European Research Studies Journal
Volume XXVII, Issue 4, 2024

pp. 1227-1237

Leveraging Knowledge and Competence Management for International Expansion in Railway Vehicle Maintenance: A Case Study

Submitted 10/09/24, 1st revision 25/09/24, 2nd revision 01/10/24, accepted 15/11/24

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Abstract:

Purpose: *The aim of the article is, on the basis of a case study, to present the specificity of the German and Polish market regulations through the prism of a company that has been successfully implementing the strategy of expanding the provision of services in the field of maintenance, servicing and repairs of rolling stock in Germany for several years.*
Design/Methodology/Approach: *A case syudy which explores specific phenomena in-depth within their real-life contexts. By focusing on a single case it provides rich, contextualized insights that may not be captured through quantitative methods.*
Findings: *The analysed case indicates that also in such traditional sectors as rail transport and maintenance of rail vehicles, knowledge and competence management, which is often related to modern sectors of the economy, may be an important element of building a business model as an element of a development strategy.*
Practical Implications: *The development strategy of the company in question assumes the configuration of external and internal resources with particular emphasis on the development of intellectual capital as a knowledge component that determines the competitiveness not only on the Polish market but also on the European Union (EU) market.*
Originality/Value: *The presented case study confirms that the railway vehicle maintenance sector absorbs innovations not only in the area of technique and technology but also in the area of business models, which have now become a tool for building business strategies.*

Keywords: *Maintenance management system, railway transport, security.*

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JEL codes: *L20, R40, L91.*

Paper Type: *Research article.*

Acknowledgements: *The Article Processing Charge was financed under the European Funds for Silesia 2021–2027 Program co-financed by the Just Transition Fund—project entitled "Supporting the staff in intensifying scientific activities in the field of transport transformation towards a green and digital economy". Project number: FESL.10.25-IZ.01-03AF/23-00; Project number at the Silesian University of Technology: 12/010/FSD24/1161.*

1. Introduction

1.1 Knowledge and Competence as a Resource of a Modern Enterprise

Knowledge has been the subject of interest of various sciences since the beginning of the development of our civilization, an example of which is Aristotle's taxonomy of knowledge. He indicated three types of knowledge, indicating their level of generality and practicality, i.e.[7]:

- knowledge that is characterized by a high degree of theorization (episteme),
- instrumental, contextual and practical knowledge (techne),
- normative knowledge based on experience, context and common sense (phronesis).

The presented division is still valid and used today in economic sciences and management sciences, adopted, among others, by the Organization for Economic Cooperation and Development (OECD):

- Know-what (know what - facts, information) - this category refers to facts and takes the form of data that can be easily stored and transmitted using traditional and electronic means of communication.
- Know-why (know why - rules and laws in force in nature and in society) - this is the knowledge of cause and effect relationships regarding the laws of nature, man and society. This kind of knowledge becomes most often a market product and is very difficult to store. It is extremely important in the chemical and electronic industries. Access to this kind of knowledge accelerates technical progress.

[7] *Niedzielski, P. (2013). Kreatywność i procesy innowacyjne na rynku usług transportowych. Ujęcie modelowe, 171-173. Polskie Towarzystwo Ekonomiczne Oddział w Szczecinie.*

- Know-how (know how - competences and skills) - this category refers to human skills, i.e. the ability to do something, is the basis for practical action, in which it manifests itself in the form of qualifications and desired skills. However, know-how should not be classified as typically practical, this applies in particular to knowledge created by scientists.
- Know-who (know who - network cooperation) - is most often the domain of an individual, team or organization; it is the knowledge of those who have the other kinds of knowledge. Its most valuable element is that it can be used to find knowledge relevant to the organization. This is the most important type of knowledge from an economic point of view.

Knowledge is the totality of knowledge and skills used by individuals and organizations to solve problems. It includes both theoretical and practical elements, general principles and detailed guidelines. Enterprises creating intellectual capital and managing knowledge resources are aware of the specific features of knowledge, including the phenomenon of spreading knowledge and a kind of "aging" of knowledge. This phenomenon is reflected in the division of knowledge into basic (basic) knowledge, advanced knowledge and innovative knowledge, which is presented in the table below.

Table 1. *Basic, advanced and innovative knowledge*[8]

Level	**Characteristic**
Fundamental knowledge (basic)	Basic knowledge necessary to deal with a given activity. Knowledge that creates an entry barrier for new businesses. **It is not a competitive advantage.**
Advanced knowledge	Its application distinguishes the company from the competition. It enables direct competition with other entities operating in the same market, because it concerns the same group of customers. **It gives the organization the opportunity to compete effectively.**
Innovative knowledge	It clearly distinguishes the given entity from the competition. It gives him a leading position in the industry. **It allows an organization to change the rules of the game.**

Source: *K. Materska, Knowledge in organizations. Prolegomena for knowledge management, p. 43 http://bbc.uw.edu.pl/Content/3/03.pdf (20.06.2013); see: A. Tiwana, Guide to knowledge management: e-business and CRM applications, Placet, Warsaw 2003, p. 125.*

Fundamental knowledge is necessary to function on the market, so it is in the intellectual capital of every competitive organization/enterprise, it must also be

[8] *Materska, K. Wiedza w organizacjach. Prolegomena do zarządzania wiedzą, 43, http://bbc.uw.edu.pl/Content/3/03.pdf.*

possessed by enterprises intending to enter this market (potential competitors), thus constituting an element of the market entry barrier.

Obtaining advanced knowledge distinguishes the company, gives it the opportunity to build a competitive advantage[9]. At the same time, advanced knowledge is the basis for creating innovative knowledge, thanks to which the enterprise will lead to distance from the competition.

The company creates knowledge sequentially, while knowledge, being dynamic, changes as a result of functioning on the market. Innovative knowledge after some time becomes advanced knowledge, and consequently becomes essential (basic). Thus, every company must develop a knowledge base, the lack of such activity may be the reason for eliminating it from the market due to the lack of basic knowledge necessary to take action on the market.

Many studies emphasize the contemporary importance of knowledge as a resource of enterprises, groups of enterprises (industry, cluster, region) or the economy of individual countries. In addition, in the resource trend, company knowledge can be divided into codified knowledge and personalized knowledge, which results from the tools related to knowledge management in the company as a key resource in modern management processes.

Nowadays, the shaping of a competitive advantage on the market takes place to a large extent in the area of knowledge, both through the competences of employees (personalized knowledge) and through the knowledge of the company as an organization (codified knowledge).

One of the manifestations of this phenomenon is having personnel with properly documented (necessary) qualifications, e.g., in the form of employee authorizations to perform specific activities, as well as through the company having certain certificates or permits allowing it to perform certain services or sell certain goods on the market. In dictionary terms, competencies are defined as: "the scope of someone's knowledge, skills and experience, or the scope of powers of an office or official to deal with specific matters and make decisions regarding them, or as the ability of cells to respond to specific stimuli"[10].

The word competence comes from the Latin word "competentia", which meant authorized to speak, entitled to make judgments. Employee competencies must be

[9]*Gierszewska, G. (2003). Budowanie strategii zarządzania wiedzą w przedsiębiorstwach, w: Zarządzanie wiedzą we współczesnych organizacjach, 62-68. Red. J. Kisielnicki, Wyższa Szkoła Handlu i Prawa im.Jana Pawła II w Szkole Handlu i Prawa R. Łazarskiego, Warszawa.*
[10]*https://sjp.pwn.pl/sjp/kompetencja;2564077.*

appropriately selected/configured for the tasks that the employee is to perform for the company.

The quoted definitions indicate that competencies can be recognized in relation to a single employee as well as in relation to a team of employees, and in relation to a defined/limited team of people/employees, e.g., a project team/task team, as well as in relation to the entire organization or a broadly defined territorial unit (region, state). This makes it possible to say *that competences are strongly related to concepts such as intellectual capital or knowledge as a resource* which today, next to land, work and capital, has become the fourth resource in modern management processes.

The term "competence" is used in various meanings. Initially, this word was used in a narrower scope than today: competence was understood as having the formal right to deal with specific matters on behalf of a given organization and to make decisions within a specified scope.

On the other hand, the ability to act effectively and efficiently was usually associated not with competences, but with qualifications, which is why we spoke of high or low qualifications, which were either sufficient or insufficient to work in a specific position.

However, "qualifications" were also understood too narrowly. This was particularly visible in old tariffs, in which the provisions regarding required qualifications were limited to only two criteria - education and work experience; this state of affairs can also be encountered today, mainly in the budgetary sphere.

Boyatzis in 1982 defined competences as "the potential existing in a person, leading to such behavior that contributes to meeting the requirements of a given job position within the parameters of the organization's environment, which in turn produces the desired results."

Without a doubt, competences constitute a specific potential, although the rest of the sentence raises considerable doubts: potential does not necessarily "lead to behavior", behavior does not necessarily contribute to "meeting the requirements of a given job position". It is not really clear what these "organizational environment parameters" are. It is also not known why these parameters should (always) "provide the desired results"[11].

Competencies can be understood in relation to an individual employee as well as in relation to a team of employees, and this in relation to a specific team of employees or a project team, as well as in relation to the entire organization or a more broadly

[11]*Oleksyn, T. (2018) Zarządzanie kompetencjami – teoria i praktyka, 19-20. Wolter Kluwer Polska SA, Warszawa.*

defined territorial unit (region, country). This allows us to state that competences are strongly linked to concepts such as intellectual capital or knowledge as a resource, which has become the fourth resource in contemporary management processes, alongside land, labor and capital.[12]

2. CSI INVEST as a Knowledge-Based Organization

CSI INVEST is a company that was founded in 2018 on the basis of experienced employees associated with the well-known manufacturer of rail vehicles PESA in Bydgoszcz. The impulse to found CSI was the crisis of PESA related to the lack of orders and problems with the implementation of a large contract for Deutsche Bahn[13], which was signed in 2012 and completed in 2020.

The specificity of the functioning of the German market in the area of rail vehicle deliveries caused financial problems for PESA in Bydgoszcz, and the company had to undergo restructuring with the support of the Polish Development Fund (PFR), which was associated with the need to reduce the company's operating costs and reduce the staff from about 4,000 employees up to 2,500 of which 1,600 directly in production.

This company originates from the former ZNTK Bydgoszcz and only in 2001 was it transformed into Pojazdy Szynowe Pesa Bydgoszcz Spółka Akcyjna Holding, changing from a service company (maintenance and repair of rolling stock) into a production company that, on the basis of its own projects, begins to deliver to the Polish market and sometimes also to European and Asian markets, rolling stock and tram rolling stock, i.e., generally rolling stock.

The delivery of the rolling stock involves not only warranty service, but also the vehicle maintenance system, which guarantees not only operational efficiency but, most importantly, operational safety, which is subject to a number of regulations.

At the same time, it should be added that the service life of the rolling stock is counted in tens of years (30-40 years can be assumed on average). The need to restructure PESA SA in Bydgoszcz, including the need to reduce the staff, resulted in the possibility of commercialization of the knowledge and experience of some of the staff who had many years of experience in the rail vehicle production and servicing industry.

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[12]*Niedzielski P., Podlewski M., Chrząstek G. (2024) Rola narzędzi e-learningowych w kształtowaniu kompetencji pracowników i zespołów projektowych – studia przypadków, Marketing i Rynek 04/2024, 58-68. DOI: 10.33226/1231-7853.2024.4.5.*

[13]*https://finanse.wp.pl/deutsche-bahn-kupi-w-zakladach-pesa-pociagi-za-120-mln-euro-6114650758362753a.*

The CSI company, guided by the previously described division of knowledge into basic, advanced and innovative knowledge, diagnosed that the entry of Polish entities from the rail vehicle maintenance and servicing sector into foreign markets is associated with the need to have at least advanced or even innovative knowledge, which results from formal and legal regulations the functioning of these markets.

A number of Polish companies providing maintenance, servicing and repairs of rail vehicles limit their activities only to the domestic market, due to the entry barrier on foreign markets, an example of which was the threat to the functioning of PESA SA in Bydgoszcz and the need to restructure it as a result of entering the German market (supplies of rolling stock for Deutsche Bahn (DB)). The increase in the share of rail transport in servicing the transport needs of the EU is reflected in a number of strategic documents of the EU. The technical and technological development of rail transport requires increasing the competences of the rail vehicle service and maintenance sector[14].

3. Certification in the Field of Rolling Stock Maintenance Systems in Poland and Germany

3.1 Railway Safety Management System

As regards the maintenance of railway vehicles (performing periodic inspections from P1 to P5), the Maintenance Management System (MMS) is in force.

The EU Commission Implementing Regulation No. 2019/779 of May 16, 2019 established detailed provisions on the system of certification of entities in charge of vehicle maintenance in accordance with Directive (EU) 2016/798 of the European Parliament and of the Council and repealing Commission Regulation (EU) No. 445/2011.

The Maintenance Management System (MMS) is a set of processes, procedures, instructions and records established, implemented and maintained in order to ensure a standardized approach to maintenance activities related to railway vehicles and their subsystems and components.

Objectives of the Maintenance Management System (MMS):

- minimizing the risk related to the maintenance activities carried out,
- ensuring safe operation of railway vehicles.

[14]*Niedzielski P., Markiewicz J. (2023) Wpływ zmian w taborze kolejowym na logistykę w dobie zrównoważonego rozwoju – studium przypadku, Gospodarka Materiałowa i Logistyka 03/2023, 2-11. DOI: 10.33226/1231-2037.2023.3.1.*

Regulation EC 445/2011 defines four functions that the Entity in Charge of Maintenance (ECM) must take into account in its activities, and says that while the first function must be performed independently, the others may be outsourced to other entities (e.g. maintenance may be outsourced to specialized rolling stock maintenance and repair facilities, former ZNTK).

3.2 The Role of Railway Market Regulators on the Example of Poland and Germany

Regulator of the railway market in Poland:
Within the meaning of the EU regulations, the national regulator of rail transport, the national safety authority and the national executive body in the field of protection of passenger rights is the President of the Office of Rail Transport (UTK), which has the status of a central government administration body.

Irrespective of the protection of competition on the railway market, the President of the Office of Competition and Consumer Protection (UOKiK) supervises, who may initiate antimonopoly proceedings against entities abusing a dominant position or concluding agreements violating the laws of fair competition.

The President of UTK is the regulatory authority competent in the following matters:
1) regulation of the rail transport market;
2) rail transport licensing;
3) technical supervision over the operation and maintenance of railway lines and railway vehicles;
4) railway traffic safety;
5) supervision over the observance of passenger rights in rail transport;
6) driver's licenses and certificates.

The President of UTK also performs tasks related to monitoring the development of the railway market and raising safety standards.

Regulator of the railway market in Germany:
The institutions regulating the German railway market include:

- Federal Railway Office (German: Eisenbahn-Bundesamt - EBA);
- Federal Agency for Regulation of Network Sectors (Bundesnetzagentur – BNetzA);
- the Antitrust Commission (Germ. Monopolkommission) and the Federal Cartel Office (Germ. Bundeskartellamt - BKA).

The first regulatory body to be established in the initial phase of the reform of the German railways in 1994 was the EBA. Its main task from the very beginning was the supervision of railway traffic safety and admission to operation. The EBA is responsible for rail traffic safety in Germany.

Certificates related to the fourth function of the MMS system - the maintenance function:

ECM certified

Pursuant to Directive (EU) 2016/798 of the European Parliament and of the Council and Commission Implementing Regulation (EU) 2019/779, entities in charge of maintenance of rolling stock should have a certificate of compliance in the field of maintenance functions - ECM certificate.

The ECM certificate of the ECM as part of the MMS maintenance development function shall:

- provide traceability of both construction and maintenance documents: the names and qualifications of those responsible for creating such documents (author and approver) must be clearly identified;
- assess new types of vehicles or newly introduced components using a step-by-step method of observing vehicles in service, testing them and scheduled analyzes to validate or adapt current maintenance rules;
- identify and manage safety-critical components;
- ensure that the risk management process is applied when changes are made to maintenance documentation or planning and implementation of structural changes and replacements as part of maintenance;
- ensure that the first documentation has been implemented correctly and supervise suppliers in this regard.

ISO/TS 22163:2017 certificate (IRIS rev.03)

The IRIS standard was established in 2006 and was transformed into the ISO/TS 22163:2017 standard (IRIS rev.03) in 2017. The implementation of this standard by entities involved in the maintenance of railway vehicles is voluntary.

The IRIS system covers: designing companies, manufacturing companies and companies responsible for maintenance in the field of rail vehicles, their components and rail infrastructure, traffic control, energy, etc.

The total number of ISO/TS 22163:2017 certificates issued by independent Certification Bodies around the world is 2,336 certificates, in Poland - 81 (source: www.iris-rail.org).

Table 2. *IRIS Certification Worldwide*[15]

COUNTRY	**PERFORMANCE LEVEL**				
	SUMA	**GOLD**	**SILVER**	**BRONZE**	**OTHERS**
POLAND	**81**	1	16	49	15
GERMANY	**134**	0	28	71	35
CZECH REPUBLIC	**23**	0	2	9	12

[15] *www.iris-rail.org*

FRANCE	**64**	0	9	39	16
AUSTRIA	**21**	1	7	7	6
ITALY	**119**	1	16	70	32
GEORGIA	**0**	0	0	0	0
UKRAINE	**3**	0	0	2	1
USA	**14**	0	3	6	5
INDIA	**154**	0	19	88	47
CHINA	**1335**	1	141	858	335
WORLD	**2336**	4	275	1438	619

Source: *www.iris-rail.org*

As you can see from the table above, only 4 countries in the world have a gold certificate, i.e., Poland, Austria, Italy and China. As you can see, Poland is in 3rd place compared to the EU countries in terms of the number of companies with certificates. When it comes to silver and bronze certificates, Poland ranks 2nd and 3rd respectively.

The world's largest economy, the U.S. has only 14 certified companies, compared to China, where 1,335 companies are IRIS certified. In the world ranking, Poland is on the 5th place, with the number of 81 certified companies, including 1 company with a gold certificate (NEWAG S.A.), 16 companies with a silver certificate (including CSI INVEST mentioned in the article above), and 49 with a bronze certificate.

The number of companies with the silver certificate gives Poland the 4th place in the world and the 5th place in the world in terms of companies with the bronze certificate. In both comparisons, Poland ranks highly.

4. Conclusions

The presented example of a CSI company operating in the sector of service, maintenance and repair of railway vehicles shows that a company with specific competences in the field of resource configuration, both within and outside the company, can achieve market success.

In addition, the described case indicates the ability to use threats in the form of restructuring as market opportunities, which is theoretically justified in economic concepts and management theories.

The actions taken by CSI were aimed at building a business model for providing services on foreign markets (primarily on the German market) due to the high barrier to entry to these markets resulting from the knowledge and competence of both employees (access to suitably qualified employees) and organizational competencies in the form of the need to have appropriate certificates necessary to start operations / provide services in the field of servicing, maintenance and repair on the indicated German market of rail vehicles.

References:

Gierszewska, G. 2003. Budowanie strategii zarządzania wiedzą w przedsiębiorstwach. In: Zarządzanie wiedzą we współczesnych organizacjach, 62-68. Red. J. Kisielnicki, Wyższa Szkoła Handlu i Prawa im. Jana Pawła II w Szkole Handlu i Prawa R. Łazarskiego, Warszawa.

https://sjp.pwn.pl/sjp/kompetencja;2564077

https://finanse.wp.pl/deutsche-bahn-kupi-w-zakladach-pesa-pociagi-za-120-mln-euro-6114650758362753a.

Materska, K. XXXX. Wiedza w organizacjach. Prolegomena do zarządzania wiedzą, 43, http://bbc.uw.edu.pl/Content/3/03.pdf

Niedzielski, P. 2013. Kreatywność i procesy innowacyjne na rynku usług transportowych. Ujęcie modelowe, 171-173. Polskie Towarzystwo Ekonomiczne Oddział w Szczecinie.

Niedzielski, P., Podlewski, M., Chrząstek, G. 2024. Rola narzędzi e-learningowych w kształtowaniu kompetencji pracowników i zespołów projektowych – studia przypadków, Marketing i Rynek 04/2024, 58-68. DOI: 10.33226/1231-7853.2024.4.5.

Niedzielski, P., Markiewicz, J. 2023. Wpływ zmian w taborze kolejowym na logistykę w dobie zrównoważonego rozwoju – studium przypadku. Gospodarka Materiałowa i Logistyka 03/2023, 2-11. DOI: 10.33226/1231-2037.2023.3.1.

Oleksyn, T. 2018, Zarządzanie kompetencjami – teoria i praktyka, 19-20. Wolter Kluwer Polska SA, Warszawa.

Zienkowski, L. 2003. Gospodarka "oparta na wiedzy" – mit czy rzeczywistość? Wiedza a wzrost gospodarczy, Red. L. Zieńkowski, WN Scholar.

www.iris-rail.org