ZESZYTY NAUKOWE UNIWERSYTETU PRZYRODNICZO-HUMANISTYCZNEGO W SIEDLCACH, Nr 134
Seria: Administracja i Zarządzanie (61) 2023
pl ISSN 2082-5501

USING THE CONCEPT OF KNOWLEDGE MAPS FOR THE AMELIOURATION OF KNOWLEDGE MANAGEMENT SYSTEMS

WYKORZYSTANIE KONCEPCJI MAP WIEDZY DO USPRAWNIENIA SYSTEMU ZARZĄDZANIA WIEDZĄ

https://doi.org/10.34739/zn.2023.61.22

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JEL Classification Codes: L22, M12, M14

Abstract: The appropriate localisation and mapping of knowledge resources in an enterprise is a necessary element for efficient knowledge management. This requires appropriate motivation on the part of employees and a number of actions on the part of managers. Looking to address this very issue, what follows presents an analysis of the process of mapping and locating knowledge resources in a selected company: one of the branches of an international company belonging to the automotive industry, located in Poland, was selected as the research object. The results of the research were used to develop proposals for solutions to improve the knowledge management system. Therefore, the aim of this publication is to diagnose the functioning of the knowledge transfer system on the example of the selected enterprise, based on an initial proprietary pilot study.
Keywords: knowledge management, knowledge maps, sharing knowledge, automotive industry

Streszczenie: Właściwa lokalizacja i mapowanie zasobów wiedzy w przedsiębiorstwie są niezbędnymi elementami efektywnego zarządzania wiedzą. Wymaga to odpowiedniej motywacji ze strony pracowników i szeregu działań ze strony menedżerów. W artykule przedstawiono analizę procesu mapowania i lokalizacji zasobów wiedzy na przykładzie wybranego przedsiębiorstwa. Jako obiekt badań wybrano jeden z oddziałów międzynarodowej firmy z branży motoryzacyjnej, zlokalizowany w Polsce. Wyniki badań posłużyły do opracowania propozycji rozwiązań usprawniających system zarządzania wiedzą. Celem publikacji jest diagnoza funkcjonowania systemu transferu wiedzy na przykładzie wybranego przedsiębiourstwa, w oparciu o wstępne, autorskie badanie pilotażowe.
Słowa kluczowe: zarządzanie wiedzą, mapy wiedzy, dzielenie się wiedzą, branża motoryzacyjna

Introduction

Dynamic changes in the global economy force companies to constantly improve the way they operate. The third millennium brings rapid transformations in all areas of business activity. It seems that a modern organisation undertaking the management of a resource, which is knowledge, faces challenges concerning, among others: use, strategic goals, quality, flow and accumulation. Similar to the case of knowledge, the concept of knowledge management, although it may seem more formalised, also remains an issue that to date has not had a unified definition. It is considered in different contexts, such as: functional, process, instrumental or institutional. Knowledge management is therefore the ability to properly manage human resources and information, while making the most effective use of innovations available on the market. Skillful knowledge management should encompass mutually complementary processes of knowledge creation and dissemination, consisting primarily of creating an organisational culture conducive to learning, implementing new technologies, improving existing processes and treating human resources as the most important resource of an enterprise. The implementation of the knowledge management

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concept is therefore a necessary condition for the proper functioning of an enterprise, assuming that knowledge as a resource should be available to specific employees at the right time.

Theoretical background

According to literature sources, the best tool for mapping the interrelationships between the intellectual assets existing in the enterprise, sources of knowledge and its structures are knowledge maps (KM) (Moreno et al., 2000; Pontevedra et al., 2018). The concept of using knowledge maps as a tool for locating knowledge resources was first proposed by the British information scientist Brooks (Cirp, Mengqi, et al., 2019). As emphasised by Cirp et al. (Cirp, Mengqi, et al., 2019), knowledge maps are an effective tool for knowledge management, enabling, e.g. knowledge searching, knowledge sharing and its exchange. Knowledge maps can also facilitate knowledge management innovation. Knowledge maps will also enable the systematisation of new intellectual resources and the linking of tasks with intellectual assets at the disposal of the organisation. This is very helpful in identifying the causes of process inefficiencies (Rao et al., 2012; Kodama 2023) and facilitating knowledge sharing (Lin, 2006). All the information contained in knowledge maps can be saved in electronic form, organised according to various criteria and presented using graphics programs (Moreno et al., 2000)(Kiklhorn et al., 2019). The variety of knowledge maps was presented by (Fionda et al., 2016). Fig. 1 shows a simplified diagram of the knowledge mapping process proposed by (Rao et al., 2012).

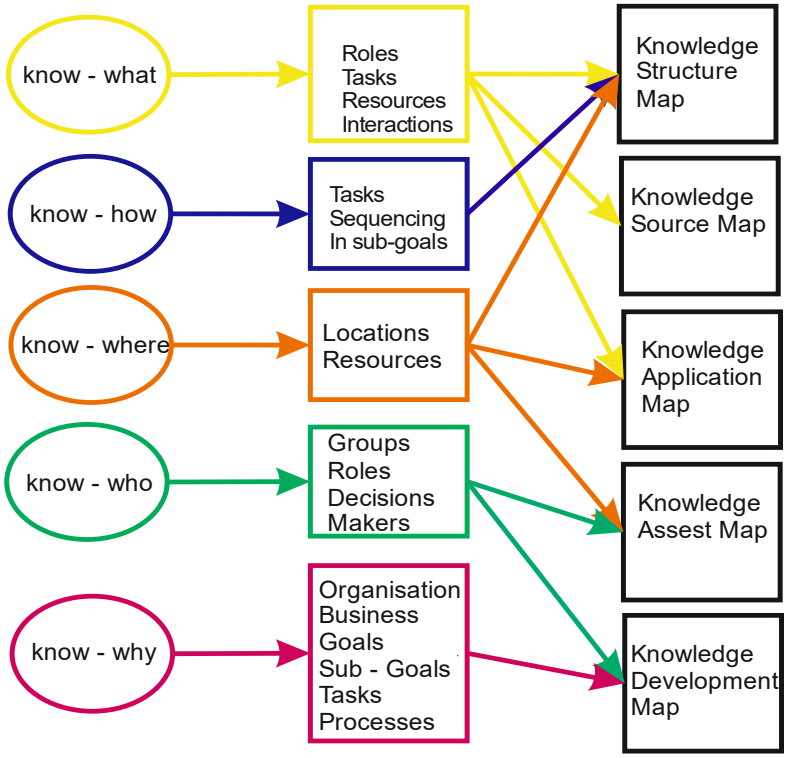

Figure 1. Knowledge Assessment Map (Rao et al., 2012)

Thanks to knowledge maps, it is also possible to obtain information about what level of the organisational hierarchy these people are at (Kiewit et al., 2018). It is also possible to comprehensively review the human resource management (HRM) and employment relations (ERs) (Yu et. al., 2023). Knowledge source maps indicate who (by name) in the team, in the entire organisation or in its environment has valuable knowledge resources that can be used in the implementation of specific projects (Abdellatif et al., 2018; Haiyan et al. 2023). Geographic information systems are used to determine the geographic distribution of knowledge resources (e.g. a map of delivery areas is useful for planning logistics activities). They can greatly influence the effectiveness of the organisation's management decisions (Kiewit et al., 2018). Wang et al. (Lai et al., 2009) concluded, based on their

research, that matching the knowledge map is the most important determinant of the success of a Knowledge Management System (KMS), showing the greatest combined impact on user satisfaction, as well as ease of use and usability (Caballero-Anthony et al., 2021). This suggests that using a knowledge map suitable for employees to search/retrieve in a more efficient and effective way is the most important factor in the success of KMS (Fote et al., 2020). From a manager's perspective, a good knowledge map not only enables knowledge workers to gain knowledge and better understand the domain concept, but can also facilitate the spread, sharing and creation of knowledge (Albassam, 2019; Ning, et al., 2023). The mapping of information and knowledge flow processes at the level of the entire organisation, between departments or independent organisational units is possible thanks to Social Network Analysis (SNA). It is a research method that allows the identification and then recreation for analytical purposes of the multi-element and multi-level structures of connections between various types of social subjects. SNA enables analysis of the structure of the entire network, its subsets, and the identification of key nodes and relations that determine the consistency and dynamics of the network. The motivation to undertake this research topic was primarily to show the possibility of using knowledge mapping in the automotive sector. In addition, an analysis of the literature from the years 2018-2022 based on keywords and restrictions introduced to the advanced search in the Scopus database made it possible to generate a map using the VOSviewer program (ver.1.6.18). As part of an attempt to interpret keywords (knowledge management system, sharing knowledge automotive industry), the type of analysis "co-occurrence" – "counting method: full counting" and the unit of analysis of all keywords – "unit of analysis – all keywords" were selected (Fig. 2).

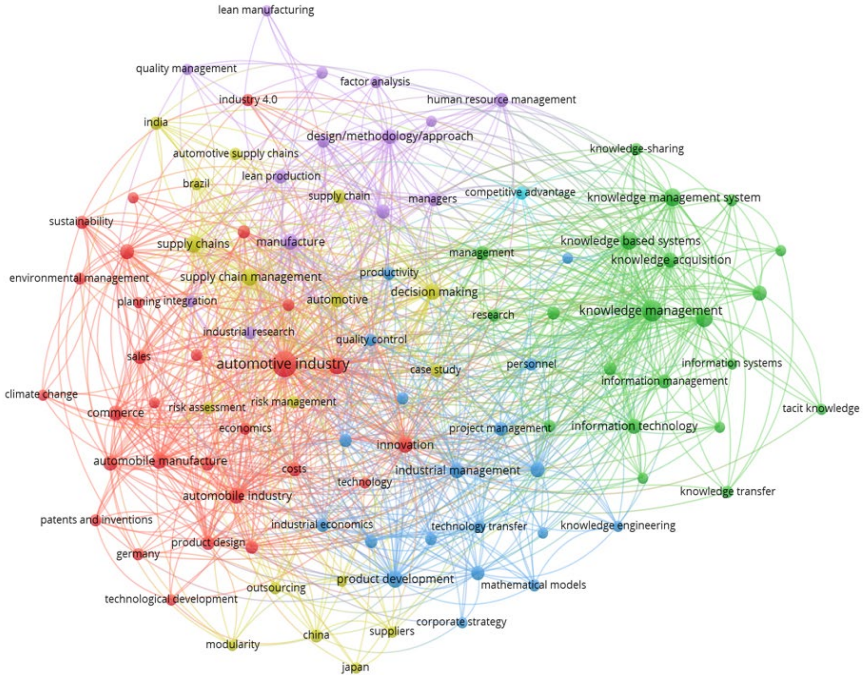

Figure 2. Keyword network (Source: own analysis in VOSviewer)

To determine the leading keywords, it was assumed that the minimum number of occurrences of a given word is 5. This assumption was made in order to intensify the weight of words and to enable the identification of elements on the map. Analysing all the results obtained on the basis of the created map, it should be stated that the issues that take into account the aspect of knowledge management in the organisation are still valid and constantly evolving. However, from the perspective of the automotive industry, there seems to be a need to expand knowledge in this area.

Methodological information

The knowledge mapping process was carried out for an Italian international company operating in the automotive industry. The plant produces electric harnesses for cars and engines. In addition, the

company produces components such as cables, PVC pipes, plastic couplings and rubber grommets. The company has had a branch in Poland since 2002. The company's headquarters are located in Italy, where the core of the management team is located. Individual production departments have their headquarters, among others in the Middle East (China), South America (Argentina, Brazil), Africa (Tunisia), and in Eastern Europe (Poland, Romania). For the purposes of the adopted research problem, the non-probabilistic (purposeful) method of research sample selection was applied using the technique of a standardised questionnaire interview as well as direct interview. The questions included in the interview questionnaire were open-ended questions regarding the knowledge management system in the enterprise, in particular: knowledge resources, knowledge sharing, knowledge transfer, access to knowledge, improving knowledge, acquiring knowledge, using knowledge, teamwork skills, the atmosphere in the company, and the motivation system.

The interview questionnaire addressed to the group of employees in the technical department and at the middle level of production management (leaders) included 8 general questions (Questionnaire 1), while for the management staff of all the analysed departments – 20 questions (Questionnaire 2). In the analysed company, based on the organisational structure, the most important sources of knowledge are presented in Table 1.

The knowledge base was the management staff and leaders of individual departments. The level of the lowest workforce located in the direct production department was the last link of knowledge. Taking into account the above criteria, the studied population was characterised in Table 2.

Table 1. Sources of knowledge in the organisation

Managing department	Technical department	Quality department	Logistics department	Purchasing department	IT department
– intellectual knowledge, – expertise knowledge, – expert knowledge (know-how, know-who)	– intellectual knowledge, – procedural knowledge (set of procedures), – innovative knowledge, – process knowledge, – expert knowledge, – analogue knowledge, – general knowledge, – codified knowledge (set of standards), – tacit knowledge	– intellectual knowledge, – procedural knowledge, – process knowledge	– intellectual knowledge (compilation of statistics, summaries)	– intellectual knowledge (compilation of statistics, summaries)	– intellectual knowledge, – process knowledge, – instrumental knowledge (IT work tools), – digital knowledge, – catalogue knowledge, – archiving knowledge, – analogue knowledge (based on practice and experience)

Source: own work.

Table 2. Characteristics of studied population

Department	Gender		Age	Education		General
	female	male		medium	high	
Technical office	50	30	25-35	50	30	80
Leaders	20	50	25-35	60	10	70
Logistics Department	-	10	25-35	0	10	10
Quality Department	-	10	25-35	0	10	10
Technical office Italian branch	-	10	35-45	0	10	10
Total research sample						N=180

Source: Own work based on questionnaire interview.

Research results

The results of the survey are presented in Tables 3 and 4. The vast majority of employees, i.e. 75%, believe that they are not encouraged to share knowledge and the sharing of it depends on their own initiative. Half of the respondents believe that there is an atmosphere of openness and trust in the company, but only in small circles of employees and closest associates. 63% believe that the company provides access to information. However, among these opinions there were also comments that access to information applies only to online resources, and not to current company events. The vast majority of respondents, i.e. 87%, believe that the company does not work on improving the skills and knowledge of employees. 75% of the respondents admit to being punished for mistakes, and the same number think that it motivates them to learn something new. Employees receive verbal reprimands and admonitions. Also, 75% believe that the company does not improve teamwork skills to improve the quality of products and services, and 100% of the respondents believe that management does not take up the discussion about the concept of the company's future. The reason for the lack of knowledge sharing may be the fact that while knowledge management publications assume that knowledge sharing is beneficial and necessary, and there are numerous examples (mainly from corporations) of the systems and activities used to support knowledge sharing, entrepreneurs (from the sector of medium and large enterprises) are rather sceptical about sharing knowledge (Rudawska, 2011) (Pyrko, Dörfler & Eden, 2017) (Gow & McDonald, 2000). On the one hand, they are concerned that introducing measures to encourage sharing (especially informal sharing) will distract them from their main job. On the other hand, they are afraid of the leakage of important information because they treat sharing knowledge as providing employees with information that they do not necessarily (in their opinion) have.

Table 3. Responses of employees from Department of Technical Office employed in Poland (Questionnaire 1) [%]

Question number	Question	I have no opinion	No	Yes
1	Are you encouraged to share your knowledge?	0	75	25
2	Is there an atmosphere of openness and trust in the workplace?	0	50	50
3	Does the company provide you with access to information?	0	63	37
4	Is the company working on improving skills and knowledge?	0	87	13
5	Are you punished for your mistakes?	0	50	50
6	Are your mistakes a motivation to learn something new?	0	25	75
7	Is the company improving teamwork to improve product and service quality?	13	75	12
8	Does your management engage in discussions with you about the concept of the future of the company?	0	100	0

Source: as in Table 2.

Table 4. Responses of employees from production department employed in Poland (Questionnaire 1) [%]

Question number	Question	I have no opinion	No	Yes
1	Are you encouraged to share your knowledge?	0	14	85
2	Is there an atmosphere of openness and trust in the workplace?	14	14	72
3	Does the company provide you with access to information?	14	43	43
4	Is the company working on improving skills and knowledge?	0	43	57
5	Are you punished for your mistakes?	0	0	100
6	Are your mistakes a motivation to learn something new?	0	43	57
7	Is the company improving teamwork to improve product and service quality?	14	14	72
8	Does your management engage in discussions with you about the concept of the future of the company?	29	42	29

Source: as in Table 2.

Employees from the group of Production Department Leaders responded extensively to the questions asked, adding comments to their answers. It provided a broader view of the issues analysed in the questionnaire related to information transfer, skills improvement and knowledge exchange. When asked about encouraging employees to share knowledge, 85% answered "yes", emphasising that knowledge sharing takes place in contacts with new employees in terms of their work. As many as 72% of the respondents stated that there is an atmosphere of openness and trust at work. One of the employees added that there is a nice atmosphere among the staff at work and that the company's management is open to employees' problems and tries to find a solution without leaving them unanswered. Three out of seven respondents stated that the company provides employees with access to information, among others, in the form of information boards, boards with production indicators, as well as access to information on innovative activities of the enterprise. Four out of seven respondents, i.e. 57%, believe that the company is working on improving the skills and knowledge of employees, providing them with access to training, conducting tests and teaching. To question 5, all the respondents replied that they were punished for their mistakes. The penalty is a reprimand or verbal rebuke and applies to situations where the employee has clearly exceeded his rights or did not comply with the applicable health and safety regulations, e.g. according to one of the employees, the lack of protective clothing results in the employee not being allowed to the workplace. Four employees believe that they learn from their mistakes, trying to avoid them and work better. As many as 72% believe that the company improves teamwork skills. Among the comments, there was an opinion that the improvement in teamwork skills that takes place in the company leads to better organisation of work, which in turn ensures the continuity of production. To question 8, regarding management discussions about the company's future concept, only two employees replied in the affirmative. The last supplementary stage of the research was to know the opinions of respondents belonging to the management staff of the quality, logistics, technical and production departments of the surveyed industry (*Questionnaire 2*). *Below is an overview of selected opinions:*

- The respondents stated unequivocally that the employees' knowledge greatly influences the company's success.
- The respondents believe that employees' access to information is very important, while admitting that there are problems with the transfer of information between departments in the company. Moreover, they stated that the access system is currently under development and supplemented with new functions.
- The respondents unanimously noticed that the knowledge acquired in the company is not used in the course of current operations.
- The respondents believe that the IT department is responsible for data management, and the responsibility of employees is based on individual responsibility, i.e. within the scope of their competences and collective responsibility, e.g. at the managerial level.
- The respondents unequivocally state that a clearly defined direction and action plan could improve the flow of information and knowledge management in the company, and the improvement in knowledge transfer is influenced by the process of sharing it between individual employees/units.
- The respondents believe that with regard to the analysis of knowledge resources, periodic verifications are carried out and the awareness of employees is analysed.
- The respondents consider knowledge sharing, information flow, and an interdisciplinary approach to be weak areas of knowledge management in the company.
- The respondents do not include in the scope of their competences activities related to the use of employees' knowledge when formulating goals.
- The respondents mentioned information saved in the form of multimedia presentations as a map of knowledge used in the company.
- The respondents were not able to state where the knowledge resource development centres are located in the company.
- The respondents unequivocally stated that the company is currently working on improving the transfer quality of the best solutions for key processes in the company.
- The subjects of the research did not encounter a situation in which an employee leaving the company would pass his knowledge on to his successors.

Proposed solutions to improve the knowledge management system in the analysed enterprise

The conducted interview made it possible to evaluate the current knowledge management system in the enterprise, as well as to develop proposals for solutions for its improvement. In the analysed enterprise, the reduction of knowledge resources is influenced, among others, by:

- insufficient or no sharing of knowledge,
- lack of support from the management staff,
- no material incentives,
- no flow of expert knowledge – specialist knowledge is possessed by a small group of employees (one or two people) and it is not transferred, archived in any way; the above-mentioned people collect, update, check, process and accept data,
- placing the smallest resources of knowledge in the technical and logistics department,
- reluctance (fear) to use innovative computer programs and systems,
- becoming accustomed to operating programs created for one's own needs,
- lack of knowledge of the possibilities and advantages of modern IT tools,
- lack of an employee motivation system, leading to:
  - low work efficiency,
  - loss of employees to competing companies, often employees with specialist knowledge that has not been passed on to anyone,
  - lack of motivation to work in a team,
  - employee competition,
  - keeping knowledge for themselves,
- incorrect management strategy of the management staff based on achieving short-term financial and intellectual benefits:
  - the "carrot and stick" principle,
  - no consistency with workers who make mistakes or neglect their duties,
  - promises without coverage,
  - lack of forward-thinking.
- In order to achieve financial benefits, the company follows a strategy that in the long run may bring about the opposite results:
  - extending the working time of employees,
- personal prejudices and resentment from management, leading to ill-considered activities in the field of staffing:
  - basing staff selection on relationships and favouritism, and not their knowledge and skills,
  - erroneous staffing system leading to the formation of "privileged groups" that compete with each other and excluding other, often better qualified employees,
  - ignorance of employees' protégés or their concealment of intellectual gaps, leading to very serious financial losses in the company, e.g. errors of one employee are verified / corrected by another employee who already has his scope of duties,
  - patronage and contacts leading to a situation in which a qualified and experienced employee trains a newly hired employee from the management division; the consequence of such activities is a waste of employees' time on training the management staff,
  - the above activities have an impact on reducing the knowledge resources of the entire department,
  - employees do not feel they should improve their skills and qualifications (they do not use the training system intended for this purpose),
  - groups of employees who gained their positions through favouritism, create the so-called support groups, aimed at maintaining their positions.

The above-mentioned errors in the management strategy of the analysed enterprise require in-depth analysis by the management and the development of a new, competitive strategy based primarily on the knowledge and experience of employees. In order to achieve the status of a producer of high-quality products, a company should (based on literature and its own thoughts):

- invest in improving the qualifications of its employees,
- control the involvement of all team members,
- disclose all errors in the company in order to eliminate them in the future,
- immediately evaluate the results of project implementation and reports submitted by employees,
- pay more attention to competitors,
- learn from the experiences of other companies,
- draw conclusions from their own activity,
- disseminate knowledge in the company,
- introduce new, innovative, but at the same time proven management methods,

- react faster to changes taking place on the market,
- create an atmosphere conducive to the exchange of information at the level of:
  - companies – exchange between employees, departments, teams,
  - teams – exchange between team members (groups) and between the teams (groups) themselves,
  - individual employees – each employee should learn by drawing conclusions from their own experience as well as share and exchange knowledge with each other,
  - build employees' trust in management,
  - improve employee relations with management,
  - make sure that the top management is a model role for employees,
  - recognise the needs of employees,
  - motivate employees by improving conditions,

Considering the above, the analysed enterprise should introduce a special information flow program – an information exchange centre, consisting of the following stages:

- searching – search for a solution with better than average results in order to determine the direction and possibilities of improving the company's own processes,
- describing – describe and document the best solution,
- transfer – transfer the solution using appropriate methods,
- dissemination – introduce the solution to all units of the company.

Determining who should be persuaded to change their behaviour in order to eliminate obstacles to gaining knowledge in the company requires the employment of external consultants who, based on conversations with employees, determine the size of the problem. Based on the experience of other companies, solutions for the analysed enterprise aimed at the following issues can be proposed:

- ensuring quick and easy access to the knowledge resource base
- eliminating temporal and spatial communication barriers
- motivating employees to share knowledge more intensively
- selecting the company's most outstanding specialists from among its employees, who would create a knowledge board coordinating, among others:
  - knowledge transfer processes,
  - following the latest technologies,
  - taking care of innovative ventures,
  - maintaining contacts with consulting companies,
  - searching for contacts with dynamic companies of same industry.

Development of a knowledge map for the considered enterprise

Based on the interview questionnaires and proposed solutions for improving the knowledge management system, as well as the literature sources available on this subject, in particular data from the automotive industry of competing companies, a map of knowledge sources for the enterprise in question was developed. The proposed map of knowledge sources defines the sources of knowledge available in individual departments, as well as in their immediate surroundings, while indicating who in the mentioned teams has valuable knowledge needed by the analysed company in order to improve the knowledge management system, and consequently, increase its competitiveness. Fig. 3 presents the knowledge map proposed for the analysed enterprise. It lists the main departments of the company that should operate on the basis of knowledge, as well as people who should have the greatest competences and experience in the analysed departments and the flow of knowledge located in the company. At present, there are gaps at many stages, both in terms of knowledge resources and its transfer. Some departments are even deprived of qualified people responsible for the effectiveness of their functioning, which translates into a reduction in knowledge resources in the company. Management positions are often filled by favouritism rather than skills and knowledge, which in turn leads to the disorganisation of departments and teams.

The proposed map of the knowledge sources includes all the factors necessary to develop a company management strategy. In each of the departments listed in Fig. 3, sources of knowledge resources and people responsible for their possession, development and flow are illustrated. The task of people with the largest resources of knowledge employed in individual departments is to build a system of information flow between departments and employees. This will ensure the functioning of departments, and consequently the whole company in an orderly manner, while increasing the intellectual culture, quality and efficiency of work.

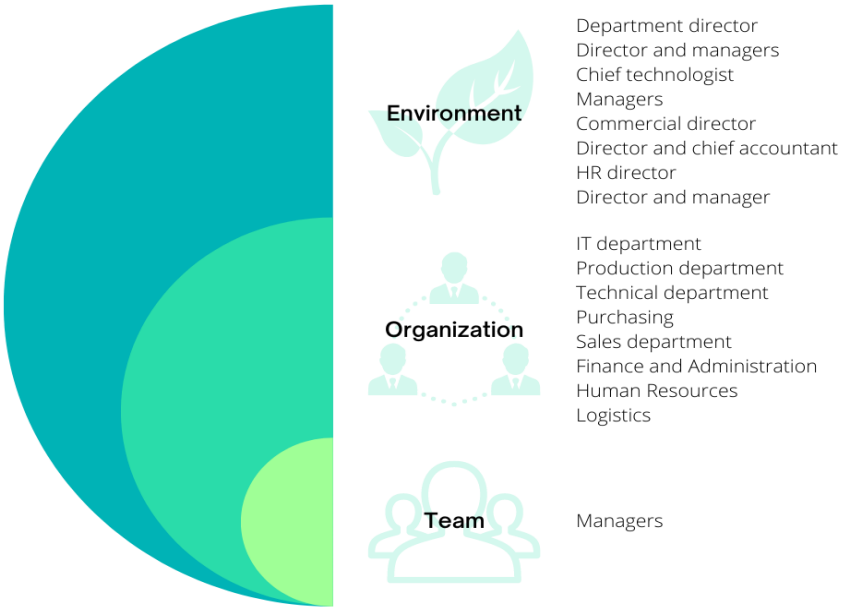

Figure 3. Diagram of proposed map of knowledge sources (Source: own work)

Conclusions

The conducted research proves that the proper localisation and mapping of knowledge resources in an enterprise is a necessary condition for efficient knowledge management. However, this requires appropriate motivation on the part of employees and a number of actions on the part of the management staff, which are insufficient in the examined enterprise. The study shows that the level of knowledge sharing varies quite significantly within organisations. In this context, a holistic view (process, determinants and effects) of knowledge sharing, in addition to understanding the specificity of this process in the functioning of the organisation, enables the selection of actions and stimulation of the desired behaviour of employees depending on the expected effects. It seems that the more the effects of knowledge sharing are not noticeable by the individual, for example, in the form of better performance of tasks executed in the organisation, and visible only at a higher (organisational) level, the more the organisation has to support knowledge sharing behaviour and create directly perceptible effects for the individual (e.g. recognition, rewards for desired behaviour) (Hogg, Abrams & Brewer, 2017). For this reason, in the process of intra-organisational knowledge sharing, the role of the organisation, and more specifically the management staff, should be to stimulate behaviours related to the transfer of knowledge (supply perspective), as well as those related to the search and use of relevant knowledge in the organisation (demand perspective), and also to create such conditions for the sharing of knowledge and its application that would minimise the individual costs associated with this process. In this regard, knowledge mapping can be a useful tool supporting knowledge management processes and can contribute to identifying the positive sides of knowledge sharing, especially in the context of intergenerational cooperation in organisations. Taking into consideration the above, one should also realise that knowledge management, although it has become a necessity today, is not a remedy for all the shortcomings of contemporary enterprises or a remedy for all ailments. It is only a very useful tool for streamlining business processes in an increasingly competitive and changing environment. Therefore, effective knowledge management in organisations should bring many benefits to the enterprise, such as maintaining the current market position or its further development, improving the results, enhancing competitiveness, discovering the knowledge possessed in the organisation and enabling access to its resources, stimulating innovative actions, generating innovative ideas, making full use of the possessed intellectual potential and continuously acquiring knowledge and experience. The authors wish to emphasise that in different parts of the organisation, different knowledge-sharing behaviours may be preferred (due to the effect), and therefore different management actions should be taken. However, more research is needed on the relationship between the forms, methods, tools and behaviours of knowledge-sharing and the specific outcomes of this process.

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