

INTERNATIONAL SCIENTIFIC JOURNAL

INNOVATIONS

YEAR V, ISSUE 3 / 2017

ISSN (PRINT) 1314-8907

ISSN (WEB) 2534-8469

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TECHNOLOGY TRANSFER DRIVERS AND BARRIERS: CASE OF DISCRETE MANUFACTURING COMPANY

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Abstract: *The research focuses on university-industry technology transfer, which is becoming increasingly important. The research analyses factors affecting the certain case of university-industry cooperation. The factors are tested by adapting the Kano methodology, often used for determining consumer needs and quality assurance purposes. The research results show that although in most cases the respondents' opinion on the importance of certain factors is not homogenous; nonetheless it indicates that the greatest importance should be paid to the factor defining the students' abilities to absorb the skills. In the meantime, the accuracy of the stated outcomes can be considered as the most successful factor in this case. The research results may not be generalized due to the limitations in the tested aspects as well as the fact that it analyses a certain case study, but it can be used for complementary purposes in the context with other case studies.*

Keywords: KNOW-HOW TRANSFER, INNOVATION, UNIVERSITY-INDUSTRY COOPERATION, LEAN MANAGEMENT, KANO MODEL, LEARNING OUTCOMES

1. Introduction

The research on the technology transfer and its practical application is becoming ever more important due to its potential positive impact on the development of the organizations, which are applying it. The technology transfer as well as its results can be considered as an innovation of a certain grade. The multilateral interrelation of these concepts is best illustrated by the Venn diagram [7]. The systematic literature search [7] identified a variety of researches [27; 37] focusing on the classification of the technology transfer. Depending on the viewpoint the technology transfer is defined as a technology, technique or knowledge that has been developed in a given organization and transferred to another where it is adopted and used [22 cited in 26]; an adoption of innovation made by another organization [28 cited in 30] or an application of technology to a new use or user [11 cited in 30]. The results of the focus group discussion [7] indicate that the technology transfer should be viewed as a systematic process of transformation in which a variety of stakeholders from individual (people), organizational (University-Industry) and macro (Industry-Science-Society) levels may be involved. The university-industry cooperation is an often studied form of technology transfer in the scientific literature (see, e.g., 15; 23; 24) and often is analysed in the context with the government, thus creating the so called Triple Helix model [see e.g. 9]. The university-industry cooperation holds the potential to create reciprocal benefits for the involved stakeholders as well as the general society, thus gaining increased importance [25 cited in 10].

The term *technology* can be referred to both a physical item and the information or knowledge [see e.g., 19; 26; 32]. The Paper analyses the Lean management techniques know-how transfer from the industry (manufacturer of vehicles) to the university. As suggested [8] the process of know-how transfer can be best implemented by using a learning outcomes oriented approach and the performance of know-how transfer is affected by the accuracy of the stated learning outcomes, applied teaching, learning and assessment methods and both internal and external environment characteristics of the stakeholders involved in the process. The aim of this Paper is to identify the drivers of and barriers to the know-how transfer. Accordingly, the research question is – which are the drivers of and barriers to the know-how (Lean management techniques) transfer from the industry to the university?

2. Factors affecting university-industry cooperation

This chapter presents factors adapted from the research on the university-industry cooperation conducted by the Latvian Association of Universities in spring 2017 [6]. Data sources of information included scientific literature, grey literature, interviews with members of the higher education institutions of both Latvia

and foreign origin, and the publicly available information on the university-industry cooperation models. As a result 90 factors were determined, both the drivers of and barriers to the cooperation between the university and the industry [6]. Using the pair-comparison method the following 14 factors affecting university-industry cooperation were chosen and adapted for this know-how transfer case study:

1. Clarity and concreteness of the stated outcomes of the skill acquisition process;
2. Existence of a common goal among all stakeholders participating in the skill acquisition process (industry representatives, academics, students);
3. Mutual trust among the stakeholders involved (industry representatives, academics, students) in the skill acquisition process;
4. The students' prior knowledge for the skill acquisition process within the company;
5. The students' ability to absorb the skills acquired as a result of the cooperation initiative;
6. Interest of the universities to learn and help provide solutions to the existing problems of the companies;
7. Capacity of the industry representatives to define the achievable outcomes of the resulting skill acquisition process;
8. Motivation of the industry representatives participating in the cooperation initiative;
9. Motivation of the academics to promote the skill acquisition process;
10. Motivation of the students to acquire new skills while cooperating with the companies;
11. Availability of rooms and equipment for students during their skill acquisition process;
12. Participation of other institutions (local municipalities, NGOs, business incubators, university career centres, etc.) in the skill acquisition process;
13. Positive legal framework regulation for the skill acquisition process in the companies;
14. Better career prospects for the graduates.

3. Methods

Quantitative and qualitative data collection was carried out by surveying students (hereinafter respondents) participating in the know-how transfer project. The questionnaire included the previously indicated drivers of and barriers to university-industry cooperation. In most cases the limitations in the attitude researches are related to the fact that there are significant differences in the subjective perspectives, attitudes and feelings of the respondents in the absence or existence of a certain criteria. In order to acquire more accurate response, for the categorization of the factors, a modified Kano methodology [14] was applied, which is often used to determine the consumer needs and for quality assurance

purposes. This method allows to analyse the aspects in a more detailed way similar to Herzberg et al. (1966), etc. [2; 3; 4; 13; 17; 18; 35 cited in 1]. The methodology of the Kano model [14] prescribes formulating the research aspects into two groups – functional and dysfunctional. The functional is a positively formulated assumption, i.e., the given aspect applies, while the dysfunctional is a negatively formulated assumption, i.e., the given aspect does not apply. Different possible options of the answers are available [see e.g. 36]; however, the following formulations have been adapted:

- 1) I like it;
- 2) I expect it;
- 3) I am neutral;
- 4) I can tolerate it;
- 5) I do not like it at all.

The importance (category) of any given aspect can be determined according to a modified evaluation matrix of the Kano methodology (see Table 1).

Table 1: Modified Kano evaluation matrix, based on [31]

Answers		Dysfunctional form of the question				
		1. I like it very much	2. I expect it	3. I am neutral	4. I can tolerate it	5. I do not like it at all
Functional form of the question	1. I like it very much	Q	A	A	A	P
	2. I expect it	R _A	Q	I	I	M
	3. I am neutral	R _A	I	I	I	M
	4. I can tolerate it	R _A	I	I	Q	M
	5. I do not like it at all	R _P	R _M	R _M	R _M	Q

The following designations have been used in the table, based on [20; 31]:

M (must-be) – in case this criterion is met, the satisfaction of the respondents does not increase, while in the case if the criterion is not met the dissatisfaction of the public increases. This is believed to be a so-called hygiene factor that is necessary to be present for a successful implementation of the skill acquisition process.

P (performance) – in case this criterion is met, the satisfaction of the respondents increases proportionally, meanwhile if it is not, the dissatisfaction increases proportionally. This is believed to be both hygiene and an attractive factor. Thus, it is important for a successful implementation of the skill acquisition process.

A (attractive) – criterion which is not expected to be met by default (excitement factor). If this criterion is met, the satisfaction of the respondents increases, while if it is not met, the dissatisfaction however does not increase. This is believed to be an important aspect, however it gains importance only after the *must-be* and *performance* criteria are met.

R (reverse) – criterion is proportionally inversed – its fulfilment causes decrease of respondents' satisfaction.

I (indifferent) – the criterion according to the respondents is believed to be relatively unimportant.

Q (questionable) – the answers provided by the respondents concerning the given criterion were contradictory.

The survey also included an open type question in which respondents were asked to explain in detail the provided answer to the criteria. The survey was conducted by using *Google* forms and disseminated to respondents, who were participants of a certain university-industry cooperation project during the spring semester of 2017. In total 10 out of 12 respondents filled the survey form.

4. Results and discussion

The survey results – the categorization or the importance of the factors tested in the research are shown in Table 2.

Table 2: Categorization of factors affecting university-industry cooperation

Factor	Number of Respondents (n=10)							
	Category							
	M	P	A	R _M	R _P	R _A	I	Q
1.	3	3	1	0	0	0	3	0
2.	5	0	3	0	0	0	2	0
3.	2	5	1	0	0	0	2	0
4.	1	0	1	0	0	0	8	0
5.	0	9	0	0	0	0	1	0
6.	0	0	1	1	0	0	8	0
7.	3	3	2	0	0	0	2	0
8.	1	5	2	0	0	0	2	0
9.	4	4	0	0	0	0	2	0
10.	1	7	1	0	0	0	1	0
11.	1	6	2	0	0	0	1	0
12.	0	2	2	0	0	0	6	0
13.	2	0	2	0	0	0	6	0
14.	0	4	3	0	0	0	3	0

The survey results indicate that in most cases the respondents' attitude towards the importance of the aspects is rather heterogeneous, except for factors as follows:

- The students' ability to learn and use skills acquired as a result of the cooperation initiative;
- The students' prior knowledge for the skill acquisition process within the company;
- Interest of the universities to learn and help provide solutions to the existing problems of the companies.

According to the Kano methodology it is clear that the final two factors are evaluated as rather unimportant, while the **ability of the students to learn and use skills acquired as a result of the cooperation initiative** is considered as the performance aspect or rather important, because if it is met or if it isn't, the satisfaction and dissatisfaction increases proportionally accordingly. The ability to acquire and use the skills (absorptive capacity) both on the individual, group and organizational level has been analysed within the *Learning organization concept* [see, e.g., 21]. The ability of a company to recognize the value of external information, to assimilate it, and apply it to commercial ends is critical to its innovative capabilities [5]. The research results confirm that the absorptive capacity is considered as very important also by the persons which acquire the knowledge.

Although the students' prior knowledge is believed to be an important factor [see, e.g., 12; 16; 33; 34], respondents found it as relatively indifferent. This could be explained by the fact that in this project the students were not required to have any additional knowledge thus it was not a defining factor for the skill acquisition. However, the situation unveils the imperfection of the Kano methodology. The evaluation results of other factors are not unambiguous, however according to the proportion of the answers, separate groups can be identified. Among them factors which are not relatively important to the respondents themselves:

- Participation of other institutions (local municipalities, NGOs, business incubators, university career centres, etc.) in the skill acquisition process;

- Positive legal framework regulation for the skill acquisition process in the companies;
The following factors were defined as rather important:
- Availability of rooms and equipment for students during their skill acquisition process;
- Mutual trust among the stakeholders (industry representatives, academics, students) in the skill acquisition process;
- Motivation of the students to acquire new skills while cooperating with the companies;
- Motivation of the academics to promote the skill acquisition process;
- Existence of a common goals among all stakeholders participating in the skill acquisition process (industry representatives, academics, students);
- Capacity of the industry representatives to define the achievable outcomes of the resulting skill acquisition process;
- Motivation of the industry representatives participating in the cooperation initiative;
- Clarity and concreteness of the stated outcomes;
- Better career prospects for the graduates.

The strength of the given criteria according to the survey results can be observed in Table 3.

Table 3: Significance of the university-industry cooperation factors according to the respondents

Factor	Number of Respondents (n=10)				
	Respondents' factor evaluation results				
	Strongly disagree	Rather disagree	Rather agree	Strongly agree	Do not know
1.	0	0	1	9	0
2.	0	0	3	7	0
3.	0	0	6	4	0
4.	0	0	9	1	0
5.	0	0	5	5	0
6.	0	3	5	0	2
7.	0	0	3	7	0
8.	0	0	2	8	0
9.	0	0	7	3	0
10.	0	0	4	6	0
11.	0	0	2	8	0
12.	0	3	3	0	4
13.	0	0	3	5	2
14.	0	0	6	3	1

The evaluation of the tested factors according to the respondents' opinion indicates that in the majority of cases they strongly agree or rather agree to the provided criteria. With the exception of the following criteria:

- Interest of the universities to learn and help provide solutions to the existing problems of the companies;
- Participation of other institutions (local municipalities, NGOs, business incubators, university career centres, etc.) in the skill acquisition process;

When evaluating the interest of the universities to learn and to provide solutions to the existing problems of the companies, the respondents have provided the following comments: "It is not in the interests of the university to solve the most significant problems of a given company, but rather to educate the students thus improving their understanding about the possible problems and solutions to them in the business environment."; "The university is interested in helping the companies to solve their problem, because by such means the university is creating closer interrelationships between the both sectors and thus creates highly valuable internship

placements in the given companies for the students to enrol in". The provided quotes provide an example of the difference in the respondents' attitudes. The evaluation results of the factors related to the other institutions' involvement in the skill acquisition process is related to the fact that such other institutions were not present. Most of the respondents (9 out of 10) strongly agree that the factor *clarity and concreteness of the stated outcome* is important within the skill acquisition process. The respondents provided the following comments: "All tasks are clear", "The achievable tasks were clearly defined", "The outcomes were defined already in the beginning of the study course, before our visit to the company.", "We were introduced to the tasks and how to conduct them well in advance as well as the possibility to approach the lecturer or the head of the company in case we had any uncertainty". The results of the evaluation as well as the fact that the given aspect is believed to be rather important, it can be suggested that in this case the factor is a technology transfer driver of the most importance.

Additional factors which importance were highly evaluated (more than half of the 10 respondents strongly agreed), are the:

- Motivation of the industry representatives participating in the cooperation initiative;
- Availability of rooms and equipment for students during their skill acquisition process;
- Existence of a common goals among all stakeholders participating in the skill acquisition process (industry representatives, academics, students);
- Capacity of the industry representatives to define the achievable outcomes of the resulting skill acquisition process;
- Motivation of the students to acquire new skills while cooperating with the companies.

Respondents provided the following comments regarding the aforementioned factors:

"All representatives of the company (...) were cooperative and replied to all of the questions by students, thus I believe they were motivated"; "For the students to acquire the skills and to effectively cooperate with the company, it is highly important to have access to rooms and equipment, which is the only way how to see and understand the real situation as well as the possible problems."; "The company was highly involved in the process of educating and informing the students. The aim of the students is to gain new knowledge and understanding about the actual processes in the companies. The same inversed aim applies to the companies which are eager to provide the necessary information to the students, thus attracting them as the new employees!"; "All of the participating parties had common goal, since everyone benefited from our visit"; "If the company is participating in this process, it has to be able to define what particularly important skills they would like to disseminate and what are the achievable outcomes."; "We were motivated to fulfil the given tasks as good as we could, so the company may gain the largest possible benefit from our cooperation."

5. Conclusions

The research results indicate that in most cases the opinion of the student groups on the factor importance is not homogenous. Nonetheless, it allows drawing conclusions. However, the factor significance evaluation indicates that the given case from the perspective of the tested factors can be defined as successful. It can be concluded that out of the tested factors the most important is the **ability of the students to learn and use skills acquired as a result of the cooperation initiative**, meanwhile the most success-defining factor - **clarity and concreteness of the stated outcomes in the skill acquisition process**. It can be concluded, that tested factors are the drivers of technology transfer. Although the sample of the case study was quantitatively limited, the results indicate the usefulness of the Kano methodology, because from the perspective of the respondents factors can be divided into multiple categories. The specificity of the research defines its limitations and limits the generalisation of the results; however, it can be used complementary with other case studies. The novelty of the research

is defined by the use of Kano methodology for categorization of factors, thus proving that the application of Kano methodology is not limited to determining of consumer needs and quality assurance purposes.

6. Acknowledgments

The Paper was supported by the National Research Program 5.2. EKOSOC-LV.

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