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GLOBALIZATION AS A SOURCE OF INNOVATION IN HARD COAL MINING

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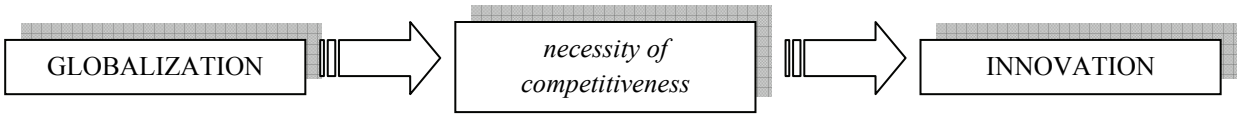
Abstract:
Globalization is an inevitable process which in a different scale influences the performance of particular industries and companies of national economies functioning in them. Considering destructive as well as constructive impact of globalization on a company, in this paper there was the following research problem raised: What are the conditions necessary for using globalization as a source of innovation in hard coal mining? In order to answer such research problem, the paper was divided into three parts. In the first part, globalization was presented as a source of innovation in hard coal mining in Poland. Therefore, literature study was used to describe premises, circumstances of implementing and types of innovations in hard coal mining. In the second part, using SWOT analysis, the list of threats and opportunities was prepared that are generated by globalization for innovation in Polish hard coal mining. The assessment was also conducted regarding the influence of strengths and weaknesses of Polish mining enterprises on innovation processes. In the third part, using scenario method, the options of hard coal mining development generated by globalization were described as well as the innovation processes triggered by it. The final results of conducted research is the SWOT analysis and scenarios of development of Polish mining enterprises in the context of globalization as a source of innovation. The research results may be used by the industry and by mining enterprises when creating development strategies and in the analysis of investment and strategic risk.

Keywords: mining enterprises, innovation, globalization.

1. GLOBALIZATION AS A SOURCE OF INNOVATION IN HARD COAL MINING IN POLAND

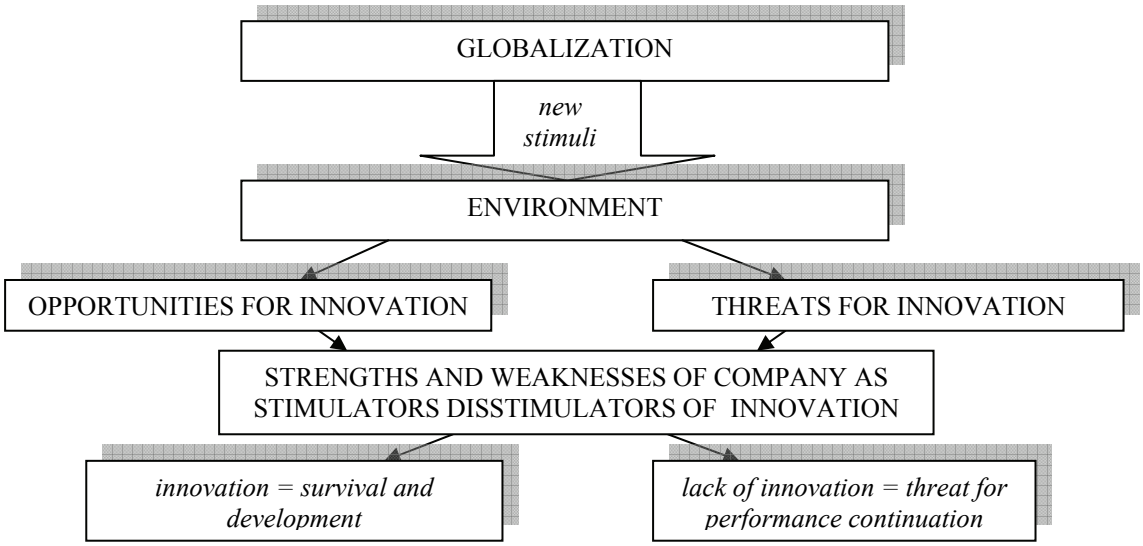
Globalization, that is "the rise of different types of relations between various subjects of international life and the rise of number and type of interactions between these subjects" (Gwiazda, 1998, p.9) causes that companies are forced to perform on international markets (Murray & Sekella, 2007, pp. 91–99). Consequently, they must recognize the specificity of the markets as well as requirements, likes and preferences of the recipients. Globalization then forces the increase in competitiveness of companies, what becomes the innovation trigger (Denton, 1999, pp. 82–85) (figure 1).

Figure 1: Globalization as a source of innovation



Globalization, forcing the increase in competitiveness and undertaking innovation processes (Ling, 2012, pp. 129–144), may constitute a threat as well as an opportunity for companies (Inauen & Schenker-Wicki, 2011, pp. 496–520). If the company is able to face the globalization challenges then it gains the possibility of surviving and developing on the international market (Slywotzky et. al, 2006, pp. 23–32). But if it does not accept the challenge or its realization ends up in failure, the further company's functioning shall be threatened. Therefore, it may be stated that globalization itself is a neutral phenomena, generating only a set of stimuli (Löscher, 2010, pp. 349–353). The direction of such stimuli depends on the company's environment, however, whether it constitutes an opportunity (Awuah & Amal, 2011, pp.120–132) or a threat (Bloch & Groth, 1996, pp. 311–321) it depends on company's internal strengths and weaknesses (figure 2).

Figure 2: Globalization, environment and inside of company in innovation creation



Globalization influences on companies of traditional industries particularly intensively, in which production has been based on permanent technologies for many years (Jonek-Kowalska, 2011, pp. 280–290). Such companies are characterized by a low flexibility in adapting to changes in environment caused by a large size, stiff organizational structures and

high consumption of capital in the innovation and investment ventures (Häggman, 2009, pp. 386–407). Nevertheless, it does not mean that these companies are doomed to failure. Also for them, globalization may become a chance for renewal and prolongation of maturity stage.

Polish hard coal mining is one of the strategic industries in the country of a key importance for Silesian region. Currently, there are three big coal enterprises functioning in the sector that constitute a property of Treasury and one resiliently performing stock enterprise, being in hands of private investors. There are also preparations in progress for launching 2 new mining enterprises supplied with private equity.

For the companies performing in the sector, the most important globalization conditions are environment factors, stemming from European Union regulations (Magda & Franik, 2011, pp.71–78). The document which started the creation process of European energy law was the Green Paper including the strategy for sustainable, competitive and secure energy (Green Paper, 2006). An extended version of this act was so called *Energy Package*, shaping a new energy policy in European Union. The most important postulates included in the document, determined as "3x20", assume that until year 2020 European Union should:

- increase energy efficiency by 20 %,
- increase the share of renewable energy in the total balance to 20 %,
- reduce carbon dioxide emission by 20 %, with the possibility of increasing this amount even to 30 % if there are favorable external conditions (Malko & Wojciechowski, 2007, pp. 13–17).

In the light of the above, a basic factor determining the functioning of mining in Poland is currently the necessity of fulfilling requirements stemming from European Union regulations included in the Energy Package. Moreover, the last aforementioned postulate, concerning carbon dioxide emission, is of a great significance. In this matter, there have been the following settlements adopted:

- for the existing sources of electric energy and those that were under construction before the end of year 2008, gradually there will be an increasing obligation of rights purchase for carbon dioxide emission from the level of 30 % in 2013 to 100 % in 2020,
- for new sources of electric energy there will be an obligation of rights purchase in 100 %,
- for producing heat network in the objects of electric engineering and installations of high-performance cogeneration producing heat for heat engineering, there will be free rights provided for combustion gases emission,
- in the remaining objects there will be an obligation of rights purchase for producing heat network, increasing to 100 % in 2027.

This means that Poland received the opportunity to use a transitional period regarding the obligation of rights purchase for green house gases emission by energy engineering units. The use of transitional period will prevent from excluding coal from the portfolio of fossil fuels, which would result in diminishing the energetic safety. However, the regulations presented require at the same time undertaking actions aimed at reducing green house gases emission significantly. Such actions are connected with the implementation of complex technologies of coal removal from fuel stream, transporting it to storage areas and storing it. These technologies are defined as CO_2 *Capture and Storage*, CCS (Turek, 2008, pp.15–20) in short. The future demand for hard coal in power industry shall depend on innovation implementation in this scope (Turek, 2007b, pp. 27–42). However, it should be stressed that

carbon dioxide emission in the process of hard coal combustion, in the group of available fuels, is one of the highest.

Nowadays, technologies of electricity production and carbon dioxide separation are developed. There are also concepts optimized of power plants with and without carbon dioxide separation. Ash supercritical units powered by coal fuel, integrated gasification combined cycles (IGCC) and natural gas combined cycles (Ściążko & Chmielniak, 2010, pp. 36–50) (NGCC) are improved in the direction of higher energetic efficiency and lower unit investment outlay (Ściążko & Chmielniak, 2010, p. 50). A geological recognition of structures appropriate for long-term and safe carbon dioxide storage is also an urgent issue.

In frames of modern coal technologies, there are also other solutions drawn up of coal-nuclear synergy use. Nuclear cogeneration is a simultaneous electricity and heat energy production by the use of nuclear reactors. However, typical nuclear reactor produces heat of a temperature that does not exceed 300°C, what limits the possibilities of heat use for electricity generation as well as numerous low-temperature use. Only the use of HTR type reactors (*High Temperature Reactors*), based on hard coal supply, will open the possibilities of providing high-temperature process heat for many technological processes. New non-emission sources of heat not only is going to limit the carbon dioxide emission but also decrease the use of natural gas and crude oil. Moreover, they will also increase the possibilities of carbon dioxide processing in chemical reactions (Pieńkowski, 2010, pp. 33–36; Taczanowski, 2010, pp. 73–86).

Besides the requirements implied by European Union regulations in hard coal mining presented above, there are also works in progress on enrichment of techniques and technologies of deposits extraction (Magda et al., 2010, pp. 34–37; Głodzik et al., 2010, pp.170–173). In the managerial, basic and supportive processes, innovation implementation is mainly directed on lowering extraction cost, what makes it possible to decrease the coal price eventually. Currently, it is mostly conducted by the automation and computerization of technological processes (Gawor, 2010, pp. 131–140).

Innovation implementation in a mining enterprise, in terms of processes of resources gain and use, mainly consists in undertaking actions leading to the quality improvement regarding extracted coal. It is a big challenge for the mining enterprises and one of their biggest problem is the price decrease of coal offered with the quality increase at the same time. Product innovation sources in this case derive from the possibilities of basic parameters shaping concerning hard coal such as: heating qualities, total dampness and amount of ash and sulfur. The use of an appropriate enrichment technology enables the production of specific coal assortments of the quality required by customer. Nevertheless, it should be remembered that the quality of coal trading assortments also depends on the coal features in deposits and the extraction system adopted. Therefore, it is strongly determined by the natural and geological-mining conditions, what considerably influences on an innovative potential of mining enterprises.

2. SWOT ANALYSIS OF THE INNOVATION PROCESSES IN POLISH HARD COAL MINING INDUSTRY

In the light of the above, globalization is an unarguable innovation impulse for Polish hard coal mining industry. Table 1 presents the circumstances in which the stimuli that are generated by globalization may become an opportunity or a threat for the Polish mining enterprises.

Table 1: Circumstances of transformation of stimuli generated by globalization into opportunities or threats for Polish mining enterprises

Stimulus generated by globalization	*Circumstances of transforming into opportunity*	*Circumstances of transforming into threat*
Restrictions concerning the carbon dioxide emission (Polonsky et.al, 2011, pp. 368-383)	Prolonging the transitional period of Poland. Fast development and implementation of technology of carbon dioxide storage.	Maintaining or tightening the restrictions of carbon dioxide emission for Poland. Lack of innovation in the area of carbon dioxide storage or faster implementation of these innovations by competition (Xodo, 2011, pp. 442-446).
Development and popularization of renewable sources of energy (Plumb & Zamfir, 2009, pp. 684-695)	Slow development and use of renewable sources of energy that allows for lengthening of technological adjustment processes in hard coal mining.	Slow development and use of renewable sources of energy that prevents from lengthening of technological adjustment processes in hard coal mining (Marigo et. al, 2010, pp. 253-268).
Development and popularization of nuclear sources of energy	Designing nuclear-coal synergy technologies and social acceptance of such technologies. No acceptance for nuclear sources of energy.	Increase in social acceptance for nuclear sources of energy as competition to coal.
Designing new technologies of hard coal mining	Design and use of new technologies for mining and spoil enrichment.	Lack of innovational technologies of mining and spoil enrichment or faster implementation of these technologies by competition.
Supply and prices of hard coal from international competitors	Low level of Chinese hard coal production (LPS). High level of using export infrastructure by competitors.	High level of Chinese hard coal production (LPS). Low level of using export infrastructure by competitors.
Prices of natural gas on international markets	High prices of natural gas	Low prices of natural gas.

The opportunities and threats for the Polish hard coal mining industry, that are presented in table 1, which are generated by globalization, according to the methodology presented in Figure 2, should be confronted with weaknesses and strengths of Polish mining enterprises (Turek et. al, 2011, p. 159-172). The former consists mostly in the lack of resources for

financing, resulting in the lack of investment expenditures. Unbeneficial conditions also are among the geological-mining factors, such as the concentration and deepening of mining which cause the increase of the production costs. Another weakness of Polish coal enterprises is the overly rigid organizational structure and the unwillingness of the aging staff of mines to accept changes (Cottam et. al, 2001, pp. 88-94). The key strength of Polish hard coal mining is a significant sufficiency of operational resources that guarantees the continuity of supplies for the needs of the energy industry as well as the high quality of the material mined. Another advantage is the lack of competitive sources of energy in the region. The aid from the government, provided to maintain and protect the industry that holds a strategic position for the economy – and the hard coal mining industry, unarguably is such an industry.

3. SCENARIOS OF INNOVATIONS DEVELOPMENT INSPIRED BY GLOBALIZATION IN POLISH HARD COAL MINING

A combination of opportunities and threats as well as strengths and weaknesses of Polish mining enterprises implies the existence of innovation development inspired by globalization (figure 3).

Figure 3: Scenarios of innovation development inspired by globalization

	opportunities	*threats*
strengths	**1**	**3**
weaknesses	**2**	**4**

In the first (1), the most favorable scenario, it is possible to use the resources and quality of Polish hard coal in the favorable conditions of environment, meaning a free development of alternative methods of satisfying energy needs and a gradual and continuous development of new extraction technologies, mining spoil enrichment and carbon dioxide storage. Such scenario, beside favorable external conditions, require a great awareness of innovation's role in mining and a proper planning of their elaboration and implementation (Morden, 1989, pp. 34–41). A necessary condition of its realization is also obtaining the financing sources for conducting research-development activity and the use of elaborated solutions.

The second (2) of possible scenarios assumes that the external conditions would conduce to innovation realization but they would be hindered by internal weaknesses of Polish mining enterprises. However, it should be noticed that some of them are only possible to eliminate when there are favorable environment conditions. The maintenance or demand growth in hard coal, with a slow competitors development, facilitate receiving the good prices of Polish resources and at the same time, improvement of financial state of mining enterprises. (Ahmed, 1998, pp. 30–43).

The third (3) scenario assumes that the environment adapts faster and more efficiently to the globalization requirements than Polish mining enterprises (Johannessen, 2001, pp. 20–31). Then they have to prepare for a struggle to survive using the attributes in a form of decent

coal and make local customers dependent on this resource. Innovations will not be a source of competitive advantage in this case, however, it may be possible to obtain them cheaper than competition does (Duarte & Sarkar, 2011, pp. 435–459).

The last (4) of the scenarios is of a declining character and assumes the realization of most unfavorable globalization conditions and emphasizing weaknesses of mining enterprises. In this case, the competitors have implemented modern technologies (Tyfield & Jin, 2010, pp. 269–282) but Polish mining enterprises struggle with the lack of capital as well as employees and management's reluctance to any changes, waiting for government's support. Such set of conditions means the fall of mining enterprises in Poland, with the possibility of keeping 1–2 private partnerships alive which produce coal more effectively than the great state giants.

4. HARD COAL MINING IN THE COUNTRIES OF EUROPEAN UNION

Among the countries of European Union, hard coal is extracted only in Poland, Germany and Spain, also in France but in very small amounts. Nevertheless, the share of this mineral in fulfilling the energetic needs of European countries is still very high. Indeed, the countries have withdrawn from the hard coal production but they still use it, satisfying the needs through the transport. Moreover, in the countries of European Union, the structure of satisfying energetic needs from various sources is changing very slowly. Over the last 10 years the amount of solid fuels in the energy supplies in EU have decreased by only 16 %. Also the supplies of oil fuels went down by 39 %, of gas by 25 % and the amount of nuclear energy decreased by 8 %. On the other hand, the level of energy from the renewable sources increased, including mainly from biofuels. The solid fuels, also the hard coal, remained the main source of energy and their significance in the last three years considerably increased due to the rise in the prices of oil and gas.

In Germany the extraction of hard coal in the last few years have become unprofitable. The plans of the hard coal mining liquidation until the year 2018 have been created. However, similarly to Poland, the fate of the industry has not been definitely decided. The hard coal is still the main source of energy and its production provides energetic safety and independence in Germany. There just one question remains: how long may the country support the unprofitable mining? At the same time, there are also works conducted on innovation implementation in mining, that is technologies of coal liquefying and gassing. Therefore, the German mining is still maintained because of the economic and social priorities and additionally, it constitutes the recipient of domestic innovation in terms of the industry of mining machines and devices, ecological installations and energetic technologies.

The hard coal mining in Spain, similarly to Germany, is unprofitable and requires government's support. However, it does not play such a significant role in the energetic policy of the government. In the Spanish mining, there are only about 7 thousand miners are employed and it fulfils only 20% of the energetic needs relating to the solid fuels. 80% of hard coal comes from import. Therefore, in the hard coal mining in Spain, in the next few years it is expected to liquidate the unprofitable mines. The supply of innovations is not included, social problem of the industry decline is partly leveled by the foreigners who are employed in mines there.

5. CONCLUSIONS – VERIFICATION OF THE SCENARIOS ASSUMED

Observation of trends in a world hard coal mining in the last two years allows to state that the scenario full of opportunities for Polish hard coal mining is mostly realized. Renewable energy sources are developed slowly and do not constitute a direct competition for solid fuels in satisfying energetic needs. An increasing people's aversion is also caused by nuclear energy. The prices of natural gas are rising, which is a direct competitor of hard coal. Beside Canada and USA, all foreign competitors have the export infrastructure used maximally. There are no fast and cheap solution concerning carbon dioxide storage either. According to the above, almost all globalization circumstances are in favor of Polish hard coal mining. Therefore, the most probable is scenario 1 or 2 regarding innovations' development inspired by globalization in Polish hard coal mining. Nevertheless, it is worth to emphasize once more that in order to achieve them, a conscious and strategically oriented management of mining enterprises is necessary (Martins & Terblanche, 2003, pp. 64–74).

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