IMPLEMENTATION OF KNOWLEDGE MANAGEMENT IN METALLURGICAL COMPANY

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Abstract

Implementing knowledge management opens avenues for company growth, along with gaining and retaining a sustainable competitive advantage. Metallurgical sector has some specifics that need to be identified and addressed when preparing and launching knowledge management implementation projects. In this article, a model for calculating the investment into knowledge management initiative is presented taking into account the investments into research and development, effects of innovations and investments into knowledge management. Moreover, results of research regarding the particularities of metallurgical companies are presented and their effects on the implementation of knowledge management are assessed.

Keywords: Metallurgical company, knowledge management, knowledge management implementation

1. INTRODUCTION

Over the past few decades, the intensification of competition brings new challenges for companies operating in many sectors. Companies that want to retain their market position are forced to seek new sources of competitive advantage, enabling them to maintain and improve their position on the globalized market. There is an intense debate ongoing amongst experts regarding the most efficient sources of competitive advantage. The most important requirement that is common for all opinions is that the source has to enable the sustainability of the competitive advantage. People (human resources) are carriers of all the knowledge that is being created in any company. Knowledge management principle states that it is crucial for any organization to systematically manage knowledge creation, transformation, storage and usage to improve results of common operations and decisions and align them with strategic goals of the organization. The aim of this article is to determine specifics that are to be reflected when implementing knowledge management in a metallurgical company.

2. KNOWLEDGE MANAGEMENT AS THE FACTOR DETERMINING COMPANY´S COMPETITIVENESS

There has been a great dispute to determine factors and inputs that can serve as the catalyst for creating and maintaining unique competency leading to sustainability of the competitive advantage. One of the methods of looking at company results may be conducting benchmarking. Many models for benchmarking exist. Many of them represent variations of a common approach. Of these, the Robert C. Camp's model is most often applied. [1]

It is necessary for metallurgical companies to look for these factors as the markets get more global and the competition increases. Several decades ago, factors such as new technologies, production know-how or innovative products were considered as decisive. Over the past few years, however, experts and companies are recognizing that there is one element that is common for all of these factors - people. People are determining the success of all processes and activities performed within the company [2]. If it is in the

production, any level of management or amongst shareholders, know-how and skills of people are the factor that decides about the success or failure of any initiative. Awad defines knowledge management as the newly established interdisciplinary business model, which focuses on knowledge as a center structure of the organization [3].

As Miklosik notes, one of the three factors that are perceived as the modern and most efficient sources of sustainable competitive advantage is knowledge management [4]. Further, the direct link between the implementation of knowledge management, generating innovations and gaining competitive advantage is proven. Empirical study of Donate and Guadamillas demonstrates the link between knowledge-oriented corporate culture, knowledge leadership, knowledge-based activities in the field of human resources and innovative products of the company [5]. Brzoska has studied the factors contributing to innovation generation in a metallurgical company. He has confirmed that the ability to innovativeness depends to high extent on knowledge management [6]. Jurkovicova notes that there are three forms of innovations that need to be incorporated into the corporate innovation processes: Product innovation, process innovation and behavioral innovation [7]. Other experts argue that knowledge management is crucial for establishing the learning organization, which is defined as the organization able to effectively use knowledge of its employees, combine and use it to continually increase the overall knowledge level and create a stable knowledge base usable for future decisions. Companies started to recognize this fact and because of it, they are starting adopting knowledge management principles. To systemize knowledge flow in the company, knowledge management needs to be systematically implemented into the company processes.

3. RESEARCH OBJECTIVES

Based on the presented facts it is necessary for companies in the metallurgical industry to realize the need for systemic work with knowledge. Implementing knowledge management requires a thorough approach. It is a long-term process that needs to be performed within a framework to achieve the final compliance of knowledge management effects with strategic goals of the company. This paper focuses on the knowledge management implementation processes. Its main goal is to determine specifics that are to be reflected when implementing knowledge management in a metallurgical company. Partial objectives have been set as follows: Argument the necessity of implementing knowledge management into the company to increase its competitiveness; create a model for calculating affordable costs allocable to knowledge management imitative; determine specifics of metallurgical companies that make this sector specific compared to other production and non-production sectors; identify possible impacts of these peculiarities on the knowledge management implementation project and propose the framework for their consideration, exploitation and mitigation.

4. KNOWLEDGE AND EDUCATION MANAGEMENT IN METALLURGICAL COMPANIES IN THE CZECH REPUBLIC

Metallurgy is the traditional focal point of Czech heavy industry. At present, the Czech Republic belongs to the leading manufacturers of iron and steel in Central Europe. **Table 1** shows the twelve largest steel producers in Europe in 2014. The Czech Republic is ranked in the tenth place.

The Czech Republic even occupies the seventh place in Europe in production per capita at present (0.5 tons / per capita). Metallurgical production represented about 3 % of the total gross domestic product in 2014. Nevertheless, this includes only the actual production of iron and steel. The entire follow-up processing industry, however, accounted for 27 % of the total gross domestic product in the same year. At the same time, approximately 200 000 jobs depended on the Czech metallurgical industry. From this perspective, it is obvious that this is an absolutely crucial area of industry of the Czech Republic. The production of iron and steel is also dominant for the Czech Republic in terms of the subsequent use of the metal. **Table 2** shows the seven key industrial branches representing the consumers of metallurgical industry. The leading consumers include mainly the areas of mechanical engineering, manufacturing of metal structures, electrical appliances and

automotive industry. These areas are dominating as far as the gross domestic product of the Czech Republic is concerned.

Table 1 The largest steel producers in Europe 2014 [8]

Ranking	State	Production (thousands of tons)
1.	Germany	42 916
2.	Italy	23 835
3.	France	16 243
4.	Spain	14 193
5.	Great Britain	12 091
6.	Poland	8 820
7.	Austria	7 999
8.	Belgium	7 315
9.	Netherlands	6 984
10.	Czech Rep.	5 370
11.	Slovakia	4 715
12.	Sweden	4 559

Table 2 Consumer branches of metallurgical production in the Czech Republic [8]

Ranking	Name	Share (%)
1.	Machinery and equipment production	17.91
2.	Production of metal structures	15.89
3.	Production of electrical appliances	14.83
4.	Production of motor vehicles	14.15
5.	Waste collection and disposal	3.69
6.	Construction of buildings	1.78
7.	Other means of transport	1.49

There are currently two dominant producers of iron and steel in the Czech Republic (Třinecké železárny, a.s., ArcelorMittal Ostrava, a.s.). **Tables 3, 4** show data related to the number of employees and profit for the years of 2013, 2014. The data show that they are significant metallurgical companies within the frame of the Czech Republic. The research has also verified the intensity of education in metallurgical organizations in the Czech Republic. The available data have revealed that employers in metallurgical industry invest 4 - 5 % of their annual profit in the development and education of their employees [8]. This may represent a relatively large amount of invested funds, with regard to the annual profit of these metallurgical companies. Global surveys have revealed that large manufacturing companies invest 8 - 12 % of their profits in the development of their employees. If a company finds itself in the phase of planned radical changes, the investment may be as high as 18 - 25 % of the profit.

Table 3 Metallurgical companies in the Czech Republic 2013 [8]

Firm	People	Profit (mil. EUR)
Třinecké železárny, a.s.	6090	51.33
ArcelorMittal Ostrava, a.s.	3981	78.11

Table 4 Metallurgical companies in the Czech Republic 2014 [8]

Firm	People	Profit (mil. EUR)
Třinecké železárny, a.s.	6040	54.03
ArcelorMittal Ostrava, a.s.	4069	82.25

From this perspective, the amount of funds invested in education can be seen as inadequate. Naturally, it is very important what groups of employees the education is focused on. In the Czech Republic, the greatest attention is paid to the education of middle management of metallurgical companies (see **Figure 1**).

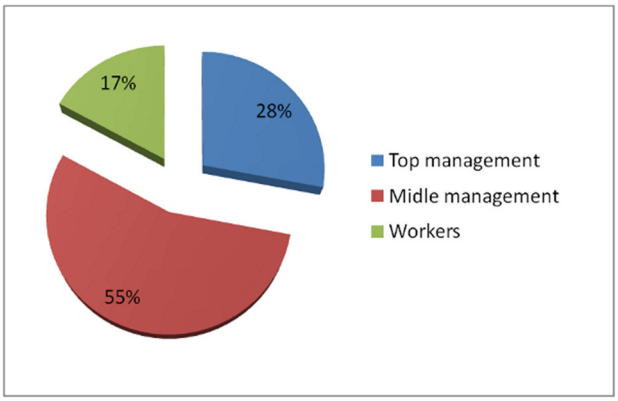

Figure 1 Education in metallurgical companies [8]

55 % of the total volume of educational projects is focused primarily on the middle management of metallurgical companies. Education of blue-collar workers accounts only for 28 % of all cases. In manufacturing segments, which are among the customer sectors of steel production, the ratio is usually reversed.

Knowledge management efficiency in metallurgical organizations naturally plays a major role in this aspect. The quality of this process will, without doubts, have a significant impact on the entire process. One can assume that the quality of knowledge management will be directly correlated with the development of innovations in metallurgical production.

5. RESULTS AND DISCUSSION

As already argued, knowledge management creates the basis for acquiring and persisting the competitive advantage. The contribution of knowledge management is apparent in many areas including:

- Alignment of strategic goals with management processes.
- Faster and more informed decision making.
- Improved efficiency of operational processes.
- Stable and positively developing relationships with customers and partners.

A simple formula can be introduced to determine the investment into the knowledge management processes. It utilizes the proven link between knowledge management and innovations. As metallurgical companies invest into the R&D, these expenditures can serve as one of the benchmarks - designated as Investments into Research and Development (IRD). As the other variables in this equation, the commercial effect of innovations needs to be determined - designated as Effects of Innovation (EIN). This is not an easy calculation and it needs to take several variables into account including revenues from sales of new or innovated products over a specific timeframe compared to previous revenues (total and/or specific product revenues) and savings from the introduction of new technology into production (including all types of costs: material, time, personal etc).

Firstly, this formula can be used as the starting point for our debate on the knowledge management investments:

$$IRD < EIN \quad (1)$$

Where:
IRD stands for Investments into Research and Development
EIN stands for Effects of Innovation

This approach is based on the prerequisite that all investments into R&D need to be profitable and thus, they need to be cost-effective over the time. When calculating the IRD and EIN and comparing them, a shift in time periods occurs typically. For instance, the company can decide to compare IRD from years 2010 - 2013 to EIN total over the period 2012 - 2015. This view reflects the continuous and long-term character of complex innovations, which are not visible immediately and it usually takes months and years to detect their impacts.

When determining the budget for the knowledge management implementation project, this formula can be enriched by another variable - the Investment into Knowledge Management (EKM) as following:

$$EKM + IRD < EIN \quad (2)$$

Where:
EKM stands for Investment into Knowledge Management
IRD stands for Investments into Research and Development
EIN stands for Effects of Innovation

Following this approach, these conclusions can be made regarding the principles of decision-making about the knowledge management implementation project budget:

- The overall costs of both knowledge management and R&D expenditures need to be covered by revenues, despite their shift in time.
- Investment into knowledge management drives innovation and thus, the investments into R&D are most likely to be decreased over time, with simultaneously maintaining the same innovative level.

There are many specifics of the metallurgical industry that differ this sector from other production and nonproduction sectors. In our research, however, the authors have concentrated on those issues that could be decisive when introducing and managing the knowledge management implementation project. The manufacturing companies will constantly have to deal with the technological and cost problems, both today and in the future. [9]

Metallurgy is one of the sectors with the highest research intensity. Despite the fact that a decrease in the intensity of R&D expenditures could be observed in the 1980´s and 1990´s, metallurgical companies continue to invest into R&D. According to OECD data, there are big differences in R&D expenditures between continents. On the one hand, European companies remain relatively stable with regard to R&D expenditures and the U.S. experience a minor slowdown. On the other hand, Chinese and Korean companies are accelerating their research investments. As Pomykalski notes, Chinese expenditures in metals and fabricated metal products have more than doubled during the period following the global economic downturn (2008 - 2012) [9]. Metallurgical companies are well aware of the importance of high research intensity and its contribution to generating competitive advantage. Research by PWC indicates that most executives of metal companies (79 %) state that their companies have a well-defined innovation strategy (compared to 63 % average) and 82 % of those executives stated that they successfully implemented their innovation strategy (compared to 64 % average) [9]. However, significant differences among the top metallurgical companies can be observed when comparing their research intensity. Data from the 2014 EU Industrial R&D Investment Scoreboard, which contains economic and financial data for the world's top 2500 companies ranked by their

investments in research and development show that the difference between the first and the last metallurgical company in the list are huge. The most innovative metallurgical company Molycorp, Inc. has the research intensity ratio 4.2 % and the last 42nd company in the list Aluminium Corporation of China only 0.1 %. The ratio is calculated by dividing R&D expenditures by revenues generated in a given period. Unfortunately, as Pomykalski states, the ratio is not really informative when comparing companies of different sizes. These facts have the following consequences on the knowledge management implementation:

- By many companies there is a lot of tacit knowledge present that is being used to drive innovations; this knowledge needs to be captured and the conversion to explicit knowledge and storage in a knowledge management information system (further as „KMS“) is essential to preserve knowledge, create stable knowledge base and minimize negative effects of fluctuation of key R&D employees.
- ArcelorMittal operating in Poland, Hungary, Slovakia, and Czech Republic is the only metallurgical company from V4 countries in the list positioning 41st with the research intensity ratio around 0.4 %. Apart from the fact that the index does not reflect company size properly this means that companies from V4 countries are not amongst the top innovators in the industry. More efficient work with knowledge and introduction of systemic knowledge management processes can help them drive innovation processes significantly. The other major advantage of knowledge management is that is accelerates the efficiency of innovation processes measured by the conversion rate between the market effects of innovations introduced and the overall amount of investments into R&D.
- High research intensity ratio does not objectively show the effects of the innovation processes with regard to market position and revenues. It only measures the ratio between R&D expenditures and revenues. It can be only assumed that higher R&D investments are contributing to identifying new technologies and innovative products that help companies get ahead commercially.

Another important fact that affects the implementation of knowledge management is the high level of involvement of sophisticated information systems that are used in the production processes. These are needed because of the complexity of production from the point of view of inputs, variables, accuracy, correctness and fidelity. There are usually several systems in operation that are securing the continuity of the production. They are typically connected to one or more managerial systems using the ETL layer. Those systems usually include decision support systems (DSS), expert systems (ES) or global company information systems - enterprise resource planning (ERP). As Danel et al. state, one of the tasks of the information system is acquiring data representing a time series, which are used for further calculations (trends, balances, forecasting) [10]. The intense use of information systems for production planning and operations, however, does not guarantee their optimal contribution to decision making. From the knowledge management initiative point of view, it is beneficial that these systems are in place and people are used to work with them. As the effect of this, the implementation of KMS into the company can be hassle free but these issues need to be addressed:

- There is a lot of data generated by operation management systems. Data need to be categorized using an own taxonomy to determine, which of them are directly sources of potential knowledge and which could be converted to sources of knowledge after possible combination or putting into another context. This work with data, data structures and their interpretation can be quite demanding, however there can be great effects visible if it is done thoroughly.
- Despite the loads of data, major knowledge remains in its tacit form. The surplus of data can be counterproductive because people will create and use their own systems of data filtering and evaluation that are not generally supported by the information systems. Thus, knowledge regarding their interpretation and usage by decision-making needs to be identified and incorporated into the to-be-built knowledge base [11]. Methods of knowledge sharing and conversion have to be in place to secure not only the initial massive conversion but the continuous sustainability of the conversion process to ensure systematic creation of the knowledge base consisting of accumulated explicit knowledge.

6. CONCLUSION

Of course, there are other factors or specifics that are less or more typical for the metallurgical industry. It can be argued that the intensification of relationships between the company and its partners is very important as well. Indeed, this is a very topical issue thanks to the concentrated market, where B2B relationships are crucial and collaborative research and development often occurs in cooperation with one or more partners. However, it is believed that the identified specifics are the most crucial for setting up a functional knowledge management project. There can be several other connected areas of research identified that can expand the presented results: Preparing the taxonomy for knowledge generated in a metallurgical company to be incorporated into the knowledge management system, creating the model for implementing knowledge management in companies within this industry, assessing the level of maturity of knowledge management implementation, or determining key blockers of successful implementation. It is hoped that future studies will connect to the presented results and enable the companies to create their own conceptual frameworks for implementing knowledge management and achieving desired outcomes in form of a sustainable competitive advantage.

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