Valuation of the Construction Machinery Using the Market Approach

Marko Popović^{1*}, Radomir Slavković¹, Peđa Perišić³

¹Faculty of Technical Science, University of Kragujevac

³D.S Inženjering, LIEBHERR Srbija

Valuation of the construction machinery and information which are obtained during and after the process of evaluation, represent important factors in bringing the decisions regarding purchasing or selling construction machinery, their replacement, maintenance, service and reparation. The value of the machines obtained by evaluation is being used in business analysis, financial reports, insurance, bringing various investment decisions, financial loans, etc. For the purpose of valuating construction machinery, in Serbia, there doesn't exist an appropriate defined standard, recommendation nor methodology, which would define a accurate procedure and act of valuation. In this writing we will show the fundaments of comparative approach and its appliance in valuation of the construction machinery with specific reference to the valuation of the hydraulic excavators with the digging bucket as a tool. Also, in this work, given is the methodology for the analysis and evaluation of the current state of the machinery from the aspect of validation, along with the corresponding examples of evaluation.

Keywords: Market Approach, Heavy machinery, Valuations, Appraising Machinery and Equipment

0. INTRODUCTION

The reason for the evaluation can be different, varying from the purpose of purchasing or selling used equipment, to financial reports, insurance, taxing, financing etc. When spoken of valuation, it doesn't refer to an actual price, because the actual price has to be defined at the moment of purchase or sale, but about the framework of value which is being determined under certain conditions and corresponding limitations. There are several value terms (for instance, market value, fair value, liquidation value, insurance value, etc.), and which one of those will be taken in consideration depends on the purpose and intent of evaluation, from limitation factors, available data, etc. Therefore, for instance, market value is defined as: *„evaluated amount for which the means could be exchanged on the day of the valuation, between the interested buyer and interested seller, in transaction between independent and unrelated parties, after an appropriate marketing, wherein both parties have reacted with sufficient knowledge, caution and without coercion.”*

Comparative method of evaluation, like one of the three methods for valuating machinery and equipment, is applicable and reliable for valuating hydraulic excavators, considering the fact that for this kind of equipment there is a developed market for purchasing and selling the machines. Defining comparative elements is accurate and clear, wherein the evaluation depending of the type of an excavator, can be done by one out of three techniques of comparison. In the case of evaluation of hydraulic excavators, value obtained by the use of comparative method, is the least subjective, and regarding the market liquidation for the purchase and sale, it is very reliable. That is very important for decision making which is based on valuation.

1. BASIC APPROACH FOR THE VALUATION OF THE MACHINES AND EQUIPMENT

When spoken about valuation of the machines and equipment, even about machinery, there are three approaches which can be applied, and those are comparative, cost and contributory approach. In the text bellow, there is a detailed description of the approaches.

1.1. Comparative (market) approach

Comparative or how it is often called, market approach, presents comparison between the same or very similar machines and equipment, and it is being used in cases where the existing secondary market is sufficiently developed. With this approach, current market price analysis is being conducted on the same or similar equipment where comparative variables are being determined along with the evaluation of the state the equipment is in and valuation.

To determine the current market price, the existence of the well developed market of the same or similar equipment is necessary, respectively such market in which the positions of trading (homogeneity, similarity, etc.), continuity of trading, availability of trading information (the price, amount, conditions, etc.), are clearly defined.

1.2. Cost Approach

Cost approach is based on determining the cost of replacing the equipment, respectively manufacturing or purchasing new equipment with the same or similar characteristics. The highest price the interested party would be willing to pay presents the new evaluated price of the equipment. However, that value is corrected by the amount of amortization of the equipment, which represents a consequence of physical utilization, but also of economical, functional and technological obsolescence, expressed in percentage as a remaining utility value. In order to determine the value of cost of the replacement,

there may be used: a) original (revalue) costs of the purchase or b) current data regarding costs, historical costs of recent purchases, or data obtained from the manufacturer or supplier. Determined values of the costs of the replaced equipment involve, besides the market price of the machine and equipment, the transport costs, installation costs and engineering.

Valuation with cost method is defined by the analysis which includes characteristics and the quality of the means, current state (real-time amortization), its functionality along with the possible appliance. Based on the average purchase price and deduction for the real-time amortization, the evaluator defines the costs of the purchase in the same or similar state (technical and economical) hence determines the value of the means within this approach.

1.3. Contributory approach

With contributory approach, the value of the equipment is being determined as the current value of the future results (income and expenses) achieved by the utilization of the equipment.

The valuation, within contributory approach, includes two methods: a) capitalization of achieved results and b) discounting of the future results.

The meaning of the use of the contributory methods in valuation is actually evaluation of economical utilization which can be obtained from the valued means. This method of valuation, as a rule, should provide the highest assessment value of the equipment, if it is being used rationally, economically wise.

In Table 1., given are advantages and disadvantages of the practical appliance of the above mentioned evaluation approaches.

Table 1. The advantages and disadvantages of the different approach to valuation of machines and equipment

	Advantages	Disadvantages
Cost approach	✓ Method good for evaluation of the machines and equipment for special (specific) appliance. ✓ Method good for evaluation of the new equipment. ✓ With this method, we can clearly classify the factors that affect the final estimated value (physical deterioration, functionality or economical obsolescence)	× In certain cases the overemphasis of the economical obsolescence might occur. × Definition of depreciation is subjective × Hindered calculation of the effective age of the equipment, especially in cases of conducted repair. × Hindered estimation of the previous utilization of the equipment
Comparative approach	✓ Market Value determined on a good secondary market, is the most reliable indicator of value ✓ Market method determines the total obsolescence of the equipment more accurately	× Some equipment may not have comparable market prices × Adaptation of the comparable factors is subjective × Data regarding the previous trades are usually not in detail, and often are questionable. × With previous trades, the motive of the buyer and seller is unknown.
Contributory approach	✓ With this method, there can be determined the contribution of the machines and equipment to the overall business of the company. ✓ Gives the total equipment obsolescence of the company equipment with the highest accuracy.	× The method is bad in cases when extraction and close observation of the special appliance equipment from the company is needed. × Determination of the rates of return is subjective, and you need to combine it with already adopted business model of the company
	✓	×

2. COMPARATIVE (MARKET) VALUATION APPROUCH

2.1. The gist of the comparative approach

The basic premise of the comparative or so called “market” valuation approach is well contemplated investor who can independently conduct a purchase or a sell of means, in the most suitable way for him. Because of that, the comparative approach is based on existence of buying and selling market, in which the price of the machines and equipment is being formed. Participants in such market are the dealers of the machines, individual

buyers and sellers, auction houses, machine manufacturers, etc.

In comparative valuation approach, value analysis is conducted by comparison of the subject of assessment with the same or technically-technologically similar and comparable subject. Comparative method is actually based on gathering data regarding prices and overall condition of the same or similar equipment on the market, which was the subject of the purchase, sell, auction, advertising, etc. Having in mind the above mentioned, the definition of the comparative valuation approach is: “*Comparative approach is a approach in which sells, purchases, and the current quotations and searching for similar properties,*

are being analyzed and evaluated in goal of indication of the most probable sale price of the subject of evaluation”.

The procedure of valuation begins with gathering data about realized buying and selling of equipment, advertised prices and auctions of the same or similar equipment. After that, there is an analysis regarding the extent to which the market data can be compared to subject to assessment. That means that certain comparative elements according to which the comparison is being conducted, are defined. By the comparative elements and their evaluation analysis, the final conclusion is made-regarding indicative price of the subject to assessment.

With comparative method, it is very important to determine the possibility of comparison of comparative with the subject of assessment. If the comparative and the subject of assessment are identical, then there is no problem, but in practice that represents only a small number of cases. The process of comparison demands the definition of the comparative elements at the beginning, so according to them, the further analysis and evaluation of the subject to assessment deviation in relation to the market comparative, can be conducted. Essentially, comparative elements are technical and technological features which are mutual for the subject of assessment and its comparatives, and also have influence on their value.

2.2. Comparative Elements

When the comparative approach is being used, it is ideal to make the conclusion of indicative price of the subject to assessment, by observing the identical means on developed and liquid market. Unfortunately, in practice that is often not the case, thus the conclusion regarding value is being made by analysis of the similarities and deviation. Analysis of the similarities comes down to comparison between comparative elements of the subject to assessment and market comparative.

Bellow are shown comparative elements which are being used in general cases when valuating machines and equipment. Those are:

A. Comparative elements which are linked to the means itself (*internal*):

1. The condition of the equipment
2. The age of the equipment
3. The Manufacturer
4. The type and dimensions
5. The Quality
6. Additional equipment, tools and accessories

B. Comparative elements which are not linked to the means (*external*):

7. The market conditions (general market condition)
8. The type of the sale (sale/advertising/auction)
9. The time of the sale/advertising/auction
10. The motive for the sale
11. The location of the means, sale/advertising/auction
12. The quantity
13. The quoted price

The Internal comparative elements are linked to the means and they represent its technical and technological characteristics and general condition in the moment of evaluation. The External comparative elements do not depend on means, but on the surrounding in which the

means is being traded. The External comparative elements can have equally huge influence as the technical characteristics of the means, hence they are shown in more details in bellow text.

The most influential External comparative element is certainly general market condition, and at the same time it is the hardest factor for analysis. The question here is: *How does the market influence the price of the subject to assessment?* If we consider the market conditions on the markets hit by crisis, recession, and general drop or closeout, then on such markets the quoted prices will be lower than the prices on the markets where the growth, high demand or low supply is expected, etc. On the other hand, if we observe the market which is different that the market of the subject to assessment, it is necessary to do the appropriate market price adaptation (for instance, quoted prices of the Caterpillar excavators in America, cannot be transferred as market data and without adaptation analyze in Serbia). The motive of the sale is also very important factor, and here also the big industries bankruptcy, manufacturer of the means, technology obsolescence and significant changes in law framework are being taken in consideration and analyzed. Also, when we observe the market price, we should pay attention to the quantity of the offered subjects which are being sold for the same price at the same time, also on the following discounts and margins. Besides that, it is significant to define what kind of quoted price is under consideration, is it auction, closed sale/purchase, advertised price, or some other quoted price.

2.3. Techniques of the comparative approach

Within comparative approach, there are three basic techniques applicable, based on which the indicative price is concluded, respectively defines the value of the subject to assessment. Those are:

- A. The Direct comparison
- B. The Comparable match
- C. The Percentage expressed price

The Direct comparison. The method of direct comparison is being applied when the subject of assessment and market comparative are identical. By direct comparison we get the most accurate value indication. In direct comparison, the comparative factors are clear and comparable, comparative are the same as for subject to assessment, and adaptation of the indicative price is done only for comparative elements which define the use of means. For instance, when evaluating a hydraulic excavator, we would choose the market comparatives of an excavator in the same class, type and year of production, and it would all be observed on the same market as for subject to assessment. In this case, adaptation would be carried through only for the number of working hours and condition of the excavator. In table 2, as an example is given overview of quoted market prices of hydraulic crawler excavators. The table will be used to explain technique of market approach.

Application of direct comparison is shown in table 3, on the example of evaluation of an excavator (excavator CAT 320DL, 2011 year of manufacture with standard equipment in very good condition with 2700 working hours on the EU market). Since in evaluation with direct

comparison, the same systems are being compared, for getting the indicative price of the excavator, market data would be used under serial numbers 4,7,8, and 9 because those are all hydraulic crawler excavators, year of

manufacture 2011. in a very good condition on EU market. In this case, deviation refers to the working hours of the excavator.

Table 2. Example of quoted market prices for different hydraulic crawler excavators

No.	Model	Market	Engine power [kW]	Weight [t]	Year of manufacture	Working hours	Quoted price on the market	Condition of the machine	The price of the new excavator
1	CAT 320 DL	EU	103	21.5	2011	7907	85,000.0 €	Good	200,000.0 €
2	CAT 320 DL	EU	103	21.5	2010	3459	85,000.0 €	Very Good	200,000.0 €
3	CAT 330 DL	EU	200	35.3	2011	3185	107,500.0 €	Very Good	200,000.0 €
4	CAT 320 DL	EU	103	21.5	2011	2703	92,188.0 €	Good	200,000.0 €
5	CAT 320 DL	USA	103	21.5	2012	1691	124,750.0 €	Excellent	200,000.0 €
6	CAT 320 DL	USA	103	21.5	2012	2403	119,000.0 €	Very Good	200,000.0 €
7	CAT 320 DL	EU	103	21.5	2011	2533	103,314.0 €	Very Good	200,000.0 €
8	CAT 320 DL	EU	103	21.5	2011	3185	107,500.0 €	Very Good	200,000.0 €
9	CAT 320 DL	EU	103	21.5	2011	2979	95,000.0 €	Very Good	200,000.0 €
10	Hitachi ZX210	USA	119	21.4	2012	525	172,000.0 €	Excellent	180,000.0 €
11	Hitachi ZX210	USA	119	21.4	2011	2651	96,029.0 €	Very Good	180,000.0 €
12	Hitachi ZX210	USA	119	21.4	2012	745	166,454.0 €	Excellent	180,000.0 €
13	Hitachi ZX210	USA	119	21.4	2012	601	149,000.0 €	Excellent	180,000.0 €
14	Kobelco SK210	EU	103	20.2	2012	960	118,500.0 €	Excellent	160,000.0 €
15	Kobelco SK210	USA	103	20.2	2011	2297	94,500.0 €	Very Good	160,000.0 €

Table 3. Example of technique for direct comparison

No.	Model	Market	Working hours	Quoted price	Condition of the machine
4	CAT 320 DL	EU	2.703	92,188.0 €	Very Good
7	CAT 320 DL	EU	2.533	103,314.0 €	Very Good
8	CAT 320 DL	EU	3.185	107,500.0 €	Very Good
9	CAT 320 DL	EU	2.979	98,000.0 €	Very Good
	Average		2.850	100,250.5 €	

As you may see in the table above, average number of working hours taken from the market examples is 2.850, and their average price is 100,250.5 €. Since the difference and deviation of working hours of the observed excavator (2700 w.h.), there should be adjustment of the average price. There are several methods of adjustment, but on liquid markets where there is a huge number of market data, the adjustment is done by additional filtration of market comparatives. For instance, in this case, market data close to object of evaluation would be adopted, respectively in this case market data which has the biggest deviation from 2700 w.h. would not be considered and that is comparative under serial number 3. In this case, we get an average number of working hours $(2.703+2.533+2.979)/3=2.738$ w.h., which is very close to the number of working hours of the observed excavator. Because of that, an indicative price of the observed excavator would be 98,000 €

Comparable match. This technique is based upon getting the indicative value by comparing similar (but not identical) means, by applying one or more technical and technological characteristics (productivity, capacity, dimensions, weight, etc.) This way, the adaptation of the

market price of the comparative is being made, from the characteristics of the subject to assessment.

For instance, if it is needed to evaluate hydraulic crawler excavator *Kobelco SK210* on the USA market, which was manufactured in the year 2011., in a very good condition with 2.350 w.h., where we have the market data from the table 2, then in lack of market data regarding the excavator the market match technique would be applied. Analysis of comparable match starts by defining comparative elements. Comparative element for evaluation of the hydraulic crawler excavator with backhoe bucket tool would be:

- 1) Manufacturer, model and type
- 2) Year of production
- 3) Number of working hours
- 4) Operating weight of the machine
- 5) Rated engine output
- 6) Condition of the machine and preservation
- 7) Additional equipment
- 8) Missing, replaced or repaired parts

After that, comparatively similar market data would be adopted (for example market, rated engine output, working hours, weight, etc.) and the comparison of the subjects to assessment would be conducted relative to mentioned comparative elements. In table 4, an example of comparable match technique is shown involving observed excavator and adopted similar market comparatives from the table 2. Comparatives are adopted so the USA market can be observed, whereas excavators with similar rated engine output, weight, year of production are adopted and which are in the same condition as the subject to assessment.

Chart 4. *Appliance of the Direct Match technique*

	C1		C2		C3	
Manufacturer, model and type	Kobelco SK210		Hitachi ZX 210		CAT 320DL	
Year of production	2011		2011		2011	
Number of working hours	2297		2651		2403	
Operating weight of the machine	20.2		21.4		21.5	
Rated engine power	103 kW		119 kW		103 kW	
Condition of the machine and preservation	Very Good		Very Good		Very Good	
Additional equipment	None		None		None	
Missing, replaced or repaired parts	-		-		-	
Source of information	USA		USA		USA	
Sales price	94,500.0 €		96,029.0 €		119,000.0 €	
Corrected price due to the market comparative	94,500.0 €		96,029.0 €		119,000.0 €	
Comparative matrix						
	C1		C2		C3	
Manufacturer, model and type	Kobelco SK210	0.0%	Kobelco SK210	-10.0%	Kobelco SK210	-10.0%
Year of production	2011	0.0%	2011	0.0%	2011	0.0%
Number of working hours	2350	-2.3%	2350	11.4%	2350	-2.2%
Operating weight of the machine	20.2	0.0%	20.2	-5.9%	20.2	-6.4%
Rated engine output	103 kW	0.0%	103 kW	0.0%	103 kW	0.0%
Condition of the machine and preservation	Very Good	0.0%	Very Good	0.0%	Very Good	0.0%
Additional equipment	None	0.0%	None	0.0%	None	0.0%
Missing, replaced or repaired parts	-	0.0%	-	0.0%	-	0.0%
Percentage comparison	98%		95%		81%	
Corrected price	94,500.0 €		96,029.0 €		119,000.0 €	
Corrected price after the comparison	92,326.5 €		91,659.7 €		96,866.0 €	
Estimated market value (indicative price):				93,617.0 €		

Percentage expressed value. This method is based upon making relations between the current market price of comparative, and its price as a new machine. By establishing this relation, and taking in consideration the means characteristics, the calculation is being made- of indicative value of the subject to assessment by applying the derived proportion in relation to comparative. This technique applies when there is a large quantity of comparative market data, because with appliance of statistic tools, we define partial functions of the comparative elements and make the proportion which is applied on subject to assessment. This way, for the similar means, we can establish functions such as: (*age – market price – the price of the new machine*); (*capacity – market price – price of the new machine*); (*condition – market price – price of the new machine*), etc.

If, base on the market data given in the table 2, it is needed to evaluate hydraulic crawler excavator *Komatsu HB215*, 105kW, 21.2t, 2011. Year of production with 2.200 w.h., in very good condition, where purchase price of the new machine is 190.000€ then in this case we should apply technique of value expressed in percentage, because market data for this excavator are missing. After defining comparative elements for the excavator, analysis of the given market price and comparative element is being conducted respectively on the purchase price of the new excavator. During the analysis, only the values which are the same or similar to the subject to assessment are being adopted (for instance weight 21.4t from the table 5., and 21.2t for the subject to assessment).

As shown in table 5., after adopting the suitable market comparative, calculation of the percentage value is conducted, by the defined comparative elements.

Table 5. Appliange of value expressed in percentage technique

No	Model	Engine Output [kW]	Weight	Year of production	Number of working hours	Quoted price	Condition of the machine	The price of the new excavator	Percentage of market value is expressed in relation to the price of a new excavator			
									Year of production	Number of working hours	Weight	Engine output
1	CAT 320 DL	103	21.5	2011	7907	85,000 €	Good	200,000 €				
2	CAT 320 DL	103	21.5	2010	3459	85,000 €	Very Good	200,000 €				
3	CAT 330 DL	200	35.3	2011	3185	107,500 €	Very Good	200,000 €	53.8%			
4	CAT 320 DL	103	21.5	2011	2703	92,188 €	Good	200,000 €				
5	CAT 320 DL	103	21.5	2012	1691	124,750 €	Excellent	200,000 €				
6	CAT 320 DL	103	21.5	2012	2403	119,000 €	Very Good	200,000 €		59.5%	59.5%	59.5%
7	CAT 320 DL	103	21.5	2011	2533	103,314 €	Very Good	200,000 €	51.7%	51.7%	51.7%	51.7%
8	CAT 320 DL	103	21.5	2011	3185	107,500 €	Very Good	200,000 €	53.8%		53.8%	53.8%
9	CAT 320 DL	103	21.5	2011	2979	95,000 €	Very Good	200,000 €	47.5%		47.5%	47.5%
10	Hitachi ZX210	119	21.4	2012	525	172,000 €	Excellent	180,000 €				
11	Hitachi ZX210	119	21.4	2011	2651	96,029 €	Very Good	180,000 €	53.3%	53.3%	53.3%	
12	Hitachi ZX210	119	21.4	2012	745	166,454 €	Excellent	180,000 €				
13	Hitachi ZX210	119	21.4	2012	601	149,000 €	Excellent	180,000 €				
14	Kobelco SK210	103	20.2	2012	960	118,500 €	Excellent	160,000 €				
15	Kobelco SK210	103	20.2	2011	2297	94,500 €	Very Good	160,000 €	59.1%	59.1%		59.1%
Mean value by comparative elements:									53.2%	55.9%	53.2%	54.3%
Average value by all comparative elements:									54.1%			
The price of the new observed excavator:									190,000.0 €			
Estimated market value (indicative price):									102,845.0 €			

3. OVERVIEW AND EVALUATION OF THE CONDITION OF THE SUBJECT TO ASSESSMENT

3.1. Overview and identification of the excavator

When valuating the machine and equipment, the first thing on the list is to do an inspection and overall estimation of the condition the machine is in. While inspecting the equipment, the assessor is conducting a macro and micro identification, analysing condition of the main segments, analysing maintenance of the equipment and conditions under which machine works. Special attention goes to analysis of possible damage or defects.

Since hydraulic excavators are mobile means, while valuating them, only microidentification is being used. Those are mandatory data which assessor needs to define in his evaluation.

With hydraulic excavators with back hoe bucket as a tool, those are the following data:

- 1) Manufacturer, type and model
- 2) Serial number
- 3) Year of production
- 4) Rated engine output and operating weight of the machine
- 5) Working area
- 6) Additional equipment
- 7) Eventual damages and defects
- 8) Evaluation of general condition of excavator preservation

Unlike other data which are available through technical and other documentation, while valuating an excavator special attention is given to evaluation of the general condition.

Evaluation of the general condition of hydraulic excavator needs to be achieved from the partial evaluation of the condition of appropriate functional segments of a hydraulic excavator.

3.2. Participation of functional segments of an excavator in its total value.

In general, from the aspect of total value, hydraulic crawler excavator with a bucket tool can be divided in the following main segments: (Fig. 1.):

- 1) *Upper carriage* which includes assembly of hydraulic pumps, hydraulic motors, hydraulic block, engine, cabin, drive gear, fuel tank, cooling system, etc., and it represents 50% ($\pm 3\%$) of the total value of the excavator.
- 2) *Undercarriage* which includes main frame, track pads, chains, sprocket, idler, top and bottom rollers, etc., and it represents approx. 23% ($\pm 2\%$) of the total value of the excavator.
- 3) *Attachment with the working tool* which includes main boom, stick, hydraulic cylinders, hydraulic lines for additional tools, bucket, etc. and it represents approx. 22% ($\pm 2\%$) of the total value of the excavator.

Fig. 1. The main elements of a crawler excavator from the aspect of valuation

In the table 6. below, shown is a detailed analysis of participation of individual functional segments of hydraulic crawler excavator in its total value, observed from the aspect of valuation.

Table 6. Participation of individual functional segments in total price of a crawler excavator shown in percentages

No.	Individual functional part	Participation in percentage
1	Diesel engine	17%
2	Hydraulic pumps	13%
3	Hydraulic motors	9%
4	Cabin with interior	10%
5	Hydraulic block	8%
6	Working attachment	19%
7	Undercarriage → Chains ~ 5%, → Rollers ~ 2% → Idler ~ 1% → Main frame and sprocket segments ~ 11%	19%
8	Other	5%
TOTAL:		100%

Fig. 2. Graphic display of the participation of functional segments in total value of the hydraulic excavators

3.3. Evaluation of the general condition of an excavator

Evaluation of the general condition of an excavator is derived from the evaluation of functional segments after the inspection of an excavator. Every functional segment is given in table 6., is being evaluated after the inspection. In table 7., is general evaluation of the condition of parts and functional segments of the machine and equipment. Also, in the table is given a detailed description of the condition and remaining lifetime of the equipment in reference with the evaluated condition.

Table 7. Condition evaluation and the remaining useful lifetime of the machine in relation to current condition [8]

CONDITITION EVALUATION/Description of equipment condition	Remaining lifetime
NEW /equipment has not been used before, hence there are no losses but physical wear.	90÷100%
EXCELLENT /Almost new equipment which had been recently purchased and which has small amount of working hours	80÷89%
VERY GOOD /Very good condition of mechanical parts and important segments of the equipment. Equipment which has had overhaul recently. The equipment which hasn't been utilized enough.	60÷79%
GOOD /Equipment which is in a good operational condition. Equipment which may require an additional service or repair. Equipment without any mechanical defects.	40÷59%
BAD /Equipment which requires overhaul or significant repair in the near future. Equipment which requires a lot of service. Equipment which has been used very intensively and under very unfavorable technological regime.	20÷39%
VERY BAD /Equipment which is worn out. Equipment which requires repair. Equipment which needs significant intervention and service, so it can work in the regimes for which it was constructed.	2.5÷19%
SPARE PARTS /Equipment which has the only remaining value in its assembly segments, sub-assembly segments and simple parts. Equipment which can be used only as a source of spare parts.	0÷2.5%
WASTE /Equipment which no longer has any function, and which has no other value but the value for which it can be sold to a junk yard as a secondary raw material	0÷1%

The evaluation from the text above, and description of condition, is used for analysis of functional segments, but also for total analysis and evaluation of the condition of the machine and equipment.

In table 8., shown is an evaluation of the condition of the functional segments of the hydraulic

excavator. Evaluation of the total condition is derived based on evaluation of the condition of every functional segment and weighting the influence of every segment separately. In analysis is used prebiousl shown table 7.

Table 8. Functional segments analysis and evaluation of general condition of a hydraulic excavator

No.	Name of the functional segment	Participati on in total value	Evaluation of a current condition of functional segment	Condition description	Estimated condition of the segment	Total condition
1	Diesel engine	17%	Very Good (60÷79%)	Very Good condition of mechanics and responsible equipment parts.	75.0%	12.8%
2	Hydraulic pumps	13%	Very Good (60÷79%)	Very Good condition of mechanics and responsible equipment parts.	75.0%	9.8%
3	Hydraulic motors	9%	Very Good (60÷79%)	Very Good condition of mechanics and responsible equipment parts.	70.0%	6.3%
4	Cabin with interior	10%	Excellent (80÷89%)	As good as new. Well kept and maintained	85.0%	8.5%
5	Hydro block	8%	Good (40÷59%)	Good operational condition	50.0%	4.0%
6	Working attachment	19%	Good (40÷59%)	Good condition without mechanical defects	50.0%	9.5%
7	Undercarriage	19%	Good (40÷59%)	Good condition without mechanical defects	45.0%	8.6%
8	Other	5%	Very Good (60÷79%)	Very Good condition of mechanics and responsible equipment parts.	65.0%	3.3%
Calculated value:						62.6%
Estimated total CONDITION OF THE MACHINE:						Very good

When evaluating the current condition of an excavator, we need to pay attention about the age and the total number of working hours of the machine. When analysing hydraulic excavators with backhoe bucket as a tool, depending on type and model, useful lifetime is around 15 years or 12 000 working hours. These data include average values with appropriate maintenance and adequate use of the excavator. For excavators which have reached and exceeded their useful lifetime, it is usually required to conduct an overhaul of the whole machine after which a new lifetime of the machine is being determined.

When evaluating an excavator and defining its general condition, a special attention should be paid to system maintenance of the excavator. Also, the data about recent overhaul in general or overhaul of some important segments such as the engine, hydraulic system, undercarriage, etc. need to be analysed.

Table 9. Useful lifetime of an excavator shown through the number of working hours of the machine

No.	Name of machinery	Average number of working hours	Average number of working hours per year
1	Universal crawler excavators	12,000	800÷1,000
2	Wheel excavators and wheel loaders	10,000	750÷900
3	Bulldozers	8,000	500÷600

In table 9., shown is useful lifetime of an excavator observed through the recommended number of working hours. In table 10. [1], shown is the amortization, economical and useful lifetime of an excavator, depending

on the type and model of the excavator. Practice showed [2], that the useful lifetime is 40÷50% longer than the economical lifetime of the equipment.

Table 9. Useful lifetime of an excavator expressed through the number of working hours of the machine

	Engine output	Amortization [%]	Economical lifetime [yrs.]	Useful lifetime [yrs.]
Crawler excavators and Wheel excavators	up to 75kW	20	5	7
	75 ÷ 150 kW	14.3	7	10
	over 150	11	9	13
Crawler drag line excavators	up to 75kW	16.5	6	9
	75 ÷ 150 kW	12.5	8	12
	over 150	10	10	14
Wheel Bulldozers	up to 75kW	16.5	6	9
	75 ÷ 150 kW	16.5	6	9
	over 150	12.5	8	12
Crawler Bulldozers	up to 75kW	20	5	7
	75 ÷ 150 kW	14.3	7	10
	over 150	11	9	13

4. CONCLUSION

In this work is shown a methodology of market approach in valuation of hydraulic crawler excavators with backhoe bucket as a tool. Also, shown is the way of

defining the total condition of an excavator through its evaluation.

When spoken of market approach, it should be noted that if assessor possesses a large number of data about the prices of the same or similar equipment, that means that the conclusions in valuation are more certain.

In the case of evaluation of hydraulic excavators, value obtained by the use of comparative method, is the least subjective, and regarding the market liquidation for the purchase and sale, it is very reliable.

While analysing and adopting the market comparatives of excavators, special attention should be focused to:

- The degree of the comparison between the observed equipment and equipment which can be found on the market
- Time of closed transaction, sale, advertising or auction on the market
- Possible existence of additional or special conditions which may have an influence on quoted market prices

When applying comparative methods, special attention should be paid to analysis of the quoted price. Observing the identical means, quoted prices might have a very vast range. That is because the quoted price does not only reflect the value of the means, but also the supply and demand for such means, individual wishes of the customer, salesmen and other participants on the market, current economy, etc. Assessor, hence, needs to be a good expert of the current condition on the market, so he can filter the market data as good as possible. The better the market data are, the better is the final conclusion about the

market value of the subject to assessment. The making of the valuation needs to be based on facts, assumptions and limitations related to every situation and evaluation separately.

REFERENCES

- [1] *Pravilnik o nomenklaturi nematerijalnih ulaganja i osnovnih sredstava sa stopama amortizacije*, Službeni list, SRJ, 17/97 i 24/2000.
- [2] Durutović, B., *Procena tržišne vrednosti opreme*, ISBN 86-7593-004-6, Grafikom, Beograd, 1992.
- [3] *Valuation of Plant and Equipment*, International Valuation GN 3, IVS Committee, 2005.
- [4] Alico, J., and etc., *Appraising Machinery and Equipment*, American Society of Appraisers, USA, 1989.
- [5] Popović, M., *Procena vrednosti korišćene proizvodne opreme*, 11th International Conference ICDQM-2008, Beograd, 2008.
- [6] M.A. Belo MON, *Guide to Plant & Machinery Valuation*, Armitage Books-Guru PR, London, 2011.
- [7] *International Valuation Standards*
- [8] Bethel, S., *Machinery & Equipment Valuation*, Frazier Capital Valuation, USA, 2005.
- [9] Kunze, G., Gohring, H., Jacob, K., *Baumaschinen – Erdbau und Tagebaumaschinen*, ISBN 978-3-528—06628-4, PRAXIS, Wiesbaden, 2009.