

Knowledge Management Models and the Innovativeness of high-tech Companies: The case study

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Abstract: The article discusses the problem of the significance of knowledge management in contemporary enterprises. The timeliness of research problems in relation to this issue is confirmed by a comprehensive literature review. The article attempts to define individual knowledge management models and to define the essence of knowledge management in enterprises. These considerations have been extended with innovation which is crucial for 21st century companies. The publication covers empirical research of selected high-tech companies. This sector has been selected due to a noticeable lack of studies in this area. The research method used in the empirical part of the paper is a case study. Two high-tech companies operating in the IT industry have been selected. It has been essential to distinguish the criteria for selecting high-tech companies in the study. The objective of the conducted comparative analysis has been to examine what knowledge management model is used by the specified enterprises and what concept of innovation they have selected. The results of the conducted analyses indicate that enterprises take similar actions. Most of all, this is conditioned by the specificity of the sector and industry in which they operate. The subject matter of the publication is important and up to date, it covers two fundamental components of the operation of contemporary enterprises since both knowledge management and innovation constitute a constantly expanded scientific issue.

Keywords: knowledge management, innovation, high-tech companies

1. Introduction

To identify knowledge management processes, it is necessary to explore the key definition of knowledge. This concept is extensively analyzed in the international subject literature. When defining knowledge, the attention should be paid to the processing process, the result of which is the transformation of different types of messages that eventually become knowledge. It should also be noted that each person creates knowledge of a completely different nature, which is related to the acquisition of the same type of information, since the information received is determined by individual experiences (Kalpič, Bernus, 2006).

Knowledge is also considered in terms of determining the significance of the meaning of *information* and *data*. Information is defined as the result of using data which are the key component of the issue. On the other hand, the data may take all forms, which are categorized differently. However, they have no integral connection until they are used in the issue (Moradi, Vallespir, 2007). Moreover, it is impossible for knowledge to run out. It is its key feature. It is possible that this is the reason for which researchers are constantly extending the meaning of this concept. Simultaneousness is also an important determinant of knowledge in terms of the enterprise. This means that knowledge can be applied at the same time in various enterprises from distant locations (Horzela, Ambrochowicz, 2019). Therefore, knowledge management is defined as the course of acquisition of different types of data and information with an intention to achieve the intended results (Adamczewski, 2017).

In order to comprehensively analyze the issue concerning knowledge management in enterprises, the attention must be paid to the aspect of innovativeness (Chierici et al, 2019). Theoreticians and practitioners of management are constantly modifying the concept of innovation. The key definition was developed by J. A. Schumpeter, focusing on the implementation of new solutions. In the definition of innovation, this author indicated the creation of innovative concepts of a different nature. Therefore, it can be stated that, nowadays, the creation and implementation of innovation is necessary for the proper company's operation (Schumpeter 1960). When referring to the analyzed issues, it should be indicated that the high-tech sector is identified with a high level of innovativeness.

With regard to the above scientific considerations, it should be emphasized that the subject of the relationship between the applied knowledge management models and the innovativeness of high technology enterprises is an important issue in the literature on the subject in the field of management sciences. In the literature on the subject, issues related to knowledge management (Davenport, Prusak, 2000) and those relating to enterprise innovation (Amit, Zott, 2012) are widely described, but separately. Moreover, there is a visible lack of studies that deal in depth with the issues of the relationship between knowledge management models and enterprise

innovation. Therefore, the considerations taken are important and up-to-date due to the fact that matching the elements of knowledge management models in their structure informs about combining them in such a way that they form a well-complex whole, taking into account the logic of operation adopted by a given enterprise. This means that the chances of high-tech enterprises to effectively compete on the global market depend on the correct matching of individual elements in the structure of knowledge management models to innovative activity. The above arguments meant that an attempt was made to make a theoretical analysis and conduct empirical research in order to fill the perceived gap by deepening the understanding of the process of creating innovative activity and knowledge management models of modern high technology enterprises.

In this context, the objective of the study was to conduct the comparative analysis and to investigate what is the knowledge management model applied in selected enterprises and what concept of innovation was chosen by these enterprises. The research method used to accomplish the assumed objective was critical analysis of the subject literature – in the theoretical part and a case study – in an empirical part.

2. The essence of knowledge management in the company of the 21st century

Knowledge management is a range of processes aimed at knowledge acquisition, accumulation, and processing. However, such an approach does not exhaust the complexity of this issue. It should be remembered that knowledge management is most of all directed to such its use so that the entity becomes more competitive in the specific economic environment (Caputo et al, 2019). One cannot forget that knowledge management is inextricably linked to human potential. In times of a dynamic technological progress, all types of novelties, combined with the ingenuity and originality of the human mind result in the creation of a completely new approach in knowledge management of enterprises (Zhao, Ordóñez de Pablos, Qi, 2012).

The indication of overarching objectives to be achieved to determine if the company properly manages knowledge is of the key importance when distinguishing the criteria that define knowledge management. Most of all, entrepreneurs must remember about the continuity of knowledge creation. The previously mentioned competitive advantage is the fundamental benefit from knowledge management in the enterprise (Centobelli, Cerchione, Esposito, 2018). Proper knowledge management in the enterprise translates into much more favorable returns on investment. The enterprise that properly manages knowledge takes all types of actions aimed at limiting the possibility of the loss of knowledge possessed. The aspect of protection of intellectual property is also important since enterprises take various actions to protect knowledge (Oztemel, Arslankaya, KorkusuzPolat, 2011). At the same time, the relationship between the issue of knowledge management and intellectual capital of enterprises can be observed since proper knowledge management in the enterprise is a paradigm in the process of generating intellectual capital. Intellectual capital is interpreted by taking into account many components, but mainly it is identified with knowledge which, when effectively used, is conducive to achieving both financial and non-financial benefits in the enterprise (Łęgowik-Świącik, 2021). As a result, the enterprise achieves the assumed objectives and gains a competitive advantage (Garcia-Perez et al, 2020).

When considering the problem of knowledge management in enterprises of the 21st century, it is worth pinpointing an increase in the use of information technologies. The changes in terms of global technologies to some extent force enterprise to constantly improve their IT infrastructure. The advanced level of all types of IT solutions is conducive to the effective creation, processing, use and sharing of knowledge. A particular role in effective knowledge management in enterprises is played by qualified staff who professionally implement knowledge management processes based on IT solutions (Gumiński, 2020). However, enterprises, when implementing various technological, IT novelties in their internal structure, also create innovation which is crucial in the operation of enterprises nowadays (Amit, Zott, 2012). It can be concluded that the current review of literature indicates the integrity of knowledge management and implementation of innovation in enterprises.

To sum up, it is worth emphasizing that knowledge management in enterprises of the 21st century is an important part of the operation of entities. It should be noted that enterprises apply varied models of knowledge management and innovation, which are characterized by a different specificity of operation. Due to the diversity of knowledge management models used by enterprises it is necessary to characterize their individual types.

3. Diversity of the use of knowledge management models in modern enterprises

There is a wide range of opportunities for the selection of knowledge management models by enterprises. It is worth pinpointing that each type also includes features of innovation. Therefore, it is necessary to characterize individual models.

The first concept to be discussed is the process-based approach. In the literature, this model is referred to as the knowledge management paradigm. This theory was developed by T. Davenport and L. Prusak. They identified knowledge creation processes, such as codification and transfer. However, knowledge creation and transfer do not require extensive interpretation as opposed to codification. Most of all, its purpose is to significantly facilitate the use of knowledge, but also to modify it, particularly paying attention to the clarity of the message for those interested (Horzela, Ambrochowicz, 2019). In terms of the company's innovativeness in this model, one should aim at using modern solutions in the process of knowledge codification, e.g., modern Internet platforms or applications.

The concept of the Japanese model focuses mainly on the fact that all the company's employees contribute to the dissemination and creation of knowledge. I. Nonaka and H. Takeuchi are considered the creators of this knowledge management model. This concept distinguishes between explicit and tacit knowledge. The key role in here is played by a range of employee experiences, but also their intelligence and intuitive skills. Several forms of knowledge transformation were identified, including socialization, externalization, combination, and internationalization (Janasz, Janasz, 2018).

The model which includes five compatible components is referred to as a resource-based model. It was developed by D. Leonard-Barton. It is crucial for the interpretation of the assumptions of this concept to pay attention to the fact that these components are linked to the organizational environment and the company's interior. The components of this model are experiment, import of knowledge from the environment, superior skills, implementation of new technologies and tools with a focus on integration and cooperation in terms of solving problems (Janasz, Janasz, 2018). It is worth pointing out that the fundamental strategic resource in this model is knowledge. Enterprises constantly strive to achieve a competitive advantage and it is knowledge that is its key source in the resource-based model (Horzela, Ambrochowicz, 2019).

Contemporary entrepreneurs have an opportunity to use various knowledge management models. The literature resources indicate that the above-mentioned knowledge management models are considered as fundamental in the defined issue. Innovativeness is reflected in each of the characterized models. Therefore, it is necessary to extend the considerations to the aspect of innovation models.

Summing up, it is worth noting that the adoption of the selected knowledge management model in enterprises justifies the argument of a comprehensive approach to the basic processes of running a business by an enterprise. This means that knowledge becomes a critical resource that allows resources to be transformed into key success factors (Soo, Devinney, Midgley, 2002). In this context, knowledge reflects the ability of enterprises to learn and shape an intelligent organization.

4. Exchange of knowledge in the concepts of open and closed innovation

Since innovativeness is the fundamental component of knowledge management in modern enterprises, the two innovation models should be identified.

A characteristic feature in the closed innovation model is most of all the entity's independence throughout the whole process of innovation. This applies to both initial and final stages. Enterprises that decide on such an innovation model do not cooperate with external entities, do not use the experiences of others and do not exchange the knowledge acquired (Sachpazidu-Wójcicka, 2016). Enterprises applying the closed innovation model limit themselves exclusively to the skills and knowledge of their own employees. This is related to a precise recruitment process since, without deriving knowledge from the external environment, enterprises must employ qualified staff. In the case of closed innovation, the enterprise must protect its intellectual property from the external environment (Skrzypek, Sagan, 2018).

The key assumption in the open innovation model is mainly the cooperation of enterprises. In this concept, enterprises are oriented to the exchange of knowledge. Operations are aimed at achieving the highest possible

level of innovation (Wolf et al, 2021). The operation of entities based on the open innovation model may significantly increase funds since enterprises may resell solutions they no longer use to other entities. It also should be noted that enterprises that derive knowledge from the external environment considerably extend the skills and resources of their own knowledge. This is also conducive to creating completely new solutions in a much shorter time (Walecka-Jankowska, Zimmer, 2019).

To sum up, it should be noted that the open innovation model is definitely more effective nowadays, at the same time, the closed innovation model is less frequently used. Depending on which knowledge management model and which innovation model the company chooses, completely different forms of operations will be undertaken. However, knowledge management is related to innovation and the choice of the open or closed innovation model. These actions are characterized by synergy. Therefore, it can be stated that the selection of the knowledge management model results in choosing the innovation model. The adoption of this assumption is justified by the argument that the knowledge management model is an element connecting the company with the client (Chen, Shih, Yang, 2009). Moreover, between the knowledge management model and the innovation model there is a feedback phenomenon, which is manifested in the fact that achieving the adaptation of elements in the knowledge management model to the operating conditions of the enterprise should enable the enterprise to undertake innovative activities (Reagans, Zuckerman, 2008). On the other hand, innovation is the basic element shaping the acquisition of a competitive market position (Teece, 1988), which determines the knowledge management process.

5. Research methodology

The empirical research was carried out based on a case study. The selection of the sample was deliberate and was determined by the availability of data and the internationalization of activities of the surveyed enterprises. Two enterprises from Poland operating in the high-tech industry were selected: Asseco Poland S.A. and WASKO S.A. These entities are listed on the Warsaw Stock Exchange and belong to the WIG-IT Index. The basic criterion for selecting the sample was the availability of data for empirical analysis. After analyzing data from forty websites of companies from the high-tech sector, an attempt was made to contact these companies, direct interview was possible only in two companies. Thanks to the interviews, primary data for empirical research was obtained.

The selection of a case study as a research method was determined by the existence of the research gap in terms of knowledge management models and innovativeness of high-tech companies. This method will make it possible to carefully examine dependencies. A case study is characterized by the occurrence of a range of operations following each other and affecting the correctness, accuracy, detail, and timeliness of research. Due to the specificity of the research conduct, the choice of this method will significantly extend the analyzed and examined phenomenon, considering many areas. Such multidimensional analyses would not be possible when selecting a different research method (Eisenhardt, Graebner, 2007).

5.1 Description of the research sample

To correctly conduct the analyses, it is necessary to characterize the operations of the analyzed entities selected for the case study. The first company is Asseco Poland S.A., and the other one is WASKO S.A.

Asseco Poland S.A. was established in 1989. The company's head office is in Poland. Asseco Poland S.A. has been listed on the Warsaw Stock Exchange since June 1998. This enterprise is a parent company of the Asseco Capital Group. The company manufactures software for various industries. It should be pointed out that Asseco Poland S.A. creates IT systems for banks. Due to the advanced requirements of this sector, the enterprise is among the few ones that undertake such activities. Asseco Poland S.A. creates various IT solutions. Copyright concepts are addressed to different sectors of the economy. At the same time, the company does not limit their activities, but on the contrary, it constantly expands them. Asseco Poland S.A. strengthens its position in foreign markets. (The Financial Statement by Asseco Poland S.A. for the year ended 31 December 2020). It is also necessary to analyze the other company, i.e., WASKO S.A.

WASKO S.A. began its activities in 1999. The head office of the company is in Poland. It has been listed on the Warsaw Stock Exchange since August 2001. It should be pointed out that the WASKO Capital Group was established. The activities of WASKO S.A. cover many areas. They are directed to the complex creation of different types of IT systems and their integration. In terms of services, outsourcing is also provided. The company deals with the introduction of network technologies and design of tele transmission equipment. It

distributes IT infrastructure and equipment from abroad. The operations of this company are extended to the maintenance of software and computer hardware. In addition, WASKO S.A. creates radio lines and data transmission networks. The fundamental components of the company's operations include the collection, storage, and processing of data. The catalogue of the conducted activities of the WASKO S.A. company is significantly more extensive than the one of the first analyzed enterprise. WASKO S.A. strives to expand its activities to foreign markets (The Annual Report by WASKO S.A. for the year ended 31 December 2020).

Both Asseco Poland S.A. and WASKO S.A. are international companies. They are characterized by a strong position in both domestic and foreign markets and the industry they operate in. It should be noted that Asseco Poland S.A. was established earlier, but WASKO S.A. is characterized by the dynamic development.

5.2 The comparative analysis of the analyzed high-tech companies in the context of knowledge management models and innovativeness of individual economic entities

In order to correctly identify high-tech companies, it is crucial to indicate the criteria for their selection (Zakrzewska-Bielawska, 2016):

- expenditure on Research and Development,
- creating innovation,
- cooperation with other entities in the field of science,
- building a competitive advantage,
- possessing qualified staff,
- national and foreign range of operations,
- short life cycle of products and technologies,
- using modern technologies.

The identified criteria for the selection of high-tech companies for the surveyed entities are presented in Table 1.

Table 1: Criteria for the selection of high-tech companies

No.	Criteria	Companies	
		Asseco Poland S.A.	WASKO S.A.
1	Expenditure on Research and Development	✓	✓
2	Creating innovation	✓	✓
3	Cooperation with other entities in the field of science	✓	✓
4	Building a competitive advantage	✓	✓
5	Qualified staff	No info	No info
6	National and foreign range of operations	✓	✓
7	Short life cycle of products and technologies	✓	✓
8	Using modern technologies	✓	✓

✓ This mark indicates the presence of the identified criterion in the company.

Source: Own study based on: <https://pl.asseco.com/>, <https://www.wasko.pl/>, The Annual Report by WASKO S.A. for the year ended 31 December 2020, The Financial Statement by Asseco Poland S.A. for the year ended 31 December 2020.

The analysis of Table 1 indicates that, in Asseco Poland S.A. and WASKO S.A., the following are present: expenditure on Research and Development, creating innovation, cooperation with other entities in the field of science, building a competitive advantage, national and foreign range of operations, short life cycle of products and technologies and using modern technologies. The available materials do not allow for determining whether the enterprises have qualified staff, however, the specificity of their operations suggests the need to employ people with the highest professional preferences. The indicated criteria confirm that both enterprises belong to the high-tech sector. The key determinants of knowledge management are presented in Table 2. The analysis of the components considered will allow for determining which management model is applied by the company.

Table 2: Determinants of knowledge management in the companies

No.	Determinants	Asseco Poland S.A.	WASKO S.A.
1.	Creating knowledge	✓	✓
2.	Codification of knowledge	No info	No info

No.	Determinants	Asseco Poland S.A.	WASKO S.A.
3.	Experimenting	✓	✓
4.	Importing knowledge	✓	✓
5.	Overarching skills	✓	✓
6.	Implementing new technologies and tools when paying attention to the aspect of integration (implementing innovation)	✓	✓
7.	Sharing knowledge	✓	✓
8.	Collaboration in solving problems	✓	✓
9.	Involvement of all employees in creating knowledge	No info	No info
10.	Transfer of knowledge	✓	✓

✓ This mark indicates the presence of the identified determinant in the company.

Source: Own study based on: <https://pl.asseco.com/>, <https://www.wasko.pl/>, The Annual Report by WASKO S.A. for the year ended 31 December 2020, The Financial Statement by Asseco Poland S.A. for the year ended 31 December 2020.

The conducted analysis of the financial statements and the information on the websites of Asseco Poland S.A. and WASKO S.A. indicate that the enterprises constantly create knowledge. The industry they operate in, to some extent, forces the constant broadening of horizons.

It should be noted that Asseco Poland S.A. significantly directs its operations to the field of R+D. In 2020 it achieved the copyright to the computer software developed by its employees. Development activities are financed from the State budget and structural and aid funds. The company has implemented many R+D projects since the beginning of its operations. An example can be the project of SMIT, PSR or AUMIS. Asseco Poland S.A. constantly takes on new challenges which include the project of establishing the R+D Center.

WASKO S.A. has been involved in many research projects for years, for which it allocates a significant part of its profits. It should be noted that the company develops the area of R+D, being supported by the institutions, i.e., the National Center for Research and Development, the Industrial Development Agency, or the State budget, etc. In the years of 2015-2018 WASKO S.A. implemented the project of MILESTONE, Biostrateg and Monitel. The company received the amount of approximately EUR 346 711 for research (the amount of PLN 1.6 million converted at EUR 4.6148). Due to the funding, the enterprise is developing the product which will significantly contribute to the development of operator networks. In 2020 the entity began the development of the NEDAPS platform with the SEC module.

The industry Asseco Poland S.A. operates in is characterized by a high level of innovativeness and the enterprise to a large extent focuses on the implementation of innovation, the evidence of which is the projects implemented. In the case of WASKO S.A., the emphasis is also placed on launching innovation. The implemented systems are characterized by a high level of innovativeness, an example can be the implemented SYZAR system, the task of which is the combination of devices covering road safety. The WASKO S.A. company wants to constantly implement innovation, also in other sectors of the economy.

The Asseco Poland S.A. company does not close itself within its internal structure but uses an opportunity to cooperate with other entities. At the same time, it derives knowledge but also shares it. WASKO S.A. does not limit itself exclusively to its own knowledge, on the contrary, it takes actions of cooperation with the external environment. The available data indicate that both Asseco Poland S.A. and WASKO S.A., in their internal structures, strive for the cooperation of employees in terms of project implementation, at the same time, this translates into the collaboration in terms of solving various problems.

To sum up, it should be indicated that the resource-based knowledge management model is applied in both Asseco Poland S.A. and WASKO S.A.. This is proven by the fact of the presence and integrity of such components as:

- possessing key skills in different structures of the company's operation,
- importing knowledge from the external environment (from other institutions, organizations),
- implementing new technologies and tools while paying attention to the aspect of integration,
- experimenting (an inherent feature of innovative enterprises),
- collaboration in solving problems.

In the resource-based model, an important component is experimenting. It is not specifically indicated in the available sources concerning the analyzed enterprises if experiments are conducted, however, R+D activities are significantly linked to carrying out many different trials before final solutions are reached.

It is worth pinpointing that knowledge is the most important and it is a source of a competitive advantage in the analyzed companies, which constitutes the determinant of their operations according to the resource-based knowledge management model. The identification of the innovation model on the basis of which the enterprises operate is also crucial. The fact of cooperation and exchange of knowledge between entities indicates the use of the open innovation model in both companies.

6. Discussion

The conducted analyses allowed for the identification of the knowledge management model applied by the companies. In both Asseco Poland S.A. and WASKO S.A., belonging to the high-tech sector, the occurrence of characteristics of the resource-based knowledge management model was observed. When deepening the research with the aspect of innovativeness it was indicated that they apply the open innovation model.

The case study was carried out based on the research which contributed to a broad exploration of the discussed research topic. The data essential for the identification of the knowledge management model and the innovation model were acquired from various materials. This enabled the consideration of the problem considering many areas.

Since the only two high-tech companies were selected to conduct the research, it was not indicated what relationships there are in other enterprises of the analyzed industry. However, it is worth emphasizing that the result of the analyzes is that both entities use the resource model of knowledge management and the open innovation model, which allows to achieve saturation from the analysis. It should be noted that this does not mean that all high-tech companies operate in the same way.

Enterprise owners that decide on the implementation of various types of product, process, marketing or organizational innovation are very often unaware of the fact that the innovation model selected by them is significantly related to the knowledge management model. Therefore, the broadly understood knowledge, research and development base and innovations play a key role in the implementation of their development strategy.

7. Conclusions

To sum up, the theoretical considerations indicate the significance of the use of knowledge management in enterprises. Nowadays, it is necessary for enterprises to use the potential provided by knowledge management. It should be remembered that it is a complex process, which requires the entrepreneur, management staff and employees themselves to take many actions. However, this translates into many benefits, which include increasing a competitive advantage, higher financial revenues, and consequently more effective performance of the entire company.

The conducted empirical research into two high-tech companies indicated that the occurrence of knowledge management processes following the resource-based model was observed in both of them. The analysis of the financial and non-financial statements and the websites of the enterprises showed that they are mostly characterized by a high level of knowledge, which is the foundation for the innovativeness of the surveyed enterprises. A very important aspect is the collaboration with external institutions. These companies are at an advanced level in the area of research and development, and the constant creation of innovative solutions translates into the implementation of innovation.

An attempt to pay attention to the aspect of integration of the applied knowledge management model with the innovation model indicated that, based on the publicly available data concerning the analyzed enterprises, the resource-based knowledge management model was combined with the open innovation model. Both WASKO S.A. and Asseco Poland S.A. are characterized by cooperation and exchange of knowledge with the external environment.

The above theoretical and empirical considerations proved that knowledge management and innovativeness are crucial for the effective and appropriate operation of enterprises of the 21st century. High-tech companies apply very extensive procedures of knowledge management, which is mostly determined by the specificity of the sector. The subject matter of the publication is important and up-to-date since it involves the study of the relationship between two fundamental components determining the operation of modern enterprises, i.e., knowledge management and innovativeness, which constitute a constantly expanding scientific issue.

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