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# A SURVEY ABOUT PATENTS, INVENTION AND COMMERCIALIZATION PROCESSES IN KAZAKHSTAN

**Ainur SHAKENOVA**
Hungarian University of Agriculture and Life Sciences, Doctoral School of Management Organizational Science, 7400 Kaposvár, Guba Sándor u. 40., Hungary

## *ABSTRACT*

*This article is about the importance of intellectual property in the innovation process. It focuses on the results obtained in the survey with owners of patents in Kazakhstan. The questions were related to the processes of invention and commercialization. From the mainstream of responses, we identified those that are crucial in the process of invention and those that can affect the process of commercialization in the future. Namely, we were interested in the variables which are significant in the process of invention and how they affect commercialization. The result of the post-hoc test identified the data which differ within groups. It was found that eight variables were different in the combination of groups: the number of authors, the type of resource R&D, the number of patents, and the evaluation of the invention, expressed in terms of money. This test revealed that these variables change from group to group. Moreover, it allowed us to look deeper into the inventive process and identify the direction of these changes.*
Keywords: intellectual property, patent, Kruskal-Wallis test, innovation
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## INTRODUCTION

Intellectual property (IP) plays a critical role in the innovation process to secure the rights of those who create new concepts, goods, and technology (*Brandl & Glenna*, 2016). IP rights, such as patents, trademarks, copyrights, and trade secrets, provide a legal framework for innovators to secure the innovation benefits and control the use of their IP assets (*Hall et al.*, 2014; *Fang et al.*, 2017).

One of the significant IP rights that contribute to innovation is patent. Patents give inventors temporary exclusive rights to their ideas, enabling them to stop others from making, utilizing, or commercializing the same product. As a result, innovators are encouraged to devote time, money, and resources to creating new technologies and goods because they know that their work will be protected and that they will profit from their ideas. Copyrights safeguard creative works like music, movies, and novels, whereas trademarks protect the branding and reputation of products. These intellectual property rights guarantee that creators have control over how their work is used and that they are fairly compensated for their work. At the same time, there is another tool for technology protection – trade secrets. Trade secrets are confidential business information that companies keep confidential to maintain a

competitive advantage. This information can include anything from client lists and the company plans to manufacture procedures and calculations. By protecting trade secrets, businesses may keep their innovations a secret and prevent competitors from stealing or copying them.

Most of the studies related to patents are interrelated with the innovation activity of Kazakhstan (*Yessengeldin et al.*, 2016; *Nurpeisova et al.*, 2021; *Raihan & Tuspekova*, 2022). The other part of the studies directly related to patents is often based on secondary data in Kazakhstan (*Sagiyeva et al.*, 2018; *Nurgalieva et al.*, 2022). The main problem of patent research in Kazakhstan is that nobody is allowed to understand the dynamics of patent development and commercialization. It is very important to understand the owners of patents and their problems in order to efficiently solve them at government level. A common problem in patenting is what to do after obtaining a patent. During the survey, we noticed that self-filed authors have more difficulty commercializing an invention than a group of authors. These questions have lead us to following goal: we aimed to identify the factors that play a noticeable role in the invention process in Kazakhstan. These questions are the following: How can the invention process be described in Kazakhstan and who plays the main role in the patent process? What factors influence inventiveness in Kazakhstan and contribute to the commercialization of intellectual property, inventions that of patents?

The structure of this paper includes 4 chapters. The first chapter introduces the key message and the article's research aim and research questions. In the second chapter, the background of intellectual property and patents are discussed. The third part includes data and methodology. The results are discussed in the fourth chapter, and the conclusion of this article is presented in the fifth chapter.

## LITERATURE REVIEW

In modern conditions, economic development is increasingly dependent on the creation and effective use of high technology, the introduction of fundamentally new technologies, and the use of information resources. All this can be expressed in one word - "innovation". However, for involving successfully innovative performance, the interests of the government and other participants in this process must be taken into account. Interest means a balance among government, suppliers, executants, and authors to consolidate and implement the rights to the results of scientific, technical, experimental design, and other activities (*Belderbos et al.*, 2014).

To regulate this balance and respect the rights of all participants, it is necessary to combine innovation together with intellectual property. Effective protection and management of intellectual property contribute to the penetration of innovations in all countries with economies in transition (*de Almeida Borges et al.*, 2020).

The principle of IP is used to protect the legal rights of individuals and organizations that create new concepts, goods, and technologies. IP rights are necessary because they provide a legal framework that allows individuals and organizations to secure the benefits of their innovations and control the use of their IP assets (*de Rassenfosse et al.*, 2019; *Wineinger et al.*, 2019). There are some reasons why society needs IP rights. First of all, it encourages innovation (*Yang et al.*, 2014). IP

rights provide an incentive for individuals and organizations to invest time, money, and resources into developing new ideas, products, and technologies. The protection of their innovations through IP rights gives innovators the confidence to take risks, knowing that their efforts will be protected and that they will be able to reap the benefits of their innovations (*Niaounakis,* 2019; *Arya & Shinde*, 2022). The second reason is promoting competition. IP rights ensure that competitors cannot freely copy or use the innovations of others, promoting a competitive and dynamic marketplace (*Maresch et al.,* 2016). This encourages companies to invest in research and development and to create new and innovative products, leading to a thriving economy (*Galasso & Schankerman*, 2015). The protection of creativity is the third reason. IP rights protect the rights of creators, artists, and authors to control the use of their creative works and to receive fair compensation for their efforts. This allows them to continue to create and share new and innovative works, contributing to the cultural and artistic richness of society (*Liu et al.*, 2017; *Raju*, 2017; *Song & Yu*, 2018). It is also important to maintain confidentiality. For instance, IP rights such as trade secrets allow companies to protect confidential information, such as manufacturing processes, formulas, and business plans, which they use to maintain a competitive advantage. This confidentiality is important for businesses to protect their innovations and to keep their operations running smoothly. The last main reason is to support the economy (*Sweet & Maggio*, 2015). IP rights play an important role in the economy by providing the legal framework that allows innovators and businesses to secure the benefits of their innovations and to commercialize their ideas and products (*Fang et al.*, 2017). This contributes to economic growth and job creation, making IP an important component of any thriving economy (*Bielig*, 2012).

In this research, we focus on invention patents that contribute more to innovation performance. Legal protection of the invention is granted if it is new, involves an inventive step, and is industrially applicable. The main normative documents are the Paris Convention for the Protection of Industrial Property, the Patent Cooperation Treaty, the Eurasian Patent Convention, and the National Patent Law. It should be noted that paragraph 3 of Article 6 of the Patent Law of the Republic of Kazakhstan provides for the list of objects that are not recognized as inventions: a) discoveries, scientific theories, and mathematical methods; b) methods of organization and management; c) conventions, mappings, rules; d) rules and methods for performing mental operations, conducting games; e) programs for computers and algorithms, as such; f) projects and layouts for buildings, and territories; g) proposals that are only the appearance of products; h) proposals that are contrary to public order, principles of humanity, and morality.

The patent certifies the priority, authorship and exclusive right to the object of industrial property. A patent document includes the following details: the invention's name, an abstract, and a complete description of it; the inventor's name, address, and country of origin; the owner of the invention's name, address, and country of origin; the technological classes to which the patent relates; and references to earlier patents, among other things (*Archibugi*, 1992; *Joung & Kim*, 2017; *Charreau et al.*, 2020). An invention patent is valid for twenty years from the filing date of the application. By mentioning the invention and its applicability, the society undertakes the benefits of

the intervention through commercialization and access to the invention. An invention usually receives legal protection if it is granted patent protection through publication. The invention can also enter the trade secret phase, where the owner is solely responsible and independently establishes the scope of protection for the invention (*Wyatt et al.*, 1985; *Levin et al.*, 1987; *Wexler*, 2017; *Glaeser*, 2018).

The relationship between patents and innovation has been discussed for many years (*Hall & Ziedonis*, 2001; *Kim & Marschke*, 2004; *Kortum & Lerner*, 1999, *Carrier*, 2002; *Boldrin & Levine*, 2013; *Moser*, 2013; *Sampat & Williams*, 2019). However, in this article, we pay attention to innovation through the value of intellectual property. By their nature, patents are more efficient in terms of innovative products than that of the process. Product innovation can be protected by both the confidentiality of the process and product patents (*Levin et al.*, 1987; *Granstrand*, 1999; *Ceccagnoli*, 2009; *Levitas & McFadyen*, 2009; *Estrada et al.*, 2016), family patenting (*De Massis et al.*, 2013).

The main reasons of low efficiency of patents in transition countries may be due to some patenting shortcomings. The main disadvantage is the ability of competitors to legally invent patents and disclose information related to patenting (*Harabi*, 1995; *Veugelers & Schweiger*, 2016), as well as high economic and non-economic costs of patenting (*Cohen et al.*, 2000; *Dang & Motohashi*, 2015). Moreover, the inventors in Kazakhstan also noted such a factor as the lack of support from the state and enterprises. Despite these shortcomings, and the relatively low efficiency of patents, companies continue to obtain patents. In some industries where patents are not considered as essential, they are nonetheless patented. By virtue of a certain time, patent holders cease to protect patents (unprofitable) for personal or financial reasons. This is sometimes called the paradox of patenting, which leads to the question: why do companies patent (*Granstrand & Holgersson*, 2013; *Leiponen & Delcamp*, 2019)?

Patent is always a component of innovative activity. More scientists confirm this through their theories and writings (*Schmookler*, 1966; *Devinney*, 1994; *Crosby*, 2000; *Papageorgiadis & Sharma*, 2016) about the impact of the patent on innovative processes. Moreover, increasing patenting activity leads to improving labour productivity and economic growth. However, patents are necessary to start to patents (*Crosby*, 2000; *Aghion et al.*, 2015; *Farre-Mensa et al.*, 2020).

Transition countries lack certain factors to move into the innovation phase (*Švarc*, 2006; *Kim et al.*, 2019). Such countries seem to be stuck in the checkpoint to move towards innovative countries and cease to be dependent on natural resources. Moreover, Kazakhstan has the possibility to move forward in innovative performance through good management, and proper distribution of natural resources and capacity building in the innovation sphere. Unfortunately, Kazakhstan has little practical experience in this area and, therefore, this work has potential importance. Certainly, one can name some common factors that hinder the innovation process in Kazakhstan, but this work will show which factors influence innovative activities of inventors in terms of intellectual property.

In addition, attention has been paid to the results of previous studies in which the authors have addressed the economic component of intellectual property. (*Pakes*, 1984; *Schankerman & Pakes*, 1986; *Griliches et al.*, 1986; *Reitzig*, 2003; *Hall et al.*, 2007; *Bessen*, 2008; *Gambardella et al.*, 2008; *Kerber*, 2016). They showed a new vision of the

value of patents for future research. The use of data on renewed patents and renewal fees helped to identify parameters that had a positive and significant impact on European countries (*Pakes*, 1984). Moreover, through the behaviour of patent holders in relation to the payment of fees for the renewal of patents it was found that the distribution of the values of patent rights was considered and investigated the private value of patent protection and its changes over time (*Schankerman & Pakes*, 1986). Valuable contribution was made by a group of authors that collected data at the firm level and described in detail the use of patent data to assess the importance of R & D distribution (*Griliches et al.*, 1986). Further studies were conducted in narrower areas of enterprises to determine the value of patents (*Reitzig*, 2003; *Hall et al.*, 2007). The concept of the economic value of a patent is difficult to calculate unequivocally. With this approach, it is always necessary to take into account such factors as the size of the inventive step, the demand for a patented product, as well as investments in the cost of patenting etc. The European survey, in which countries such as Germany, the Netherlands, France, Italy, Spain participated (*Gambardella et al.*, 2008) helped us in the formation of our questions. Another theory considers the need for new exclusive intellectual property rights for data related to the economic aspects of the patent (*Kerber*, 2016). These studies formed the basis of this questionnaire. In this paper we presented the factors that influence inventiveness and commercialization process.

**About Kazakhstan Patent Profile**

The first patent of the Republic of Kazakhstan was issued in the name of the Institute of Chemical Sciences A.B. Bekturov on "redoxide" with the date of publication 16.06.1997. During the independence of the Republic of Kazakhstan, more than 37.553 inventions, 4.558 utility models, 3.586 industrial designs, and 917 new varieties successes have been filed until 2019. These are elements of intellectual property that have a direct impact on patent law and patenting.

In 2019, the Kazakhstan Patent Office received 973 innovation applications, including 811 from domestic applicants and 162 from foreign applicants. These numbers are 0.9% lower than in 2018. The proportion of domestic and international applicants was around 83% and 17%, respectively. In addition, 544 national applicants and 186 international applicants received patent protection for the invention in 2019. In the same year, the number of applications submitted patent applications under the Patent Cooperation Agreement (PCT) protocol increased by 38.9% in 2018, while the number of applications filed patent applications under the Eurasian Patent Convention (EAPC) procedure increased by 14.6%.

## MATERIALS AND METHODS

The original language of the questionnaire to was English. The paper-based interviews were in Kazakh and Russian languages because both of them were the native languages of Kazakhstan`s inventors. The Patent office in Kazakhstan supported the survey. The development of the questionnaire started at the end of 2018, and it was translated in Kazakh and Russian) at the beginning of 2019.

The study started in 2008. For some patents, for example, in the field of medicine and chemistry, the commercialization process usually takes more than 6 years. Therefore, research started in 2008 to give all patents time to be approved. We also focused on this year, because the global financial crisis started in 2008, which for some countries brought a standstill in the development of innovation and new technologies. The total amount of granted patents was 171 in 2008. 8% of granted patents were foreign patents. We excluded foreign patents because we were interested in how national patents develop in Kazakhstan. 96 patents were filed by organizations, research institutes and universities, while 36 inventions were filed independently by one owner or a group of owners. During filling of the questionnaire by hand we found a lot of difficulties, for example the authors died; some authors had serious problems with their health; some of them changed the patent more than once or they moved out from Kazakhstan.

Despite these problems, we found 47 inventors and they helped us to find other authors and co-authors. We asked them 43 questions about their patent and the inventive process. The questionnaire used Likert-type scales, semantic differentials, yes/no questions, multiple choice questions, rank order questions, dichotomous questions etc. The questionnaires were collected only by one person who visited the most significant patent regions in Kazakhstan. The total amount of respondents was 66 authors of inventions with a priority date in 2008.

Some of the answers of the inventors were greatly expanded and we categorized them by the total number of patents by one inventor, time spent on the invention and the value of the patent. The research includes the dependent variables (*Table 1*) and the groups (*Table 2*).

**Table 1: Dependent variables of the patent survey**

| Variable name | Description of variables | Types of variables | Type of answer |
|---|---|---|---|
| authors | Number of authors in one granted patent | categorical variables | "1", "2", "3", "4", "5", "6", "7", "8", "9" |
| pat_rank | Total number of patents by one inventor | categorical variables | "1-3", "4-10", "11-20", "21-50", "< 50" |
| srs_R&D | Source for R&D<br>"1" - Internal funds<br>"2" - Funds from any other organization<br>"3" - Funds from the financial intermediaries of any kind<br>"4" - Government research programs<br>"5" - Other | categorical variables | "1", "2", "3", "4", "5" |
| time_rank | Time spent on invention | categorical variables | "3 months – 1 year", "1-2 years", "2-4 years", "4-6 year" |
| val_pat_rank | The value of patent | categorical variables | "L $ 30 000", "$ 30 000 - $ 100 000", "$ 100 000 - $ 1 000 00", "$ 1 000 000 - $ 3 000 000" |

**Table 2: Groups used after patent survey**

| Name in R | Description of variables | Types of variables | Type of answer |
|---|---|---|---|
| city_inv | City of invention | categorical variables | "Almaty", "Astana", "others" |
| com_use | Commercial use of granted patent | categorical variables | "yes", "no", "I don`t know" |
| educ | Education of respondents | categorical variables | "PhD", "Bachelors", "others" |
| pat_fam | Existence of the patent family | categorical variables | "yes", "no", "I don`t know" |
| work | Workplace during the invention process | categorical variables | "Hospital", "University or research institution", "Private and public research organization", "Private companies and others" |
| year | The age of the author | categorical variables | "<45", "46-59" and ">60" |

The method that was used was related to nonparametric analysis. This research focused on the Kruskal-Wallis test for some variables by R statistical program. The Kruskal-Wallis (*Kruskal & Wallis*, 1952) is a nonparametric statistical test that assesses the differences among three or more independently sampled groups on a single, non-normally distributed variable. Before starting the Kruskal-Wallis test, we had to estimate the probability of getting data from the normal distribution. We chose the Shapiro-Wilk test (*Shapiro & Wilk*, 1965) because it was appropriate for sample sizes we had. For this reason, we used the Shapiro-Wilk test as numerical means to assess normality. Each of the normality tests is essentially a compliance test and compares the observed data with the quantiles of the normal or other specified distribution. For our investigation, we chose p-value = 0.1 (*Neyman & Pearson*, 1933; *Fisher*, 1992). Before starting the main test we needed to analyse the distribution of variables by the Shapiro-Wilk test. The dependent variables are suitable for the the Kruskal-Wallis test. After a Kruskal-Wallis test, post-hoc tests such as the Dunn's test (Dunn's test with Bonferroni correction), were applied and the same rankings were found as in the Kruskal-Wallis test. The null hypothesis was aimed at discovering which sample pairings are significantly different (*Dunn*, 1964).

## RESULTS AND DISCUSSION

The normalization data process by Shapiro-Wilks test showed that the data such as he author, pat_rank, srs_R.D, time-rank, val_pat_rank are significantly deviate from the normal distribution (*Table 3*).

If the data are not distributed normally, we need to use a nonparametric test. The results of the Kruskal-Wallis test is shown in the *Table 4*.

Significant values were obtained in the groups of city_inv, com_use, patent family, work, year. The dependent variables showed significant differences in the groups of

the authors, the value of the patent, and the source for R&D and the total number of patents (*Table 4*).

**Table 3: The normalization data process of dependent variables by Shapiro-Wilks test**

| Data | W | P-value |
|---|---|---|
| author | 0.93854 | 0.0027 |
| pat_rank | 0.95214 | 0.0125 |
| srs_R&D | 0.70669 | 3.467e-10 |
| time_rank | 0.91989 | 0.0003 |
| val_pat_rank | 0.91588 | 0.0122 |

**Table 4: Results of the Kruskal-Wallis test**

| Data | Chi-squared | Df | P-value |
|---|---|---|---|
| srs_R.D by city_inv | 5.3474 | 2 | 0.0690 |
| val_pat_rank by city_inv | 5.2935 | 2 | 0.0708 |
| srs_R.D by com_use | 4.5646 | 2 | 0.1020 |
| authors by pat_fam | 5.7157 | 2 | 0.0573 |
| pat_rank by work | 5.8954 | 3 | 0.1168 |
| srs_R.D by work | 7.2558 | 3 | 0.0641 |
| val_pat_rank by work | 8.1159 | 3 | 0.0436 |
| srs_R.D by year | 7.5333 | 2 | 0.0231 |

The important next step after the nonparametric test was the post hoc test – the Dunn test. It clarified and showed the differences inside the groups of the study.

When we interfaced R&D resources with cities, we observed that the main focus was on the national cities of Astana and Almaty. As a result, survey respondents emphasized the necessity of regional R&D development for potential growth in inventiveness (*Ray*, 1998; *Guo & Jiang*, 2022) (*Figure 1*).

**Figure 1: The post hoc test variables result «*srs_R.D by city_inv*»**

```
> dunn.test(kwt$srs_R.D,kwt$city_inv, alpha=0.1, method="bonferroni")
  Kruskal-Wallis rank sum test

data: x and group
Kruskal-Wallis chi-squared = 5.3474, df = 2, p-value = 0.07


                           Comparison of x by group
                                 (Bonferroni)
Col Mean-|
Row Mean |     Almaty     Astana
---------+----------------------
  Astana |  -2.300514
         |    0.0321*
         |
  others |  -0.712635   1.565961
         |     0.7141     0.1760

alpha = 0.1
Reject Ho if p <= alpha/2
>
```

Simultaneously, significant results were obtained about the value of patents in Almaty and other cities. This confirms that the authors recognise the value of their patentsin the society, which may influence the future of licensing in these cities (*Figure 2*).

**Figure 2: The post hoc test of variables result «*val_pat_rank by city_inv*»**

```
> dunn.test(kwt$val_pat_rank,kwt$city_inv, alpha=0.1, method="bonferroni")
  Kruskal-Wallis rank sum test

data: x and group
Kruskal-Wallis chi-squared = 5.2935, df = 2, p-value = 0.07


                           Comparison of x by group
                                 (Bonferroni)
Col Mean-|
Row Mean |     Almaty     Astana
---------+----------------------
  Astana |  -0.758491
         |     0.6722
         |
  others |  -2.283019  -0.873235
         |    0.0336*     0.5738

alpha = 0.1
Reject Ho if p <= alpha/2
>
```

When we looked at R&D resources in relation to commercialization, we observed that awareness of the significance of commercialization and concerns about profitability and intellectual property licensing are important variables. It showed the necessity to establish and train patent management, as well as introduce incentives in the public and commercial sectors and support patent implementation (*Etzkowitz*, 2002) (*Figure 3*).

**Figure 3 Table 7: The post hoc test of variables result «*srs_R.D by com_use*»**

```
> dunn.test(kwt$srs_R.D,kwt$com_use, alpha=0.1, method="bonferroni")
  Kruskal-Wallis rank sum test

data: x and group
Kruskal-Wallis chi-squared = 4.5646, df = 2, p-value = 0.1


                           Comparison of x by group
                                 (Bonferroni)
Col Mean-|
Row Mean |        IDN         No
---------+----------------------
      No |   1.225919
         |     0.3303
         |
     Yes |   1.862232   1.555181
         |     0.0939     0.1799

alpha = 0.1
Reject Ho if p <= alpha/2
>
```

Furthermore, to increase the number of patents and protect them, it is required to educate the relevant stakeholders and expand their capacity to make strong patents (*Harhoff et al.*, 2003). It allows various technologies to protect the interests of the basic patent and to improve manufacturing technology, resulting in a reliable spiral of protection (*Block et al.*, 2013). According to the results of the questionnaire, there is a minimal likelihood of developing a family of patents with one author.

Additionally, the post-test enabled us to see that the two variables R&D and the inventor's place of work were crucial in inventiveness. Private firms, as well as government and private research organizations, produced major results. Obviously,

research institutes and private firms have more access to R&D. For example, research institutes at hospitals provide a budget for R&D too, but they primarily focus on solving problems of a certain diagnosis and are non-commercial. Their contribution to the medical profession's development is considerable. Based on the findings, we may conclude that universities play a minor role in the production of patents. As a result, capacity building in this area is essential. For example, more research, relevant and practical projects should be conducted and developed that solve local social problems and might be significant for universities (*van Zeebroeck et al.*, 2008). We also saw a relationship between the significance of patents and the location of employment. Private enterprises and research institutions value the option of licensing their patents as a consequence of their work. Such organizations frequently have divisions in charge of the technological and legal rights of the authors and patent holders, who have access to more information than other single authors. Nevertheless, during the last three years, Kazakhstan has rapidly begun to build acceleration programmes to assist innovators and intellectual property owners using private and governmental funding via a grant system (*Abeuova*, 2022).

The age range of Kazakhstan inventors is approximately between 45 and 60 years old. According to the survey findings, invention activity is beginning to pick up around the age of 45 but peaks between the ages of 59 and 60 in Kazakhstan. What elements, though, can have an impact on young people's involvement in invention? The experience of developed nations should be researched and resources should be allocated to entice young people to inventiveness.

## CONCLUSIONS

In conclusion, intellectual property rights are crucial to the innovation process because they give inventors the tools they need to protect the financial gains from their discoveries and to manage the use of their IP assets. Additionally, these rights promote an environment that stimulates spending on R&D, which results in a thriving and progressive economy.

In this article, the variables that affect the inventive process were analysed, using group data on patents from the year of 2018. According to the nonparametric test, we found that only 3 variables showed differences with the groups: source for R&D, the value of patent and number of authors in one granted patent. We found that the majority of patents were made in the main cities: Astana and Almaty, while, the rest of the patents was distributed in other cities. Despite the openness of many inventors to cooperation and the commercialization, we noticed that many inventions would never be patented. Perhaps, the number of inventive units of one organization (to support reputation) is important for research institutions. However, they should also pay more attention to the commercialization indicators of patents. Moreover, we found that there was no clear idea of who is responsible for the commercialization of a patent: the inventor, the patent owner, the state or SME (*Hanel*, 2006). The process of patent commercialization was discussed superficially, despite the fact that it is an integral part of the innovation process in any country. During the survey and in the meetings with the inventors promising direction for future research in Kazakhstan was seen.

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Corresponding author:

**Ainur SHAKENOVA**
Hungarian University of Agriculture and Life Sciences
Doctoral School of Management Organizational Science
7400 Kaposvár, Guba Sándor u. 40., Hungary
Tel.: +36 70 2828 451
e-mail: ipshakenova@gmail.com