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## MINING INDUSTRY IN THE KNOWLEDGE ECONOMY\*\*

### Abstract

*With the appearance of the knowledge economy, it is of the utmost importance for the mining industry to be involved in the global world trends and to develop its activity field in the areas which have knowledge as a resource in their base, such as development of new and advancement of old exploitation technologies, mining equipment and technology development, introduction of knowledge management in mining corporations, development the new technologies for environmental protection, implementation the new technologies in research works for faster, more reliable and cheaper finding of mine deposits and development of workers' knowledge, as a human resource in the mining industry. The aim of this work is to show that, although the added value of the companies in the mining industry in the last decade was created by the increase in the raw material prices in the world market, the knowledge economy is the path which the mining industry must negotiate in order to enter the XXI century.*

**Keywords:** mining industry, knowledge, knowledge economy

### INTRODUCTION

The mining industry is one of the industries which, in times of crisis, experiences its full expansion, for reasons of increase the prices of metal in the world stock exchanges, which we are witnessing. The deficit of gold and silver has been felt for the whole decade and, according to the data published by GATA [1], gold reserves, silver and other metals are very limited, in times when the demand and the market itself are increasingly growing. The USA silver reserves are decreased each year, while the mines have already sold in advance their many years worth of silver production, so it has become physically impossible to raise larger quantities of these metals. The current debt for silver is approximately half a million ounces. This means that exactly the same

quantity of silver ounces was sold at a time when a large deficit already existed [2]. All these are reasons due to which the mining industry in the last decade was realising added value and the question is asked how important is it that the mining industry follows trends which have become more than obvious in all other sectors and which have transformed the world economy from industrial and informatics into the knowledge economy. These trends contributed to the fact that, during and following the recession, companies started to look for new methods of achieving competitiveness, which led to finding new methods to stimulate and exploit their employees' potentials, which generated better business results, despite the hard conditions.

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If these facts are observed with respect to the mining industry expansion, it can be concluded that it is the mining industry itself which can achieve the greatest advancement in the decades to come, provided it accepts the innovations implemented by those industries which have been affected by the crisis as the global phenomenon and which are, above all, founded on knowledge. If it is the case, it is clear that the state itself has to initiate the stimulation of those industrial branches and areas in which the highest profit is realised, as one of the strategic goals, for transition to the knowledge economy. According to Machulp, there are 11 reasons for that and, among them; the most important are the following [3]:

- Knowledge increases the national budget,
- Knowledge brings social benefits, which replace private benefits,
- Knowledge is in great measure linked to the increase in national productivity and economic development,
- Knowledge leads to development of new technologies,
- Knowledge will facilitate the transfer of work from physical work to knowledge workers,
- Knowledge will make contributions and affect the increase in competitiveness in the world market.

Apart from the accelerated modern technology development, the globalisation as a general phenomenon and associated phenomena, the famous Drucker also emphasises knowledge and education and all the impacts they have on the economy and society as a whole, as the main characteristics of the new economy [4]. Knowledge and continuous learning represent a key element of success in the new economy, i.e. the knowledge economy. The dominant component in the value which a product has for the product/services user is the very knowledge incorporated into that product or service. For

that reason, the move towards knowledge, as the primary source of value, means that the new economy should be managed by those who, in an efficient and effective way, manage knowledge – those who conquer, create, store, share and combine knowledge in a new way in an organisation and incorporate it into products and services, but faster than it is done by their competitors [5]. From the aspect of the mining industry, which has the privilege that in times of crisis experiences expansion, enabling to allocate more resources to development the new technologies. This work is aimed to identify the development areas and knowledge which are essential for introduction of the mining industry into the knowledge economy.

#### **KNOWLEDGE AS A RESOURCE IN THE MINING INDUSTRY**

As it was previously mentioned, in times of the global economic crisis, in the majority of industries it was concluded that only knowledge, which is not a process on its own, but forms an integral part of expression of a specific activity, is capable of creating new values. This is the reason why, in literature, in the last years of the twentieth century, an increased interest in Knowledge, as a resource which is solely capable of contributing to further development of companies and societies and of affecting the creation of competitive advantage, occurred. This is the very reason why in the mining industry, in which, as we saw from the previous section, added value was obtained by a considerable increase in the value of metal in the world stock markets, it is important to be involved in contemporary economic flows, as in that economic branch, too, it will soon become clear that material resources, which can be presented by classical statistical data, such as land, number of workers and capital, no longer bring a stable competitive advantage. Introduction of knowledge into classical industrial production is not an easy task in

the least and it requires compliance with new economic principles which, at the very beginning, may appear rather frightening. Knowledge on its own is not a concept, but it is a process which can hardly be measured prior to its systematisation in a specific system, which is not at all an easy task. It is difficult to transfer certain types of knowledge from one place to another, while it is easy to transfer some other knowledge to a large number of people. However, knowledge which will bring competitive advantage to companies in the mining industry, as well as a greater efficiency in exploitation, while preserving the environment, certainly is: 1. *Development of new and advancement of old technologies*; 2. *Mining equipment development*; 3. *Development of technologies for environmental protection*; 4. *Increase in energy efficiency*; 5. *Research work on new deposits and exploitation*; 6. *Introduction of knowledge management*; 7. *Knowledge worker development*.

As the knowledge economy imposes the imperative for the mining industry, that is, creation, storing, sharing and implementation of contemporary and current knowledge, in order for the employed in this industry to be able to maximally advance their organisation's business and make their industry itself competitive and sustainable. The prerequisite for the goals set in such a way is certainly the implementation of the knowledge management programme and the creation of the knowledge worker, which we will discuss further below in this paper.

## **KNOWLEDGE MANAGEMENT INTRODUCTION**

With the emergence of the idea of the knowledge economy, a need is also created for knowledge management within companies, in order for it to be stimulated or used in an economically justified manner. Disse-

mination of knowledge within an organisation and a correct activity allocation within those processes, harmonisation of relationships among the employees, management and consumers, have become crucial for the increase in the competitive advantage of a company. It is thus evident that the only sustainable advantage of a modern organisation emanates from what the company knows, how efficiently it uses what it knows and how fast it acquires and uses new knowledge [6]. In that sense, it is necessary to ensure real knowledge in the right place and at the right time, which is the essential definition of knowledge management.

Modern managers realise that efficient knowledge management is not only the creation of a series of storage facilities or databases. Interested in achieving better results for their companies, faster decision making processes and a high degree of accuracy and authenticity of relevant information, managers implement knowledge management as a system which permeates into all functional business areas – business processes, technology, human resources and external influences of clients, suppliers and business partners. Briefly, knowledge management is a process through which an organisation generates the value of its intellectual property and property based on knowledge [7]. Knowledge management is a process of adoption and use of the collective experience of an organisation no matter where in the business process - on paper, in documents, databases, constituting explicit knowledge, or in the minds of the employees, so-called tacit knowledge. It is interesting that approximately 95% of information exists as tacit knowledge. This is the very moving power for innovations – the only competitive advantage which supports a company in the unpredictable business environment. The purpose of modern business is use of technology in the way that knowledge is stored, distributed and

disseminated throughout the entire organisation by means of linking of the employed with the documented knowledge, all through the complex system of knowledge management.

Modern organisations in the mining industry should be directed towards achieving knowledge by knowledge transfer itself, with the use of technologies which will facilitate better cooperation and innovativeness. Attention should be paid to both explicit knowledge, which can be articulated, stored in documents, databases and manuals, and tacit knowledge, which is most frequently connected to the knowledge of experts, which is directly linked with practice, experience and even with the experts' intuition [8].

Modern, smart organisations in the mining industry have been increasingly focussing on adoption of key knowledge management methods and technologies, in order to satisfy demands for insurance of safe and profitable operations and activities in the future, and that through documentation which monitors already verified methods, procedures, best practices and experiences. This industry branch is, perhaps more than any other, directed to the imperativeness of keeping knowledge in organisations by means of storage of the necessary knowledge and its transfer from experienced experts to less experienced employees. This is, actually, the task of knowledge management.

Knowledge management should start from a strategic level and link it with the organisational goals and company performance indicators. This, of course, should be applied also to the mining industry, which is the object of this paper. The phases in implementation of knowledge management in the mining industry organisations, follow. Namely, the implementation of the knowledge management system, according

to the authors *Elias M., Awad and Hassan M., Ghaziri*, includes the analysis and implementation of the following fundamental activities. [9]

**1. The role of strategic planning.** Prior to the implementation of a new knowledge management system, it is essential to consider a series of questions, such as system planning, inclusion into the system of both the employed and top management and insurance of the methods for its implementation and support. As a consequence of the evaluation of the existing infrastructure, an organisation needs to define a strategic plan in accordance with the vision, which, in its base, has short term and long term business goals and all that bearing in mind the knowledge management system. For the purposes of linking of the users, in this case the employees, with the essence and content of the knowledge which they need, it is essential to re-examine the whole organisation's needs for knowledge, as well as to consider the contents of the knowledge needed for the creation of added value for the organisation.

**2. Team formation.** Following the evaluation of the existing infrastructure, a team needs to be formed, which will follow the building of the process as far as the final implementation of the knowledge management programme. The team formation includes:

- Identification of main units, departments, sections and divisions, as the main stakeholders of the possible knowledge management system. Each stakeholder has specific requirements and one or more experts who should participate in the team for implementation of knowledge management.
- Organisational, strategic and technological balancing of the team size and competencies. In other words, the

knowledge management team should be composed of experts from each of those fields in order to cooperate in the building of the knowledge management system, which is multidimensional by its nature.

The success of the team for knowledge management system depends on several factors:

- *The abilities of team members concerning personal characteristics, communicational skills and experience.* Preferred team members are persons who are capable of communicating and, of course, individuals with enviable experience in a specific area.
- *Team size.* Team should have an optimal number of members who, in a proper way, should represent the organisation in its entirety. Practice so far has shown that this number ranges between 4 and 20 members. It is difficult to manage a team with a larger number of members, as it can become counterproductive.
- *Project complexity.* The complexity of the knowledge management system depends on the size of the organisation, the nature of the product and services offered by the organisation, the degree of technology and team members' experience.
- *Leadership and team motivation.* Effective leadership can advance the motivation, cooperation and coordination within the team, which will, furthermore, ensure a positive outcome.

**3. Knowledge capture.** In the third phase of the implementation of the knowledge management system in the mining industry, in practice, knowledge capture can have different meanings. Briefly, explicit or accessible knowledge is captured from the documentation, database and other media.

As opposed to that, tacit knowledge lies in the minds of experts who work in the organisation. Knowledge capture includes the feasibility analysis, selection of experts, dissemination of expert knowledge, filling in of gaps in the management system and verification of the knowledge validity following the system activation. It follows from the quoted that all the phases of the knowledge management system are constantly developing and, by their dynamics, follow the organisational needs.

**4. Prototype.** The majority of knowledge management systems begin as a small one-degree system based on limited knowledge, acquired through the first meetings with the organisational experts. The system grows gradually with addition of new knowledge elements, which are added to the prototype. Basic advantages of the prototype creation consist of the following: mistakes can be corrected faster, the system is tested each time when new changes or amendments are integrated, product checks are facilitated in an early phase, a gradual system growth and development are enabled, parallelly with changes in users' perceptions, the significance of acceleration of the knowledge acquisition process and demonstration of possibilities of the knowledge system base, which is in the process of being built.

**5. Selection of experts.** A professional and cooperative expert, who is prepared to share his/her knowledge with the others, thus making it collective, forms a base for the success of the process of introduction of knowledge management. An expert must be able to exchange information in an intelligible way and sufficiently accurately. The following facts should be considered when selecting an expert: the extent of the expert's experience, whether the expert is able to see the project through to the end and what alternative solution there is in the

event that the expert loses his interest or decides to abandon the project.

**6. Designing information structure** is the prerequisite for successful implementation of a knowledge management system. Designing a knowledge management system includes consideration of a few questions:

1. Channelling towards the system operability which an organisation already has
2. Defining possibilities of the proposed knowledge management system, taking into consideration all the infrastructural advantages
3. Making a decision on the proposed system components
4. Developing the foundations of the knowledge management architecture which would satisfy organisational needs.

**7. Testing of the knowledge management system.** The testing of the knowledge management system includes two phases: procedure verification and procedure validation. Procedure verification affirms that the system is real and that it performs those functions which it should perform, i.e. that the real knowledge is accessible when needed and in the form in which it is needed. The validity affirms that the system is adequate, i.e. that it satisfies users' needs and requirements and that it will be useful. In other words, the validity procedure verifies the reliability of the knowledge management system.

**8. Implementation of the knowledge management system.** The next phase once the knowledge has been captured, coded in the database, verified and validated, is the actual implementation of the system. The implementation includes integration of the knowledge management system into specific operations and taking into account constant system quality insurance, training

of the employees to be included in the knowledge management system and, of course, management of changes, which are constant, both in the environment and in organisations themselves.

**9. Postsystem evaluation.** Following the implementation and activation of the knowledge management system, the impacts of the new system on the organisation should be carefully evaluated. The impact of the new system should be considered separately in respect of its impact on people, procedures and business results. There are several key questions which need to be asked in the post-implementation phase:

- How much has the knowledge management system influenced an improvement in accuracy and decision making time?
- Has the new system caused organisational changes? How constructive have the changes been?
- How and in what way has the new knowledge management system reflected on the end users' attitudes?
- How has the new knowledge management system affected the change in business cost?
- In what way has the new system affected the link between end users and the organisation?
- Have the solutions, anticipated by the new system, justified the investment cost?

## DEVELOPMENT OF KNOWLEDGE WORKER

One of the knowledge economy characteristics is certainly also a stereotype division in so-called *blue - collar* and *white-collar* workers. This division occurred as the result of increased need to acquire and apply new knowledge and new techno-

logies, as well as turn towards service businesses ("white collars"), which, on the other hand, resulted in a decreased need for physical labour ("blue collars"). The knowledge economy itself, however, also led to the linking of these worker categories. Although the white collars are associated with advancement of technology and orientation to the service sector, the members of this group are classified also in state bureaucracy. On the other hand, blue collars have often been the object of positive cultural stereotypes, such as is logical reasoning and common sense, positive work ethics, feeling of solidarity and belonging to a team or a group.

The division in blue and white collars clearly surpasses the present times and knowledge economy requirements. Corporations increasingly demand a new level of knowledge workers: highly qualified, multidisciplinary oriented workers, who combine the mind of a white collar and the hands and skilfulness of a blue collar. Armed with knowledge from information technologies, technological and mathematical sciences, these workers have been named "gold collars" due to the contributions they make to their organisations, as well as for their ability to apply their knowledge in production industries [10]. Parallely with the recognition of these workers in the modern organisation business as the bearers of the future development and prosperity, a demand emerges for the educational system to prepare potential workers of the 21<sup>st</sup> century in an adequate way, as well as the need to invest the necessary means for strengthening of such programmes. As gold collar workers should regularly update their skills in order to remain competitive with a forever changeable technology, learning in their case should be a continuous process, which will have the support of the organisation itself, but also of the whole system.

Examples of good practice of linking of the educational with the production system do exist and generate good results. For example, the Colorado's Higher Education and Advanced Technology Center, HEAT, in cooperation with the college community in Colorado and with the support of the corporations such as Cisco Systems, Intel, Lucent Technologies, Miller Electric, Haas Automation, and Parametric Technology, schools and educates "gold" workers in technologies such as electronic production, problem solving in laser application, precise joining, electro-optics, fibre optics, biotechnological production, digital film and video production. The opportunity to be able, during the process of learning, to apply all acquired skills and knowledge in a specific industry, aided by technologies used by the corporations on an everyday basis, is very important.

This kind of cooperative technologically oriented educational system in which the state, local community, educational system and business environment of a specific industrial branch work together, is a significant option for alleviating the present lack of educated technological profiles, which needs to be considered both generally and when it concerns the mining industry. Certainly, speaking of knowledge technology in the mining industry, it is essential to mention one more concepts which appear in the literature and which deems that the only workers who are relevant for the XXI century business are so-called "green collars", i.e. workers who can ensure two key things for their organisations – profitability and sustainability. According to the supporters of this idea, everything else is completely irrelevant [11].

As it is stated in the Strategy of the Scientific and Technological Development of the Republic of Serbia itself in the period between 2010 and 2015, one of the key in

vestments in the future period is the investment in people, for which an amount of 33million euros is anticipated for the period of five years [12]; it becomes clear that the emphasis of the development of the mining industry itself, which is encompassed in this strategy, should also be the investment in human resources, i.e. in knowledge workers. This is clearly indicated also by the strategic goals of the Serbian Oil industry, which, in the year 2012, as its goals, set technical and technological development and the development of human resources. In 2012, therefore, 50.8 billion dinars were invested in the company development, namely in technology and staff training. [13]

As it is seen, the knowledge workers are those workers who are able to use symbols, concepts, different knowledge and information in their work [14] and who are able to create added value thanks to their own originality, ability to think analytically and their evaluation, among which mainly middle and high managerial levels are included, professionals and professionals' associates, with exceptionally developed specific characteristics [15]. Due to the fact that knowledge workers produce added value using their knowledge as an instrument of work, the relationship between them and the work tasks themselves which they perform, has essentially changed [16]. Today, they are the moving force behind the development of the new economy and the key strategic and competitive source of modern organisations [17]. They are, therefore, those individuals who, in times of the knowledge economy, perform the work which they have created themselves, i.e. the work which was created during the process of their thinking or other activities which, basically, contain their own knowledge and skills. Or, as Horibe said, knowledge workers are those employees

who create and make production values using rather their brain than their hands [18].

## CONCLUSION

Those employed in the mining industry are facing a series of challenges which are characteristic of only that economic field, so they, it appears, more than commonly, need assistance and training in order to overcome the circumstances in which they live and work. Namely, work in this industry is mainly performed in mining areas which are usually situated in distant places and outside large university and trade centres. In such conditions, the employees face a climate which can be extreme, tropical forests or deserts and also in the conditions of underground mines, work positions include activities carried out underground in conditions filled with heat, darkness and humidity. In the mining industry work goes on for 24 hours a day and the working hours are dissimilar to other industries. All this points to the magnitude of the challenges the mining industry of the century faces. Due to the increase in the complexity of modern technologies in the mining industry, an increasingly larger number of educated people are needed, who will have the ability to manage those processes in the afore-described conditions. Apart from vocational knowledge, those people also need to have a whole set of personal business skills and personal qualities, as well as information technology literacy. If it is added to this the fact that mining industry work belongs to the group of the most dangerous jobs [19] and that mining work is not exclusively the man work, but also includes all the other work positions, starting from the secretarial jobs to the highly expert ones, it becomes increasingly clear that investment in human resources



and implementation of knowledge management also in the mining industry and energetics is really one of the prerequisites for its competitive advantage.

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## RUDARSKA INDUSTRIJA U EKONOMIJI ZNANJA\*\*

### *Izvod*

*Sa pojavom ekonomije znanja, od vitalnog je značaja za rudarsku industriju da se uključi u globalne svetske tokove i da razvije svoje polje delovanja u oblastima koje u svojoj osnovi imaju znanje kao resurs, kao što su razvoj novih i unapređenje starih tehnologija za eksploataciju, razvoj rudarske opreme i tehnologije, uvođenje menadžmenta znanja u rudarske korporacije, razvijanje novih tehnologija za zaštitu životne sredine, primena novih tehnologija u istražnim radovima za brže, pouzdanije i jeftinije nalaženje ležišta rude i razvijanje radnika znanja kao ljudskog resursa u rudarskoj industriji. Svrha ovog rada jeste da pokaže da iako je dodatna vrednost kompanija u rudarskoj industriji u poslednjoj deceniji stvorena povećanjem cena sirovina na svetskom tržištu, ekonomija znanja jeste put koji i rudarska industrija mora da pređe da bi ušla u XXI vek.*

***Cljučne reči:*** rudarska industrija, znanje, ekonomija znanja

### 1. UVOD

Rudarska industrija jeste jedna od industrija koja u vremenu krize doživljava svoju punu ekspanziju upravo zbog povećanja cena metala na svetskim berzama kojoj smo svedoci. Deficit zlata i srebra oseća se već čitavu deceniju, a prema podacima koje je GATA (Gold Anti-Trust Action Committee (GATA) je američka organizacija čija je osnovna aktivnost praćenje i kontrola institucija koje imaju veze sa zlatom, u cilju onemogućavanja kontrole cena i količine tog metala na berzi) objavila, zalihe zlata, srebra i drugih metala su veoma ograničene, u vreme kada je potražnja sve veća kao i samo tržište. Zalihe srebra Sjedinjenih Američkih Država se smanjuju svake godine, dok su rudnici

prodali unapred svoju višegodišnju proizvodnju srebra, tako da je postalo gotovo nemoguće fizički podići veće količine ovih metala. Današnji dug za srebro iznosi oko pola miliona unci. To znači da je upravo toliko unci srebra prodato u trenutku kada već postoji veliki deficit. Sve su to razlozi zbog kojih je rudarska industrija u poslednjoj deceniji ostvarivala dodatnu vrednost, pa se postavlja pitanje, koliko je važno da rudarska industrija prati trendove koji su postali više nego očigledni u svim ostalim sektorima, a koji su svetsku ekonomiju sa industrijske i informatičke transformisali u ekonomiju znanja. Ti trendovi su doprineli tome da su za vreme i nakon recesije,

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kompanije počele da traže nove načine za postizanje konkurentnosti, što je dovelo do toga da pronađu nove načine da podstaknu i iskoriste potencijale svojih zaposlenih, što je proizvelo bolje poslovne rezultate čak i u teškim uslovima.

Ukoliko ove činjenice posmatramo spram ekspanzije u kojima se nalazi rudarska industrija, možemo da zaključimo da je upravo rudarska industrija ta koja može da ostvari najveći napredak u decenijama koje dolaze, ukoliko prihvati novine koje su uvele one industrije koje su pogođene krizom kao globalnim fenomenom, a koje se pre svega zasnivaju na znanju. Ukoliko je to tako, jasno je da i država sama po sebi, kao jedan od strateških ciljeva treba da postavi stimulisanje onih industrijskih grana i oblasti u kojima se ostvaruje najveći profit, za prelazak u ekonomiju znanja. Prema Machulpu, 11 je razloga za to, a među njima najvažniji su:

- Znanja povećavaju nacionalni budžet.
- Znanja donose socijalne beneficije, koje zamenjuju privatne beneficije.
- Znanja su u velikoj meri povezana sa povećanjem produktivnosti i ekonomskim razvojem nacije.
- Znanja vode razvoju novih tehnologija.
- Znanja su ta koja će da omoguće transfer radne snage iz fizičke radne snaga u radnike znanja.
- Znanja su ta koja će da doprinesu i koja utiču na povećanje konkurentnosti na svetskom tržištu.

Uz ubrzan razvoj savremenih tehnologija, globalizaciju kao opštu pojavu i pojave koje ih prate, čuveni Drucker kao osnovno obeležje nove ekonomije ističe znanje i obrazovanje i sve one uticaje koje oni imaju na ekonomiju i društvo kao celinu. Znanje i kontinuirano učenje predstavlja ključni element uspeha u novoj ekonomiji, tj. ekonomiji znanja. Dominantna komponenta u vrednosti koju proizvod ima za korisnika proizvoda/usluga upravo je znanje ugrađeno u taj proizvod ili uslugu. Iz tog razloga, pomak ka znanju kao

primarnom izvoru vrednosti, čini da novom ekonomijom treba da rukovode oni koji na efektivan i efikasan način upravljaju znanjem – koji osvajaju, stvaraju, čuvaju, dele i na novi način kombinuju znanje u organizaciji i ugrađuju ga u proizvode i usluge, ali brže nego što to čine njihovi konkurenti. Posmatrano sa stanovišta rudarske industrije, koja ima tu privilegiju da u vreme krize doživljava ekspanziju, što joj omogućuje da više resursa izdvoji za razvoj novih tehnologija u ovom radu smo želeli da prikazemo koje su to sve oblasti razvoja i koja su to znanja neophodna za uvođenje rudarske industrije u ekonomiju znanja.

## **ZNANJE KAO RESURS U RUDARSKOJ INDUSTRIJI**

Kako smo već ranije rekli, u vreme globalne ekonomske krize u većini industrija došlo se do zaključka da je jedino znanje, koje nije proces sam za sebe nego je integralni deo ispoljavanja određene aktivnosti u stanju da stvori nove vrednosti. Zbog toga je u literaturi poslednjih godina dvadesetog veka došlo do povećanja interesa za Znanjem kao resursom koje je jedino u stanju da doprinese daljem razvoju kompanija i društva i da utiče na stvaranje konkurentne prednosti. I upravo iz tog razloga u rudarskoj industriji, u kojoj je, kako smo videli u prethodnom poglavlju dodatnu vrednost donelo značajno povećanje vrednosti metala na svetskim berzama, važno je uključiti se u savremene ekonomske tokove, jer će i u toj privrednoj grani veoma brzo postati jasno da materijalni resursi, koji mogu da se predstave klasičnim statističkim podacima, kao što su zemlja, broj radne snage, kapital, više ne donose stabilnu konkurentsku prednost. Uvođenje znanja u klasičnu industrijsku proizvodnju nije ni malo lak zadatak, i zahteva poštovanje novih ekonomskih principa koji mogu izgledati zastrašujuće na samom početku. Znanje samo po sebi nije pojam nego proces koji teško može da se meri do njegovog sistematizovanja u određeni sistem, što nije ni malo lak zada-

tak. Neke vrste znanja teško je preneti sa jednog mesta na drugo, dok je drugo znanje lako preneti velikom broju ljudi. Ipak znanje koje će doneti konkurentsku prednost kompanijama u rudarskoj industriji i veću efikasnost iskorišćenja uz očuvanje životne sredine svakako su: 1. *Razvoj novih i unapređenje starih tehnologija*; 2. *Razvoj rudarske opreme*; 3. *Razvoj tehnologija za zaštitu životne sredine*; 4. *Povećanje energetske efikasnosti*; 5. *Istražni radovi za nova ležišta i eksploatacija*; 6. *Uvođenje menadžmenta znanja*; 7. *Razvijanje radnika znanja*.

Kako ekonomija znanja nameće imperativ za rudarsku industriju, a to je stvaranje, čuvanje, deljenje i primena savremenih i aktuelnih znanja, kako bi zaposleni u ovoj industriji, mogli maksimalno da unaprede poslovanje svoje organizacije, a samu industriju učine konkurentnom i održivom. Preduslov za ovako postavljene ciljeve svakako je implementacija programa menadžmenta znanja i stvaranje radnika znanja, o kojima će biti reči u daljem tekstu rada.

## UVODENJE MENADŽMENTA ZNANJA

Sa pojavom ideje ekonomije znanja, stvara se i potreba za menadžmentom znanja u okviru kompanija, kako bi se ono podstaklo ili upotrebilo na ekonomski opravdan način. Širenje znanja u okviru organizacije i pravilna raspodela aktivnosti u okviru tih procesa, harmonizacija odnosa između zaposlenih, menadžmenta i potrošača, postali su ključni za povećanje konkurentne prednosti jedne kompanije. Tako postaje očigledno da jedina održiva prednost savremene organizacije proizilazi iz onog što firma zna, koliko efikasno koristi ono što zna i koliko brzo stiže i koristi novo znanje. U tom smislu, potrebno je obezbediti pravo znanje na pravom mestu i u pravo vreme, što i jeste suštinska definicija menadžmenta znanja.

Savremeni menadžeri shvataju da efikasan menadžment znanja nije samo stvaranje niza skladišta ili baza podataka.

Zainteresovani da donesu bolje rezultate svojoj firmi, brže donošenje odluka i visok stepen tačnosti i verodostojnosti relevantnih informacija, menadžeri implementiraju menadžment znanja kao sistem koji prožima sve funkcionalne oblasti poslovanja – poslovne procese, tehnologiju, ljudske resurse i eksterne uticaje klijenata, snabdevača i poslovnih partnera. Najkraće rečeno, menadžment znanja je proces kroz koji organizacija generiše vrednost svoje intelektualne i imovine bazirane na znanju. Menadžment znanja je proces usvajanja i korišćenja kolektivnog iskustva organizacije bilo gde u poslovnom procesu – na papiru, u dokumentima, bazama podataka (*explicit knowledge* – eksplicitno, vidljivo znanje) ili u umovima zaposlenih (tzv. *tacit knowledge* – prećutno, nevidljivo znanje). Interesantno je da oko 95% informacija postoji kao tzv. prećutno znanje. Upravo je to pokretačka snaga za inovacije – jedina konkurentna prednost koja podržava kompaniju u nepredvidivom poslovnom okruženju. Svrha savremenog poslovanja je korišćenje tehnologije tako da se znanje čuva, distribuira i širi kroz celu organizaciju povezivanjem zaposlenih sa dokumentovanim znanjem, a sve putem složenog sistema menadžmenta znanja.

Savremne organizacije u rudarskoj industriji treba da budu usmerene na postizanje prednosti upravo transferom znanja, uz korišćenje tehnologija koje će omogućiti bolju saradnju i inovativnost. Pažnju treba posveti kako eksplicitnom znanju koje može biti artikulirano, skladišteno u dokumentima, bazama podataka i priručnicima, tako i prećutnom znanju koje se najčešće dovodi u vezu sa znanjem stručnjaka koje je u direktnoj vezi sa praksom, iskustvom, pa čak i sa intuicijom eksperata.

Savremene, pametne organizacije u rudarskoj industriji se sve više fokusiraju na usvajanje ključnih metoda i tehnologija menadžmenta znanja, a kako bi izašle u susret zahtevima za obezbeđenjem sigurnih i profitabilnih operacija i aktivnosti u budućnosti, upravo kroz dokumentaciju

koja prati već proverene postupke, procedure, najbolje prakse i iskustva. Ova grana industrije, možda više nego ijedna druga, upućena je na nužnost čuvanja znanja u organizacijama putem skladištenja potrebnog znanja i njegovog transfera od iskusnih stručnjaka, ka manje iskusnim zaposlenima. To je, upravo, zadatak menadžmenta znanja.

Sa menadžmentom znanja treba krenuti od strategijskog nivoa i povezati ga sa organizacionim ciljevima i pokazateljima uspeha kompanije. Navedeno, naravno, treba primeniti i na rudarsku industriju koja je predmet ovog rada. U nastavku teksta slede faze u implementaciji menadžmenta znanja u organizacijama u rudarskoj industriji. Naime, implementacija sistema menadžmenta znanja, prema autorima *Elias M., Awad i Hassan M., Ghaziri*, podrazumeva analizu i sprovođenje osnovnih aktivnosti koje slede:

**1. Uloga strategijskog planiranja.** Pre primene novog sistema menadžmenta znanja neophodno je razmotriti niz pitanja kao što su planiranje sistema, uključivanje u sistem, kako zaposlenih, tako i top menadžmenta, obezbeđivanje metoda za njegovo sprovođenje i podršku. Kao posledica procene postojeće infrastrukture, organizacija treba da definiše strategijski plan u skladu sa vizijom koja u osnovi ima kratkoročne i dugoročne ciljeve poslovanja, a sve to imajući u vidu sistem menadžmenta znanja. U cilju povezivanja korisnika, u ovom slučaju zaposlenih, sa suštinom i sadržajem njima potrebnog znanja, neophodno je preispitati potrebe za znanjem cele organizacije i sagledati sadržinu znanja neophodnog za stvaranje dodate vrednosti za organizaciju.

**2. Formiranje tima.** Nakon procene postojeće infrastrukture organizacije, treba formirati tim koji će ispratiti izgradnju procesa sve do konačne implementacije programa menadžmenta znanja. Formiranje tima podrazumeva:

- Identifikovanje osnovnih jedinica, departmana, odseka i odeljenja kao

osnovne stejkholdere mogućeg sistema menadžmenta znanja. Svaki stejkholder ima određene zahteve i jednog ili više eksperta koji treba da uzmu učešće u timu za implementaciju menadžmenta znanja.

- Organizaciono, strategijsko i tehnološko uravnoteženje veličine i kompetencija tima. Drugim rečima, tim menadžmenta znanja treba da bude sastavljen od stručnjaka iz svake od ovih oblasti kako bi saradivali na izgradnji sistema menadžmenta znanja koji je po svojoj prirodi multidimenzionalan.

Uspešnost tima za sistem menadžmenta znanja zavisi od nekoliko faktora:

- *Sposobnosti članova tima koje se tiču ličnih osobina, veština komuniciranja i iskustva.* Poželjni članovi tima su osobe koje su sposobne za komunikaciju i naravno, pojedinci sa zavidnim iskustvom iz određene oblasti.
- *Veličina tima.* Tim treba da ima optimalan broj članova koji na pravi način treba da predstavlja organizaciju u celini. Dosadašnja praksa je pokazala da se taj broj kreće od 4 do 20 članova. Timom sa većim brojem članova teško je upravljati i on postaje kontra-produktivan.
- *Složenost projekta.* Složenost i kompleksnost sistema menadžmenta znanja zavisi od veličine organizacije, prirode proizvoda i usluga koje pruža organizacija, stepena tehnologije i iskustva članova tima.
- *Liderstvo i timska motivacija.* Efektivno liderstvo može unaprediti motivaciju, kooperaciju i koordinaciju unutar tima koje će, dalje, obezbediti pozitivan ishod.

**3. Osvajanje znanja.** U trećoj fazi uvođenja sistema menadžmenta znanja u rudarskoj industriji, u praksi osvajanje znanja može imati različita značenja. Ukratko, eksplicitno ili dostupno znanje se

osvaja iz dokumentacije, baze podataka i drugih medija. Nasuprot tome, prečutno (*tacit*, eng.) znanje se nalazi u umovima stručnjaka koji rade u organizaciji. Osvajanje znanja uključuje analizu izvodljivosti, izbor eksperata, širenje ekspertskog znanja, popunjavanje praznina u sistemu menadžmenta znanja i verifikovanje validnosti znanja nakon aktiviranja sistema. Iz navedenog sledi da se sve faze sistema menadžmenta znanja stalno razvijaju i svojom dinamikom prate potrebe organizacije.

4. **Prototip.** Većina sistema menadžmenta znanja počinje kao mali jednostepeni sistem baziran na ograničenom znanju stečenom kroz prve sastanke sa ekspertima organizacije. Sistem raste postepeno sa dodavanjem novih elemenata znanja koji se dodaju na prototip. Osnovne prednosti stvaranja prototipa sastoje se u sledećem: greške se mogu brže korigovati, sistem se testira svaki put kada se ugrade nove izmene ili dopune, omogućava da proizvode provere u ranoj fazi, omogućava se postepen porast i razvoj sistema i to uporedo sa izmenama shvatanja korisnika, promovise značaj ubrzavanja procesa sticanja znanja i demonstrira mogućnosti osnove sistema znanja koji je u izgradnji.

5. **Selekcija eksperata.** Stručan i kooperativan ekspert, koji je spreman da svoje znanje podeli sa drugima i učini ga kolektivnim, osnova je za uspeh procesa uvođenja menadžment znanja. Ekspert mora biti sposoban da razmenjuje informacije razumljivo i dovoljno precizno. Prilikom selekcije eksperata potrebno je razmotriti sledeće činjenice: koliko je iskustvo eksperta, da li je ekspert u mogućnosti da isprati projekat do kraja, koje je rezervno rešenje u slučaju da ekspert izgubi interes ili odluči da napusti projekat.

6. **Dizajniranje informacione strukture** je preduslov za uspešno uvođenje sistema menadžmenta znanja. Dizajniranje sistema menadžmenta znanja podrazumeva razmatranje nekoliko pitanja.

1. Usmeriti se na operativnost sistema koja organizacija već poseduje

2. Definirati mogućnosti predloženog sistema menadžmenta znanja imajući u vidu sve prednosti infrastrukture
3. Doneti odluku o predloženim komponentama sistema
4. Razvijati osnove arhitekture menadžmenta znanja koja bi zadovoljila potrebe organizacije.

7. **Testiranje sistema menadžmenta znanja.** Testiranje sistema menadžmenta znanja uključuje dve faze: verifikaciju procedure i validaciju procedure. Verifikacija procedure potvrđuje da je sistem pravi i da obavlja one funkcije koje treba da obavlja, tj. da je pravo znanje dostupno kada je potrebno i to u obliku u kome je potrebno. Validnost potvrđuje da je sistem odgovarajući, tj. da izlazi u susret potrebama i zahtevima korisnika i da će biti koristan. Drugim rečima, postupak validnosti proverava pouzdanost sistema menadžmenta znanja.

8. **Implementacija sistema menadžmenta znanja.** Naredna faza nakon jednom osvojenog znanja, kodiranog u bazi podataka, verifikovanog i validnog, jeste implementacija sistema. Implementacija podrazumeva ugradnju sistema menadžmenta znanja u konkretne operacije i vođenje računa o stalnom obezbeđivanju kvaliteta sistema, obuci zaposlenih da se uključe u sistem menadžmenta znanja i, naravno, upravljanje promenama koje su stalne, kako u okruženju, tako i u samim organizacijama.

9. **Postsistemska procena.** Nakon uvođenja i aktiviranja sistema menadžmenta znanja, efekti novog sistema na organizaciju treba da budu pažljivo procenjeni. Uticaj novog sistema treba razmatrati posebno u odnosu na njegov uticaj na ljude, procedure i rezultate poslovanja. Postoji nekoliko ključnih pitanja koje treba postaviti u postimplemenatcionoj fazi:

- Koliko je sistem menadžmenta znanja uticao na poboljšanje preciznosti i vremena donošenja odluka?
- Da li je novi sistem prouzrokovao organizacione promene? Koliko konstruktivne su promene bile?

- Kako i na koji način se novi sistem menadžmenta znanja odrazio na stavove krajnjih korisnika?
- Kako je novi sistem menadžmenta znanja delovao na promenu cene poslovanja?
- Na koji način je novi sistem delovao na vezu između krajnjih korisnika i organizacije?
- Da li su rešenja koja predviđa novi sistem opravdala cenu investicija

## RAZVIJANJE RADNIKA ZNANJA

Jedna od karakteristika ekonomije znanja svakako je i stereotipna podela na tzv. *blue-collar* i *white-collar* radnike ili radnike plavog i belog okovratnika. Navedena podela nastala je kao rezultat povećane potrebe za sticanjem i primenom novih znanja i nove tehnologije i okretanjem ka uslužnim delatnostima ("beli okovratnici"), što je, s druge strane rezultiralo smanjenom potrebom za fizičkim radom ("plavi okovratnici"). Međutim, sama ekonomija znanja je dovela i do povezivanja ovih kategorija zaposlenih. Iako se beli okovratnici vezuju za napredak tehnologije i orijentaciju na uslužni sektor, pripadnici ove grupe svrstavaju se i u državnu birokratiju. S druge strane plavi okovratnici su često predmet pozitivnih kulturnih stereotipa, kao što je logičko rezonovanje i zdrav razum, pozitivna radna etika, osećaj solidarnosti, pripadnost timu ili grupi.

Podela na plave i bele okovratnike jasno prevazilazi sadašnje vreme i zahteve ekonomije znanja. Korporacije sve više zahtevaju novi nivo radnika znanja: visoko kvalifikovanog, multidisciplinarno orijentisanog radnika koji kombinuje um belog okovratnika sa rukama i spretnošću plavog okovratnika. Naoružani znanjem iz informacionih tehnologija, tehnoloških i matematičkih nauka, ovi radnici su nazvani "zlatnim okovratnicima" zbog doprinosa koji daju svojim organizacijama, kao i zbog svoje

sposobnosti da primene svoje znanje u proizvodnim industrijama. Uporedo sa prepoznavanjem ovih radnika u poslovanju savremenih organizacija kao nosioca budućeg razvoja i prosperiteta, javlja se zahtev obrazovnom sistemu da pripreme potencijalne radnike u 21. veku na adekvatan način, kao i potreba za ulaganjem potrebnih sredstava za jačanje ovakvih programa. Kako radnici zlatnog okovratnika treba da redovno ažuriraju svoje veštine da bi ostali konkurentni sa stalno promenljivom tehnologijom, učenje u njihovom slučaju treba da bude kontinuiran proces, koji će naići na potporu i same organizacije, ali i čitavog sistema.

Primeri dobre prakse povezivanja obrazovnog sa proizvodnom sistemom postoje i daju dobre rezultate. Tako npr. Centar za visoko obrazovanje i naprednu tehnologiju u Denveru (Colorado's Higher Education and Advanced Technology Center, HEAT) u saradnji sa zajednicom koledža u Koloradu i uz podršku korporacija poput Cisco Systems, Intel, Lucent Technologies, Miller Electric, Haas Automation, and Parametric Technology, školuje i obrazuje "zlatne" radnike u tehnologijama kao što su elektronska proizvodnja, rešavanje problema u primeni lasera, precizno spajanje, elektro optika, fiber optika, biotehnoška proizvodnja, digitalni film i video produkcija. Veoma je važna mogućnost da se u procesu učenja primene sve naučene veštine i znanja u konkretnoj industriji i uz pomoć tehnologija koje korporacije koriste svakodnevno.

Ova vrsta kooperativnog tehnološki orijentisanog edukativnog sistema u kojima država, lokalna zajednica, obrazovni sistem i poslovno okruženje određene industrijske grane rade zajedno, jeste značajna opcija za ublažavanje prisutne nestašice za obrazovanim tehnološkim kadrovima koju je neophodno razmotriti svakako i kada je u pitanju rudarska industrija. Naravno, govoreći o ekonomiji znanja u rudarskoj industriji neophodno je pomenuti i još jedno shvatanje koje se javlja u literaturi, a koje smatra



da jedini radnici relevantni za poslovanje u 21. veku jesu tzv. "zeleni okovratnici", tj. radnici koji mogu obezbediti dve ključne stvari za svoje organizacije - profitabilnost i održivost. Sve ostalo je, po pristalicama ovog shvatanja, potpuno i relevantno.

Kako je u samoj Strategiji naučnog i tehnološkog razvoja Republike Srbije u periodu od 2010. do 2015. godine navedeno, jedna od ključnih investicija u budućem periodu jeste investicija u ljude, za koje je predviđeno čak 33 miliona evra za period od pet godina, tako postaje jasno da akcenat razvoja i same rudarske industrije, koja je obuhvaćena ovom strategijom takođe treba da bude investicija u ljudske potencijale, odnosno u radnike znanja. To jasno pokazuju i strateški ciljevi Naftne industrije Srbije koja je u 2012. godini kao svoje ciljeve postavila tehničko-tehnološki razvoj i razvoj ljudskih potencijala. Pa je tako u razvoj kompanije u 2012. godini uloženo 50,8 milijardi dinara u tehnologiju u obuku zaposlenih.

Kao što smo videli, radnici znanja su oni radnici koji su u stanju da u svom radu koriste simbole, koncepte, različita znanja i informacije, i koji su u stanju da stvore dodatnu vrednost zahvaljujući svojoj sopstvenoj originalnosti, sposobnosti analitičnog razmišljanja i proceni, među koje se uglavnom ubraja srednji i visoki sloj menadžera, profesionalci i saradnici profesionalaca sa izuzetno razvijenim posebnim osobinama. Zahvaljujući tome što radnici znanja proizvode dodatnu vrednost koristeći svoje znanje kao instrument rada, odnos između njih i samih poslova koje obavljaju se suštinski promenio. Oni su danas pokretač razvoja nove ekonomije i ključni strateški i konkurentski izvor savremenih organizacija. To su dakle oni pojedinci koji u doba ekonomije znanja obavljaju poslove koje su sami kreirali, odnosno poslove koji su nastali u procesu njihovog razmišljanja ili drugih aktivnosti koje u osnovi imaju njihovo sopstveno znanje i veštine. Ili kako je to rekao Horibe, radnici znanja su oni

zaposleni koji kreiraju i stvaraju proizvodne vrednosti koristeći više mozak nego ruke.

## ZAKLJUČAK

Zaposleni u rudarskoj industriji se suočavaju sa nizom izazova koji su karakteristični samo za tu privrednu oblast, pa je njima, čini se, više nego inače potrebna pomoć i obuka za prevazilaženje okolnosti u kojima žive i rade. Naime poslovi u ovoj industriji su uglavnom u rudarskim oblastima koje se obično nalaze na udaljenim mestima i izvan velikih Univerzitetskih i privrednih centara. U takvim uslovima zaposleni su suočeni sa klimom koja može biti ekstremna, tropskim šumama ili pustinjama, a u uslovima podzemnih rudnika, radna mesta podrazumevaju aktivnosti ispod zemlje u okolnostima ispunjenim toplotom, tamom i vlagom. U rudarstvu se radi 24 h dnevno, a radno vreme nije kao u drugim industrijama. Sve to ukazuje na veličinu izazova sa kojima se susreće rudarstvo XXI veka. Zbog povećanja kompleksnosti savremenih tehnologija u rudarstvu, potreban je sve veći broj obrazovanih ljudi koji će biti u stanju da upravljaju tim procesima u uslovima koje smo opisali. Ti ljudi treba da imaju pored stručnih znanja i čitav set personalnih poslovnih veština i ličnih osobina, kao i informatičku pismenost. Ukoliko se tome doda činjenica da poslovi u rudarskoj industriji spadaju u grupu najopasnijih poslova i da rudarski poslovi nisu samo muški, već podrazumevaju sve poslove od sekretarskih do visoko stručnih, postaje sve jasnije da su ulaganje u ljudske resurse i uvođenje menadžmenta znanja i u rudarstvu i energetici zaista jedan od uslova njene konkurentске prednosti.

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