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FACTORS AFFECTING KNOWLEDGE TRANSFER: A SYSTEMATIC LITERATURE REVIEW AND THE METHOD TO ASSESS MANUFACTURING COMPANY`S READINESS FOR KNOWLEDGE TRANSFER PROJECTS

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Abstract

In today's business environment, with organizations enhancing performance, maintaining a competitive edge, and fostering innovation, the efficient transfer of knowledge plays an increasingly pivotal role. As industries recognize the importance of and strive for more and more productive knowledge transfer, understanding the factors affecting this process becomes imperative. Manufacturing is considered a strategic sector, and well-performing knowledge transfer is necessary for higher innovation and competitiveness. To increase knowledge transfer performance, companies must have the awareness, ability, and opportunity to identify the main aspects that need operational improvement. Studies based on systematic literature review and mapping impact factors have shown that knowledge transfer is hypothetically affected by a vast variety of factors, which creates challenges for companies in selecting and applying these factors. Therefore, **the two research questions** of this study are – RQ1: What are the relationships between the knowledge transfer-influencing factors identified in the literature analysis and the dependent variables? RQ2: What is the weight of the statistically significant factors identified in the empirical study?

Research purpose. Based on the results of the systematic literature review and the complex quantitative analysis, the study aims to develop a method to assess readiness for knowledge transfer.

Design / Methodology / Approach. To answer the stated research questions, the study compiles diverse research methods: a systematic review of the literature, factors' mapping, the online survey of manufacturing companies, correlation analysis, and experts' evaluation using the analytic hierarchy process (AHP) approach, thus ensuring data triangulation.

Findings. The qualitative study of the literature review through iterative analysis and mapping resulted in 29 factors affecting knowledge transfer. Further, the empirical results led to 14 statistically significant factors in 3 groups ranked sequentially – individual factors (recipient's absorptive capacity, recipient`s experience, recipient's confidence in their abilities, and recipient's ability to focus on knowledge transfer), mentoring factors (senior management involvement and support, quick decision-making), and organizational factors (training, finances, internal policy, shared vision, organizational structure, staff turnover, HR quantity, and HR quality). The strongest correlations between the factors affecting knowledge transfer and the defined performance variables to measure knowledge transfer manifested in the group of the recipients' individual factors. The most critical factor is the absorptive capacity of knowledge recipients, which managers should pay attention to.

Originality / Value / Practical implications. As a result of the compound study, including a proposal of a new definition of knowledge transfer, a unified method with equations' calculations to quantifiably assess a company's readiness for knowledge transfer projects was developed, tested and validated. With the help of this study, the hypothetical factors affecting the transfer of knowledge in manufacturing have been identified, and the most important ones have been determined. The study also employed a novel approach of combining statistical analysis and AHP assessments to develop equations' calculations to quantifiably assess the company's readiness for knowledge transfer projects.

Keywords: Knowledge Transfer, Knowledge Sharing, Systematic literature review, Factors mapping, Knowledge Transfer Performance, Absorptive Capacity, Manufacturing, Mechanical Engineering, Metalworking

JEL codes: D80; O31; O32; C38; O14; D24; L61

Introduction

As today's competition among companies becomes fiercer, the creation of more innovative products and services becomes increasingly necessary. Organizations accumulate knowledge to innovate in products and processes, including knowledge acquired outside of the organization; thus knowledge, in general, is becoming an increasingly important factor of production. The systematic literature review, including the search for and analysis of definitions and considerations about the essence of a knowledge transfer, revealed that there is not yet a conventionally accepted and applied terminology and understanding of what the knowledge transfer is – it differs across sectors and by types, skills, information and by many other aspects of work. Generally, the most often used and relevant keywords, such as knowledge transfer, knowledge sharing, and knowledge acquisition, define a process in which knowledge, information, and skills are systematically exchanged between individuals. The condition of systematicity assumes that the knowledge transfer is a process both organized and structured. Furthermore, the circulation, exchange, transfer, or sharing of information or knowledge through the experience of people or industries can affect the individuals, the organizational unit, and even the entire company. Therefore, knowledge transfer is also a management process with the cross-discipline circulation of knowledge. Thus, with the evolving importance of knowledge becoming increasingly crucial for competitive advantage, identifying and exploring the factors affecting how knowledge moves and shifts between people and organizations becomes an essential focus.

The manufacturing sector in the economy is considered a strategic sector with high added value, as it influences the level of technology and performance of other sectors by providing them with the necessary production systems, their components, tools, equipment, and technologies (EESC, 2013; LIAA, 2022,). With today's competition among companies growing fiercer, creating more innovative products and services is necessary (e.g. Zelmenis et al., 2023). To do this, companies accumulate knowledge, including knowledge acquired outside the organization (EC, 2007; OECD, 2022). Based on the Latvian Productivity Report 2020 and clearly emphasized again in 2022, companies should invest in research and development and improve people's knowledge and skills to increase innovation activity in Latvia (Austers et al., 2020; LU PEAK, 2022). As one of the major focuses and case studies of the research is the manufacturing industry, the authors, as well as the scientific and applied debate, stress that a well-performing knowledge transfer is necessary for engineering and metalworking manufacturing companies to achieve higher innovation and competitiveness (Al-Dalaien et al., 2019; MASOC, 2005). Regular knowledge acquisition naturally reduces the risk of lacking knowledge and can prevent the company from the negative consequences deriving from offboarding key specialists, which is a particularly pronounced problem in the mechanical engineering and metalworking industry (Patalas-Maliszewska & Sliwa, 2017).

The applied topicality of the research also grounds in the data dynamics on the labour age structure in various professions – for instance, in metalworking, mechanical engineering, and their related sectors in 2022, 38% of the employed are above 50 years of age (Latvian Ministry of Economics, 2022), while those in age decades of 20's, 30's and 40's are respectively 16%, 25% and 23% (Latvian Central Statistical Bureau, 2022). Furthermore, the Labor Market Forecasts until 2040 by the Ministry of Economics in Latvia show that also visibly, in metalworking, mechanical engineering, and their related sectors, the demand for labour (specialists) will not be sufficiently met by the needed supply, but rather opposite – the gap or the labour shortage will increase exponentially – -4% in 2030, and -8,4% in 2040 (EURES, 2023; Latvian Ministry of Economics, 2023). In addition, the Association of Entrepreneurs of Mechanical Engineering and Metalworking Industry (MASOC) in Latvia has repeatedly drawn attention to the fact that with the increase in the efficiency and technological modernization of the companies in the industry, the lack of qualified specialists is still one of the major problems, manifested in approximately 70% of the companies in the industry. In the manufacturing industry, which also includes the mechanical engineering and metalworking sub-sectors, about a quarter of the employees are aged 50-69, which means that the industry will, as a result, need even more new specialists to replace pre-retirement and retirement-age employees, as long-term employees have accumulated industry-specific

technical knowledge and work experience, therefore the transfer of knowledge to companies is becoming more and more relevant (MASOC, 2005, 2022, 2023). As the data shows both the challenges and potential perspective, the research is necessary to contribute to efficient – considered, precise, and smooth – knowledge transfer, purposefully addressing the factors actually and justifiably affecting the knowledge transfer.

Knowledge transfer is affected by various factors, hence, the systematic review of the scientific literature results in the mapping of identified impact factors, which are further explored via research questions determining to what extent the impact factors affect knowledge transfer, particularly within manufacturing companies in the mechanical engineering and metalworking sector. Further, to increase the performance of knowledge transfer, companies need to find the opportunity to identify the aspects that need to be improved in their operation. Therefore, the study develops a method for assessing the readiness for knowledge transfer. Based on the outcomes of the systematic review of the scientific literature and the mapping of factors affecting knowledge transfer, the framework of 4 factors groups – 1) Individual, 2) Mentoring, 3) Organizational, 4) Technological – is used for companies' survey and factors` correlation analysis.

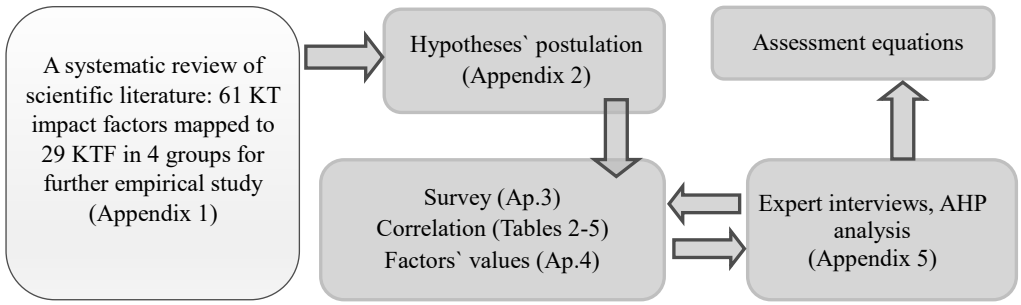
Research Methodology

The research is divided into several stages, including qualitative and quantitative research methods. The systematic literature review and the mapping of identified impact factors (Balaid et al., 2016; Booth et al., 2021, Pedersen et al., 2020) identified and extensively examined what factors generally might affect the transfer of knowledge. Further, quantitative research methods – an online survey of manufacturing companies and expert assessment using the analytic hierarchy process (AHP) approach (Ramanathan, 2006; Saaty, 1994) - are applied in the study providing factual data that were coded and measured. Qualitative and quantitative results are used for correlation and impact significance analysis, using data across research stages, thus overall ensuring data triangulation.

The overall structure of the research methodology design consists of 5 consecutively constructed and implemented stages with the respective research and analysis methods, and with every next stage built up relevantly to the resulted contents of the previous stages (see also Figure 1 below):

1) A systematic review of scientific literature resulted in 47 selected sources producing 61 hypothetically valid impact factors from 15 sectors further grouped into 8 groups of 36 aggregated factors that could hypothetically affect the transfer of knowledge (**Error! Reference source not found.**). Iterative mapping of factors resulted in 29 justifiably selected factors in 4 groups to be further analysed empirically (Appendix 2. Results of the systematic literature review: factors` map of 29 factors across 4 major groups.).
2) Setting 58 **hypotheses** of 29 factors within 4 groups against the two dependent variables – the achieved stage of knowledge transfer and – the frequency of using the acquired knowledge (see Appendix 3. Knowledge transfer factors` hypotheses). The hypotheses formulated for the empirical part of the study are based on factors influencing knowledge transfer, which were identified through the analysis of scientific literature. Considering the research questions and the literature review results, 58 hypotheses were put forward for empirical research on how different factors in 4 groups affect the achieved stage in knowledge transfer and the frequency of using the acquired knowledge.
3) Companies' **survey** (see Appendix 4. Companies survey questionnaire) based on **correlation analysis** narrowing to 14 statistically significant factors. The survey also includes **factors' values** to be set for statistically significant factors used further in research (see Appendix 5. Factors` statement values.).
4) **Expert interviews in the AHP approach** (see Appendix 6. AHP questionnaire for comparing factors affecting knowledge transfer.) to identify the relative weights of the 14 statistically significant factors.

5) Creation of equation as well as calculation and testing of the method to assess the a) knowledge transfer performance via two variables (the achieved stage of knowledge transfer and the frequency of knowledge usage) and b) company's overall readiness for knowledge transfer projects.



* KTF – knowledge transfer factors

Fig. 1. Research methodology design scheme (Source: made by the authors)

The factors identified as a result of the literature review were iteratively grouped based on considerations and peculiarities also discussed in the literature, and thus further evaluated for inclusion in the empirical study. The literature review and the factors identified also led to the discussion about the definition of knowledge transfer. As a result, the authors offer a more contemporary, complete definition of knowledge transfer; see further in the analysis. Furthermore, the results of the systematic literature review provided also valuable discussion and outcomes on characteristics and parameters which were further used for structured classification and mapping of the factors affecting the knowledge transfer, for instance, the types of knowledge, the levels, and structures (e.g. hierarchical, scope, external, internal) of knowledge exchange, their usability, expediency, and other. The parametrical characteristics resulted from the systematic literature review also provided the two dependent variables – the achieved stage of knowledge transfer and the frequency of using the acquired knowledge – that are further fundamentally used in the empirical part of the research to design a method for assessing manufacturing company`s readiness for knowledge transfer projects.

The online survey of the production companies in the database of MASOC (the Association of Entrepreneurs of Mechanical Engineering and Metalworking Industry) members was used to study which influencing factors are significant in the manufacturing companies of the mechanical engineering and metalworking industry (see Appendix 4. Companies survey questionnaire). The survey was conducted using Google Forms from April 25 to May 9, 2022. The online questionnaire was sent to 122 respondents, of which 42 respondents took part in the survey. As a result, 27 questionnaires were used to process the results. The following limits were set for collecting the survey data: the survey was conducted only in Latvian manufacturing companies; only companies in the engineering and metalworking industry participated.

The survey uses the concept of *knowledge transfer*, defined in this study *as the process of acquiring tacit and explicit knowledge or using existing knowledge within a company, which is then adapted to the needs of a particular company and shared or disseminated from one organizational structure to another*. Tacit knowledge is based on the individual's experience and skills, which is difficult to express in words but can mainly be acquired through practice. Explicit knowledge means any knowledge that can be obtained and transferred in a coded form, such as a document, database, or image (e.g., Dubickis & Gaile-Sarkane, 2017). The survey first asks a qualification question: Has a new knowledge transfer (knowledge acquisition, transformation, and distribution) project been implemented in the company in the last three years and has been concluded at the given moment? In the framework of this survey, the concept of new knowledge and technologies following Dubickis and Gaile-Sarkane (2021) is perceived as knowledge and technologies that may have already been used in other companies but are new to the particular company. If several knowledge transfer projects were implemented in the company, then the

survey participants were invited to answer only about one of the most critical knowledge transfer projects in the company's opinion. The survey also used concepts such as white and blue-collar, where white-collar refers to employees who perform managerial or administrative work in an office or other administrative environment, and blue-collar employees, in turn, perform physical, skilled, or unskilled labour.

To achieve the purpose of the survey, for each studied factor affecting knowledge transfer, a statement was created, which was associated with two performance indicators:

1) **the extent** to which the knowledge has been acquired by concluding a new knowledge transfer (knowledge acquisition, transformation, and distribution) project. The following **stages of knowledge transfer** were set in the questionnaire, characterizing the extent of knowledge transfer implementation:

1) Knowledge was acquired (obtained).
2) Knowledge was acquired and adapted to the company's needs.
3) Knowledge was acquired, transformed for the company's needs, and distributed among the company's structural units.
4) Knowledge was acquired, transformed for the company's needs, distributed among the company's structural units, and is still being used.

2) **the usage frequency** of the acquired knowledge, i.e., how frequently it continued to be used after concluding a new knowledge transfer (knowledge acquisition, transformation, and distribution) project. The following frequency scale was set in the questionnaire, characterizing the usage frequency of the acquired knowledge: 1) Never; 2) Rare; 3) Sometimes; 4) Often; 5) Always.

The significant factor correlations in manufacturing companies were discovered based on the survey data processed and analysed using *Microsoft Excel* and *PSPP* software.

Further, based on correlation analysis results, the **Analytical Hierarchy Process (AHP) questionnaire** was created containing factors that have been found to correlate (statistically significant) with knowledge transfer. The AHP is a structured method that helps make complex decisions based on mutually comparing factors. This method is often used to rank alternatives from best to worst. This article compares the influencing factors of knowledge transfer in pairs by determining each factor's importance (relative weight) (Ramanathan, R., 2006). To obtain evaluation data using the AHP approach, experts who have conducted scientific research in knowledge transfer or have practically encountered knowledge acquisition and transfer within a company were invited. A total of 29 experts were approached, of which 24 were researchers, and 5 were representatives of production companies. Considering the experts' time availability, 10 experts filled out the AHP questionnaires from the experts approached.

During the AHP, the experts were asked to compare the factors in pairs using the importance intensity scale (Saaty, 1994.) shown below in Table 1.

Table 1. AHP scale for pairwise comparisons (Source: Saaty, 1994)

Importance intensity	**Explanation**
1	Two activities contribute equally to the objective
3	Experience and judgement slightly favour one activity over another
5	Experience and judgement strongly favour one activity over another
7	An activity is favoured very strongly over another; its dominance is demonstrated in practice
9	The evidence favouring one activity over another is of the highest possible order of affirmation

A simplified AHP approach is used throughout the questionnaire, where factors within one group are compared in pairs, streamlining the comparison process for the experts and reducing the number of compared pairs (Saaty, 1994). Each factor is additionally defined so that experts can better understand the meaning of the factor (see Appendix 6. AHP questionnaire for comparing factors affecting knowledge transfer.).

Research Results

The systematic review of scientific literature

The systematic review of scientific literature explored and summarized the factors from scientific studies published and available in the *Google Scholar* database. An automated search using the keywords "*factors knowledge transfer*" in March 2022 yielded 4,630,000 search records. Advanced search options were selected to limit search results where keywords are in the article title, resulting in 566 search records. A time period restriction was set in the advanced search options using the "since 2016" search filter to narrow the search results further. This resulted in 132 search records – 2 unrelated to keywords, 15 were citations, 12 were in a language other than English, and 10 were master or doctoral dissertations. Therefore, the 39 results were not included in the further screening, leaving the search with 93 records. Of the retrieved search results, 46 were only abstracts or no full text, leaving the remaining 47 search records used in the subsequent literature review. Overall, the 2016-2021 search period returned a total of 132 records, 47 of which were eligible for the systematic review of the results in the scientific literature. The 47 articles selected provided 61 knowledge transfer factors from 15 different sectors:

1. Entrepreneurship (Ebrahiminejad, 2017; Ghazinoori et al., 2019; Marjani et al., 2019; Sondari & Akbar, 2016; Szondi & Gergely, 2020; Tuan & Thang, 2021),
2. Education (Djeflat & Maaref, 2021; Es-Sadki & Arundel, 2021; Habtoor et al., 2020; Hu, 2016; Kurniawan & Asari, 2019; Mohidin et al., 2019; Sharma & Garg, 2020; Yancey et al., 2018; Yin, 2017),
3. Medicine (Al-Dalaien et al., 2019; Chelagat et al., 2019; Gerbin & Drnovsek, 2020; Ghodsian et al., 2017; ; Hassan et al., 2016; Vasli et al., 2018; Wang et al., 2017; Xia et al., 2016),
4. Human resources (Enane, 2016; Ismail, 2015; Mokhtarzadeh & Faghei, 2017 Zulkifly et al., 2017),
5. Information technology (Madhu & Reddy, 2019; Sahu & Dwivedi, 2020; Siu & Chu, 2017; Wang et al., 2021),
6. Public institutions (Azizan et al., 2017; Azizan et al., 2018),
7. Catering (Moon et al., 2021),
8. Hotels (Powell & da Sousa, 2016),
9. Construction (Khamaksorn et al., 2017; Osabutey & Jin, 2016),
10. Energy (Uttaphut, 2018),
11. Project management (Shoeleh et al., 2019; Srisuksa et al., 2021),
12. Sports (Quer & Pedro, 2021),
13. Transport (Geresu, 2020),
14. Product development (Gurcan et al., 2018; Hu, 2016),
15. Manufacturing (Albers et al., 2018; Davoudi & Fartash, 2012; Frank et al., 2018).

The most shared factors are internal communication, mutual trust, organization culture, company management aspects (engagement and support), absorptive capacity, and training of the knowledge

recipient. The overall relatively scattered results across factors and articles evidence a diverse and often dissimilar understanding and various broad interpretations of the factors affecting knowledge transfer factors, thus yet again indicating the necessity for more in-depth research on this topic. Within the analysis, the obtained knowledge transfer factors were aggregated and grouped by similarity in order to facilitate their feasibility in relation to the research purpose, as well as by the type or area of their influence considering both cause and effect and impact directions. As a result, 36 aggregated factors that could hypothetically affect the transfer of knowledge were divided into 8 groups 1) technological, 2) human resources, 3) individual, 4) organizational, 5) academic environment, 6) external, and 7) communication, (see **Error! Reference source not found.**). The greatest factors' variation is seen in the organizational and individual factors, allowing us to conclude that in most cases, knowledge transfer is influenced by either the individual or the organization factors such as the recipient's absorptive capacity, motivation, mutual trust, and management, particularly its level of engagement and support. Further, considering which potential factors might have different effects for different companies and which could be measured, the factors affecting knowledge transfer were 2nd-fold iteratively regrouped. For example, factors from the group "readiness of the academic environment" could have the same impact on companies of the same industry, so this group is excluded from further research. By a similar analogy, factors such as *environment*, *guidelines*, *government policy*, *culture*, *time zone*, and *language* are also discarded because companies within one country have the same external factors that could affect knowledge transfer. Nevertheless, given the principally similar strive for innovation via knowledge accumulation in both private and public sectors, the latter searching for more efficient, productive and co-productive provisions and implementation of public policies and services (see, e.g. Putans & Zeibote, 2021), the identified factors shall be relevant for both sectors. Additionally, the 2nd iteration of factors` grouping was largely based also on the scientific findings related to structures and classification of knowledge motion in an organization – its exchange and transfer aspects – revealing that knowledge exchange can take place at three levels: individual, organizational, and technological with each of the levels having different barriers (factors) to knowledge sharing – e.g., at the individual level, the main problem is related to the lack of time and communication and employee's distrust of other employees; at the organizational level, the exchange of knowledge is hindered due to the lack of suitable premises and contacts of cooperation partners; and at the level of technology, the lack of competence and the desire to use technologies are mentioned as the main obstacles (Patalas-Maliszewska, 2014). Furthermore, the group of mentoring factors was formed based on scientific discoveries on the importance of knowledge motion, particularly on the various and indefinable forms of how knowledge is shared and exchanged. It is considered the most important process in the field of knowledge management (Ibrahim et al., 2018), in which interpersonal cooperation takes place (Ryu et al., 2003) both inside and outside the organization (Charterina & Landet, 2013). Knowledge sharing is defined as a two-way process where employees communicate by sharing knowledge (Patalas-Maliszewska & Klos, 2019). Interestingly, also vice versa – knowledge sharing is a way of organizational structures and how participants communicate and learn from each other (Yoon et al., 2021). In particular, the intangible or tacit knowledge exchange takes place via communication between management and employees (Crhova et al., 2015). Thus, the mentoring factors largely derive from individual and organizational factors and their synergy, for instance, the availability of knowledge within an organization and willingness to transfer communication between the knowledge provider and the recipient, as well as organization management's involvement, including support and organization of for knowledge transfer. As a result of the extensive in-depth analysis and various aspect exploration of considerations, the knowledge transfer factors` grouping was settled into a map of 29 factors in 4 general groups: 1) 8 individual factors, 2) 7 mentoring factors, 3) 10 organizational factors, 4) 4 technological factors (see Appendix 2. Results of the systematic literature review: factors` map of 29 factors across 4 major groups.). These factors shall be used further in the empirical part of the research according to the methodological design.

Finally, to fully establish the groundwork for further research, the systematic review of the scientific literature has also led to the determination of performance indicators or dependent variables crucial in the subsequent empirical study for assessing the effectiveness of knowledge transfer by evaluating the identified factors. Based particularly on the author`s augmented definition of knowledge transfer – a

process in which internal or external tacit and explicit knowledge is acquired and is further adapted to the needs of a company and shared or distributed from one organizational structure to another – two dependent variables as performance indicators for characterizing knowledge transfer success were developed:

1) the extent to which the knowledge is acquired or the achieved stage in knowledge transfer by concluding a new knowledge transfer (knowledge acquisition, transformation, and distribution) project – such an indicator should allow us to determine whether the acquired knowledge has been transformed for the company's needs and shared between different structural units of the company;

2) the usage frequency of the acquired knowledge after concluding a new knowledge transfer (knowledge acquisition, its transformation, and distribution) project – such an indicator shall determine whether the transferred knowledge has been useful at all and whether the company has used it after the conclusion of the knowledge transfer project.

The authors consider knowledge transfer to be successful if the acquired knowledge is transformed and shared and used in the company as a valuable resource.

The results of the correlation analysis showed that the proposed hypotheses had obtained a correlation on the influence of various factors on knowledge transfer performance variables: P1 – the achieved stage of knowledge transfer, and P2 – the frequency of using the acquired knowledge. Table 2 below shows the correlation of individual factors of recipients with the efficiency indicators of knowledge transfer.

Table 2. Correlation of the individual factors of recipients with the achieved stage of knowledge transfer and the frequency of using the acquired knowledge (Source: Made by the authors based on survey results)

Individual factors	**Statistically significant correlations with performance variables**	
	P1	P2
Recipient's ability to focus on the knowledge acquisition process	0.640*	
Recipient's motivation		
Recipient's intellectual level, including emotional intelligence		
Recipient's absorptive capacity	0.445*	0.547*
Recipient's confidence in their abilities		0.491*
Recipient's work experience		0.546*
Recipient's education level for white-collar workers		
Recipient's education level for blue-collar workers		

P1 – the achieved stage of knowledge transfer; P2 – the frequency of using the acquired knowledge.

According to the data in Table 2, it can be seen that the achieved stage of knowledge transfer (P1) has two while the frequency of using the acquired knowledge (P2) has three statistically significant positive correlations with the individual factors of recipients. *The recipient's ability to focus on the knowledge acquisition process* has relatively the highest correlation with *the achieved knowledge transfer stage*. *The recipient's absorptive capacity* is the only factor from this group that significantly correlates with both performance indicators. Such correlation allows the conclusion that the higher the *recipient's ability to focus* and the higher the *absorptive capacity*, the better the recipient has mastered the knowledge. Thus, the recipients are more able to adapt the knowledge to the company's needs and use it in daily operations. In addition, this factor also stood out in the scientific literature review, showing that the *recipient's absorptive capacity* is one of the factors affecting transnational knowledge transfer projects particularly (Shoeleh et al., 2019). Also, there is a relatively high positive correlation between the

recipient's work experience and *the frequency of use of the acquired knowledge*. The obtained correlation could be explained by the fact that often the most experienced employees of the company have acquired both explicit and tacit knowledge, which is directly based on their previous experience. Based on theory analysis within the literature review, tacit knowledge is highly valued because it is the most difficult to transfer. Therefore, if there are more experienced employees in the company, the more they can recommend how the company should act or not based on the knowledge already acquired in practice. As a result, companies can better focus on knowledge transfer and avoid the most typical mistakes that make knowledge transfer less successful, such as, e.g., overestimation of employees' eagerness, readiness, and ability to participate in the knowledge transfer process efficiently or underestimation of indirect impact aspects such as company`s strategic and tactical culture or organization structure. Although the level of education as an individual factor did not reveal statistically significant correlations with any of the knowledge transfer performance indicators in the empirical case study, still based on the literature review as well as taking into account recent trends in industrial development (Greco, 2023), including the role of knowledge in the knowledge economy, the authors envisage the potential relevance of education as individual factors.

Further, Table 3 shows a comparatively smaller volume of correlation between the identified **mentoring factors** and the achieved stage of knowledge transfer and the frequency of use of acquired knowledge.

Table 3. Correlation of mentoring factors with the achieved stage of knowledge transfer and the frequency of use of acquired knowledge (Source: Made by the authors based on survey results)

Mentoring factors	Statistically significant correlations with performance variables	
	P1	P2
Availability of knowledge		
Content and quality of knowledge		
Communication with the recipient		
Skills to transfer knowledge		
Willingness to transfer knowledge		
Top management involvement and support		0.490*
Quick decision-making		0.444*

P1 – the achieved stage of knowledge transfer; P2 – the frequency of using the acquired knowledge.

Only two factors considered for mentoring – top management involvement and support and decision-making – have a statistically significant positive correlation, with only one of the performance variables being how often the acquired knowledge is used after the conclusion of the knowledge transfer project. The results confirm that the employees appreciate top management's involvement in the knowledge transfer process. The participation of the management can inspire and motivate the employee.

In turn, the **organizational factors**, as shown in Table 4, show a broad correlation with both performance variables of knowledge transfer.

Table 4. Correlation of organizational factors with the achieved stage of knowledge transfer and the frequency of use of acquired knowledge (Source: Made by the authors based on survey results)

Organizational factors	**Statistically significant correlations with performance variables**	
	P1	P2
Communication among the employees		

Staff turnover		0.412*
Human resource quantity		0.471*
Human resource quality	0.505*	
Training		**0.559***
Financial resources		0.531*
Organizational culture		
Company's internal policy	**0.613***	0.434*
A shared vision		0.518*
Organizational structure		0.438*

P1 – the achieved stage of knowledge transfer; P2 – the frequency of using the acquired knowledge.

The organizational factors group has the most statistically significant correlations in terms of an amount compared to other groups of factors. Furthermore, the correlations reveal both of the performance variables. In terms of correlations' significance within the organizational factors group, the strongest correlation is established between the achieved stage of knowledge transfer and the factor such as the *Company's internal policy* followed by the frequency of using the acquired knowledge with the highest correlation to the factor *training*, which is a process in which an employee is taught the skills needed to upgrade their qualifications. Therefore, it can be concluded that training to raise qualifications positively affects the frequency of using the acquired knowledge. Accordingly, there is a higher probability that by regularly holding employee training, knowledge transfer can be more successfully implemented (employees can accumulate knowledge even more and use it to transform and share knowledge). Interestingly, the second most correlated factor with the frequency of using the acquired knowledge is the shared vision, which proves that if the company's employees have a clear picture of the company and understand it, then the transferred knowledge can be used longer because the employees have learned the knowledge, transformed and shared in such a way that they correspond as much as possible to the company's vision, which describes the company's desired achievable goal in the long term. This also aligns clearly with the finding of a systematic review of scientific literature – shared vision fosters mutual understanding and provides an essential mechanism among employees to integrate, share, and transfer knowledge within the organization (Zulkifly et al., 2017). It can be said that knowledge transfer also helps employees understand what the company wants to achieve through knowledge transfer if they understand the company's long-term goals. Such observation is also justified by the abovementioned company`s internal policy`s impact on the achieved knowledge transfer stage. Overall, there will be 8 organization factors extracted for further grouping and AHP analysis based on correlation results.

Finally, Table 5 shows the correlation coefficients of the **technological factors** to the achieved stage of knowledge transfer and the frequency of use of acquired knowledge.

Table 5. Correlation of technological factors with the achieved stage of knowledge transfer and the frequency of use of acquired knowledge (Source: Made by the authors based on survey results)

Technological factors	**Statistically significant correlations with performance variables**	
	P1	P2
The average age of computers		
The average age of software updates		0.417*
Frequency of database updates		-0.445*
Frequency of applied technology, knowledge, and methods revision		

P1 – the achieved stage of knowledge transfer; P2 – the frequency of using the acquired knowledge.

According to the data in Table 5, it can be seen that the only two factors showing a significant correlation with the frequency of using the acquired knowledge are – the *average age of software updates,* which correlates positively with the frequency of using the acquired knowledge, and the *frequency of database updates* correlating negatively with the frequency of using the acquired knowledge. According to the survey data, no statistically significant correlations were obtained for *the average age of computers and the frequency of updates of technology, knowledge, and methods used to implement the activity*. However, the literature review strongly emphasized that technology significantly impacts knowledge transfer. Since the obtained results are contrary to what was hypothesized, **the group of technological factors was excluded** from further research and was not presented in the expert evaluation.

As a result of the correlation analysis on the factors identified in the survey findings and the knowledge transfer performance variables, the study has identified 14 factors (see below Figure 2) with empirically justified significance (found statistically significant correlation) in the context of knowledge transfer performance. As a result, the initially identified 61 factors based on their empirically justified significance in correlation to their impact performance variables are now re-grouped into the mentioned 14 factors of 3 groups:

- 4 individual factors of recipients (recipient's ability to focus on the knowledge acquisition process, recipient's absorptive capacity, recipient's confidence in their abilities, and the existing work experience of the recipient).
- 2 mentoring factors (involvement and support of senior management, the ability of senior management to make decisions quickly). The selected mentoring factors showed correlations with only the second performance variable – the frequency of using the acquired knowledge.
- 8 organizational factors (staff turnover, sufficiency of human resources, qualification (quality) of human resources, training for employees, resources for employee training, compliance with company policy, shared vision, organizational structure facilitating information exchange).

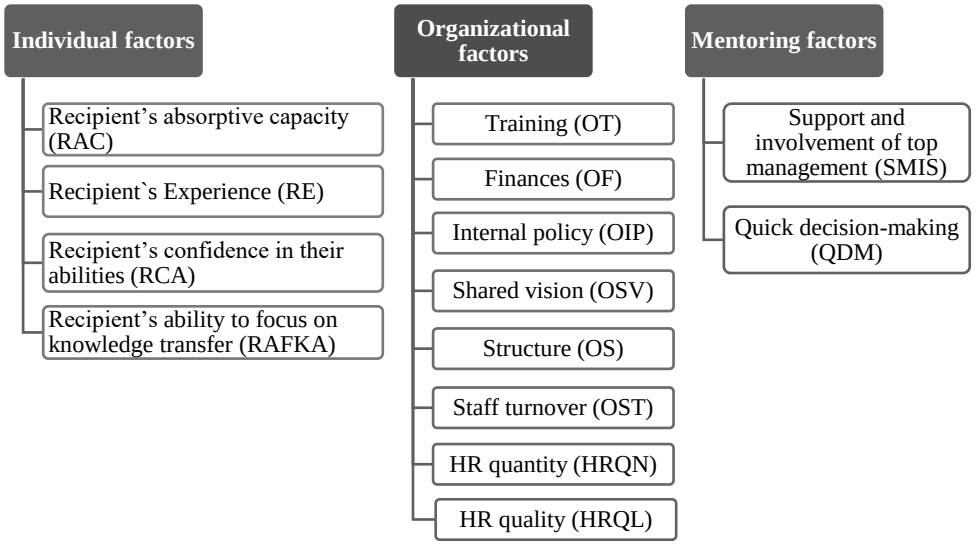


Fig. 2. Post-correlation re-grouped knowledge transfer factors. (Source: Made by the authors based on correlation analysis results)

Abbreviations' acronym codes are used further with quantitative values in calculation equations (see Equation 1. The knowledge transfer performance equation.).

The experts' assessment

The experts were offered 14 factors in 3 groups for evaluation, which were found to have a statistically significant correlation with the two dependent variables – the achieved stage of knowledge transfer and – the frequency of using the acquired knowledge. The weights of individual recipient factors are shown in Table 6.

Table 6. Individual factors' weights. **(**Source: Made by the authors based on experts' survey via AHP.)

Experts	Factor weights			
	Recipient's ability to focus on the knowledge acquisition process	**Recipient's absorptive capacity**	**Recipient's confidence in their abilities**	**The existing work experience of the recipient**
1	0.15	0.33	0.09	0.43
2	0.06	0.66	0.21	0.07
3	0.04	0.62	0.09	0.25
4	0.27	0.54	0.08	0.11
5	0.09	0.19	0.61	0.11
6	0.11	0.29	0.06	0.54
7	0.20	0.57	0.10	0.13
8	0.12	0.43	0.05	0.4
9	0.05	0.39	0.26	0.3
10	0.13	0.61	0.05	0.21
Average	**0.12**	**0.46**	**0.16**	**0.26**

The results show that the experts considered the most crucial factor to be *recipients' absorptive capacity,* but relatively less critical – *recipients' ability to focus on the knowledge acquisition process* and *the recipient's confidence in their abilities*. Also, in the correlation analysis from the company survey data, it can be found that in the group of recipients' individual factors, *the recipients' absorptive capacity* has the highest correlation with the frequency of using the knowledge acquired in the transfer of knowledge. Further, the weights of mentoring factors are shown in Table 7.

Table 7. Mentoring factors' weights (Source: Made by the authors based on experts' survey via AHP)

Experts	Factors' weight	
	Involvement and support of senior management	**The ability of senior management to make decisions quickly**
1	0.75	0.25
2	0.5	0.5
3	0.9	0.1
4	0.75	0.25
5	0.5	0.5
6	0.75	0.25
7	0.5	0.5
8	0.83	0.17

9	0.75	0.25
10	0.75	0.25
Average	**0.70**	**0.30**

Within the correlation analysis of the mentoring factors, only two factors showed statistically significant correlations with one of the performance variables and thus were further evaluated in this group. It can be seen from the table above that the experts have recognized that the *involvement and support of senior management* has more than twice the weight of *the ability of senior management to make quick decisions*. This could be explained by the fact that the most essential thing in the mentoring process is that the top management participates. If the top management does not get involved in the mentoring process, quick decision-making becomes less critical. Also, the correlation analysis showed a higher correlation for the *involvement and support of senior management.* Thus confirming the reliability of the research results.

And lastly, the weights of organizational factors are shown in Table 8.

Table 8. Organizational factors' weights (Source: Made by the authors based on experts' survey via AHP)

Experts	**Factors' weight**							
	Staff turnover	**Sufficiency of human resources**	**Quality of human resources**	**Training for employees**	**Financial resources for employee training**	**Shared vision**	**Organizational structure facilitating information exchange**	**Compliance with company`s policy**
1	0.04	0.04	0.26	0.07	0.07	0.36	0.08	0.08
2	0.07	0.04	0.26	0.04	0.10	0.37	0.09	0.03
3	0.02	0.05	0.20	0.25	0.20	0.19	0.03	0.06
4	0.02	0.05	0.30	0.11	0.09	0.14	0.09	0.20
5	0.10	0.08	0.26	0.17	0.06	0.13	0.16	0.04
6	0.03	0.02	0.24	0.12	0.09	0.40	0.05	0.05
7	0.05	0.04	0.20	0.18	0.12	0.16	0.11	0.14
8	0.08	0.02	0.23	0.06	0.13	0.12	0.14	0.22
9	0.05	0.11	0.21	0.18	0.19	0.16	0.06	0.04
10	0.02	0.10	0.33	0.06	0.08	0.25	0.10	0.06
Average	**0.05**	**0.06**	**0.25**	**0.12**	**0.11**	**0.23**	**0.09**	**0.09**

Experts' evaluations of the knowledge transfer organizational factors' weights show that 2 out of 8 factors of this group are evaluated substantially higher than others. According to experts' considerations, the most important organizational factor is human resources' qualification (quality), which is only 0,02 points ahead of the company's shared vision. The lowest importance factor among organizational factors evaluated by experts is *Staff turnover*, which shows as low as 0,05 points and is closely followed by the *Sufficiency of human resources*, which experts evaluated as low as 0,06 points. In this group of factors, the opinion of experts is less consistent with the survey-based factors' correlation analysis results in manufacturing companies – according to the results of the companies' survey, the highest correlation coefficients were obtained for a) the *Training* factor, evaluating its effect on the frequency of use of knowledge acquired in knowledge transfer, and b) for the *Compliance with company policy* factor, when evaluating its effect on the extent of knowledge transfer implementation. However, in the experts' assessment, the *Quality of human resources* was considered the most important factor and the second

most important factor in the survey. *Staff turnover* was recognized as the least important factor in both studies – the survey and the experts' evaluation.

The study also evaluated the relative value of the factors' groups, identifying their values in the transfer of knowledge of production companies. Table 9 below illustrates how the experts assessed the groups of knowledge transfer factors among one another in order of importance. The experts considered the most important group of factors to be individual factors (average value of 0,42), followed by mentoring factors (0,3), and as the least important, but closely following – the organizational factors (0,28). Compared to the results of the survey of manufacturing companies, where the most significant correlation was found for organizational factors, then for the individual factors of recipients, and the least for mentoring factors, the experts may have found individual factors the most important group because knowledge transfer, for the most part, is highly dependent on how employees as individuals can learn and absorb the acquired knowledge themselves so that they can then be used in the company.

Table 9. Comparison of groups of factors affecting knowledge transfer. (Source: Made by the authors based on experts' survey via AHP)

Experts	**Weights of the Factors` groups**		
	Individual factors	**Mentoring factors**	**Organizational factors**
1	0.14	0.57	0.29
2	0.66	0.09	0.25
3	0.43	0.43	0.14
4	0.63	0.11	0.26
5	0.10	0.21	0.69
6	0.45	0.23	0.32
7	0.14	0.57	0.29
8	0.70	0.07	0.23
9	0.43	0.43	0.14
10	0.57	0.29	0.14
Average	**0.42**	**0.30**	**0.28**

To conclude on experts' assessment of the factors affecting knowledge transfer, it can be concluded that the opinion of the experts largely matches the results of the survey of manufacturing companies – in two of the three-factor groups, i.e., in the group of individual factors and the group of mentoring factors. Small differences are observed in the opinion of experts and companies in the organizational factors' group, and the comparison of the groups of factors in terms of importance is different.

Based on the results of the conducted qualitative and quantitative research in order to methodologically assess the readiness of knowledge transfer in a mechanical engineering and metalworking industry production company, the authors have **developed equations** to calculate and show quantitatively the performance of knowledge transfer indicators used in the study – the achieved stage of knowledge transfer and the frequency of use of acquired knowledge. For each of the performance indicators, as well as for both indicators jointly, equations are composed of the factors with statistically significant correlations based on the survey of production companies, as well as the weight coefficients based on experts' AHP assessment results, both for factor groups and individually for each factor. Equations are created according to the following principle (Eq. 1.):

Equation 1. The knowledge transfer performance equation. (Source: Developed by the authors.)

$$\text{The achieved stage of knowledge transfer} = \quad (1)$$

$$= \mathbf{G1w}\ (F1w*v + F2w*v + \cdots + F\#w*v) + \mathbf{G2w}\ (F1w*v + \cdots + F\#w*v) +$$

$$+ \mathbf{G3w}\ (F1w*v + \cdots + F\#w*v) + \mathbf{G\#w}\ (F1w*v + \cdots + F\#w*v)$$

Where, G#w – factors` group weight; F#w – factor weight; F#v – factors value.

The formulation of the equations consisted of several methodological (systematic) steps:

1) Identification of factors showing statistically significant correlation with each of the performance indicators (companies' survey – see Appendix 4. Companies survey questionnaire; and correlation analysis);

2) Defining the values of the statistically significantly correlating factors. The values derive from the respective questions/answers of the survey and are set from 0 to 1 in tertiles (0, 0.33, 0.66, 1) and quartiles (0, 0.25, 0.5, 0.75, 1) (see Appendix 5. Factors` statement values.);

3) Obtaining weights for each factor and group of factors (AHP assessments by experts – see Appendix 6. AHP questionnaire for comparing factors affecting knowledge transfer);

4) In case one of the factors or groups of factors is excluded, the weights of factors and groups of factors obtained in the AHP questionnaire are recalculated proportionally;

5) Creating an equation allowing for quantified calculation of knowledge transfer performance, considering the values and weights of the respective statistically significant correlation factors and their corresponding groups.

As a result, two sets of equations determine the knowledge transfer stage achieved and the frequency of use of acquired knowledge; the factors and their respective groups used in the equations are determined based on the correlation results between factors and the two dependent variables. The quantified calculated results obtained using the equations can vary from 0 to 1.

In the current study based on the MASOC Latvia case study, the acquired knowledge transfer stage in manufacturing companies in Latvia expressed is as follows (Eq. 2):

Equation 2. The achieved stage of knowledge transfer, MASOC Latvia case study. (Source: Developed by the authors.)

$$\text{The achieved stage of knowledge transfer} = \quad (2)$$

$$= \mathbf{IFG(0,6)} * \mathbf{(}\text{RAFKA}(0{,}21*\textit{0/0.33/0.66/1}) + \text{RAC}(0{,}79*\textit{0/0.33/0.66/1})\mathbf{)} +$$

$$+\ \mathbf{OFG(0,4)} * \mathbf{(}(\text{HRQL}(0{,}74*\textit{0/0.33/0.66/1}) + \text{OIP}(0{,}26*\textit{0/0.33/0.66/1})\mathbf{)}$$

, where

IFG – Individual factors` group, **0,6** – IFG total average weight recalculated;

RAFKA – Recipient's ability to focus on knowledge transfer; 0,21 – RAFKA weight from AHP experts and 0;0.33;0.66;1 – value from companies` survey (Q9);

RAC – Recipient's absorptive capacity; 0,79 – RAC weight from AHP experts; 0;0.33;0.66;1 – value from companies` survey (Q9)

OFG – Organizational factors` group, **0,4** – OFG total average weight recalculated;

HRQL – Human resource quality; 0,74 – HRQL weight from AHP experts; 0/0.33/0.66/1 – value from companies` survey (Q21);

OIP – Organization`s internal policy; 0,26 – OIP weight from AHP experts and 0/0.33/0.66/1 – value from companies` survey (Q21).

Using the same principle, the equation of the frequency of use of knowledge acquired by manufacturing companies was also obtained:

Equation 3. The usage frequency of the acquired knowledge, MASOC Latvia case study. (Source: Developed by the authors.)

$$\textbf{The usage frequency of the acquired knowledge} = \quad (3)$$

$$= \textbf{IFG(0,42)} * \textbf{(}\text{RAC}(0{,}52*0.33;0.66;1) + \text{RCA}(0{,}18*0.33;0.66;1)+\text{RE}(0{,}30*0.33;0.66;1)\textbf{)} +$$

$$+ \textbf{MFG(0,30)} * \textbf{(}\text{SMIS}(0{,}7*0.25;0.5;0.75;1) + \text{QDM}(0{,}3*0.25;0.5;0.75;1)\textbf{)} +$$

$$+ \textbf{OFG(0,28)}* (\text{OST}(0{,}07*v)+\text{HRQN}(0{,}08*v)+\text{OT}(0{,}16*v)+\text{OF}(0{,}15*v)+\text{OSV}(0{,}31*v)+\text{OS}(0{,}12*v)+\text{OIP}(0{,}12*v)\textbf{)}$$

where

IFG – Individual factors` group, **0,42** – IFG total average weight;

RAC – Recipient's absorptive capacity; 0,52 – RAC weight from AHP experts and 0.33; 0.66 – value from companies` survey (Q9);

RCA – Recipient's confidence in their abilities; 0,18 – RCA weight from AHP experts and 0.33; 0.66 – value from companies` survey (Q9);

RE – Recipient's experience; 0,30 – RCA weight from AHP experts and 0.33; 0.66 – value from companies` survey (Q9);

MFG – Mentoring factors` group, **0,30** – MFG total average weight;

SMIS – Senior management involvement and support; 0,7 – SMIS weight from AHP experts and 0.25-0.5-0.75-1 – value from companies` survey (Q17);

QDM - Quick decision-making; 0,3 – QDM weight from AHP experts and 0.25-0.5-0.75-1 – value from companies` survey (Q17);

OFG – Organizational factors` group, **0,28** – OFG total average weight;

OST – Organization staff turnover; HRQN – Human resource quantity; OT – Organization`s training;

OF – Organization`s finances. OSV – Organization`s shared vision. OS – Organization`s structure.

OIP – Organization`s internal policy.

– weight from AHP experts and v – value from companies` survey (Q19-Q23)

To verify the accuracy of the equations, four questionnaires from the survey of companies were tested, the results of which are illustrated below (Fig. 3):

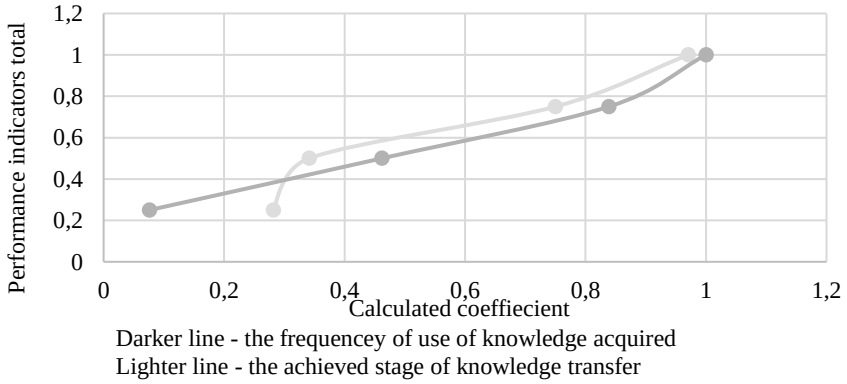


Fig. 3. Approbations of knowledge transfer calculation methodology equations. (Sources: Made by authors based on method approbation)

Figure 3 shows both performance indicators having an upward trend, i.e., the higher calculated coefficient is for those companies that have reached a higher stage of knowledge transfer and use the acquired knowledge the most after the conclusion of the knowledge transfer project.

Overall, it must be noted that the methodological calculation model's thorough validation process affirmed its accuracy and showed its meaningful efficacy, strengthening its applicability to provide reliable results.

Conclusions

Based on the systematic review of the scientific literature, knowledge transfer is a complex and complicated process with comparatively short and low-level conceptual research. It is concluded that there is yet no common understanding of the concept of *knowledge transfer* in studies. Depending on the authors, knowledge transfer can also mean knowledge acquisition and knowledge sharing, which are only part of the knowledge transfer, which is a much more complex process. However, all these concepts include both explicit and tacit knowledge. In addition, all definitions and considerations emphasize the importance of communication; equally, acquiring knowledge is a crucial factor.

The mechanical engineering and metalworking industry is one of Latvia's most exportable industries. Therefore, its development is critical. To ensure competitive export products and services, they must be as innovative as possible with high added value, which can be achieved by carrying out knowledge transfer projects, for example, by attracting the experience of companies from other sectors in Latvia and abroad, as well as higher education and research institutions.

Knowledge transfer in manufacturing companies is influenced by 14 factors, which can be divided into three groups: individual recipients, mentoring, and organizational factors. According to experts, the groups of factors affecting knowledge transfer in the production sector are ranked in the following order – individual factors of recipients, mentoring factors, and organizational factors. The survey of manufacturing companies found that the strongest correlations are in the group of the recipients' individual factors. *The absorptive capacity of recipients* is the most frequently mentioned factor in literature sources. The empirical study found the highest correlation with knowledge transfer performance. Experts have given the most weight to this factor, so it is considered the most critical factor affecting knowledge transfer, which managers should pay attention to. Therefore, to develop the absorptive capacity of employees, companies must provide training not only on the acquisition and use of knowledge but also on identification from external sources. Therefore, internal R&D work must be carried out.

The study employs a novel approach combining statistical analysis and AHP assessments to develop equations` calculations to assess a company`s readiness for knowledge transfer projects quantifiably. The methodology was developed and tested using the data obtained from questionnaires filled by Mechanical Engineering and Metalworking Industry companies in Latvia and data from expert interviews and representatives of industries in Latvia. Since the research is, in essence, based on a scientific literature review resulting in factors affecting the knowledge transfer in general, and given the principally similar strive for innovation via knowledge accumulation in both private and public sectors, the latter searching for more efficient and productive provisions and implementation of public policies and services (see e.g. Putans & Zeibote, 2021), the assessment method can be adjusted to other sectors, including the public sector. In this respect, although the method is well validated and shall be used further, the authors point out several research peculiarities to preserve academic integrity: a) taking into account the innovative nature of the method and its development during the factual progress of research, sets of factors submitted for expert evaluation for weights determination (Appendix 6. AHP questionnaire for comparing factors affecting knowledge transfer) on several occasions have been slightly different; b) also possible survival bias are present in the research as the data is obtained only from companies that have had knowledge transfer projects. In further studies, factors in companies where knowledge transfer does not occur should also be collected and considered; c) Lastly, the

presented assessment method considers only hypothetically positive effects (or lack thereof) of identified factors. Further research must include hypothetically negative effects (or lack thereof) of the factors` correlation with dependent variables for better comparison-based method validation.

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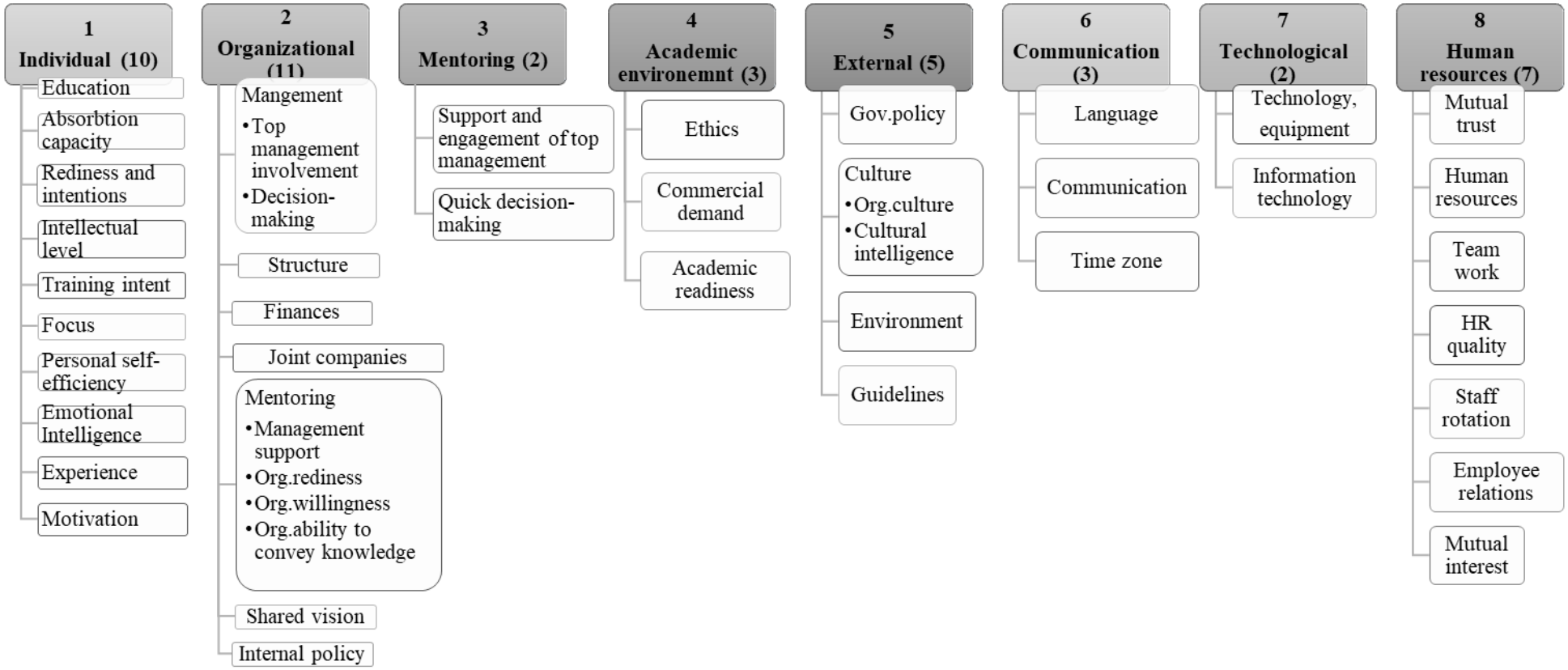
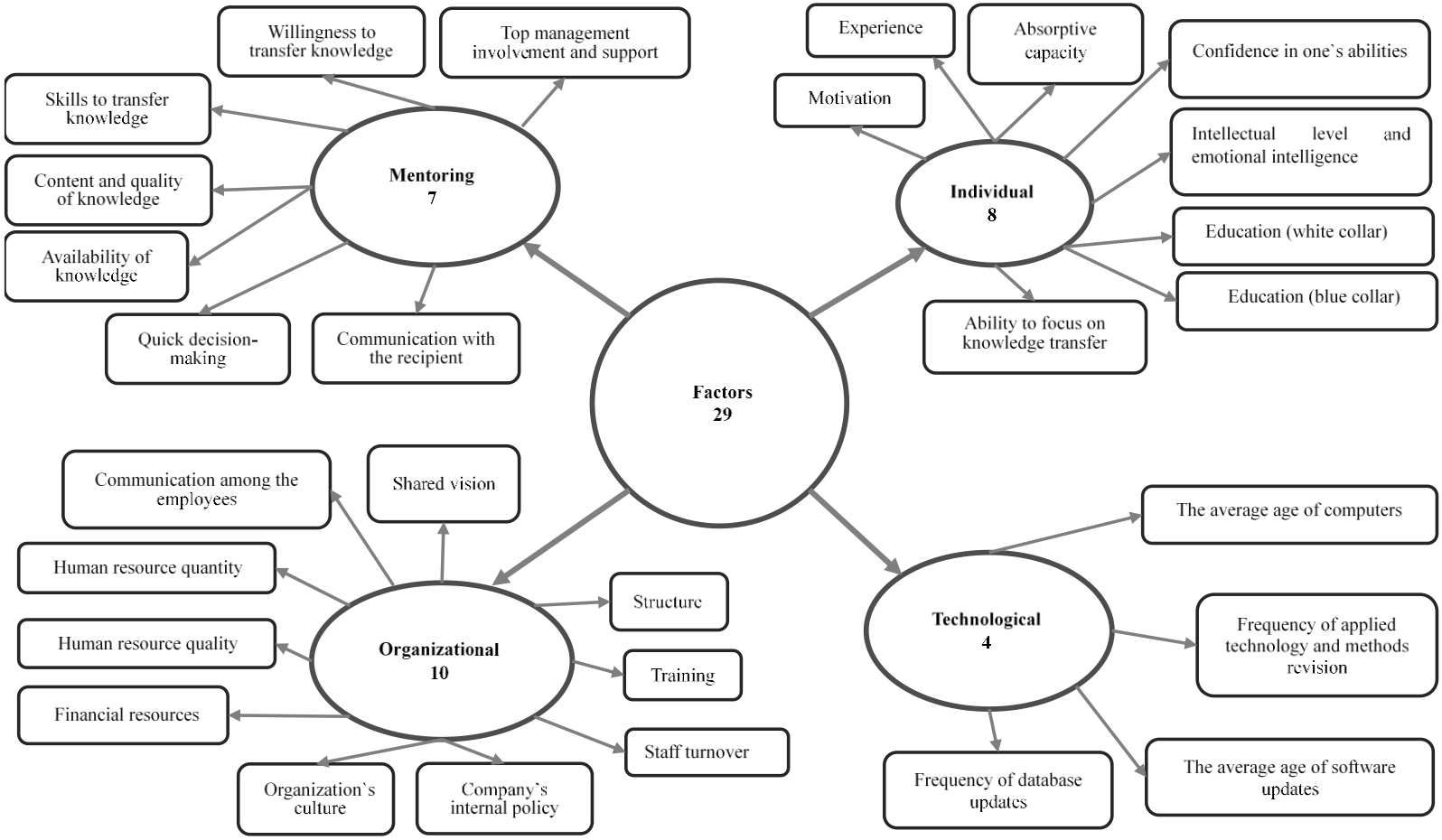
Appendix 1. Groupings of the determined knowledge transfer factors



Appendix 2. Results of the systematic literature review: factors` map of 29 factors across 4 major groups.



Appendix 3. Knowledge transfer factors` hypotheses

Hypotheses (16) about individual factors:

H.2.1: The recipients' ability to focus on the knowledge acquisition process has a positive correlation with the achieved stage of knowledge transfer.

H.2.2: The recipients' ability to focus on the knowledge acquisition process has a positive correlation with the frequency of use of knowledge acquired in knowledge transfer.

H.2.3: The motivation of recipients has a positive correlation with the achieved knowledge transfer stage.

H.2.4: The motivation of recipients has a positive correlation with the frequency of using the knowledge acquired in knowledge transfer.

H.2.5: The intellectual level of recipients, including emotional intelligence, has a positive correlation with the achieved stage of knowledge transfer.

H.2.6: The intellectual level of recipients, including emotional intelligence, has a positive correlation with the frequency of using knowledge acquired in knowledge transfer.

H.2.7: The recipients' absorptive capacity has a positive correlation with the achieved stage of knowledge transfer.

H.2.8: The recipients' absorptive capacity has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.2.9: The recipients' confidence in their abilities has a positive correlation with the achieved stage of knowledge transfer.

H.2.10: The recipients' confidence in their abilities has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.2.11: The recipients' existing work experience has a positive correlation with the achieved stage of knowledge transfer.

H.2.12: The recipients' existing work experience has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.2.13: The education level of the learning white-collar workers has a positive correlation with the achieved stage of knowledge transfer.

H.2.14: The education level of the learning white-collar workers has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.2.15: The education level of the learning blue-collar workers has a positive correlation with the achieved stage of knowledge transfer.

H.2.16: The education level of the learning blue-collar workers has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

Hypotheses (8) about technological factors:

H3.1: Lower average age of computers has a positive correlation with the achieved stage of knowledge transfer.

H3.2: Lower average age of computers has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H3.3: Lower average age of software updates has a positive correlation with the achieved stage of knowledge transfer.

H3.4: Lower average age of software updates has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H3.5: Frequent updates of databases have a positive effect on the achieved stage of knowledge transfer.

H3.6: Frequent updates of databases have a positive effect on the frequency of using the knowledge acquired in the transfer of knowledge.

H3.7: Frequently renewed technologies, knowledge, and methods used to implement the activity have a positive effect on the achieved stage of knowledge transfer.

H3.8: Frequently renewed technologies, knowledge, and methods used to implement the activity have a positive effect on the frequency of using the knowledge acquired in the transfer of knowledge.

Hypotheses (14) about mentoring factors:

H4.1: Availability of knowledge has a positive correlation with the achieved stage of knowledge transfer.

H4.2: Availability of knowledge has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H4.3: Content and quality of knowledge has a positive correlation with the achieved stage of knowledge transfer.

H4.4: Content and quality of knowledge has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H4.5: Communication of mentors with trainees has a positive correlation with the achieved stage of knowledge transfer.

H4.6: Communication of mentors with trainees has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H4.7: The ability of mentors to transfer knowledge to trainees has a positive correlation with the achieved stage of knowledge transfer.

H4.8: The ability of mentors to transfer knowledge to trainees has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H4.9: The willingness of mentors to transfer knowledge to trainees has a positive correlation with the achieved stage of knowledge transfer.

H4.10: The willingness of mentors to transfer knowledge to trainees has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H4.11: Involvement and support of senior management have a positive effect on the achieved stage of knowledge transfer.

H4.12: Involvement and support of senior management have a positive effect on the frequency of using the knowledge acquired in the transfer of knowledge.

H4.13: The ability of senior management to make decisions quickly has a positive correlation with the achieved stage of knowledge transfer.

H4.14: The ability of senior management to make decisions quickly has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

Hypotheses (20) about organizational factors:

H.5.1: Communication among employees has a positive correlation with the achieved stage of knowledge transfer.

H.5.2: Communication among employees has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.3: Low staff turnover has a positive correlation with the achieved stage of knowledge transfer.

H.5.4: Low staff turnover has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.5: Sufficiency of human resources has a positive correlation with the achieved stage of knowledge transfer.

H.5.6: Sufficiency of human resources has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.7: Quality of human resources has a positive correlation with the achieved stage of knowledge transfer.

H.5.8: Quality of human resources has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.9: Training has a positive correlation with the achieved stage of knowledge transfer.

H.5.10: Training has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.11: Financial resources for employee training have a positive effect on the achieved stage of knowledge transfer.

H.5.12: Financial resources for employee training have a positive effect on the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.13: Compliance with company`s policy (written norms) has a positive correlation with the achieved stage of knowledge transfer.

H.5.14: Compliance with company`s policy (written norms) has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.15: Compliance with organization`s culture (unwritten norms) has a positive correlation with the achieved stage of knowledge transfer.

H.5.16: Compliance with organization`s culture (unwritten norms) has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H5.17: Shared vision has a positive correlation with the achieved stage of knowledge transfer.

H5.18: Shared vision has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

H.5.19: Communication among employees has a positive correlation with the achieved stage of knowledge transfer.

H.5.20: Communication among employees has a positive correlation with the frequency of using the knowledge acquired in the transfer of knowledge.

Appendix 4. Companies survey questionnaire

1. Has your company implemented new knowledge transfer (knowledge acquisition, transformation and distribution) project during the last 3 years, which is concluded at the given moment? *(New knowledge and technologies are understood as those that may have already been used in other companies but are new to your company. If several projects were implemented, please answer only about 1, in your opinion, the most important knowledge acquisition project.)*

- o Yes
- o No

2. When concluding a new knowledge transfer (knowledge acquisition, transformation and distribution) project, to what extent was the knowledge acquired?

- o Knowledge was acquired
- o Knowledge was acquired and transformed to the company's needs
- o Knowledge was acquired, transformed for the company's needs, and distributed among the company's structural units
- o Knowledge was acquired, transformed for the company's needs, distributed among the company's structural units and is still being used

3. When concluding a new knowledge transfer (acquisition, transformation and dissemination) project, how often did the acquired knowledge continue to be used?

- o Never
- o Rare
- o Sometimes
- o Often
- o Always

4. Please indicate the age of the technologies listed below in the company when the knowledge transfer (acquisition, transformation and dissemination) project was implemented?

Technology / Oldness	Less than 1 year	1-3 years	4-6 years	7 or more years
Average age of computers (from the time of purchase)				
Average age of software updates (how long since the last updates)				

5. Please indicate how often the technologies listed below were updated in the company's knowledge transfer (acquisition, transformation, and dissemination) project. *(Update means an update made during the knowledge transfer, not one made as a result of the knowledge transfer.)*

Statements / Frequency	Never	Rarely	Sometimes	Often	Always
Databases (e.g., a database of potential customers, a compilation of technologies used by competitors, etc.)					
Technologies, knowledge, and methods used to implement the activity					

6. Please evaluate the situation regarding the learners involved in the knowledge transfer (acquisition, transformation, and distribution) project concluded in your company. (Please provide an overview of the overall average situation in the company.)

Statement / Evaluation	Fully disagree	Rather disagree	Rather agree	Fully agree
Recipients were able to focus on the process of acquiring knowledge				
Recipients were motivated to learn new knowledge				
Recipients' ability to think logically and understand ideas, as well as their ability to identify, control, express their emotions, and perceive the emotions of others, were relevant to acquiring knowledge				
Recipients could identify, acquire, and use knowledge in performing their daily duties				
Recipients felt confident in their abilities in the process of acquiring knowledge				
Recipients have extensive work experience				

7. Approximately what proportion of your company's white-collar employees has a master's degree? (White-collar workers are workers who perform professional, managerial, or administrative work in an office or other administrative setting.)

- o 0 %
- o 1-10 %
- o 11-20 %
- o 21-30 %
- o 31-40 %
- o 41-50 %
- o 51-60 %
- o 61-70 %
- o 71-80 %
- o 81-90 %
- o 91-100 %

8. Approximately what part of your company's blue-collar employees (recipients) has a professional education (secondary vocational education) certificate? (Blue collar is a class of workers who perform manual, skilled, or unskilled work.)

- o 0 %
- o 1-10 %
- o 11-20 %
- o 21-30 %
- o 31-40 %
- o 41-50 %
- o 51-60 %
- o 61-70 %
- o 71-80 %
- o 81-90 %
- o 91-100 %

9. Were mentors assigned to employees in the process of knowledge transfer (acquiring, transformation, and distribution) in your company? (A mentor teaches or provides help and advice to a less experienced and often younger person.)

- o Yes
- o No

10. In the process of mentoring, mentors communicated with trainee employees. (A mentor teaches or provides help and advice to a less experienced and often younger person.)

- o Never
- o Rare

- Sometimes
- Often
- Always

11. During the mentoring process, the mentor (someone who teaches or gives help and advice to a less experienced and often younger person):

	Fully disagree	Rather disagree	Rather agree	Fully agree	Mentors were not assigned
Conveyed the planned knowledge in the mentor ing process to educated employees in an underst andable way					
Voluntarily transferred knowledge and taught tr ainees (i.e., management did not have to motiva te and force mentors to transfer knowledge regu larly)					

12. All employees involved in the knowledge transfer (acquisition, transformation, and distribution) project had access to support materials (e.g., literature, brochures, instructions, presentations, or any other materials in the e-environment).

- Fully disagree
- Rather disagree
- Rather agree
- Fully agree

13. The available support materials (e.g., literature, brochures, instructions, presentations, or any other materials in the e-environment) were available in a timely manner, they were complete, related to the intended purpose of knowledge transfer (acquiring, transformation, and dissemination) and contained the most current information.

- Fully disagree
- Rather disagree
- Rather agree
- Fully agree

14. Within the framework of the knowledge transfer (knowledge acquisition, transformation and distribution) project, the top management of the company:

Statements / Frequency	Never	Rarely	Sometimes	Often	Always
Participates and supports the mentoring process					
Can make quick decisions					

15. Employees learning in the company communicate with other employees at all stages of knowledge transfer (acquisition, transformation, and dissemination).

- Never
- Rare
- Sometimes
- Often
- Always

16. Staff turnover (rotation) in the company is:

- Very low
- Low
- Average
- High

- Very high

17. The company has a sufficient number of employees for the tasks.

- Fully disagree
- Rather disagree
- Rather agree
- Fully agree

18. The company's employees' qualifications are appropriate for the tasks.

- Fully disagree
- Rather disagree
- Rather agree
- Fully agree

19. Please evaluate the situation in your company on the following statements and frequency.

Statements / Frequency	Never	Rarely	Sometimes	Often	Always
There are trainings for company employees to improve their qualifications					
The company pays for training of employees to improve their qualifications					

20. Please evaluate the situation in your company on the following characteristics.

	Fully disagree	Rather disagree	Rather agree	Fully agree
Company employees follow values and unwritten work norms				
Company employees follow the internal working procedures (written work norms)				
Company employees have a clear vision of the company and understand it				
Company employees can freely exchange information with each other, regardless of divisions or departments				

Appendix 5. Factors` statement values.

N#	Factor`s code for the equation	Factors → Statement (respective questions Q from the Survey)	Answer options and value (for each question /statement separately)	
1	IFG	INDIVIDUAL FACTORS` GROUP		
1	RAC	The recipients' absorptive capacity ← Recipients were able to identify, acquire, and use knowledge in performing their daily duties (Q6)	*For each factor:* Fully disagree Rather disagree Rather agree Fully agree	0 0.33 0.66 1
2	RE	The recipients' existing work experience ← Recipients have extensive work experience (Q6)		
3	RCA	The recipient's confidence in their abilities ← Recipients felt confident in their abilities in the process of acquiring knowledge (Q6)		

4	RAFKA	Recipient's ability to focus on the knowledge acquisition process ← Recipients were able to focus on the process of acquiring knowledge (Q6)		
2	OFG	ORGANIZATIONAL FACTORS` GROUP		
1	OT	Organization Training ← There are trainings for company employees to improve their qualifications (Q19)	Never Rarely Sometimes Often Always	0 0.25 0.5 0.75 1
2	OF	Organization Finance for training ← The company pays for training o f employees to improve their qualifications (Q19)	*For each factor:* Fully disagree Rather disagree Rather agree Fully agree	 0 0.33 0.66 1
3	OIP	Organization Internal Policy ← Company employees follow the inter nal working procedures (written work norms (Q20)		
4	OSV	Organization Shared Vision ← Company employees have a clear visi on of the company and understand it (Q20)		
5	OS	Organization Structure ← Company employees can freely exchange i nformation with each other, regardless of divisions or departments (Q 20)		
6	HRQN	Human Resources Quantity ← The company has a sufficient number of employees for the tasks (Q17)		
7	HRQL	Human Resources Quality ← The company's employees' qualificatio ns are appropriate for the tasks (Q18)		
8	OST	Organization staff turnover ← Staff turnover in the company is (Q16):	Very low Low Average High Very high	1 0.75 0.5 0.25 0
3	MFG	MENTORING FACTORS` GROUP		
1	SMIS	Senior management involvement and support ← Senior management participates and supports the mentoring process (Q14)	Never Rarely Sometimes Often Always	0 0.25 0.5 0.75 1
2	QDM	Quick decision-making ← Senior management can make quick decisi ons (Q14)		

Appendix 6. AHP questionnaire for comparing factors affecting knowledge transfer.

Group 1 – Individual factors.

1. Recipients' ability to focus on the process of acquiring knowledge.

2. Recipients' absorptive capacity – the ability to identify, acquire and use knowledge.

3. Employees' confidence in their abilities.

4. Experience – the amount of existing work experience of the recipients.

1. Which of the learner's individual factors and to what extent are mutually more important in the transfer of knowledge (acquisition of knowledge, its transformation and dissemination)?							
Please mark which of the given factors is more important (Factor 1 or Factor 2) and to what extent it is more important (1 – both factors are equally important; 3 – the selected factor is slightly more important than the other factor; 5 – the selected factor is more important than the other factor; 7 – the selected factor is much more important than the other factor; 9 – the selected factor is immeasurably more important than the other factor).							
	Factor 1	Factor 2	1	3	5	7	9
1.Recipients' ability to focus on the process of acquiring knowledge or **2.**Recipients' absorptive capacity (ability to identify, acquire and use knowledge)	□	□	□	□	□	□	□
1.Recipients' ability to focus on the process of acquiring	□	□	□	□	□	□	□

knowledge or **2.**Employees' confidence in their abilities							
1.Recipients' ability to focus on the process of acquiring knowledge or **2.**Experience	□	□	□	□	□	□	□
1.Recipients' absorptive capacity (ability to identify, acquire and use knowledge) or **2.**Employees' confidence in their abilities	□	□	□	□	□	□	□
1.Recipients' absorptive capacity (ability to identify, acquire and use knowledge) or **2.**Experience	□	□	□	□	□	□	□
1.Employees' confidence in their abilities or **2.**Experience	□	□	□	□	□	□	□

Group 2 – Mentoring factors.

1. Top management involvement and support – the involvement of the company's top management in the mentoring process and providing comfort, encouragement, or assistance.

2. Quick decision-making – the ability of top management to quickly make decisions on various issues, evaluating pros and cons to facilitate the transfer of knowledge within the company.

2. Which mentoring factors and to what extent are mutually more important in transferring knowledge (acquisition of knowledge, its transformation, and dissemination)?							
Please mark which of the given factors is more important (Factor 1 or Factor 2) and to what extent it is more important (1 – both factors are equally important; 3 – the selected factor is slightly more important than the other factor; 5 – the selected factor is more important than the other factor; 7 – the selected factor is much more important than the other factor; 9 – the selected factor is immeasurably more important than the other factor).							
	Factor 1	Factor 2	1	3	5	7	9
1. Top management involvement and support or **2.** Decision-making (top management ability to quickly make decisions)	□	□	□	□	□	□	□

Group 3 – Organizational factors.

1. Staff turnover – change of personnel (rotation) in the company.

2. Sufficiency of human resources – a sufficient number of company employees.

3. Quality of human resources – qualification of human resources for the tasks.

4. Training – teaching employees the skills necessary to upgrade their qualifications (upskilling).

5. Financial resources for employee training.

6. Compliance with company policy – employees follow internal work procedures (written work norms).

7. Shared vision – the company's employees have a clear understanding of the vision of the company.

8. Organizational structure – company employees can freely exchange information with each other, regardless of divisions or departments.

3. Which organizational factors and to what extent are mutually more important in transferring knowledge (acquisition of knowledge, its transformation, and dissemination)?							
Please mark which of the given factors is more important (Factor 1 or Factor 2) and to what extent it is more important (1 – both factors are equally important; 3 – the selected factor is slightly more important than the other factor; 5 – the selected factor is more important than the other factor; 7 – the selected factor is much more important than the other factor; 9 – the selected factor is immeasurably more important than the other factor).							
	Factor **1**	Factor **2**	1	3	5	7	9
1.Staff turnover or **2.**Sufficiency of human resources	□	□	□	□	□	□	□
1.Staff turnover or **2.** Quality of human resources	□	□	□	□	□	□	□
1.Staff turnover or **2.**Training	□	□	□	□	□	□	□

1.Staff turnover or **2.**Financial resources for employee training	□	□	□	□	□	□	□
1.Staff turnover or **2.**Compliance with company policy	□	□	□	□	□	□	□
1.Staff turnover or **2.**Shared vision	□	□	□	□	□	□	□
1.Staff turnover or **2.**Shared vision	□	□	□	□	□	□	□
1.Sufficiency of human resources or **2.**Quality of human resources	□	□	□	□	□	□	□
1.Sufficiency of human resources or **2.**Training	□	□	□	□	□	□	□
1.Sufficiency of human resources or **2.**Financial resources for employee training	□	□	□	□	□	□	□
1.Sufficiency of human resources or **2.**Compliance with company policy	□	□	□	□	□	□	□
1.Sufficiency of human resources or **2.**Shared vision	□	□	□	□	□	□	□
1.Sufficiency of human resources or **2.**Organizational structure	□	□	□	□	□	□	□
1. Quality of human resources or **2.**Training	□	□	□	□	□	□	□
1. Quality of human resources or **2.**Financial resources for employee training	□	□	□	□	□	□	□
1. Quality of human resources or **2.**Compliance with company policy	□	□	□	□	□	□	□
1. Quality of human resources or **2.**Shared vision	□	□	□	□	□	□	□
1. Quality of human resources or **2.**Organizational structure	□	□	□	□	□	□	□
1.Training or **2.**Financial resources for employee training	□	□	□	□	□	□	□
1.Training or **2.**Compliance with company policy	□	□	□	□	□	□	□
1.Training or **2.**Shared vision	□	□	□	□	□	□	□
1.Training or **2.**Organizational structure	□	□	□	□	□	□	□
1.Financial resources for employee training or **2.**Compliance with company policy	□	□	□	□	□	□	□
1.Financial resources for employee training or **2.**Shared vision	□	□	□	□	□	□	□
1.Financial resources for employee training or **2.**Organizational structure	□	□	□	□	□	□	□
1.Compliance with company policy or **2.**Shared vision	□	□	□	□	□	□	□
1.Compliance with company policy or **2.**Organizational structure	□	□	□	□	□	□	□
1.Shared vision or **2.**Organizational structure	□	□	□	□	□	□	□