deserve more financial investments. The authors claim that the analysis of productivity of research units with the KGER method can be a source of valuable managerial information, which could be the basis for scientific assessment in Russia and other countries.

Keywords: knowledge creation, knowledge management tools, university, measurement, transaction cost

JEL Code: O33, O34

Introduction

The distinctive feature is that knowledge plays a leading role, and its generation predetermines economic growth. According to reports and studies reported in many countries, universi-

ties played a leading role in the transition to a productive knowledge-based economy. There is an ongoing discussion among experts concerning the ultimate result of university activities and whether the diploma and academic degree can be considered as the one. One point of view, following Flexner (1994), is that universities should be considered as places of research and measured by their contribution to science. Another view, following Brown (2008) and many others, argues that the primary mission of a university is education. The third mission linked to public service is considered as important in a diverse democratic society and equally important to the other missions of a University (Checkoway, 2001). Finally, there is the approach which considers every university a unique organization combining many missions (Marginson, 2007; Hladchenko, 2016).). Institutional analysis of university activities results can be based on resource dependence theory which states that on the one hand organizations depend on the environment, but the contrary can influence the environment they are functioning in (Pfeffer & Salancik,2009).

Therefore, active university development strategy cannot be formulated without understanding robust and weak points of knowledge management system. Knowledge generation efficacy evaluation, in its turn, is a primary source of information for formulating knowledge management strategy.

The aim of the research is to formulate a methodological approach to assessing research productivity at the universities based on the assumption that the growth transaction costs define higher education institution knowledge generation. The authors present a proposal of new ratio, called the Knowledge Generation Efficacy Ratio (KGER), which assess the research productivity at the universities. This is subsequently verified by analysis of its associations with selected measures of company performance and shareholder value creation. To test this ratio, an empirical survey has been conducted based on data for four various universities of Russia.

The article begins with a brief, critical analysis of the frequently used in many types of researchers on the research productivity at the Universities. The paper continues with the presentation of the KGER structure; then the research methodology is introduced, followed by a discussion about obtained results. The article concludes with a summary of the findings and recommendations regarding further directions of research.

1. Knowledge management institutions at the universities

The recognition of knowledge for the success of the organization and the need to take advantage of them has led some researchers to propose methods that are useful to manage this high-value knowledge efficiently (Dangelico et al., 2010; Pucciarelli & Kaplan, 2016). In scientific literature, the problem of evaluation of knowledge creation at the organization devoted much attention. Nonaka and Toyama (2005) developed dynamic models that allow the development of capacities to transfer and combine knowledge in companies. Jugdev (2007) proposed that companies most likely to achieve successful innovation would be those that can learn how to create, transfer and manage knowledge. A special place is given to research into the processes of education and knowledge generation (Bonett, 2000) in the overall landscape of the knowledge economy (Brown, Hesketh, 2004), including the role of individual scholars participating in intellectual activities and places at universities (Foray, 2004). Thus, as shown in some publications, the process of knowledge creation requires systematic evaluation (Arnold, 2004). Such systematic evaluations may be carried out by institutional structures that reflect real processes of knowledge management at the universities (Bibiana et all, 2016; Miller et all, 2016).

For the purpose of present research, we designed a set of knowledge generation performance indicators subdivided into two categories: explicit knowledge growth criteria (number of articles published by lecturers; number of new courses; number of developed and published teaching materials; number of monographs published; number of theses defended) and tacit knowledge (number of posts – graduate students; number of articles published by post – graduate students; number of prizes won by students at external competition; students' participation at external academic conferences).

In the context of developing "Knowledge-based Economy" evaluation of transaction costs related to knowledge generation becomes particularly important. At the same time multitude of researches on the topic of challenges to the knowledge-based economy does not answer the question on the interrelation between intellectual results and costs.

The concept of transaction costs was first introduced by R. Coase in the 30s of the last century in his article 'The Nature of a Firm'. It was used to provide insight on the existence of such a hierarchical structure as a firm, being oppositional to a market. R. Coase explained the emergence of these 'islands of consciousness' with their respective advantages regarding transaction cost minimization. Specificity of a firm functioning he thought to be brought

about by the suppression of a price mechanism and its substitution with the inner administrative control (Coase, 1937).

According to the Charters of universities, principal activities of educational institutions included first of all training of personnel and conducted fundamental and applied research (which is directly related to knowledge generation). Costs incurred as a result of main activities can be subdivided into material, salary, amortization and other costs.

Besides teaching and research universities are also engaged in other activities related to the main ones: publishing, information and library support, conducting conferences and participating in them, innovation activities, advertising and exhibition, international relations, legal work, Public Relations, etc. All these activities support the knowledge generation process. University costs related to these activities are transaction costs of knowledge increase.

Therefore, knowledge increase transaction costs are those costs related to forming and supporting economic institutions providing generation, dissemination and implementation of new knowledge.

2. Methodology

To evaluate research productivity at the University authors suggest introducing the following performance criterion: knowledge generation efficacy ratio, which is a quantitative characteristic of knowledge generation efficacy demonstrating the share of knowledge increase in the context of knowledge generation transaction costs increase (1).

Knowledge Generation Efficacy Ratio at the University can be calculated with the following formula: $$\nu_{ij} = \frac{dk_j}{dTC_i} \qquad (1)$$

vij – knowledge generation efficacy of j type research activities increase in the context of i-type change of transaction costs;

dkj – growth of j–type knowledge, i.e. knowledge increases results (Table 1);

dTCi – growth of i-type transaction costs.

The parameter vij allows one to estimate the degree of effect of a transaction cost on knowledge generation.

It should be noted at this step, that by knowledge we understand structured and systematized information meant to meet certain objectives and to support the lives of human beings.

In the present research, the indicators of tacit knowledge will include participation of students in external academic conferences, the number of prizes won by students at external academic competitions, the number of posts – graduate students. Explicit knowledge involves the number of articles published by lecturers, the number of teaching and methodic materials published, the number of monographs published.

Evaluating the vij performance criterion allows for defining the degree of influence of different types of transaction costs on the knowledge generation processes Possible cases for vij performance criterion numbers are given in table 1.

Tab. 1: Knowledge Generation Efficacy Ratio performance criterion (vij)

Figure v_{ij}	Economic meaning	Notes	Management task
$v_{ij} < 0$	Institutional trap	Growth of transaction costs coincides with knowledge decrease ($dTC_i>0$, $dk_j<0$)	Formulate ways of avoiding institutional trap
$v_{ij} = 0$	Absence of knowledge generation process	There is no knowledge generation despite the growth of transaction costs ($dTC_i>0$, $dk_j = 0$)	The change of ways (areas) of financial investments.
$0 < v_{ij} <1$	Knowledge generation process is not effective	The growth of transaction costs is larger than knowledge increase ($dTC_i>0$, $dk_j> 0$, $dk_j<dTC_i$)	Change the pattern of transaction costs
$v_{ij} =1$	Knowledge generation process is effective	Transaction costs growth coincides with knowledge increase ($dTC_i>0$, $dk_j> 0$, $dk_j=dTC_i$)	Preserve functioning institutions of knowledge generation
$1< v_{ij}$	Knowledge generation process has created synergy	Knowledge increase is faster than the change in transaction costs ($dTC_i>0$, $dk_j> 0$, $dk_j> dTC_i$)	Formalize institutions creating synergy

Source: own elaboration

Thus, for determination of Knowledge Generation Efficacy Ratio, it is necessary to calculate transaction costs of each knowledge increase performance criteria (Tab. 1) and to compare them with the received knowledge increase results in dynamics (Formula 1).

3. Development of the method

At the first stage, authors formed the list of educational organizations from Russian Asia, Siberia. Selection criteria included the experience of forming a knowledge management system and availability of required information for measurement of Knowledge Generation Efficacy Ratio. The list of universities whose knowledge institutions were chosen for further analysis consisted of 14 higher educational organizations from 7 regions.

At the second stage, authors chose universities, which differed by the following criteria: type of legal organizational form (federal and sub-federal); significantly different rankings in the national ratings (best and worst positions in Russian university ratings); level and direction of specialization; size of universities (large or small number of students). The final list of universities, whose research productivity was chosen for further analysis, consisted of four higher educational organizations: 1) Khakass Technical Institute is a sub-federal, small and very specialized institute, that occupies fairly modest positions in Russian rankings; 2) Katanov Khakass State University is a sub-federal, medium and diversified university that takes weak positions in Russian rankings; 3) Tomsk State University is a national research university (federal), the oldest and one of the largest universities in the Russian Asia, in Siberia; 4) Siberian Federal University is a federal, large and diversified university, the biggest educational organization in the Siberia.

The third stage included distant analysis of universities according to the following parameters: tacit knowledge increases results, explicit knowledge increases results and transaction costs of each knowledge results. Qualitative data for the third stage was gathered from multiple sources (annual activity reports, reports on university self – evaluation, websites of analyzed educational institutions; printed and electronic Mass Media; portals in the relevant field). The fourth stage was a measurement of Knowledge Generation Efficacy Ratio for each indicator of research productivity in dynamics.

4. Result and Discussion:

Most research productivity parameters were found in the annual activity reports from 2010-2015; information on the parameters of "number of prizes won by students" and "number of posts – graduate students" has been found in the reports on university self – evaluation. Then we have calculated annual growth on each of parameters (dkj). Further we determined the magnitudes of the transactional costs separately by each of research productivity parameters. The most part of the data was received through the analysis of the financial reporting of universities, in certain cases we specified the cost on the advising Mass Media, websites and portals (for example, information on the transportation expenses, accommodation and the arrangement fees was specified for measurement of transactional costs for the "Participation of students in conferences" parameter). Then we have calculated annual growth on transactional costs for each of parameters (dTCi). Further we have calculated annual magnitudes of

knowledge generation efficacy (vij) by the formula 1 and have found average magnitudes of knowledge generation efficacy (KGER) during 2010-2015 in each parameter of the universities that were studied.

Table 2 presents the results of Knowledge Generation Efficacy Ratio at the universities under consideration.

Tab. 2: Knowledge Generation Efficacy Ratio

№ п/п	Knowledge increases performance criteria at the University	Khakass Technical Institute	Siberian Federal University	KhSU	Tomsk State University
1.	*Tacit knowledge increases results*				
1.1	Participation of students in external academic conferences	-2,49	3,51	2,89	6,31
,1.2	Number of prizes won by students at external academic competitions	23,8	38,4	22,9	32,51
1.3	Number of posts – graduate students	3,17	3,21	2,15	2,83
1.4	Average tacit knowledge increases efficacy	7,31	13,61	9,55	13,03
2.	*Explicit knowledge increases results*				
2.1	Number of articles published by lecturers	-1,81	42	27,5	39,8
2.2	Number of teaching and methodic materials published	2,71	18,51	0	37,8
2.3	Number of monographs published	0,71	9,43	7,12	21,73
2.4	Average evident knowledge increases efficacy	0,5	22,57	11,52	31,78
Integral knowledge increases efficacy criterion		**4,31**	**19,71**	**10,41**	**22,94**

Source: own elaboration

We offer the following interpretation of the research results concerning knowledge generation institutions efficacy at the universities:

1. All the studied universities have integral knowledge increase efficacy criterion above 0. It shows that overall knowledge generation process in these universities is effective, though Khakass Technical Institute demonstrates significantly lower performance efficacy whereas Siberian Federal University and Tomsk State University have the much better number.

2. Tacit knowledge increase at the universities under consideration does not show significant differences meaning that effectiveness of research work with students and post – graduates are quite high.

3. Explicit knowledge increase performance numbers greatly vary in different universities. The lowest efficacy is demonstrated by Khakass Technical Institute, the highest by Tomsk State University. Average indicators of explicit knowledge increase at the University describe the efficacy of knowledge generation institutions among teaching and research staff. Due to the suggested transaction efficacy criteria, it is possible to identify challenging points in university research activities.

4. Average efficacy of explicit knowledge increase at Khakass Technical Institute at 0,5 demonstrates that knowledge generation process is ineffective, and existing financial investment strategy should be reviewed.

5. Knowledge management system at Khakass Technical Institute demonstrated two institutional traps when transaction costs growth leads to knowledge decrease: 1) student participation at external conferences; 2) lecturers publications at scientific journals. University management should review its attitude to financing these knowledge generation areas.

6. Siberian Federal University has a different problem in the knowledge generation system - teaching and methodic materials publishing. Knowledge increase performance results in this area equal 0 which shows no knowledge increase as a result of transaction costs growth.

5. Practical Implications

The suggested methodical approach can be used as an instrument for managerial decision-making concerning improving research productivity at different universities irrespective of their organizational form, position in national and international ratings, specialization and size. A small modification of the method allows for using it in the process of planning research and academic work at the university, monitoring and evaluating performance results of structural units and academic groups. The main practical value of KGER calculation is that it allows for conducting a quantitative (monetary) evaluation of the efficacy of knowledge generation institutions functioning at the university.

Results of the analysis demonstrate the following advantages of the suggested methodological approach to evaluating knowledge generation results at the University:

- Evaluating new opportunities.

- Analysis of advantages and problems of knowledge generation institution introduction.

- Result correction.

Therefore the use of suggested methodological approach to evaluating productivity allows for evaluating and monitoring the quality of knowledge generation institutions at the university as well as design new knowledge generation institutions. The main advantage of the suggested method is that it allows for evaluating the economic efficacy of knowledge management institutions. Besides that KGER helps in identifying and removing institutional traps of knowledge generation process hindering academic potential implementation.

Conclusion

The active university development strategy cannot be formulated without understanding strong and weak points of knowledge management institutions. Within the last decades, there have been some methods developed to measure research productivity and its constituents. Alas, none of these methods has been commonly accepted.

This article contributes to the knowledge management literature with the proposition of new method for research productivity measurement at the universities – Knowledge Generation Efficacy Ratio (KGER) based on the assumption that productivity of institution knowledge generation is defined by the transaction costs for knowledge generation. To test these method authors conducted an evaluation of KGER at several Russian universities.

The results of this research contribute to the development of research productivity measurement theory and also have several practical implications.

The theoretical importance of this research is in formulating and testing university performance efficacy criteria allowing for the further formulation of methodological recommendations on improving academic activities at higher educational institutions.

The practical importance of obtained results is that they can be used in analysis and design of institutional knowledge generation environment at the University. Knowledge Generation Efficacy Ratio can be used for making a decision concerning which research activities of students and university staff deserve more financial investments. The authors claim that the analysis of productivity of research units with the KGER method can be a source of

valuable managerial information, which could be the basis for scientific assessment in Russia and other countries.

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Contact

Svetlana Panikarova

Ural Federal University named after the first President of Russia B.N.Yeltsin

620002, 19 Mira street, Ekaterinburg, Russia

panikarova_s@mail.ru

Maxim Vlasov

Ural Federal University named after the first President of Russia B.N.Yeltsin

620002, 19 Mira street, Ekaterinburg, Russia

Rosko2000@mail.ru