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## PREDICTING THE COST OF ANTIQUE COLD WEAPONS BY A COMPARATIVE METHOD

*This article describes one of the possible methods of forecasting the value of cold steel based on the analysis of the permanent state of the market and documented quality parameters of the object of evaluation.*

*Keywords:* attribution, cold weapons, work forecasting, Antique cold weapons, comparative method.

*Вовк Ю. Прогнозирование стоимости антикварного холодного оружия сравнительным методом. Описан один из возможных методов прогнозирования стоимости холодного оружия на основе анализа перманентного состояния рынка и задокументированных параметров качества объекта оценки.*

*Ключевые слова:* атрибуция, холодное оружие, прогнозирование стоимости, антикварное холодное оружие, сравнительный метод исследования.

**Background.** The issue of valuation of cultural monuments today is urgent due to the need to determine the so-called "estimated value" in court cases of lost property, the lawfulness of the transfer of property rights, determining insurance amounts, assessing inheritance, conducting transactions of purchase and sale, pledge, lease or use of objects that are of great socio-cultural importance in banking operations. It is clear that in all named cases there is a significant specificity in the formulations of the evaluation task, which is due to the need to take into account different types of supporting information, the results of the analysis of the current state of the market of related items and the formulation of the general principle of valuation. This explains the reasons for the significant differences in the projected cost figures, which were performed at different times and by different valuers [1]. At the same time, if the evaluation report is concluded in such a way that each conclusion is a contradictory result of the study of objectively existing features of the monument and can be verified by an independent expert, the evaluation should be considered to be correct and suitable for practical use.

**Analysis of recent research and publications.** Many studies of historical artifacts have been conducted in recent years, but very few analytical results have been published. Scientists predict the value of antique and rare monuments of culture and history by a comparative method.

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Thus, in the work "Commodity characteristics of antique melee weapons on the market of Ukraine", the authors of which are Merezhko N. V. and Indutny V. V. [2] a comparative method was used to determine the value of the studied samples of antique melee weapons.

The author presents the results of investigation of Ukrainian market of antique cold steel. Further the author states that the distribution of price indices for antique cold weapons in Ukraine is stable and allows to establish three commodity groups of arms depending on the qualitative characteristics. To determine samples belonging to the one described groups of products, the arm should be assessed with seven criteria: "age", "involvement in the cultural and historical events of the past"; "rarity", "the level of technical perfection"; "artistic value"; "labels and stamps" and "conservation status".

Authors also gave several examples of cost forecasting, which demonstrate the effectiveness of the proposed development in the tasks of independent valuation. The results of the research prove the practical expediency of using specialized commodity classifications of goods, which are built on the basis of limited lists of quality criteria [2].

*The aim* of this article is to describe one of the possible algorithms for calculating the estimated value of antique and ornamental melee weapons based on the results of the analysis of cost indicators for related items presented on the Ukrainian market, as well as taking into account the features of the functioning of the respective auctions [2]. The paper also proposes an optimized algorithm for solving the estimation problem of forecasting the value of cultural monuments at their open sale on the Ukrainian market.

**Materials and methods.** The methodological framework of the research is based on the methods of scientific cognition, system approach and generalization and scientific works.

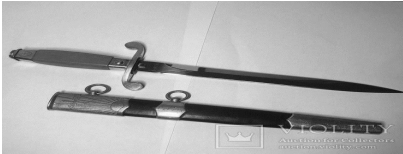





The samples were selected at open auctions in Ukraine, namely "VIOLITE" and "OLX" [3; 4]. *Research objects:* Antique Cold Weapons.

**Results.** The analysis of the state of the Ukrainian market for antique and decorative cold weapons was carried out by collecting and processing information on cost indicators presented on the Internet sites of Ukrainian auctions, in particular, the auction "VIOLITE", where the largest number of related items is for sale. For a systematic study of the features of the market and the work of auctions, an output Table was compiled, a fragment of which is given below (*Table 1*) [1].

*Table 1* shows the data on the quality and cost characteristics of cold steel presented on the Ukrainian market. At the time of submission of the table, the items are displayed in a row at a price from the lowest to the highest, and some of them (from the first to the twenty-fifth) at the initial exhibition at the auction was valued at one UAH.

Table 1

Quality and cost characteristics of cold steel  
presented on the Ukrainian market\*

Sample number	Brief description	The cost, UAH**	Photo
1	Dagger Air Force ZiK 1954	1	
2	Palash of Polish Winged Hussars, late 17th century	1	
26	Knife forged steel 40x13 65g Art. 3 cutting edge shh15 hardening approximately 59 units, handle oak, cap maple, spacers plastic brass mounting hinge	41	
27	Complex knife Germany	55	
129	General's saber	70000	
130	Flamberg. Germany	200000	

\* A fragment of the Table of initial data.

\*\* At the time of the Table layout.

Source: compiled by the author for [3].

The items were sorted in order to increase the value of their permanently fixed value in order to study the general tendency of increasing the value of cold weapons in the process of bidding, as well as to study the peculiarities of the increase in value within separate intervals. These trends can be visualized using the Chart of Cost Modeling of Cold Weapons displayed on the internet sites as of November 5, 2019 and sorted in order of least to highest (Figure 1).

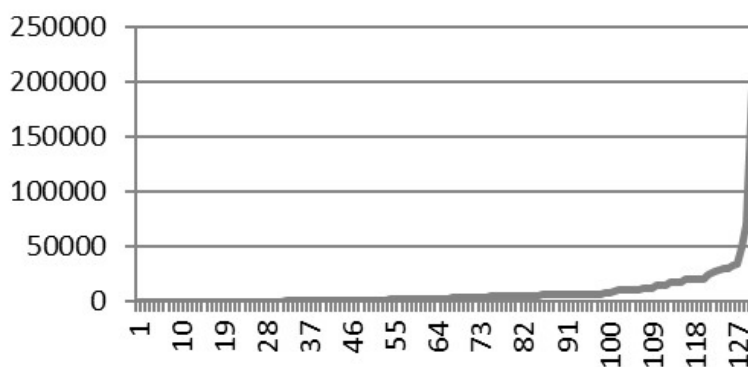


Figure 1. Distribution of indicators of value of models of the cold weapon  
(as of 05.11.2019)

*Note:* The Y-axis shows the value characteristic; X-axis – the number of the sample of a cold weapon in the Table of initial data.

*Source:* compiled by the author for the market of Ukraine according to data of online auctions.

The chart points to extremely large variations in the cost of a cold weapon from the start of their exposure on the auction site to the end of the auction – the observed trend is described by the exponential function. First of all, we observe such features. *First.* Not all auctioned items show a rapid increase in the value proposition. Some of them are left unattended by potential buyers, despite the minimum starting price of 1 UAH. Typically, these are items that are unrelated to outstanding historical events, personalities, duplicated and poorly preserved. *Second.* If an item catches the attention of potential buyers, its value rises to a certain level over a very short period of time, and then rises rather slowly. *Third.* There are items whose starting value is significantly inflated by sellers and probably due to a set of factors of emotional nature.

In order to study the features of the above distribution of cost indicators, we hypothesize that changes in permanent values are described by the basic law of commodity science: "The more positive information about a product, the higher its quality and, accordingly, value." Therefore, the increase in the present value of a particular model of a cold weapon in the bidding process until the whole volume of positive information about him is exhausted and he takes the appropriate position between the related model, which is characterized by a smaller amount of positive information and a related model by the modeler.

Based on the formal definition of the basic law of commodity science, namely:

$$C = \alpha 2^i;$$

where: C is the estimated cost;  $\alpha$  – base of assessment; I – the amount of information in bits [1].

Transform the scale of value estimation in Figure 1 into logarithmic view on *Figure 2*. Thus obtained, the new chart allows to visualize, highlight and differentiate the existing tendencies of increase in the value of cold weapons during the bidding process.

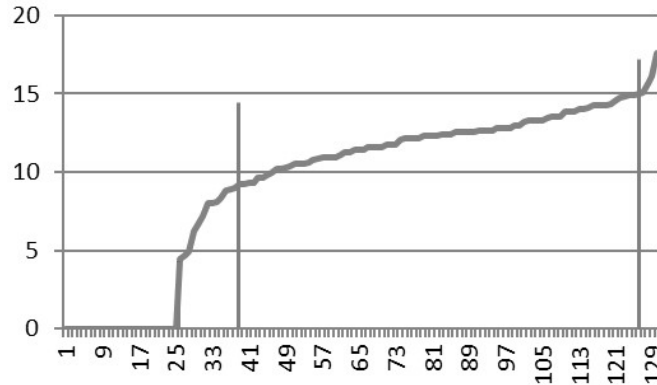


Figure 2\*. Diagram of distribution of logos based on "2" indicators of the value of models of cold weapons (as of 05.11.2019)\*\*

\* Presented on the Ukrainian market according to the Internet auctions.

\*\* The ordinate axis shows the logarithmic of the cost characteristic; abscissa axis – the number of the sample of a cold weapon in the Table of initial data.

By examining the diagram, there are five areas that can be distinguished by different trends in value growth. The first plot of cost indicators – from the first to the 25th position (on the abscissa axis) is represented by items that are offered for sale with a minimum starting value – 1 UAH. These items have either just been exhibited or have not yet attracted the attention of potential buyers.

The second section from model 26 to 37, is characterized by a rapid increase in the value index over a small period of time (1–2 days) of bidding. The trend is well described by the saturation function and is limited by the value index, which is the basis of valuation in subsequent bids. It is important to note that the values in this range indicate: *Firstly*. The cold weapon models described in this range attract significant attention from a large number of potential buyers for their quality characteristics. *Secondly*, the values recorded in this range (from 1 to 450 UAH) are initially unreasonably low, so if the model of a cold weapon deserves the attention of collectors, its purchase at a certain value in the named interval allows further profit to be obtained quickly in the future, as a result of the resale operation, which, in fact, motivates the auction participants.

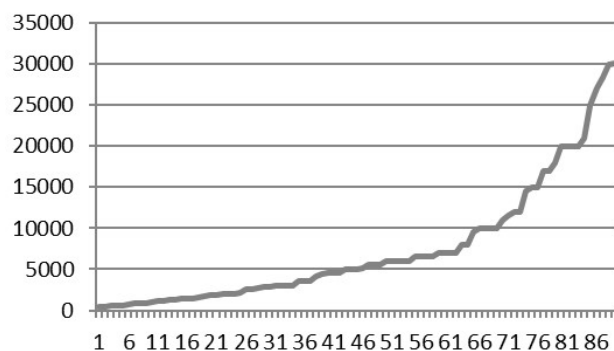
The third section of the chart indicates a moderate increase in value in accordance with the above-mentioned law of commodity studies, because in the logarithmic scale on the basis of "2" we observe the linear nature of the trend – its correspondence to the formal expression of the function of increase in value due to the increase in information. Bidding for such items occurs only in the circle of expert collectors, who are guided by the

idea of the total value of the objects that are cultural monuments, and take into account that the disclosure of additional information or the emergence of emotional factors can significantly increase the value and take new collections [1].

The last section, as we have already indicated, visualizes a situation with unreasonably high cost figures, which can be explained only in the following cases: when the seller conceals some important information about the memorial; the seller does not want to sell the item but only uses the auction to display his property; the seller hopes for an emotional effect that forces potential buyers to agree to an unreasonably high bid.

The above ranges of distribution of values can be observed on most antique items – numismatic monuments, porcelain, painting and graphics, sculpture and more. Therefore, when performing work in the field of professional appraisal, the described tendencies and peculiarities of the auction should be taken into account, namely to use information only for the sights, which are described in the third range of value distribution, where the smallest value can be considered as justified. It is in this range that the highest level of reasoning of forecasts is achieved.

Therefore, when calculating the value of a cold weapon, we will use the market value indicators described in the output Table in the range from 450 to 30 000 UAH. The graph of the distribution of cost indicators in the named range is shown in *Figure 3*. Let's consider this range of cost indicators in more detail.



*Figure 3\**. Diagram of the distribution of indicators of the value of cold weapons from the third interval (as of 05.11.2019)\*\*

\* Presented on the Ukrainian market according to the data of online auctions. The y-axis shows the value characteristic.

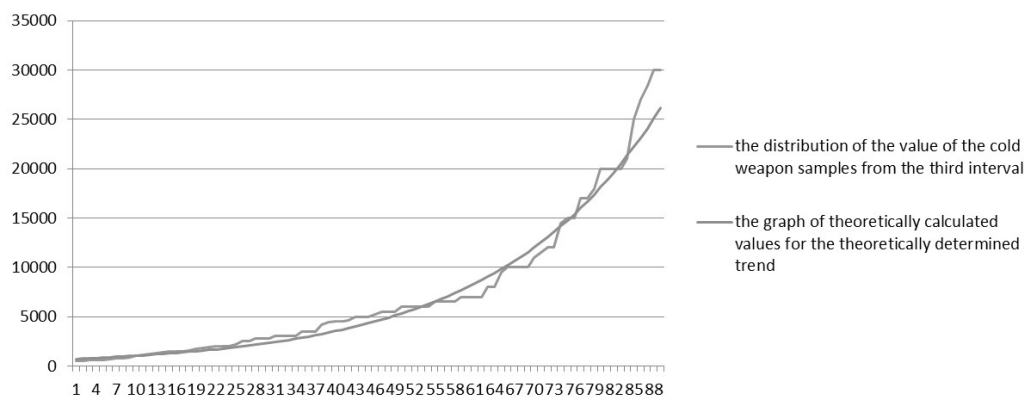
\*\* Abscissa axis – new order number of the sample of a cold weapon in the new output Table from which information on cost indicators from other ranges is removed.

As already mentioned, the observed exponential tendency is well described by the law of commodity science and it allows us to describe it theoretically on the basis of the calculation of the corresponding parameters

of the approximate function by the method of least Gaussian CF [1]. The theoretical function that describes the trend observed in *Figure 4* has the form:

$$C = 2^{0.059x + 7.31}$$

where: C = estimated value; X is the model number in *Figure 4*.



*Figure 4.* Diagram of the distribution of the value of the cold weapon samples from the third interval and the graph of theoretically calculated values for the theoretically determined trend\*

*Note:* by the method of least Gaussian CFF deviations.

\* The Y-axis shows the value characteristic; abscissa axis – new order number of the sample of a cold weapon in the new corrected Table of initial data.

The quality of the approximation, determined on the basis of the K. Pearson correlation index, is 0.99 units, which indicates the high accuracy of the predicted indicators. The ratio of the observed values to the theoretically calculated are shown (see *Figure 4*).

A detailed study of attributive information describing the quality of bidding cold weapons indicates the possibility of formulating a fairly short list of the most important criteria for assessing their quality (*Table 2*). Among them: the age of the monument, technical excellence, the level of artistic value, involvement in outstanding historical events, circulation, value of materials used to create, state of preservation. Certain (very small) models of melee weapons have additional qualities due to the properties of the relation and can be evaluated by a more comprehensive general protocol of cultural valuation.

Therefore, for the evaluation work with cold weapons models for the assessment base now (as of 05.11.2019), an indicator of 450 UAH (for the sample) should be taken and, depending on the result of the quality assessment according to the protocol presented in *Table 1*, this evaluation base should increase in proportion to the socio-cultural value of the subject of the assessment.

Table 2

**Protocol (list of basic criteria) for the evaluation  
of the quality of the weapons in the course of evaluation operations**

№	The name of the evaluation criterion	Ranking of criterion and coefficient "n+" (underscores required)	Ranking of the controversial evaluation criterion and the decreasing coefficient "n-" (underline necessary)	Indicator of socio-cultural value $N = n+ \times n-$
1.	Age of the monument	Unknown (1)	Known or unknown but not intended for use criterion (1)	2
		Up to 50 years (1)	Information needed but partially confirmed (0.5)	
		Up to 100 years (2)		
		Up to 300 years (4)		
		Up to 1000 years (8)	Information is decisive but not known or unverified (0.25)	
2.	Circulation of the monument	Replicated (typical) (1)	Known or unknown but not intended for use criterion (1)	2
		Rarely (2)	Information needed but partially confirmed (0.5)	
		Unique (4)		
3.	Monument involvement in cultural traditions	Local and ancestral traditions (1)	Known or unknown but not intended for use criterion (1)	1
		National traditions (2)	Information needed but partially confirmed (0.5)	
		World traditions (4)		
4.	Participation of the monument in historical events	Local and ancestral traditions (1)	Known or unknown but not intended for use criterion (1)	4
		National traditions (2)	Information needed but partially confirmed (0.5)	
		World traditions (4)		
5.	The involvement of the monument to outstanding manufactories and schools	Local and ancestral traditions (1)	Known or unknown but not intended for use criterion (1)	2
		National traditions (2)	Information needed but partially confirmed (0.5)	
		World traditions (4)		
6.	The artistic value of the monument	Average or no artistic value (1)	Known or unknown but not intended for use criterion (1)	1
		High (2)	Information needed but partially confirmed (0.5)	
		The highest (4)		
7.	The level of technical excellence	Average (1)	Imperfect (0.5)	1
		High (2)		
		The highest (4)		
8.	The presence of signs and marks	Signs and marks are present (2)	Known or unknown but not intended for use criterion (1) Information needed but partially confirmed (0.5) Information is decisive but not known or unverified (0.25)	2
9.	The state of storage of the monument	Without damage (1)	Satisfactory (0.5) Poor (0.25) In Fragments (0.125) In single fragments (0.0625)	0.5
The overall level of socio-cultural value is the product of all indicators of socio-cultural value				32

Source: [1].



Based on the results of our study of the status of the market for antique firearms, as well as the features of its sale at auctions, we can conclude that the tables of indicators predict their value in accordance with the amount of information recorded (*Table 2*), which greatly simplifies the evaluation procedure [1]. Please note that these metrics are not required for sales or other cultural monument operations, they only show a logically inconsistent result of cost forecasting. Therefore, using the above protocol, the expert calculates useful information and, using *Table 3*, determines the level of sociocultural value of the model of antique firearms, as well as the indicator of its estimated value in accordance with the state of the current market.

Table 3

**Nomenclature quality classification and cost indicators  
on the sample of cold weapons**

	The level of socio-cultural significance of antique cold												
	Local cultural recognition sites			Monuments of culture of national level of recognition									
				Third order			Second order			First order*			
Indicator of socio-cultural value "N"	1	2	4	8	16	32	64	128	256	512	1028	2048	4096
The amount of information in bits	0	1	2	3	4	5	6	7	8	9	10	11	12
Estimated cost in UAH per unit	450	900	1800	3600	7200	14400	28800	57600	115200	230400	460800	921600	1843200

\* *Note:* The estimated value of a N weapon with higher sociocultural value "N" is calculated according to the general classification of cultural monuments. The red shows extrapolative indicators for very valuable types of cold weapons, which are not yet presented on the domestic internet market (online auctions) [1].

As a result of the market analysis, we also get the opportunity to create a collection of small standards of cold weapons, such as bayonets. To do this, select the items that have already been sold and verify that they are in accordance with the protocol described above to the price at which they were sold. This procedure will help to clarify the possibility of using benchmarks for rapid evaluation of cold weapons based on visual inspection.

Attention should also be paid to some objectively existing limitations to the procedures for evaluating weapons.

*Firstly*, valuable small arms, which are of great importance as cultural monuments, often become the subject of copying, restoration, and reconstruction from fragments, which raises the question of determining the level of authenticity of the object of study.

*Secondly*. The antiques market is dependent on the financial potential of potential buyers, so the valuation base index can change very sharply over several months and affect the liquidity index, which must be taken into account by the valuer taking into account the desired rate of sale.

Thirdly, the appraiser, taking into account the specifics of the appraisal task (insurance, loss, sale, collateral, etc.) may take into account the different sets of appraisal criteria, deliberately ignoring some of the criteria described in the protocol above or in the general appraisal protocol. In doing so, the evaluator may apply a new and previously not described criterion. The general requirement for a reasoned conclusion will be met.

For example, we propose to consider the procedure of forecasting the value of the German cloak of the Luftwaffe during the Second World War, put up for sale on November 5, 2019 at the VIOLITY auction (*Figure 5*).

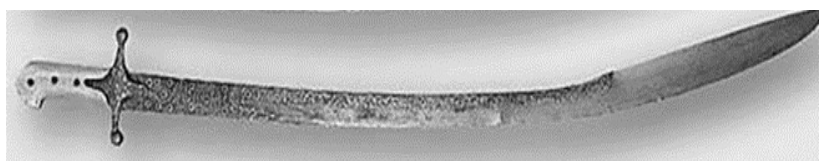


*Figure 5.* Kortik Luftwaffe

Source: [3].

Accounting for the accompanying information allows you to conclude an appropriate assessment protocol (see *Table 1*) and nomenclaturally define the quality of the item as a "cultural monument of the national level of value of the second order" (socio-cultural value index – 32). In doing so, we have taken into account the age of the item, its rarity, its involvement in world-class events, the level of recognition of the manufacturer, the presence of authentic symbolism and a satisfactory state of preservation. There-

fore, the estimated cost of this model of cold weapons will be 14 400 UAH (according to *Table 2*). The owner of the item has determined the value of the lot at the level of 14 500 UAH, which generally coincides with our forecast. At the same time, it should be noted that the starting price (estimate) for the beginning of bidding would be appropriate at the level of only 450 UAH. If potential investors do not wish to purchase this item at a higher estimated cost, it may be appropriate to recommend that it be withdrawn from trading. The predicted value obtained is also quite suitable for use as an insurance amount, pledge amount, or potential loss amount [5]. However, the guaranteed liquidation value will not exceed the starting value of 450 UAH.



*Figure 6.* Cossack sabers of the eighteenth century

Source: [3].

The second example. One of the Cossack sabers of the eighteenth century from the holdings of the Dmytro Yavornytsky Historical Museum in Dnipro (*Figure 6*) will be characterized in accordance with the criteria described in *Table 1* as follows: age – 8 (more than 300 years); circulation – 2 (rare); involvement in national traditions – 2; involvement in outstanding events – 2 (Cossack movement); Participation of a monument in outstanding manu-

factories and schools – 1 (there is no information for a specific monument); The monument's artistic value is 1 (average); Level of technical excellence – 2 (high); The presence of signs and marks – 1 (missing); The storage state of the monument is 0.5 (satisfactory). As an additional evaluation criterion, one should take into account the involvement of this monument in the collection of a prominent person – Academician Dmitry Yavornitsky, which, according to the general protocol, doubles the projected value, and also doubles the projected value of the value in relation to the value of other memorials. (a collection of Cossack weapons of the National Museum of History, popularized at the national level) [6]. Therefore, the aggregate index of socio-cultural value will be – 256, which corresponds to the nomenclature definition of quality "cultural monument of the national level of the value of the second order, as well as the projected value indicator, which amounts to 115 5200 UAH. The indicator can be considered as a well-grounded level of possible financial losses of national culture as a result of a loss of a monument – an insurance amount. Of course, the forecast is correct only about 6 months from the time of its conclusion, taking into account the overall dynamics of changes in value indicators in the antique market of Ukraine.

**Conclusion.** For the operation of forecasting the value of cold weapons, including those of historical and cultural importance, it is necessary: *first.* Create a detailed description of the subject of the examination (perform scientific attribution) taking into account and documenting all available information about it, conduct a study of the level of authenticity of the subject and take into account changes made later intervention (restoration and reconstruction). *Second.* The market for related items (items of the same name and purpose) should be analyzed using the method described above and the quality assessment protocol updated. *Third.* Nomenclature to determine the quality of the object of expertise in order to justify the range of projected cost indicators. *Fourth.* Attach a complete assessment report, to which all available supporting documents and tables of output are added.

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**Вовк Ю. Прогнозування вартості антикварної холодної зброї порівняльним методом.**

**Постановка проблеми.** Питання оцінки пам'яток культури є актуальним через необхідність визначення так званої кошторисної вартості у судових справах про втрачене майно, законності передачі права власності, встановлення страхових сум, оцінки спадщини, проведення операцій купівлі – продажу, застави, оренди або використання об'єктів, що мають велике соціокультурне значення в банківських операціях.

*Метою роботи є здійснення обрахунку прогнозованої вартості холодної зброї порівняльним методом.*

**Матеріали та методи.** Основу методологічної бази дослідження становлять методи наукового пізнання, системного підходу й узагальнення, наукові праці.

**Результати дослідження.** В ході дослідження проаналізовано понад 120 зразків, що представлені на відкритих аукціонах України. Для операції прогнозування вартості холодної зброї, зокрема історичної та культурної важливості, необхідно: *по-перше*, створити детальний опис предмета експертизи (виконати наукову атрибуцію) з урахуванням та документуванням всієї наявної інформації про неї, провести дослідження рівня вірогідності предмета та врахувати зміни, внесені при подальшому втручанні (відновлення та реконструкція). *По-друге*, ринок супутніх товарів (однойменних предметів та цілей) варто проаналізувати, використовуючи описаний вище метод, та оновити протокол оцінки якості. *По-третє*, треба сформулювати номенклатуру для визначення якості об'єкта експертизи з метою обґрунтування діапазону прогнозованих показників витрат. *По-четверте*, долучити повний звіт про оцінку, до якого додаються всі наявні супровідні документи та таблиці результатів.

**Висновки.** Отже, прогнозування вартості холодної зброї порівняльним методом є доцільним для використання експертами. Цей метод охоплює 9 основних критеріїв оцінки зразків і якісно визначає вплив кожного з них на фінальну прогнозовану вартість зразків.

*Ключові слова:* антикварна холодна зброя, порівняльний метод прогнозування вартості, аукціон, відкриті аукціони України, наукова атрибуція.