ZAŁĄCZNIK NR 3b

SUMMARY OF PROFESIONAL ACHIEVEMENTS

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1. Name

Urszula Kaźmierczak

2. Diplomas, academic degrees – including the name, place and year of obtaining thereof and the title of the doctoral dissertation

a) Master's studies diploma:

- Wrocław University of Science and Technology, Faculty of Mining
- subject area: mining and engineering geology
- specialisation: Earth Resources Management
- obtained on 7 July 1997
- thesis title: *Dobór roślinności zielnej i drzewiastej w ramach rekultywacji biologicznej zwałowiska zewnętrznego KWB Bełchatów*
- advisor: dr inż. Aureliusz Mikłaszewski

b) Degree of Doctor of Technical Sciences:

- Wrocław University of Science and Technology, Faculty of Mining
- subject area: mining and engineering geology
- obtained on 30 September 2002
- doctoral dissertation title: *Economic, natural and spatial functions of rock mining in the surrounding area of Wrocław*
- advisor: dr hab. inż. Jerzy Malewski
- reviewers: prof. dr hab. inż. Jerzy Bednarczyk, prof. dr hab. inż. Jerzy Chwastek

3. History of employment in research units

Wrocław University of Science and Technology
Faculty of Geoengineering, Mining and Geology,
ul. Wybrzeże Wyspiańskiego 27, 50-370 Wrocław

01-Oct-2002 – 30-Sep-2005 – employed as Assistant
01-Oct-2005 – present – employed as Assistant Professor
01-Oct-2015 – present – Head of the Laboratory of Research on Rocks and Minerals
01-Oct-2016 – present – Deputy Head of the Department of Mining
since 2019 – Head of the Laboratory of Mineral Engineering at the Laboratory of Earth Sciences and Mineral Engineering

On 1 October 2002, I began working as Assistant at the Department of Mineral Resources and Waste Processing, Institute of Mining, Wrocław University of Science and Technology. Since 1 October 2005, I have been employed as Assistant Professor. On 1 October 2015, I have become Head of the of Laboratory of Research on Rocks and Minerals of the Faculty of Geoengineering, Mining and Geology. At present, I also serve as Deputy Head of the Department of Mining, as which I have been appointed on 1 October 2016 by the Dean of the Faculty of Geoengineering, Mining and Geology.

4. Indication of the accomplishment as per article 16 section 2 of the Act of 14 March 2003 on academic degrees and academic title and art degrees and title (Journal of Laws 2017, item 1789)

4.1. Title of the Academic Accomplishment

The basis for application for the academic degree of *doktor habilitowany* (D.Sc.) is a single-authored monograph entitled:

VALORIZATION EFFECTIVENESS OF POST-MINING AREAS OF ROCK RAW MATERIALS

4.2. Author, publication title, publication year, publisher name, publication reviewers

Author: **Urszula Kaźmierczak**
Publication title: **Valorization effectiveness of post-mining areas of rock raw materials**
Publication year: **2019**
Publisher name: **Oficyna Wydawnicza Politechniki Wrocławskiej**
Publication reviewers
dr hab. inż. Jan Kudełko, University Professor
prof. dr hab. Marek Lorenc

4.3. Overview of the scientific purpose of the above-mentioned work and results with an overview of their potential use

The thesis of the subject work was included in its title and it applies to the efficiency of valuation of the areas used for rock mining, in particular the functions that the given area may fulfil after reclamation. The issue that I addressed was very complex and difficult, because literature and mining practice include no standards for analysing the environmental, economical and social impact of new mining projects in the entire life cycle, considering this task as rolling costs. I noticed that any attempts to refer to the considered impacts in literature are only individual, isolated and separated into the particular life cycle stages of a mining undertaking. This is invalid, because any changes in the environment, resulting from new projects, should be considered in entirety, including both the positive and the negative impacts on the environment, society and local economy. These nuances prompted me to undertake an attempt to develop the methodological basis of the efficiency of area revaluation as the relationship of the results of the current and target use of the mineral resource deposit and the use of post-mining areas, which was the utility purpose of the subject work. However, I considered this issue as a function of time, because at different stages of development, the given project achieves different values. The rule in this type of activity is that at the initial stage, the costs are usually greater than the benefits, however this situation may be reversed at the final stages of the project, provided, however, that the post-production area use concept is accurately selected and designed already at the beginning of project implementation. Therefore, balancing project costs and benefits in the entire life cycle, considering them as rolling costs, seemed to be an essential problem.

In the subject work, I also undertook to present the analyses and explanations of how and what legal, environmental and economic conditions influence the entire process of strip rock

mining activity, at every stage of the mining project life cycle, including the complexity of all stages resulting from their mutual interpenetration.

My area of interest in the subject work was the so-called small area mining (rock mining), of which the impact range is clearly local in nature (commune level). In my work, I distinguished the impact of large area mining (power coal, metal ore and sulphur mining) and small area mining (rock mining). The basic difference is the magnitude of extraction and the impact range of a single site. In addition, large area mining is concentrated in several mining companies, while small area (rock) mining is in the scale of several thousands of economic entities. As a result of this situation, the scale of impact of large area mining yields great economic benefits to individual communes, while in the case of small area mining, the impact range of a single mine is local (fig. 1).

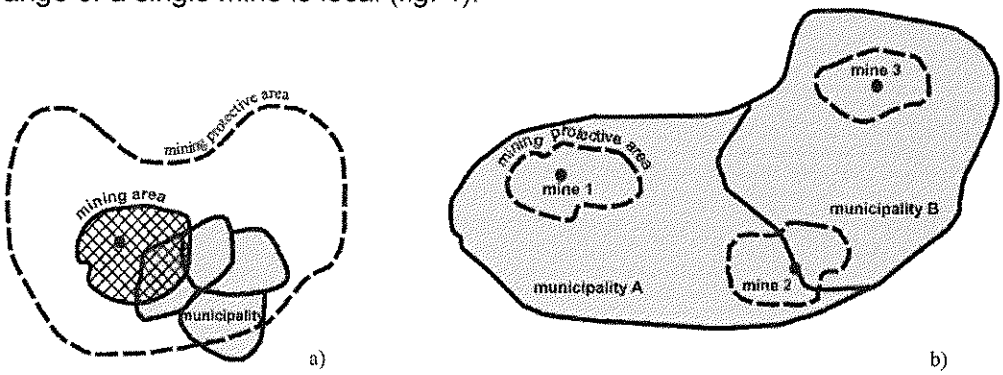

Fig. Impact range of (a) large and (b) small area mining on the local socio-economical and natural landscape

My research was focused on the Lower Silesia region, because from the geological perspective, it belongs to the most interesting regions of Poland. Almost 90% of the mineral resources extracted nationally, for the production of construction and road components, comes from Lower Silesia deposits (Kaźmierczak and Kaźmierczak 2012). Furthermore, Dolnośląskie Voivodeship is one of the most valuable, from the perspective of environmental resources, regions of Poland. This finds confirmation in the environmental legal protection covering approx. 20% of the voivodeship area. This is also the basis of the estimates that 39% of documented deposits of rock raw materials is located in environmentally valuable areas, often covered by one or more protection forms. Considering the depletion of deposits in areas with running mining activities, attention begins to be paid to the resources in areas covered by environmental protection.

To achieve the first assumed objective of my work, I analysed the aspects of the environment as a natural and social space. I addressed the issues of the environmental impact of mining and presented in broad terms the issues of social conflicts related to the start-up, operation and shut-down of raw material projects. I paid particular attention to the role of environmental and spatial planning conditions in the functioning of mining projects. I proposed to refer to a mining project as an investment project. I analysed the costs and benefits of parties resulting from the mining activity being started-up, operated and shut-down. Finally, I proposed an original methodology for the assessment of efficiency of valuation of post-mining areas and provided an example of practical application thereof. In the subject work, I proved that a proper selection of the direction of reclamation may lead to the provision of the post-mining area with new, often more attractive functions than it had

before exploitation. It may also result in an increase of the market value of the post-production area. Furthermore, the design and implementation of proper direction of reclamation may result in the reception thereof as benefits from a planned project, thus having a positive impact on the social acceptance of the project. In addition, I indicated that positive aspects, in the environmental and social assessment, will include revenues to commune budgets and creation of new jobs, both in the context of the planned project and in its surroundings.

The environment as a natural and social space and social conflicts

My analysis of the environment as a natural and social space proved that the natural environment is a total of components of animate and inanimate nature, which are not man-made. A component of this environment are the natural resources that play a foundational role in the processes of economic development and become indispensable in satisfying the raw material requirements of any economy (Lipiński 2015). Therefore, mineral resources exist in a particular natural, but also social space. The social significance of mining is that the subject of exploitation is a deposit that is a common good in nature, which should bring economic benefits to the society (Malewski 2008). The extraction of mineral resources brings benefits not only because it supplies the raw materials necessary in many areas of the economy, but also because it generates economic revenues in communes. Based my research, I noticed that the primary revenues from the exploitation of the local mineral resources are: usage fees, taxes on economic use of land, income taxes on the legal and natural persons living and working in the commune, where the deposit is exploited, charges and annual fees for the exclusion of agricultural and forest lands from production and taxes on the transport means of private persons. It should be also noted that rock mining provides an additional support to the local economy, because on the one hand it creates competitive job and generates employment in sectors or services for the purposes of mining employees (transport, trade, services, construction etc.), while o the other hand increased economic activity improves the conditions for the influx of additional capital and increases the opportunities for developing geotourism and ecotourism on post-mining sites and investment, e.g. in recreation and cultural infrastructure or public utility structure (Pietrzyk-Sokulska 2015, Nieć et al. 2008, Czaja et al. 1997). In addition to the economic benefits listed, rock industry also delivers many social benefits connected to the opportunities for career development and life-long learning related to higher income, better living standards, revitalisation of post-mining areas and services linked to mining activity, thus stimulating the local population, contributing to the development of identity and social bonds by creating new cultural values and mining heritage in the process of revitalisation of post-mining areas or maintaining a positive migration balance (Baczyńska et al. 2017a,b and 2018, Pietrzyk-Sokulska 2015, Uberman et al. 2014, Kasztelewicz 2010, Naworyta 2013).

Based on the analysis of literature, I addressed the issues of social conflicts and indicated their origins by characterising the environmental impact of mining activity with respect to rock mining. Because human economy, by using the natural space in mining activity, causes environmental impacts. In most general terms, these impacts may be characterised as direct and indirect. Direct impacts involve the deliberate and planned use of land for the construction of a mining site, which results in a reduction of the nature area. In turn, indirect

impacts are the unintended, incidental and negative consequences of mining activity, which may occur in the form of: geomechanical deformation, water accumulation, drainage, earthquakes, water flow disturbance etc. These changes, resulting from mining activity, cause conflict situations both during operation and at the time of planning. Hence, problematic situations occur, in which reaching a compromise may be difficult (Kaźmierczak 2014, Pietrzyk-Sokulska 2015). In this conflict, mining is in a specific situation, because it is determined by the geological structure, i.e. the presence of specific resources at a specific time. Another source of conflicts is the occurrence of different forms of use of the given space in the given area. In this area conflicts most often take the form of a conflict of interest. Because at the moment of start-up of a new mining project, its duration or decommissioning or reclamation, all parties to the conflict want to fulfil their interests in the given space. The parties to the conflict are: the mining company, the local community, the territorial administration. In some cases, the parties to the conflict may also be: local non-governmental organisations (e.g. environmental or tourist-sightseeing organisations), national organisations, as well as global organisations (with national representation). In the aspect of conflicts, one may not neglect the involvement of economic entities, budget units or social organisations active in the given area. The interests of these parties may be convergent with the policy of the mining company (e.g. trade unions) or not, e.g. in case of State Forests, voivodeship natural landscape park complexes etc. In addition, parties may include the research units, of which the employees act as independent experts. The media also play a very significant role in conflicts, because they deliberately or not express a certain attitude to the problem (Badera 2010, Pietrzyk-Sokulska 2015).

The origins of conflicts are, of course, conflicting expectations of the parties. Due to the environmental impact of mining, the most frequently raised issues in these conflicts is the concern about the deterioration of the environment and maintenance of the existing land management of the given area. Environmental protection issues relate to air and water pollution, the loss of soil productivity and noise. In turn, a change of the existing land management of the documented deposit area may be received as e.g. a loss of tourist-recreation values of the given area. This, by consequence, may cause concerns in the entities that profit from recreation and tourism (agritourism farms or golf clubs) (Badera 2010). Another very sensitive issue is the transport of raw materials outside the mining site. This problem is special, because transport has an impact on all components of human environment, starting from the traffic of heavy vehicles, through noise and vibrations, road safety, air pollution to road infrastructure damage. The spatial distribution of rock raw material deposits determines the passage of the roads used to transport the aggregate. A definite majority of products in the case of rock mining is transported y road, which causes noise, vibrations, deteriorated technical condition of roads, increased nuisance to the inhabitants and lower safety of road users.

Conflicts in mining activity also occur at the shut-down of mining activity, i.e. the decommissioning of the mining site. The origin of conflicts is connected with the notion of the value of land, which depends on the utility functions that the given area is to serve, which may be different. In most general terms, these functions may be *economic*: agriculture, forest, industry, construction; *social*: sport-recreation, aesthetics (landscape), education;

natural: flora, fauna, biodiversity, species protection, nature monuments etc. This is connected with the differences in reclamation and management costs, depending on the reclamation direction. Assuming (which is generally true) that the mining company is not the future user of the recultivated area, a conflict of interest arises between the parties to the reclamation and management process. Because the mining company will always seek to minimise the reclamation costs. However, the future user will always focus on the maximisation of the economic value of the post-mining reclamation area. Depending on the future user of the given post-mining site, the value of the reclamation area depends on the potential economic benefits that the given area features – in the case of a private owner. In the case of public owners (e.g. commune), the value of land is assessed in the context of the existing nature resources and social and economic needs – in general: on the socio-economical policy of the commune (Kaźmierczak and Malewski 2002). In the subject conflict, there is usually one more party – the local authority that determines the spatial distribution of objects fulfilling various natural and economic functions through local land utilisation plans. Post-mining areas must be recultivated and managed to fulfil their functions according to the land utilisation plans of the given commune.

The concept of mining project as investment project

The next stage of my work was to propose a concept of treating a mining project as an investment project. Every mining project meets all the conditions of an investment project, i.e. it has a development intention, a clearly defined production objective, it is specifically defined with regards to the material scope, place and time of implementation, and it consists of a series of investment activities, divided into three stages: pre-investment, investment and closing. Since a typical mining project consists of a series of characteristic investment tasks or operations, it may be successfully classified as an investment project, which consists of the three basic stages, as in fig. 2. I propose to treat searching and documenting, design, formal and legal works, obtaining permits and excluding lands from agricultural and forest production as the pre-investment stage. In turn, the investment stage includes: operating records, enabling works, i.e. the removal and storage of the waste and the extraction of the mineral resource. The reclamation and decommissioning of the mine are included in the closing stage of the investment project. I also indicated that the period of operation of such project ranges from a dozen months to several decades. The pre-investment phase lasts from several months up to 1,5 year, the investment phase up to several decades and the closing stage up to 5 years from the discontinuation of mining activity.

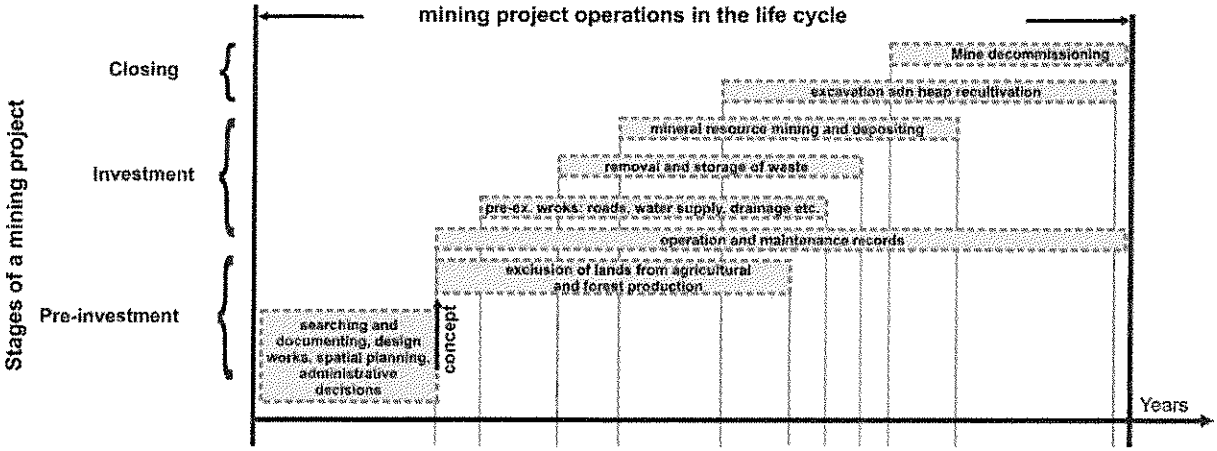

Fig. 2. Stages of a mining project (original work based on Malewski 2012b)

Cost and benefit characteristics of a mining investment project

Based on the proposed approach to mining activity as investment project, I have characterised the individual stages of the entire life cycle thereof. In addition, for each stage I presented a cost and benefit characteristics of the investment project in relation to: the mining company, the local authority (commune) and the environment (table 1). The analysis showed no benefits at the pre-investment stage. However, costs are incurred on the part of the mining company, the commune (including the inhabitants) and the environment. Similarly, at the investment stage, costs are incurred by: the mining company, the commune and the environment. The mining company incurs costs related to preparatory and enabling works, operation and maintenance records, permits, concessions, taxes and fees and mining plant maintenance. The commune incurs costs related to the loss of land value, as well as the loss of recreation-tourist values. In case of the environment, the costs are related to the transformation of the relief of the terrain, changes to the microclimate, fauna and flora, waste, noise, vibrations, air pollution and increased traffic of heavy vehicles. As far as benefits are concerned, they exist as the sales of finished on the part of the company and as revenues to commune budgets, economic stimulation and jobs on the part of the commune. At the final stage of the project, the mining company incurs costs in the form of decommissioning of the mining site, including reclamation, taxes and fees. Benefits exist on the part of the natural environment, as the absence of impact of raw material exploitation and processing, and on the part of the commune, as taxes and fees, new functions of recultivated areas, development opportunities of the new functions of recultivated areas.

Table 1. Cost and benefit characteristics of a mining investment project

	Costs	Benefits
PRE-INVESTMENT STAGE		
The mining company	- documenting the deposit and obtaining the right to geological information - planning procedure (local land utilisation plan of the mining area - optional) - environmental procedure - concession procedure (deposit utilisation design) - right to property - exclusion of lands from agricultural and forest production	-
The commune	- study on the conditions and directions of land utilisation - local land utilisation plan	-
The environment	- geological works - exclusion of lands from agricultural and forest production for economic use	
INVESTMENT STAGE		
The mining company	- preparatory and enabling works (utilities, infrastructure, machine park, processing site) - approvals and arrangements (e.g. operation and maintenance records, water permits) - taxes and fees - mining site maintenance (repairs of the machines and equipment necessary for deposit mining and exploitation)	- finished goods sales
The commune	- loss of land value - loss of recreation-tourist values	- revenues to commune budgets - economic stimulation - creation of new jobs
The environment	- transformation of the relief of the terrain (heaps, dumps, storage of finished goods etc.) - changes to the microclimate, fauna and flora - waste production, noise, vibrations, air pollution - increased traffic of heavy vehicles	-
CLOSING STAGE		
The mining company	- decommissioning of the mining site - post-mining area reclamation - taxes and fees	- revenues in case of reclamation connected with the storage of inert waste in the excavation
The commune		- revenues from taxes on economic use of lands and income - new functions of recultivated areas - development opportunities in newly created functions of the recultivated area
The environment		- absence of impact of exploitation and processing

Methodology of analysis of efficiency of valuation of post-mining areas of rock mining

In the final part of my work, I proposed an original methodology for the assessment of the efficiency of the valuation of post-mining areas, as a relationship of the results of the current and target use of the mineral resource, including the post-mining area reclamation. The subject methodology assumes the estimation of the market value of the areas used for deposit exploitation and after exploitation. The analysis also includes the impact of the project on the local economy, in the form of revenues to commune budgets and creation of new jobs. The most extended form of application of the assessment of the efficiency of valuation of post-mining areas assumes an environmental and social assessment of mining

projects, i.e. a total "cost and benefit" analysis. As the key performance indicators, I assumed: the market value of the land property before and after exploitation, including the functions of post-reclamation areas and the total social and environmental "cost and benefit" analysis, determined according to the particular interest groups. As indirect indicators, I proposed revenues to commune budgets, due to the functioning of the mining project, and the estimated number of jobs due to the operation of such activity, as well as due to the presence of industry in the given area.

For the valuation of property with deposit, I proposed an income approach using discounted cash flow, including the cost approach element related to the estimated reclamation costs. The income approach is used for the valuation of properties that generate or may generate income. In general, this approach consists in estimating the property value assuming that the purchaser will pay the price depending on the expected income from the property. In other words, the value of the property depends on the planned cash flow generated by it (Dydenko 2006). Under this approach, three methods are distinguished: the profit, investment and discounted cash flow method. The investment methods is used to estimate the value of properties that may generate income from rental fees or lease fees. This fee should be determined based on an analysis of trends in market fees. On the other hand. the income method is used if the property to appraise generates other types of income. Furthermore, the income corresponds to the share of the property owner in the income from activity in the property to appraise, i.e. from deposit exploitation in the case of mining activity. The use of this method to estimate the value of property with deposit is based on two key assumptions:

1) the value of the deposit is identical with the value of the project consisting in its management and extracted mineral resource sales,
2) the value of the investment project is identical to the net present value of the cash flows resulting from its implementation.

For the estimation of reclamation costs, I used the reclamation expenditure forecast model, in which the calculation concept is based on a detailed analysis of the type and scope of reclamation works and the calculation of material and financial expenditure on the post-mining area reclamation, both in terms of technical and biological reclamation.

To estimate property value after mine decommissioning and reclamation, I proposed using a comparative approach using comparison in pairs. This method is used in case of few transactions involving similar properties on the given market (which is the case in case of recultivated post-mining areas). The basic principle of the method of comparison in pairs is to compare properties in pairs, i.e. the reference property, of which the price and features are known, and the property to appraise, of which the features are known, but the price is unknown.

I investigated the impact of planned investment on the local economy by a context analysis of revenues to commune budgets due to mining activity At this point, I used the indicator analysis of local authority units (budget indicators of own revenues in total revenues, share of tax and fee revenues in total budget revenues), which is conducted based on financial indicator calculations, their assessments and comparisons (Ministry of Finances 2014, Łukomska-Szarek 2012, Dylewski et al. 2011). This method provides information on

the financial situation of the given unit, the results of its activities based on interrelated sets of indicators. Another purpose of this method is to determine the impact of all factors and components on the activities and financial situation of local authorities. In this analysis, I assessed the rock mining of the Dolnośląskie Voivodeship due to its diversity in the investigated area. The research covered the analysis of one calendar year to show the potential level of this impact. In the research, I included service fees, taxes on economic use of lands and taxes on natural and legal persons. The results indicated that revenues were from 0.001% up to 51% of commune budgets, so the researched revenues from rock mining activity to commune budgets were diverse. In 33% of researched communes, these revenues were up to 1% of commune budgets, while in 38% communes, they were up to 10%. Revenues higher than 10% were found in 26% of commune, of which 4 communes (6%) had the revenues of more than 40% and 11% communes in the range of 20-30%. Finally, I concluded that since the revenues to commune budgets, from the exploitation of rock materials may account for up to 50% of revenues (of course, this depends on the level of extraction, the area covered by mining activities and the number of persons employed), they may and should be considered an important argument in the debate on documented deposits management. With regard to the creation of jobs, I proposed using a methodology based on stochastic data analysis methods, which enable proving the correlation between variables. Therefore, to estimate the employment, I used data on the number of employees obtained from rock raw material exploitation companies and included in WUG (2014) and Kaźmierczak (2002). My research proved that in the Dolnośląskie Voivodeship the number of jobs created corresponds to as much as 18% of all people employed in industry.

For the environmental and social assessment of mining investment projects, I used the expert method, which I adapted for the purposes of this assessment for interest group preferences and analysis weights. Of course, the issue of the assessment of mining projects for environmental and local economic impact is known. Thus, in reference literature, one may find at least some methods used for the analysis of this issue, e.g.. the multiple-criteria CBA analysis (Cost-Benefit Analysis) supported by expert assessments, soil formation activity classification, assessment of idle land classification for biological reclamation (Uberman and Uberman 2010), cross-analysis of revenues with a Delphic method of expert assessments (Żbikowska 2011) or methods based on neural networks (Ptak 2011). As noticed by Malewski (2012), all these methods have a common denominator, which consists in the prioritisation of specific choices or impact analyses of one factor on another. However, these methods do not show results in the form of integrated assessment, i.e. combining the natural and social aspects of a mining project. Therefore, the methodology proposed seems the most suitable, because its innovation consists in synthesising expert assessments and the so-called party/interest group opinions. The nature of this method is the integration of independent assessments by experts and opinions of interest groups to obtain the objectivity of arguments in the planning and administrative decision-making process. The end result of the analysis is a total "cost and benefit" analysis, showing an objective image of the environmental and social impact of the planned mining project.

The application of the proposed methodology of the efficiency of reclamation of post-mining areas was shown on the example of a natural aggregate mine project. The analysis of

a mining project with an area of 17.9 ha, which was meant to be implemented in agricultural land. I assumed dry and wet natural aggregate exploitation processes, using a single-bucket excavator. I designed the reclamation with water-recreation-service functions. This area after the reclamation was assumed to be connected with recreation by small bodies of water (fishing, swimming, sports) and in green areas. In addition, I assumed the possibility of developing a part of the area for service functions, e.g. an inn or accommodation buildings.

In accordance with the presented methodology, I estimated the value of property with documented deposit (W_{Nuz}) and after reclamation with the assumed functions (W_{Nzrek}). The comparison of the indicator of the market value at the moment of mining project start-up and the market value of reclaimed areas showed that proper selection of the direction of reclamation may lead to an increased market value of the post-mining area. The example analysed in the work proved an as much as 7-fold increase of the market price.

The context analysis of revenues to the commune budget presented on the subject example proved that the revenues from taxes and fees on the planned project in the entire life cycle of the planned project will amount to more than PLN 4.2 million. Per annum, the revenues to the commune budget from mining activity will account for 0.67 to 0.7% of the total budget revenues. As far as the revenues of the researched commune are concerned, fees and taxes on the planned mining activities will account for approx. 8%. At this point, one should note that the example commune has high budget revenues, i.e. approx. PLN 60 million. In communes with a lower budget, such as the commune of Wojcieszów - PLN 17.8 million from the subject mining activity in one year will account for 2% of the annual revenues of this commune and more than 5% of own revenues.

The employment for the analysed project was assumed at 5 persons, due to the two-shift work organisation and machine fleet of the project. In addition, one should consider the context of the use of other forms of services, which could not be present in the given area without the presence of the industry (e.g. services related to leisure time!). Considering this aspect, the number of jobs resulting from the functioning of the subject project and its surroundings may be estimated already at the level of 20 to 30.

The total "cost and benefit" analysis prepared showed that with full information, both on the expected negative implications and benefits of the planned project, the rate of acceptance for this type of initiatives could increase significantly. Because in the case of the subject project, based on the data showing the perspectives of individual interest groups, a hostile approach to the subject project is represented by one interest group – environmentalists, however this hostile position is close to 0 (i.e. no final influence).

In conclusion, the practical example of application of the proposed methodology of efficiency of valuation of post-mining areas presented in the work confirmed its applicability to the assessment of projects consisting in the exploitation of rock raw materials. In my work, I proved that the property value after reclamation, assuming properly considered and designed functions of the post-mining area, is higher than the value of property with deposit ($W_{Nud} < W_{Nrek}$). I showed that in the case of the subject project, social choices and the environmental impact form a predominantly positive image as a whole (positive values). Because the majority of interest groups has a positive opinion of the planned project. The least favourable (negative value) opinion of the project is represented by environmentalists.

I also noted that this negative opinion is an assessment close to 0. In the analysis of this case I noted that the revenues to the commune budget in the entire life cycle of the project would amount to PLN 4 million, i.e. more than PLN 400,000 per annum, and the functioning of the planned project would result in the creation of 20 to 30 jobs.

Conclusion

Starting up new projects, such as rock mining projects, causes concerns and objections of local communities. This is accompanied by negative opinions of environmental organisations. All concerns manifest as conflicts between the parties that seek to fulfil their expectations in the given space. Thus, it seemed essential to propose a methodology of the assessment of efficiency of post-mining areas in rock mining, of which the results may contribute to the mitigation of conflicts by strengthening the argumentation for and against in the entire life cycle of the mining project. The benefits of properly designed reclamation of the post-mining area deserves special treatment in this issue.

In my opinion, the most important accomplishments of the subject work are:

- treating mining activity as an investment project, consisting of three stages: pre-investment, investment and closing,
- the specification of the time of functioning of the mining activity (divided into individual stages), which ranges from several months to several decades, in which the pre-investment phase lasts from several months up to 1,5 year, the investment phase up to several decades and the closing stage up to 5 years from the discontinuation of mining activity,
- the proposition of an original methodology of assessment of the efficiency of valuation of rock mining areas, based on four basic stages:
  - assessment of the market value of property with deposit,
  - valuation of post-production area, i.e. estimation of the market value of recultivated land,
  - analysis of revenues to commune budgets and contribution to the local employment market resulting from the functioning of the mining project in the given area,
  - environmental and social assessment of mining projects as a total "cost and benefit" analysis,
- proposition of primary and secondary performance indicators. As primary performance indicators, I specified the market value of the property and the total "cost and benefit" analysis. On the other hand, as secondary indicators, I specified revenues to commune budgets and the number of jobs that may be created in connection with the planned project and its surroundings,
- assumption of the income approach using discounted cash flow with the introduced component of the cost approach in the form of post-production area reclamation costs in the estimation of the market value of property with documented deposit,
- use of the expert method in the environmental and social assessment of planned project, modified for the purposes of the proposed methodology, of which the measure is the synthesis of expert assessments and social assessment of changes in the natural and social environment in the form of numerical value distribution,

- noting that for an individual rock mining project, revenues to commune budgets are not always significant, but one special feature should be considered: these resources are owned by the commune, which has the right to use them freely, because legal requirements include no restrictions in this area. Therefore, this is the most valuable asset for commune budgets,
- I proved, on the example of practical application of the methodology of efficiency of valuation of post-mining areas, that proper choice of the direction of reclamation may lead to: Firstly, providing the post-mining area with new attractive functions. Secondly, it may cause the increase of the market value of post-production area, because in the subject case $W_{NUD} < W_{Nzrek}$. Designing and implementing proper reclamation directions may also contribute to the reception of the functions of such post-mining areas as benefits of the planned project, resulting in a positive impact on the social acceptance of projects, i.e. the total environmental and social "cost and benefit" analysis. In addition, positive aspects (added value) in the environmental and social assessment, will include revenues to commune budgets and creation of new jobs, both in the context of the planned project and in its surroundings.
- I stated, also based on the example practical application, that the proposed methodology of efficiency of valuation of rock mining areas fulfils its assumptions and its results may constitute a basis for argumentation in the administrative and planning practice, as well as the mitigation of social conflicts or the improvement of efficiency of mining project management.

5. Overview of other scientific and research accomplishments

5.1. Accomplishments before obtaining the doctoral academic degree

In October 199, I began doctoral studies in the Faculty of Mining of the Wrocław University of Science and Technology. I dealt with issues related to the directions of reclamation of post-extraction areas of common mineral resources, legal regulations, economic and environmental conditions of the reclamation and management of post-mining areas. I collected my research results in the doctoral dissertation entitled "Gospodarcze, przyrodnicze i przestrzenne funkcje górnictwa skalnego okolic Wrocławia". Based on the research and analyses, I determined a strict relationship between the use of deposits and environmental conditions. Spatial planning, which defines the use of managed lands, is a component of politics, mitigating the conflicts between the environment and human activity. I also noticed that spatial planning is an essential component of politics related to the post-mining area management strategy, which should be integrated with long-term planning at the regional level. For proper post-mining area management planning, I proposed a precise classification of directions of reclamation, which distinguishes general and precise directions of reclamation. The essence of this classification, apart from the division of directions, was the possibility of integrating them in meaning combinations, which enabled a more detailed manner of defining the directions of reclamation. I proved that as much as 48% of mines had no specific reclamation intentions, which resulted from the absence of legal regulations on the time for obtaining a reclamation decision. I also proved that a conflict of interests of the parties related to the post-mining area reclamation and management process. Therefore,

I proposed to treat the selection of directions of reclamation as an optimisation problem, which should be solved with the involvement of the parties to the administration process, supported by independent expert opinions, considering existing environmental assets included in a uniform functional and spatial system.

During my doctoral studies, I also focused on the issue of funding reclamation tasks. My research on the comparison of reclamation costs in strip mining showed that reclamation costs differ according to the direction of reclamation and mining type. This cost is lower in rock raw material mines and higher in chemical and power resources. Furthermore, the analyses proved that the mining company may reduce reclamation costs by optimising the exploitation process, provided that it defined its reclamation needs at the beginning of its activity.

In the period prior to obtaining the doctoral degree, I participated at 3 academic conferences. My presentations were distinguished at doctoral student conferences of the Faculty of Mining of the Wrocław University of Technology three times (honours in 2000, 2nd place in 2001 and 2002). My academic accomplishments during doctoral studies includes 7 items:

- 3 publications in national conference materials, including: 1 – authored and 2 – co-authored,
- 2 articles, including: 1 – authored and 1 – co-authored),
- 1 book chapter - co-authored,
- 1 book – co-authored.

In addition, I co-authored 3 non-published academic papers (reports). The detailed accomplishments of this period are presented in the list of post-doctoral accomplishments – technical sciences in appendix no. 4 to the Application

As part of the teaching load, I conducted the following classes:

- Reclamation and management of post-mining areas – lecture,
- Reclamation and management of post-mining areas – project,
- Waste management – seminar,
- Technologies of mineral resources processing – seminar,
- Design and analysis of processing systems – seminar,
- Basics of mineral processing – laboratory,
- Mineral resource processing – laboratory,
- IT – laboratory,
- Rock processing – laboratory.

5.2. Accomplishments after obtaining the doctoral academic degree

After obtaining the doctoral title on 01-Oct-2002, I have been employed at the Faculty of Geoengineering, Mining and Geology (earlier: the Faculty of Mining) of the Wrocław University of Technology. The research activity I conducted since was concentrated on several important areas with a significant impact on the development of the field of mining and geology. The most important issues related to my scientific work include:

A. Environmental damage, compensations and securing claims in strip mining areas

This issue was addressed in the research project 5T12A02025, funded by the Committee of Scientific Research in 2003-2005. The project covered the identification of claim and compensation processes for environmental damages, which occurred as a result of mining site operation, and legal and economic analyses of the use of environmental insurance in the administrative and economic practice of strip mining. The objective was to assess the feasibility of implementing an important instrument of environmental damage risk management into the mining and administrative practice — environmental insurance.

The problem was analysed in three dimensions: geoengineering, legal and economic, because most claim and compensation problems occur at the interface of these three disciplines of knowledge and economic practice.

Under the project, claim and compensation processes were investigated at the interface of activity of public administration – the mining company – the claimant. The research was conducted in strip mine mining areas, mainly of lignite, where such phenomena occur at a higher frequency. Furthermore, a review was completed of the geoengineering practice regarding the quality of the methods of identification, marking and predicting the impact of mining activity. In addition, a study was conducted of the current environmental protection, administrative, economic, geological, mining, community and international law for environmental damage and the rights to submit claims. Furthermore, the project included a review of problems and systemic solutions, national and global, regarding environmental insurance as the form of security of claims in economic and administrative practice. Also, a practical example of estimation of the value of claim security in economic and administrative practice was presented.

Under this project, I was focused primarily on claim and compensation processes. My analysis confirmed the thesis that in practice public administration does not use its legal instrument to secure the interest of the state and citizens regarding the protection of resources and the environment as a common good. However, claims and compensations change in time. The characteristic features of this process is a variable dynamics of the increase of claims and compensations. In addition, the research conducted proved the thesis that the claimant tends to overestimate their losses and the perpetrator of damage considers themselves as too generous in compensating for these losses.

The research results contributed to the development of the methods of compensation risk management (securities, insurances), while in practice to improve the natural resources management at the level of the company, as well as state administration.

Under the subject project, on 13-14 May 2004, the conference entitled *Damages, compensations and securing clams in mining areas* took place, which I co-organised.

Furthermore, the research results of the project were published in the monograph entitled *Szkody w środowisku, odszkodowania i zabezpieczenia roszczeń na terenach górnictwa odkrywkowego,*, edited by J. Malewski (2007).

B. Environmental and social conditions of exploitation of the lignite deposits of Legnica

The social problem of natural capital management – the wealth of lignite deposits – is a primary problem related to securing the strategic reserves of lignite in the state energy resources balance. My research inquiry in this area were connected to the implementation of the research project co-funded by the European Union, from the funds of the European Regional Development Fund entitled *Scenarios of the technological development of the lignite extraction and processing industry*, task 12 – *Verification of scenarios of the technological development for the Legnica region by social consultations with local authorities, administration and specialists*. The research under this project covered the public opinion of local communities at the pre-investment stage. The planned project was the construction of a lignite strip mine and the power plant connected with the mine. The construction of both the mine and the power plant was not decided. As part of research in this area, I focused on two issues. The first was the characteristics and evaluation of the natural and economical environment of the Legnica region. The second task was the research on public opinion based on the survey of social preferences, which resulted in the formation of interest groups with their preferences regarding the particular components of the environment. Finally, based on the analyses, a method was presented for the assessment of the impact of the future mine on the Legnica region environment, consisting in a quantitative assessment of environmental and social impact of preferences (choices, valuation) of the environment as a whole by different social groups, to obtain the objectivity of arguments in the process of making planning and administrative decisions at the pre-investment stage.
Research results were published in the monograph entitled *Środowiskowe i społeczne uwarunkowania eksploatacji złoża węgla brunatnego Legnica* (J. Malewski, J. Blachowski, U. Kaźmierczak, M. Kucharska).

C. Protection of rock raw material deposits

As part of this issue, I focused on multiple aspects: valuation, unused rock mineral resource deposits, access to rock mineral resources in the context of legally protected areas in the Dolnośląskie Voivodeship, analysis of the impact of land utilisation plans on deposit management and analysis of the impact environmental protection on deposit management.

Research on the valuation of non-used rock mineral resource deposits (for the Łódzkie and Wielkopolskie voivoeships), the impact of the analysis of land utilisation plans on deposit management and the analysis of impact of environmental protection on deposit management were conducted under project no. UDA-POIG.01.03.01-00-001/09, Strategies and technological scenarios of the management and utilisation, co-funded by the European Regional Development Plan, as part of the Innovative Economy Operational Programme. As a result of implementation of this project, deposits were selected with the highest and high raw material values (mineral resource amount and quality), attractive for mining use and the

corresponding degree of access restriction by the requirements of environmental protection and land utilisation.

The issues related to the legal conditions of environmental protection and deposit management regarding the impact of deposit management was analysed in the entire mining project life cycle, in institutional forms of environmental protection, such as: landscape and nature protection forms, underground waters protection forms, soil protection forms and forest protection forms. During my analyses, I noticed that the process of expansion of legal protection to increasingly large spatial areas was progressing year by year. This process results in an increase of protection requirements for the mining activity planned in the given area. I also emphasised that deposit management should be conducted rationally and in accordance with the spatial policy implemented at every stage of administration. The extraction and exploitation of mineral resources should be economically justified and conducted using measures that reduce the negative impact of the individual deposit life cycles on the components of the environment directly in the planned or operated mining activity and in its vicinity. I also stated that mining activity may be operated in areas covered by institutional protection, subject to the meeting of the requirements resulting from legal regulations and after obtaining an environmental permit for the implementation of the planned mining activity.

Under the subject project, I also conducted a full analysis of the impact of land utilisation plans on rock resource management. As a result of this analysis, I noticed that the mechanism of shaping land utilisation planning policy is relatively difficult and complex, because it requires integrating economic, social and environmental problems. Its end result are local land utilisation plans that determine, where, when and how the given space may be used. Mining activity must follow the rules of spatial planning. This is determined by the Act of 7 July 1994 *on spatial planning*, pursuant to which the determination of the purpose and rules of land utilisation is made in the *Local land utilisation plan of the commune*. The council of the commune, when adopting the *local land utilisation plan* is absolutely bound by the findings of the *Study*. The land use in the *Study* is not synonymous with the land use in the *local land utilisation plan* of the commune. It has different consequences. The land use in the *Study* is relevant to the adoption of the plan, while the land use in the *local land utilisation plan* of the commune causes an effect to third parties, i.e. mining companies. This effect will be financial, because changes to the *Study* and the *local land utilisation plan* will be borne by the commune. On the other hand, the execution of the local land utilisation plan of the mining area will burden the budget of the mining company. In the further analysis of the subject issue, I proved that the use of the raw material deposit is not possible only after changes to the land use in the *Study* and the *local land utilisation plan of the commune*. Furthermore, lands should be excluded from the existing use that lie above the deposit. Such exclusion is made by means of the decision in the *local land utilisation plan*. This may also cause consequences to the excluding party (the mining company), related to the preparation of proper documentation and fees, such as: annual fees and charges[1], and in the case of forest lands – a one-time compensation for the exclusion of lands and then (already after

[1]Only applicable to mineral and organic origin soils, class I, II, III, IIIa, IIIb (article 11 section 1a *of the agricultural and forest land protection act*).

changing the land use) higher fees for the land use for industrial activity. The final stage of deposit development is the discontinuation of mining activity, which is connected with the reclamation and then utilisation of the post-mining areas. This means that after the reclamation and utilisation, the given area will be used for purposes other than related to mining activities, so its functions shall meet the provisions of the *Study* and the *local land utilisation plan of the commune*. Therefore, in this case as well it is necessary to change the provisions of the *Study* and the *local land utilisation plan of the commune* (unless they have already been made earlier).

In conclusion, my analysis of the effects caused by spatial policies also proved that rock mineral resource deposits are not sufficiently protected. Above all, the problem is the possibility of using the area above the deposit for non-mining purposes, the dispersion of ownership of lands above the deposit and the protection of animate nature resources. Despite ready propositions, broadly presented in literature, and the development of the method for the valuation of the rock mineral resource deposits and performance thereof for the entire Poland, the problem of deposit protection has not been solved and finds no understanding in the authorities determining the economic and social development strategy and local authorities. Therefore, I emphasise that in the area of deposit protection, the remaining unsolved problems are:

- the consideration of deposit protection as a public goal,
- the development of a deposit protection act or proper legal regulations in the environmental protection, geological and mining law, as well as in spatial management acts
- low social awareness of the role of mining in the economic and civilisation development of the society.

A complement of the research in the project was my analysis of access to the raw material base in the context of protected areas of the Dolnośląskie Voivodeship. The research proved that in legally protected areas or areas projected for protection of the voivodeship, there are 39 documented and non-operated rock mineral resource deposits, which account for 985.2 million Mg in total. These deposits are located in: Landscape Parks (9 deposits), Protected Landscape Areas (5 deposits), Natura 2000 areas (20 deposits), under the reservoir of Słup (1 deposit) and in projected Landscape Parks (5 deposits). In conclusion, my analyses proved that environmental protection reasons do not completely exclude the exploitation of mineral resources, but restrict it to a large extent, because the possibility of exploiting these deposits depends on obtaining environmental permits for project implementation and legal conditions, connected with the environmental protection act and acts establishing the given Landscape Park.

The research results in the field of protection of rock raw material deposits were presented in 3 chapters in monographs and 6 articles, including 2 found in the base of Journal Citation Reports:

- Kaźmierczak U., *Województwo łódzkie*, Waloryzacja niezagospodarowanych złóż kopalin skalnych w Polsce, collective work edited by Marek Nieć, chapter in the monograph, Wrocław: Poltegor – Instytut 2013, pp. 71-78,

- Kaźmierczak U., Górniak-Zimroz J., *Waloryzacja złóż kopalin skalnych województwa łódzkiego*, Scenariusze technologiczne pozyskiwania i zagospodarowania surowców skalnych w województwie łódzkim, Duchmal et al., chapter in the monograph, Wrocław, Poltegor-Instytut, 2013, pp. 23-37,
- Górniak-Zimroz J., Kaźmierczak U., *Waloryzacja złóż kopalin skalnych województwa wielkopolskiego*, Scenariusze technologiczne pozyskiwania i zagospodarowania surowców skalnych w województwie wielkopolskim, Duchmal et al., chapter in the monograph, Wrocław, Poltegor-Instytut, 2013, pp. 21-32,
- Kaźmierczak U., Górniak-Zimroz J., *Institutional environmental protection and exploitation of rock deposits with open cast method, Mining Science*, 2015, vol. 22, pp. 85-100 (MNiSW – 8 pts.),
- Kaźmierczak U, *Dostępność złóż kopalin skalnych w kontekście obszarów prawnie chronionych województwa dolnośląskiego*, Gospodarka Surowcami Mineralnymi – Mineral Resources Management, 2014, v. 30, no. 2, pp. 35-50, (MNiSW – 15 pts., IF – 0.54),
- Kaźmierczak U., *Analysis of results of spatial development plants for management of rock raw material deposits*, Gospodarka Surowcami Mineralnymi – Mineral Resources Management, 2014, v. 30, vol. 3, pp. 43-53, (MNiSW – 15 pts., IF – 0.54),
- Kaźmierczak U., Górniak-Zimroz J., *Waloryzacja złóż surowców skalnych województwa łódzkiego*, Górnictwo Odkrywkowe, 2013, R, 54, no. 2, pp. 146-154, (MNiSW – 7 pts),
- Kaźmierczak U., Górniak-Zimroz J., *Waloryzacja złóż surowców skalnych województwa łódzkiego i wielkopolskiego*, Górnictwo Odkrywkowe, 2013, R 54, no. 5/6, pp. 52-58, (MNiSW – 7 pts),
- Górniak-Zimroz J., Kaźmierczak U., *Waloryzacja złóż surowców skalnych województwa wielkopolskiego*, Przegląd Górniczy, 2013, no. 7, pp. 93-98, (MNiSW – 7 pts).

D. Reclamation and management of post-mining areas

Within my scientific interests connected with the reclamation and utilisation of post-mining areas, I deal with the issues related to the international terminology related to the use of post-mining areas, classification of the directions of reclamation (including the utilisation and revitalisation), funding and the scope and type of reclamation works. In connection with the multitude of inaccuracies, ambiguity and incomparability both in the terminology used and in the classifications proposed by different authors, I proposed the specification of certain notions: restoration, reclamation, land development, rehabilitation, revitalisation. In addition, at the international forum, I proposed the application of a new classification of the directions of reclamation, which may be successfully used also for specifying the directions of the utilisation or revitalisation of post-mining areas.

Reclamation is the final stage of mining activity, which occurs at the time of declining production and thus revenues of the company. At this stage, reclamation tasks and expenditure increase. To enable the optimisation of reclamation costs, an important issue is planning a specific type and scope of reclamation works already at the beginning of the mining activity. The studies enabled stating that depending on the exploitation site of packed, aggregate or silt raw materials, the scope of works necessary to achieve the same

reclamation direction will be different. Therefore, an attempt was made to unify the scope of works related to the reclamation of areas after the exploitation of rock raw materials and the characteristics of the exploitation site. I marked that the systematisation of reclamation works would allow the mining company to optimise the exploitation process and thus to reduce the reclamation costs. Furthermore, in the case of funding the reclamation of post-mining areas, I have noticed the problem of insufficient funds collected by the Mining Sites Decommissioning Fund. Hence, the proposed solution is to create reserves for future events, justified by a suitable amount ($Z(t)$), e.g. resulting from the design and performance schedule of reclamation works. Then, if the reclamation design cannot be performed progressively using current income, it seems permissible to distribute the equivalent of dues evenly over the entire production period. This amount should be compared to the Mining Sites Decommissioning Fund ($FLZG(t)$), and if it is not covered by the fund, it should be completed to the equivalent of $Z(t)$ as the reserve fund $FR(t)$. The value of this security was also expressed as a function $FR(t)=FLZG(t)-Z(t)$. The status of reclamation dues $Z(t)$ should be estimated according to the material progress of the mine and performed reclamation works, expressed in the current purchasing power of money.

The results of analysis and research in this area were shown in 2 chapters of the monograph, 7 publications (including 3 international) and two conference messages. The most important are:

- Kaźmierczak U., Strzałkowski P., Lorenc M. W., *The analysis of the existing terminology related to a post mining land use: a proposal for new classification*, Environmental Earth Science, 2017, pp. 1-10, (MNiSW – 25 pts, IF – 1.435),
- Strzałkowski P., Kaźmierczak U., *Systematyka kierunków rekultywacji i przykłady jej zastosowania na terenach pogórniczych województwa dolnośląskiego*, Innowacyjne rozwiązania rewitalizacji terenów zdegradowanych, collective work edited by Jan Skowronek, Katowice: Instytut Ekologii Terenów Uprzemysłowionych, 2014, pp. 289-300,
- Strzałkowski P., Kaźmierczak U., *The scope of reclamation works for areas after the exploitation of rock raw materials*, Applied Sciences, Vol. 9(6), 2019, (MNiSW – 25 pts, IF – 1.689),
- Strzałkowski P., Kaźmierczak U., *Scope of reclamation in the agricultural, forest and aquatic directions after exploitation of rock raw materials*, 18th International Multidisciplinary Scientific GeoConference, SGEM 2018: conference proceedings. vol. 18, Ecology, economics, education and legislation. Iss. 5.2, Ecology and environmental protection, 2 July - 8 July, 2018, Albena, Bułgaria. Sofia: STEF92 Technology, cop., 2018, pp. 851-859,
- Kaźmierczak U., Strzałkowski P., *Zakres prac rekultywacyjnych w kierunku wodnym terenów po eksploatacji surowców skalnych*, Zeszyty Naukowe Instytutu Gospodarki Surowcami Mineralnymi i Energią PAN, 2016, no. 94, pp. 127-136, (MNiSW – 9 pts),
- Kaźmierczak U., Malewski J., Strzałkowski P., *Finansowe skutki zobowiązania rekultywacji w górnictwie skalnym*, Górnictwo Odkrywkowe, no. 5, 2015, pp. 9-13 (MNiSW – 7 pts).

E. Landscape attractiveness of quarries

In 2015-2018, I dealt with the issues related to the attractiveness of the landscape of non-operating quarries. The research objective was to determine, whether quarry landscape attractiveness exists and to what extent it may contribute to the increased attractiveness of the region. As part of considerations, a procedure was developed for the assessment of the attractiveness of the landscape of non-operational quarries. The verification of the proposed procedure was made on selected example from the Ślężański Region. For a more in-depth exploration of the subject problem, comparative research was conducted in the United Kingdom and Austria. As a result of research and analyses, I formulated the following conclusions:

- non-operating quarries are attractive and the main reason for it is their uniqueness, and the interest and curiosity that they cause,
- the attractiveness level of the landscape of non-operational quarries may be determined using a procedure consisting of the combination and modification of three research methods: semantic differential, entropy principles and point evaluation,
- the research enabled me to create four classification groups of quarry attractiveness: very attractive, attractive, hardly attractive and unattractive.
- The quarries that are very attractive feature high vertical diversity, a good conservation status, low progress of natural succession, presence of surface waters, high contrast with adjacent terrain and very good road access. On the other hand, unattractive quarries have little height diversity, very poor conservation status and they are unnoticeable due to the lack of road access and a significant progress of natural succession.
- The areas of quarries with high attractiveness may contribute to the achievement of a greater number of tourists and development of pedestrian, cyclist, horseback and sometimes even qualified tourism (mountain climbing or diving) by constituting a so-called secondary attraction. Furthermore, non-operational quarries, due to their uniqueness and diverse forms, may be used for public social education, by becoming a didactic place in the programme of tourist trips, natural science lessens and environmental education.

The results of research and analyses were published in 5 publications, including 2 found in the base of Journal Citation Reports:

- Baczyńska E., Lorenc M. W., Kaźmierczak U, The landscape attractiveness of abandoned quarries, Geoheritatge, 2018, vol. 10, no. 2, pp. 271-285 (MNiSW – 25 pts, IF – 2.333),
- Baczyńska E., Lorenc M. W., Kaźmierczak U, Research of the landscape attractiveness of the selected abandoned quarries, International Journal of Mining Reclamation and Environment, 2018, vol. 32, no. 6, pp. 401-419, (MNiSW – 20 pts, IF- 1.258)

F. Rock waste management

In the rock mining sector, there are problems related to the extraction and processing waste generation. I analysed the issues of the quantitative and spatial analysis, as well as the usability of extraction and processing waste of rock mining in a work commissioned by the Marshal Office of the Dolnośląskie Voivodeship under the CircE project (European Regions Toward Circular Economy), co-funded from the European Regional Development Fund, the Interreg Europe Programme. The objective of the project was to develop a regional

action plan towards a closed-loop economy with recommendations for regional authorities. The analyses prepared under the project were to indicate the scale of the problem and the possibilities of improving the situation by discussing the existing or new technologies of rock mining waste use. In this work, I conducted qualitative analysis research, which enabled the identification of the characteristics and type composition of the deposited waste and, as a consequence, to provide recommendations on the use thereof. The field of research was the rock mining of the Lower Silesia. The subject research enabled:

- the development of a quantitative and spatial base of the generated extraction waste, of which the analysis showed a growth tendency of waste production and that extraction waste is also generated in companies that process national or imported rocks.
- the development of a methodology of the qualitative analysis of waste in two planes: economic and environmental. In the environmental plane: Criterion 1 – waste category (dangerous or inert) and Criterion 2 – location in nature protection areas and the High Yield Aquifer. On the other hand, the economic criteria were: Criterion 3 – key raw materials for the economy, Criterion 4 – occurrence of over 10,000,000. Mg, Criterion 5 – occurrence of silt raw materials (used e.g. in the agriculture or food industry), Criterion 6 – occurrence of raw materials as a source of potassium – dusts and fine granite fractions, Criterion 7 – occurrence of raw materials as a source of magnesium – e.g. serpentinite, basalt, syenite.
- the determination of the importance of the economic and environmental criteria used in the assessment of usability of waste for potential economic use. The highest weight was given to the criteria of: location in protected areas, the occurrence of key raw materials for national economy and the occurrence of silt raw materials in waste. The smallest wast the criterion of category of dangerous or inert waste.
- selection of 6 Extraction Waste Treatment Sites, which may be a source of potential use (Krzeniów, Lubień, Grabina Śląska Kam. 15/27, Gniewków and Boguszyce).
- recommendation of further potential directions of use of the waste on the selected sites.

The results of analyses and research from this area were presented in 3 publications found in the base of Journal Citation Reports:

- Kaźmierczak U., Blachowski J., Górniak-Zimroz J., *Multi-criteria analysis of potential applications of waste from rock minerals mining,* Applied Sciences, 2019, vol. 9, no. 3, pp. 1-15 (MNiSW – 25 pts, IF- 1.689),
- Blachowski J., Kaźmierczak U., Górniak-Zimroz J., *Spatial and quantitative analysis of waste from raw minerals mining: a case study of Lower Siliesia region in Poland*, Sustainability, 2018, vol.10, no. 12, art. 4493, pp. 1-21, (MNiSW – 20 pts, IF- 2.075),
- Kaźmierczak U., Blachowski J., Górniak-Zimroz J., Wirth H., *Quantitative and quaitative research on the waste from the mining of rock raw materials in Lower Silesia*, Minerals, 2018, no. 9, pp. 1-19, (MNiSW – 25 pts, IF- 1.835).

The works quoted in 5.2 and the list of all scientific publications after the achievement of the technical sciences doctor degree are presented in the post-doctoral accomplishments – technical sciences, appendix no. 4 to the Application.

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6.1. Summary of academic accomplishments

The indicators summarising my academic accomplishments (post-doctoral) are listed in table no. 3. The summary includes articles in the scientific periodicals found in the base of Journal Citation Reports, the base of SCOPUS and the list of MNiSW, books, chapters in monographs, papers for international and national conferences and other publications. My scientific and research accomplishments consist of 90, items, including 66 scientific publications, 23 collective works and records of research works and 1 doctorate dissertation.

Table 2. Summary of academic accomplishments

	Pre-doctorate	**Post-doctorate**	**Total**
Scientific publications in the periodical of the base of JCR	-	9	9 (including 2 independent works)
Books	1	1	2
Chapters in monographs/books	1	7	8 (including 1 independent work)
Publications outside the base of JCR	3	42	47 (including 7 independent works)
Total publications	7	59	66
Lectures given at conferences	4	21	25
Collective works, research work records	3	20	23
Participation at research projects	-	11	11
International and national awards for scientific activity	2	14	16
Total Impact Factor	-	13,412	13,412
Total MNISW pts.	30	387 (432*)	417 (462*)

Table 3. Total number of citations and H index (Hirsch)

	Web of Science	Google Scholar
Number of citations	12	76
H index (Hirsch)	2	4

7. Didactic activity

As part of didactic activities, the delivery of courses in the following forms may be distinguished: lectures, project exercises and seminars. I have been running didactic courses at the Faculty of Geoengineering, Mining and Geology (former Faculty of Mining) of the Wrocław University of Technology since 1999, first as part of doctoral studies (1999-2002), then as assistant and since 01-Oct-2005 as assistant professor for the full-time and part-time studies in the subject area of mining and geology.

To date, I have taught 15 subjects, including 4 in the form of lectures. In my didactic activities, I promote interest in the subjects of reclamation and management of post-mining areas and the use of waste materials, i.a. by presenting the experience obtained through research, training, conferences, workshops and seminars.

Until now, I have been the promoter of 76 theses. One thesis under my supervision was distinguished and one of the candidates I promoted conducted research in the doctoral dissertation, entitled *Model prognozowania kosztów rekultywacji w górnictwie skalnym,* in with I was an auxiliary supervisor (2013-2016) and continues to work at the Faculty of Geoengineering, Mining and Geology. At present, since 2018, I have been the ancillary adviser of the doctoral dissertation of dr. Inż. Andrzej Zibrow, entitled *Wielokryterialny model decyzyjny procesu wznowienia eksploatacji złóż węgla kamiennego dla terenów pogórniczych.* Since 2010 I have been a reviewer of 34 diploma theses.

An important field of didactic and academic activity is the REVIMINING Student Scientific and Research Association at the Faculty of Geoengineering, Mining and Geology. In this activity, I support students in the development of interests related to the revitalisation of post-industrial areas. The students scientific association is very active. Until now, it has completed several projects, of which the most important are: "The Most Beautiful Quarries of Lower Silesia", "The Most Beautiful Mines of Lower Silesia". At present, the association is working on a project of the model of a revitalised mining areas after basalt exploitation. The student association is also very active in the academic life. Every year, it organises a "Miner's Day" for children, giving an opportunity to meet the history of mining, mining traditions and the basics of geology. To promote the results of their activity, the associated students participated at scientific conferences at the 4th Polish Mining Congress (2017) and GUS - Geological Association of University Students (2018). They also deliver mining-related lectures in schools. In addition, the students of the scientific association participate on a regular basis at a series of academic life events, i.e. Student Activity Days, Raw Materials University Day or the Lower Silesia Science Festival, while presenting the results of their activity and organising various competitions for the children.

Detailed information on my didactic and promotional activities is included in appendix no. 4 to the Application.

8. Organisational activity

During my employment at the Faculty of Geoengineering, Mining and Geology, in parallel to the scientific and research and didactic activities, I also performed organisational functions related both to education and management. The most important are:

- Deputy Head of the Department of Mining (since 2017),

- Head of the Laboratory of Research on Rocks and Minerals (since 2016),
- Member of the Steering Committee of the Integrated Development Programme of the Wrocław University of Technology (since 2018),
- Head of the Laboratory of Mineral Engineering at the Laboratory of Earth Sciences and Mineral Engineering (since 2019)
- Member of the Programme Committee for Evaluation and Teaching Quality Assurance in the subject area of mining and geology (since 2012),
- Secretary of the Mining Sciences Committee of the Polish Academy of Sciences Wrocław Branch (since 2011).

The remaining period of my organisational activity is presented in appendix no. 4 to the documentation.

Urszula Kaźmierczak