www.czasopisma.pan.pl PAN www.journals.pan.pl

VERSITA

Arch. Min. Sci., Vol. 57 (2012), No 3, p. 799–814

Electronic version (in color) of this paper is available: http://mining.archives.pl

DOI 10.2478/v10267-012-0052-z

MARIAN TUREK*, ANETA MICHALAK*

A METHOD OF PRICING AN ASSET LOST IN A MINING CATASTROPHE

METODA WYCENY ŚRODKA TRWAŁEGO UTRACONEGO W WYNIKU KATASTROFY GÓRNICZEJ

The authors of the paper present a problem of pricing assets lost in result of mining catastrophes. In the subsequent steps of a pricing procedure the Authors suggest a methodology of an asset identification in relation to its technical, functional and environmental wear and particular methods of calculating its value. In the paper there were market, property and income method included, it especially concerned the technique of pair comparison, average price correction and statistical market analysis as well as the technique of replacement cost, reconstruction cost and investment method.

Keywords: value, pricing, technical assets, operating assessment

Autorzy prezentują w artykule problematykę wyceny środków trwałych utraconych w wyniku katastrof górniczych. W kolejnych krokach procedury wyceny Autorzy proponują metodykę identyfikacji środka trwałego z uwzględnieniem jego zużycia technicznego, funkcjonalnego i środowiskowego oraz konkretne metody kalkulacji jego wartości. W opracowaniu uwzględniono metody rynkowe, majątkowe i dochodowe, a w szczególności odniesiono się do techniki porównywania parami, korygowania ceny średniej i analizy statystycznej rynku oraz techniki kosztów zastąpienia, kosztów odtworzenia i metody inwestycyjnej.

Słowa kluczowe: wartość, wycena, środki trwałe, ocena ekspolatacyjna

1. Introduction

The concept of the „value" is debatable and ambiguous. It refers not only to the application of the concept of values in various scientific disciplines such as accounting, finance, economics or law, but also to the richness of meaning in the other disciplines. Each of the concept which builds a theory of value is based on numerous general and specific assumptions, it is rich in definitions introduced by its authors, often solely for the purpose of a given concept (Michalak, 2010).

* THE SILESIAN UNIVERSITY OF TECHNOLOGY, FACULTY OF ORGANISATION AND MANAGEMENT, UL. ROOSVELTA 26-28, 41-800 ZABRZE, POLAND

This paper focuses on determining the value of fixed assets because they play an important role in the activities of economic entities. They are especially important in mining enterprises, which due to the activity profile, are characterized by a high value of fixed assets (they are typically about 80% of total assets (Michalak, 2011), as well as immobilization of a large property which in a big part is very difficult to monetize (buildings and facilities of underground engineering, underground excavation, professional mining equipment etc.). The value of a fixed asset may be determined in special circumstances such as mining catastrophe. Then we speak of the loss of fixed assets. This raises the need to determine the value of such asset on the date of occurrence of catastrophe and estimation of damage resulting from the loss of this value or part of thereof.

2. The concept and the elements of fixed assets as the object of the value pricing

Fixed assets are an element of company's assets, which mean the resources of reliably determined value controlled by the company, arising from past events that will impact the future flows of economic benefits to company (see Article 3, Accounting Act of 29th September 1994). According to this definition, fixed assets need not to be a property or ownership units, they should only be controlled by a company. One should also note the requirement for a reliable determination of the value of fixed asset. This problem will be elaborated in the further part of this study. Fixed assets are characterized by longer than 1 year period of economic usefulness. Moreover, in order to recognize fixed assets as an element of given company's assets, they must be complete and usable for the needs of the company. In a situation when they are put into use under the **tenancy, rental or leasing,** then they are treated as the assets of the one of the parties to the contract. Accounting Act defines that if an entity has adopted the use of foreign fixed assets, under the contract according to which one party (lessor) lets the other party (lessee) fixed assets for paid use or also beneficial use for a fixed period, these assets are classified as lessee's fixed assets if the contract meets at least one of the following conditions:

1) transfers ownership of the object to the lessee at the end of the period for which it was concluded;
2) includes the right of the purchase of the subject matter by the lessee at the end of the period for which it was concluded, at the price lower than market value at the date of purchase;
3) the period for which it was concluded corresponds in the most part to the expected period of economic usefulness of the fixed asset but it cannot be shorter than 3/4 of this period. Ownership of the object of the contract may be transferred to the lessee after the period for which the contract was concluded;
4) amount of fees, net of any discount, determined on the contract date and payable during the period of its validity, exceed 90% of the market value of the object of the contract for this day. The sum of fees includes a residual value of the object of the contract which lessee shall pay for the transfer of the ownership of this object. The sum of fees does not include payments to the lessor for additional services, taxes as well as insurance contributions of this object on condition that the lessee covers them regardless of the charges for the use;

5) includes the promise of the lessor to enter into another contract with the lessee for paid use of the object or to extend the existing contact on terms more favorable than those provided in the existing contract;
6) provides possibility for its termination on condition that any resulting costs of this title as well as losses incurred by the lessor are covered by the lessee;
7) the object of the contract was adapted to the individual needs of the lessee. It may be used exclusively by the user without introducing any significant changes (see Article 3, Accounting Act of 29th September 1994).

Fixed assets include especially **machines and devices**. A machine, in accordance with the Decree of the Minister of Economy on essential requirements for machines and elements of safety, is a an assembly of linked parts or components among which at least one is movable, together with the relevant elements of the actuators, control and power circuits, connected together to a particular application, especially for processing, treatment, moving or packing of the materials.

The valuation methodology often uses the concept of a **technical mean**. It is a generalized name for a machine, device and tool. The examples of technical means are machine, device, vehicle, aggregate, technological line etc. working under the operational system. Technical means are subject to intentional organizational-technical and economic actions within which the relations between them and people appear. This process is called **operation** (PN – 82/N – 04001). The ability of technical mean to realize operational tasks is called operational potential. **The operational potential** as a feature characterizes the supply capacity of the machine to perform the provided functions. In the process of use a gradual loss of this potential occurs and its intensity depends on the type and conditions of use as well as on the strategy of realized services. **The intensity of use** plays a very important role in the process of technical means valuation. It is understood as the time (in the terms of technology) of technical facility relative to calendar time (e.g. number of hectares processed per year) (Dwiliński, 1991).

From the perspective of the valuation, it is important to distinguish between the types of consumption of technical facilities during operation. There are:

- Technical wear,
- Functional wear,
- Environmental wear.

Technical wear (physical) is a process of deterioration of the performance of machine elements, mainly as a result of operation. It occurs as a result of changes of the properties, shapes and sizes of the elements caused by friction of loads as well as chemical reactions. The process of consumption as a result of corrosion consists of destruction of metals as a consequence of the influence of the surrounding environment.

Functional wear results from technical and technological progress. Scientific and technical progress as well as competition cause that manufactured machines and devices have better construction elements, lower operating costs, better efficiency, lower energy consumption, provide greater safety and comfort of work. Functional wear is a result of aging of technical facilities in terms of construction and technology. Functional wear is sometimes called moral consumption as well as consumption caused by internal reasons.

Environmental wear is caused by the influence of internal factors such as economic, legal, ecological and social conditions. This type of consumption may be a result of reduction of the demand for specific products and services, changes of the regulations, reduction of supply of raw materials or labor, constraints caused by environmental considerations. Environmental wear is defined as consumption caused by external reasons (Ricardo, 1957)

All types of consumption mentioned above are connected with **the loss of value at the time of operation.** The measure of consumption which we use **for valuation purposes** is **the degree of wear.** This is the relative loss of value expressed in percentage or the decimal fraction. The methodology of calculating of the degree of wear is presented in the further part of this paper.

Specific conditions under which the process of technical mean pricing is undertaken, and which are the subject of interest of this paper refer to (mining) catastrophes. Under these conditions **the damage of the technical mean** usually occurs. It means transition of the element and sometimes the entire mechanical facility from the state of full capacity to the state of inaptitude.

3. Specificity of the fixed assets lost as a result of mining catastrophe

Fixed assets which are used in coal mining are vulnerable to the influence of difficult geological and mining conditions as well as natural hazards known in mining industry. It refers mainly to the tremor threat and methane threat which lead to the situation of a **catastrophe** nature. The catastrophe is defined as a sudden and unexpected event causing negative effects: material losses and loss in life. Material losses often relate to fixed assets. **Fixed assets lost** by means of catastrophe are valued in order to assess the suffered loss and for the compensation proceedings (Malewski, 2007).

Prior to the valuation, it is necessary to identify **the object of the valuation,** which means that an accurate diagnosis and determination of the basic characteristics of the valued technical facility should be made. This is done mostly during the site inspection where the facility is located or on the basis of source documents. Then the following data are fixed: name of the object of the valuation, manufacturer, model and type, year of production, serial number, inventory number and other basic technical data.

Then the most important characteristics of technical mean influencing the estimated value are analyzed, first of all: purpose, the essence of functioning or/and design, basic nominal technical data, basic and additional equipment, information referring to the technical state as well as the values of the measure of consumption, information about conducted repairs (time, range and cost), information about any possible necessary repairs (range and projected cost), information about the course of operation, characteristics of the intensity of use, forecast for the remaining time of use, information about the secondary market for the valued mechanical facility as well as other important information justifying the accepted method of valuation or commenting on the obtained values of facilities.

Among the information about the technical state it is indispensable to define the data such as: completeness of the valued facility, previous reliability, predicted time of use in the current technical condition, conducted repairs and modernization (date, range and cost) necessary for conduction of repair and service (range and cost), forecast of the time of use after the conducted repairs, types of consumption of the elements as well as the determination of their causes, determination of the quantitative measures of consumption (Napiórkowski & Źróbek, 2001)

As a part of identification of the object of the valuation it is necessary to conduct the **operational assessment of the technical mean.** It includes technical, functional and environmental wear.

Technical wear is described by time models because the life time is a basic unit for machines and devices which determines their value. The easiest, linear model of consumption, may be described by means of the following mathematical formula:

$$\frac{z}{100} = \frac{t}{T}$$

where:

z — degree of technical wear in percentage,
t — age of the machine,
T — working life.

In some cases it may be deliberate to apply the model as a exponential, polynomial, power or logarithmic function.

For machines rebuilt during operation, i.e. when all units were exchanged (e.g. engine) it is useful to determine the degree of consumption as a weighted average wear of individual units. Weights are then determined as the values of individual units in the value of the entire facility.

Determination of the functional wear should be based on such technical parameters as productivity, efficiency, installed capacity of the valued facility and the comparable facility. In practice of valuation the coefficient of modernity is used:

$$K = 1 - f$$

where: f — the degree of functional wear

The degree of functional wear depends on the degree of technical and technological advancement of the machine design, its usefulness, possibility of the conduction of repair and obtaining of spare parts.

The degree of functional wear may take the following values:
$f = 0 – 0.2$ for technical facilities currently produced,
$f = 0.2 – 0.4$ for technical facilities not produced when the spare parts are available,
$f > 0.4$ for old-fashioned technical facilities whose production has been ceased.

The degree of **environmental wear** is determined in an expert way. Experts take into consideration economic, legal and environmental conditions as well as they study market situation. By means of the degree of environmental wear historical data on the object of valuation are updated (e.g. data on production costs). It allows to take into consideration current market situation during the calculation of the value of the fixed asset. The degree of the environmental wear may also be determined from the dependence:

$$Z = \frac{C_{ia}}{C_{ip}}$$

where:

C_{ia} — average prices of i-number of fixed assets in current external conditions,
C_{ip} — average prices of i-number of fixed assets before the change of external conditions.

4. The methodology of calculating the value of fixed assets lost as a result of a mining disaster

4.1. Market approach

In the economic practice the market approach is very popular. In relation to the loss of fixed assets as the results of mining catastrophes, this approach translates into a **comparison technique.** This technique is based on performing an analysis of transactional prices and market feature of similar technical means and of the evaluated object, in order to determine its market value. The features that are most commonly taken into consideration in the comparison technique are: the age of the technical asset, technical wear (technical status), basic technical and operating parameters, accessories and additional equipment and other features important for the given type of the technical asset.

The comparison technique is based on the assumption that the value of the object corresponds to the prices that have to be paid on the market for similar object. The requirement for using this method is the existence on the market of the same or similar objects and collecting relevant data regarding them (Oscypiuk, 2009).

The comparison technique can be used in three different variants:

- pair comparison,
- average price adjustment,
- statistical market analysis.

Pair comparison is based on a detailed assessment of the evaluated object using the market features as the criteria. Then the market segment, on which the object is traded, has to be determined and a set of market data about similar objects that were subjected to market transactions has to be created. One should particularly concentrate on such pieces of data as: dates of transactions, prices, market features of the objects of transactions. Market features of the evaluated object should be then related to the objects chosen in the analyzed market segment that are the most similar to the evaluated object. This leads to a situation in which the evaluated machine with known features but unknown value is being compared with machines sold that have known features and transactional prices. In the next step the prices of the reference objects' prices are adjusted due to the existing differences in the assessment of market features of these objects and the evaluated object. In order to do this, the value of adjustments, stemming from the differences between the evaluated machine and reference machines, is calculated.

Another variant of the comparison technique is the **average price adjustment.** It involves the determination of the machine value based on several sales transactions of comparable machines, after including adjustments stemming from the differences in the attributes' value. Firstly, one should identify the attributes (market features) of the evaluated machine and choose reference machines (several) that have known transactional prices. Then the identification of the reference machines' features is done – the cheapest and the most expensive – and its advantages and disadvantages are quantified according to the accepted scale. An example of a scale describing the technical condition of a given asset may be in the following form:

0 – unsatisfactory technical condition, requires total overhaul, no possibility to operate;

1 – average technical condition, the machine is working but it does not reach the nominal technical parameters;

2 – good technical condition, suitable for the age of the machine;
3 – very good technical condition, object after a major overhaul.

Then the average transactional price C_{av} and the indicator of price variability has to be determined:
- maximum $V_{\max} = C_{\max}/C_{av}$
- minimum $V_{\min} = C_{\min}/C_{av}$

The next step is to determine the weight of attributes and adjustment indicators. The following methods can be used to determine weights:
- based on the analysis of data about the influence of a given attribute on the machine value;
- based on the analysis of data about the influence of a given attribute on the other, comparable machines value;
- based on expert knowledge, using data from the previous evaluations.

Adjustment indicators take the following form:

$$W_{i\,(\min)} = S_i * V_{\min}$$

$$W_{i\,(\max)} = S_i * V_{\max}$$

The process of determining the adjustment indicators is presented in table 1. Then the next step is to determine k_i adjustment indicators of the evaluated machine with the machines of the highest and lowest sales price (table 2).

TABLE 1

Determination of adjustment indicators

Attribute	**Weight S_i**	**Adjustment indicator**		
		$W_{i\,(\min)}$	$W_{i\,(\max)}$	ΔW_i
A_1	S_1	$S_1 V_{\min}$	$S_1 V_{\max}$	$S_1(V_{\max} - V_{\min})$
A_2	S_2	$S_2 V_{\min}$	$S_2 V_{\max}$	$S_2(V_{\max} - V_{\min})$
.	.	.	.	.
.	.	.	.	.
Total	100%	$V_{\min}$	$V_{\max}$	$\Sigma\, S_i(V_{\max} - V_{\min})$

The example values of parameters characterizing attributes are as follows:

0 – 0.2 – 0.4 – 0.6 – 0.8 – 1 for the six-condition attribute value;
0 – 0.25 – 0.5 – 0.75 – 1 for the five-condition attribute value;
0 – 0.33 – 0.66 – 1 for the four-condition attribute value;
0 – 0.5 – 1 for the three-condition attribute value.

TABLE 2

Determination of k_i adjustment indicator for i-th attribute

Attribute	The k_i indicator for the i-th attribute		
	Evaluated machine	Machine with the highest price	Machine with the lowest price
A_1	0.2	1	0
A_2	0.66	1	0
.			
.			
A_n	0.33	1	0.66

Based on this, following the method adopted from Napiórkowski, one may determine the adjustments of the attribute condition for the evaluated machine:

$$p_i = w_{i(\min)} + \Delta w_i k_i$$

and the value of the evaluated machine can be calculated:

$$W = (C_{av} \sum_{j=1}^{n} p_i) K$$

where K is the correlation parameter that includes attributes that were not included in the compared machines.

The third variant of the comparison technique is the **market statistical analysis**. The starting point in this analysis is, similarly as in the other analyses, the identification of market features of the evaluated object and creating a set of data about similar objects that were the objects of market transactions, which allows the creation of a statistical model (the representative sample should include around 30 objects) (Hozer et al., 2002). The model should be based on the standard condition of the machine in the n-th year of operating. The differences in technical conditions of the machines evaluated require introducing adjustments in relation to the pattern. The adjustments in the suggested technique are recognized on the basis of costs. The procedure of pricing using the market statistical analysis assumes the determination of an average price of the machine, based on the characteristics of a sample of machines. In order to determine the average price of machines, one uses functions describing the variations of the machine value parameter in relation to years of operating and arithmetic means of other comparable machines' prices. The value parameter is the parameter describing the statistical value of the machine in the n-th year of operating, related to the price of comparable machines that are currently produced. In the next steps, taking into consideration the operating intensity and the technical condition of the machine, the adjustment is determined. The first of them may be introduced when the real value of the operating intensity is known and it deviates from the average values for the given group of machines. The adjustment may be positive, in case when the operating intensity is lower than the average value and negative in the opposite situation. The adjustment that included the technical condition of the machine, takes into consideration the degree of improvement or deterioration of the machine technical condition in relation to the average technical condition for a given year of operating of objects that are in the sample. The adjustment should include documented costs of repairs, but the repairs usually do not fully restore the operational potential of the evaluated object. The value of the degree of deterioration (symbol -) or improvement (symbol +) comes from the assessment made by an expert. In some cases the degree of deterioration may be also determined basing on the expenditures necessary to restore the object to an average condition. In the description of the technical condition of the machine, the replacements and repairs of the main parts in the period of last 12 months of operation should be noted down. The adjustment of the machine value, taking the parts replacement into consideration, should by 10% lower than the difference between the value of the assembled and disassembled part (because of the installation outside the factory). In the case of the repair the adjustment cannot be equal to the total cost of the repair. The machine value may be increased by not more than 70% of the difference in the value of the component before and after the repair in case of major repairs and proportionally less in case of repairs with a lesser extent. On the other hand the adjustment of the machine value occurs when the description of the technical condition suggests the necessity of conducting repairs. The adjustment may equal up to 100% of the projected repair costs. The value of the machine determined using this technique is calculated from the following equation (Oscypiuk, 2009):

$$W = C_{av} + \sum_{j=1}^{n} v_j K_{pj} + C_{av} K_e + K_W (1 - Z)$$

$$C_{av} = C_p W_W$$

where:

K_{pj} – cost of the repairs or improving the technical condition of the component j

v_j – adjusting indicator of cost of the component j

C_{av} – average price of the technical asset on the market in the n-th operating year

K_e – adjusting indicator of course of operation

K_w – cost of additional equipment

Z – degree of the wear of additional equipment

C_p – initial price of the technical asset

W_w – value indicator.

4.2. Property approach

Aside from the comparison approach, which is a special technique of pricing market value, there is also a **property (cost) approach.** It is used in case when:

- there is a total lack of any reference data on the market to determine the current value of the market machine (atypical, prototype),
- it is necessary for insurance purposes,
- there is need to estimate the value machines and equipment that do not appear on the secondary market,
- on customer's demand.

In the cost approach two techniques are most commonly used: technique of restoration costs and technique of replacement costs. While using the **technique of restoration costs** one should determine the price or the manufacturing cost of a technical asset in new condition. Then one has to estimate the degrees of technical, functional and environmental wear that are the measures of value loss from technical, functional and environmental reasons. In such case the following formula is used:

$$W_{OD} = C_N * (1 - z) * (1 - f) * (1 - s)$$

where:

C_N — price of purchasing a new technical asset (in case of objects made on one's own or for an individual order the purchase price is replaced by manufacturing cost Kw),
z — degree of technical wear,
f — degree of functional wear,
s — degree of environmental wear.

The degree of wear is expressed using a fraction (or as a percentage).

In case of specific machines with an individual construction, in order to determine the initial price one may use the **detailed technique,** according to which:

$$C_N = K_m + K_p + K_{dt} + k_r * n$$

where:

K_m — cost of materials,
K_p — indirect costs,
K_{dt} — costs of technical documentation,
K_r — unit labour cost
n — workload expressed in man-hours.

Also the **indicator technique** may be used in such situation:

$$C = \sum_{i=1}^{n} m_i * K_{mi}$$

where:

m_i — the reference unit for the i-th component, e.g. kg
K_{mi} — manufacturing cost for the accepted reference unit for the i-th component.

If the given model of the machine or technical device being evaluated is currently not produced or offered in mint condition any more, the method of restoration costs cannot be used. In such case it is suggested to use the **method of replacement costs**. In this method we take the $\boldsymbol{C_N}$ price or manufacturing cost ***KW*** of the most similar object in mint condition and we estimate the degree of functional wear for the evaluated machine or device. This adjusts the price or manufacturing cost of the model of the technical asset, due to the functional wear of the evaluated object. The formula for the replacement costs method is the same as for the method of restoration costs.

Technical assets due to be liquidated are indicated using the detailed method that takes into considerations the remnants:

$$W = \sum m_i \times C_{ji} \times V_i - K_d$$

where:

m_i — the mass of the i-th type of construction material,

C_{ji} — unit cost of the i-th type of construction material,

V_i — recovery rate of the i-th material,

K_d — costs of disassembling,

or using a simplified technique that includes the remnants:

$$W = \sum W_i - K_d$$

where: W_i — the value of the i-th component of the machine.

4.3. Income approach

The third approach towards the evaluation of the fixed asset is the **income approach.** It is based on the assumption that the buyer will buy the asset for the price, the height of which will be dependent on the predicted income he will receive from the machine. This approach may be used in technical assets that are operating on their own and providing income. This income is possible to be determined in the case of a machine destined to be leased or rented or which in the given moment is bringing its owner benefits from lease or rental. Such requirements are met by e.g. mining heading machines that are mining enterprises' lease from the producers. In this approach one may also use the **investment method**, according to which the income is the rent that is possible to be gained from lease or rental of the technical asset. It may be determined based on the analysis of rents gained from similar objects, with known market features. In order to do it, the techniques of the comparison approach are used. In the investment method the technique of discounting cash flows should be used, due to their existence in long periods in which there is a loss of the value of money in time. This technique is based on determining the predicted income flows in particular years of the estimation period, calculating the residual value, determining the discount rate and calculating the value of the object, according to the following formula (Oscypiuk, 2009):

$$W_d = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_i}{(1+r)^i} + \frac{RV}{(1+r)^i}$$

where:

W — income value of the object,

CF — income flow at the end of every period of operating,

$1, 2, \ldots, i$ — consecutive years of the prognosis,

RV — residual value (object terminal value after the i-th year of operating),

R — discount rate.

5. Case study – pricing of a heading machine KGS- 600S lost in result of a mining catastrophe

The object of pricing is a heading machine of a hydraulic drive, type KGS-600S, produced in 2005 by the manufacturer of machines and tools for a mining industry – Partnership X. **The legal status of the object of pricing** is the following: machine's manufacturer leased it for the mining enterprise Y. In the further study the Partnership X shall be named as the lessor and the mining enterprise Y named as the lessee. The leasing agreement includes 20 months since the date of machine's launch. The operating time lasted 18 months and after that mining catastrophe occurred, in result of which the coal face was under dyke where the heading machine was installed. After the occurrence, the lessee does not possess a technical ability to disassemble the machine from the wall and returning it on terms stated in the contract. In the documentation regarding the leasing contract, the value of the machine leased was not determined on the day of handing it for leasing. Determining the value shall be the subject of the further analysis conducted in the hereby paper.

Information source about the evaluating object and the market where such technical assets are sold are the industry specialists, manufacturers and companies dealing with sales, leasing and servicing the same or similar machines. The ways of information gathering about the market of the machines and tools are: inquiry, request of an offer, price list, community interview, consultancy, tenders results analysis, advertisement, offers and publications studying etc.

An important element of a pricing process is a description of a **technical state of the priced heading machine** KGS-600S. In may be extended using the model of production process course in the longwall which includes a theoretical efficiency of the heading machine as well as the level of its usage in the conditions of exploitation (Jaszczuk & kania, 2008). The aforementioned machine is a hydraulic heading machine manufactured by the lessor – mining machines and tools manufacturer. During the leasing period the machine was operated and maintained according to the needs, by current repairs and replacement of used or broken parts. Before handing the machine to enterprise Y for leasing, a general (major) overhaul was not conducted as the lessee does not conduct such overhauls on his own, maintaining a technical state currently on the level enabling a regular operating. When handing the heading machine for leasing to the enterprise Y, the lessor conducted its technical inspection performing necessary repairs, replacing exploitation parts and conducting conservation works. The intensity of the aforementioned machine's exploitation may be identified as very high. This causes a high **technical wear** connected with the process of deterioration of usability features of machine elements due to the change in features, shapes and sizes of elements caused by the load friction and chemical reactions (corrosion). Moreover, technical advance on the market of heading machine causes that the **functional (moral) wear** of a valued machine is high. In the recent years the hydraulic heading machines of similar parameters to the machine KGS-600S have come out of sale. They were replaced by electric heading machines. The decreased demand for heading machines of this type is mostly an effect of **environmental wear**. The priced machine cannot be operated because of the mining catastrophe. There is no possibility to conduct examination of the object of valuation and assessing its technical state on the day of catastrophe due to a lack of access to the coal face where it was operated.

In order to determine the value of the heading machine it was assumed that due to the fact that the priced asset is not on sale and it rarely appears on the market, there will be an approach used on the basis of market value but modified for the needs of the analyzed case. The market value shall be estimated in two ways:

- market value of a new heading machine on the basis of an average market price of electric heading machines (hydraulic are not available);
- market price of a second-hand heading machine on the basis of community interview.

There is no possibility to use comparison and cost techniques because of lack of data.

It is assumed that pricing is conducted on the day of asset loss, that is September 2009. This value shall be up-dated to the present value (the end of year 2011) with a discount rate equal to average interest rate of 52-week treasury bills.

In the first approach, the market of heading machines was examined in order to estimate market value of the machine. Sales transactions of such machines are rare and obtaining market data is very difficult. On the market there is a practice of such machines' lease dominating. There are also no possibilities to refer to market price lists as these prices are settled through individual negotiations, for a particular order. Moreover, a final price of a machine is determined by additional equipment, that is individually chosen for the conditions in which a particular machine will be working. For the purpose of a conducted pricing, the following data was gathered on the sales prices of heading machines in years 2007-2010 (table 3).

TABLE 3

Listing of prices of heading machines obtained in a form of purchase in years 2007-2011

Tender date	Buyer	Net price of heading machine (PLN)	Manufacturer
April 2007	KHW SA	**5,487,560**	FAMUR
June 2007	KHW SA	**5,593,700**	ZZM
April 2008	KHW SA (offer)	**5,691,300**	JOY
July 2008	JSW SA - Zofiówka	**5,990,000**	ZZM
August 2008	JSW SA - Pniówek	**4,986,000**	FAMUR
August 2008	JSW SA - Jas-Mos	**7,677,000**	JOY
August 2008	KHW SA - Murcki	**10,188,800**	JOY
December 2008	KW SA - Jankowice	**4,950,000**	JOY
April 2010	LW Bogdanka	**5,576,844**	FAMUR.

In order to estimate an average price of a new heading machine, the two highest values of transactions made in August 2008 by JOY company were excluded as they concern a delivery of a new heading machine with additional equipment of a high value which distort average prices of heading machines. It is not possible to separate machine's price from additional equipment's price because both these elements were a part of tender's object. On the basis of remaining values, arithmetic mean of analyzed prices was determined which equaled **PLN5,467,915.** Therefore, it may be stated that it is a **market value of the priced technical asset in a mint state**. Nevertheless, it should be emphasized that such value was calculated for transactions made on the market in years 2007-2010 (limited access to data), but the heading machine being the object of the research was manufactured in 2005. This value should be recalculated into present prices from the beginning of an analyzed period, that is year 2007 in relation to money value decrease in time for year 2005, with the use of a discount rate equaled to average interest rate of 52-week treasury bills in the period January 2005 – April 2007, which was included in table 4.

TABLE 4

Average yearly profitability of 52-week treasury bills in years 2005-2007

Year	Risk-free discount rate
2005	4.94%
2006	4.02%
2007	4.39%

In order to recalculate the value of a new heading machine from year 2007 into present prices from year 2005, the following formula was used:

$$C_{2005} = C_{2007} * 1/(1 + r_{2005}) * 1/(1 + r_{2006}) * 1/(1 + r_{2007})$$

where:

C — price of a new heading machine in a particular year
r — discount year equal to yearly-average interest rate of 52-week treasury bills

The price of a new heading machine presented in present prices from year 2005 amounts to PLN4,798,493.

For the purpose of market value estimation of a heading machine it is assumed that the **period of economic usability** of this technical mean is 10 years, in relation to the process of recreating used elements and conducting repairs which provide a regular technical capacity. The loss of the heading machine being the object of research occurred in year 2009, that is in a moment when the machine was 4 years and 8 months old. To such age the **indicator of technical wear** is assigned equaled 46.7%. Moreover, on the basis of community review, taking a technical advance on the market of heading machines into account, it was assumed that the **indicator of functional wear** of the hydraulic heading machine amounted to 30%. On the grounds of expert method it was additionally determined that the **indicator of environmental wear** equaled 10%. The value of the analyzed heading machine in September 2009 was estimated according to the formula:

$$W_{2009} = C_{2005} * (1 - z) * (1 - f) * (1 - s)$$

where:

W — value of the analyzed heading machine in year 2009
C_{2005} — price of a new heading machine in year 2005
z — degree of technical wear
f — degree of functional wear
s — degree of environmental wear.

On the basis of analysis and calculations conducted, it may be assumed that the market value of heading machine KGS-600S in September 2009 equaled PLN1,790,318. This value was updated to the present value (that is after recalculation into prices valid for year 2011), with a discount rate being a yearly-average interest rate of 52-week treasury bills, amounts to PLN1,943,103.

For the purpose of comparison, there was also a market value pricing used for a second-hand heading machine on the basis of the **second approach**. Through the way of community interview (manufacturer's declaration), the information was obtained that the restoration value of heading machine KGS-600S in the moment of letting it for company Y, that is in March 2008, equaled PLN3,700,000 (stated in prices of year 2011). According to the second approach, this value shall be treated as the initial price of the heading machine in the particular period of lease. The value is provided by the manufacturer in relation to the age and previous history of machine's exploitation with the assumption that the heading machine, before forwarding it to lease, is restored to a full technical capacity by the manufacturer (lessor). In such approach, it is assumed that the period of economic usability equals 3 years (machine's consumption is estimated on the level of 33% yearly). After this period, the machine must be restored again. It begins then another 3-year life cycle, however, due to the increasing age, the machine has a lower initial value in the subsequent cycles. In the subsequent cycles, its initial value is decreased by 33% yearly but on the other hand, this value is increased by repairs and spare parts changes conducted in a particular cycle. According to the approach suggested above, the adjustment of machine's value concerning spare parts change should be 10% lower than the difference between the value of installed and uninstalled part (due to installation outside the factory). In case of repair, the adjustment may increase machine's value by maximally 70% of the difference between the construction value after repair and before repair in case of overhauls and proportionally lower with the repair of a minor scale.

In the analyzed case, in year 2008, there were repairs conducted of a net total amount of PLN221,075.94 and in year 2009 of net total amount of PLN853,209.87. These repairs shall be accounted for the machine's value in 70% of their amount. The analyzed heading machine began its lease period in March 2008, therefore in 2008 its economical wear was referred to 9 months only, however in 2009 the machine was operated to September, thus its wear regards 9 months of this year as well. The heading machine's value, according to this approach, is presented in table 5.

TABLE 5

Calculation of heading machine's value (second approach)

Year	Value at the beginning of the period	Economical wear (decrease)	Repairs value	Indicator of repairs influence on the value	Value increase after repair	Value at the end of the period
2008	3 700 000	915 750	221 076	0.70	154 753	2 939 003
2009	2 939 003	727 403	853 210	0.70	597 247	2 808 847

According to the second approach, the value of the lost heading machine on the day of mining catastrophe equaled PLN2,808,847 (expressed in present prices). This value is considerably different from the value obtained in the first approach. Nevertheless, it should be noted that it bases only on the restoration value declared by the manufacturer (lessor) provided on the day of lease initiation. This value is much higher than the market value estimated for a particular year.

References

Dwiliński L., 1991. *Wstęp do teorii eksploatacji obiektu technicznego*. WPW, Warszawa.

Hozer J., Kokot S., Kuźmiński W., 2002. *Metody analizy statystycznej rynku w wycenie nieruchomości*. PFSRM, Warszawa.

Jaszczuk M., Kania J., 2008. *Coal production costs components and coal price as crucial factors in the designation of coal output*. Arch. Min. Sci., Vol. 53, No 2, p. 183-214.

Jonek-Kowalska I., 2011. *Environmental factors as a source of operational risk in mining enterprises*. [in:] Management under conditions of risk and uncertainty, Domańska-Szaruga B. and Wereda W. (Ed.), Warszawa.

Jonek-Kowalska I., 2011. *Ewaluacja kosztów wytworzenia zorientowana na poprawę efektywności w polskim górnictwie węgla kamiennego*. Zeszyty Naukowe Uniwersytetu Szczecińskiego, Nr 639, Finanse, Rynki finansowe, Ubezpieczenia nr 37, Zarzecki D. (Ed.), Szczecin.

Malewski J. (Ed.), 2007. *Szkody w środowisku, odszkodowania i zabezpieczenia roszczeń na terenach górnictwa odkrywkowego*. Oficyna Wyd. Politechniki Wrocławskiej, Wrocław, 11.

Michalak A., 2010. *Przegląd koncepcji metod wyceny inwestycji rzeczowych*. [in:]: Zarządzanie wartością przedsiębiorstwa, Zeszyty Naukowe Uniwersytetu Szczecińskiego nr 635, Finanse Rynki Finansowe i Ubezpieczenia nr 35, E. Urbańczyk (Ed.), Szczecin, 549-562.

Michalak A., 2011. *Analiza dynamiki i struktury aktywów i pasywów wybranych przedsiębiorstw górniczych w latach 2003-2009*. [in]: Modele finansowania działalności operacyjnej przedsiębiorstw górniczych, M. Turek (Ed.), Wyd. GIG, Katowice, 54-89.

Napiórkowski J., Źróbek R., 2001. *Metody wyceny maszyn i urządzeń*. Wyd. Zachodnie Centrum Organizacji, Zielona Góra.

Napiórkowski J. *Wycena maszyn i urządzeń*. http://www2.wpia.uw.edu.pl/files//podyplomowe/rzeczoznawstwo/wycena_maszy_urzadzen_Napiorkowski.pdf

Oscypiuk R., 2009. *Wycena maszyn i urządzeń*. http://ebookbrowse.com/roman-osypiuk-wycena-maszyn-i-urzadzen-2009-pdf-d35503813.

Osypiuk R.W., 1995. *Wykorzystanie diagnostyki technicznej w wycenie maszyn i urządzeń*. Rzeczoznawca Majątkowy Nr 4/1995.

Ricardo D., 1957. *Zasady ekonomii politycznej i opodatkowania*. PWN, Warszawa.

Rozporządzenie Ministra Gospodarki z dnia 20 grudnia 2005 r. w sprawie zasadniczych wymagań dla maszyn i elementów bezpieczeństwa. Dz. U. Nr 259, poz. 2170.

Schumpeter J., 1960. *Teoria rozwoju gospodarczego*. PWN, Warszawa.

Standardy Zawodowe Rzeczoznawców Majątkowych, 2002. Wydanie VIII, PFSRM Warszawa.

Standardy Zawodowe Rzeczoznawców Majątkowych, 2006a. Standard III.1. – Wartość rynkowa jako podstawa wyceny. Polska Federacja Stowarzyszeń Rzeczoznawców Majątkowych.

Standardy Zawodowe Rzeczoznawców Majątkowych, 2006b. Standard VI.1 – Wycena maszyn i urządzeń trwale związanych z nieruchomością. Polska Federacja Stowarzyszeń Rzeczoznawców Majątkowych.

Turek M., Jonek-Kowalska I., 2009. *Dylematy kalkulacji kosztu kapitału w przedsiębiorstwie górniczym*. Szkoła Ekonomiki i Zarządzania w Górnictwie, Przegląd Górniczy nr 9.

Turek M., Jonek-Kowalska I., 2010. *Koncentracja przedsiębiorstw przemysłowych – przyczyny, przebieg, efekty*. Wydawnictwo Politechniki Śląskiej, Gliwice.

Ustawa z dnia 29 września 1994 r. o rachunkowości. Dz. U. 1994, Nr 121, poz. 591 z późn. zm.

Zarzecki D (Ed.), 2000. *Metody wyceny przedsiębiorstw – zarys teorii a praktyka*. Wyd. Uniwersytetu Szczecińskiego, Szczecin.

Received: 31 January 2012