# Integrated depreciation management system

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**Abstract.** To substantiate the benefits of an integrated depreciation system, the article aims to find an optimal combination of methods of depreciation and calculation of the amount of profit and property taxes. Using the developed mathematical model, it is possible to calculate the amount of money released by the enterprise during the period of deferred taxation for the renewal of fixed assets and the amount of profit and property taxes to be paid. The method allows for conclusion that only the combination of the sum-of-the-years-digits (a decreasing depreciation option) and sum-of-the-years-digits (an increasing depreciation option) methods has the greatest economic effect, i.e. it allows for an increase in profit and property tax revenues to the budget.

## 1. Introduction
A number of works are devoted to the depreciation mechanism combining financial and tax accounting. The need for this mechanism is due to significant problems in the accounting area caused by application financial and tax accounting systems and non-compliance of the latest accounting standards with those applied in Europe and North America. These problems have been analyzed by a lot of researchers [1].

In our opinion, the combination of financial and tax accounting systems for the purpose of managing funds released from taxation during the depreciation accrual period can be solved if a comprehensive depreciation accrual system is created.

An integrated depreciation system is a system that combines various methods of depreciation which will minimize the amount of property and profit taxes in order to invest funds released from taxation in the renewal of assets under unconditional return of the unpaid amount of taxes [2].

To substantiate the benefits of an integrated depreciation system, let us find an optimal combination of methods used for depreciation and calculation of the amount of profit and property taxes.

The purpose of optimization is to maximize the amount of depreciation charges in the initial periods of asset usage, which will allow the enterprise to maximize the amount of funds for renewal of fixed assets with a subsequent increase in the the amount of profit and property taxes [3].

The following constraints were taken into account:

- funds received due to the profit and property tax amount minimization are directed to the purchase of additional assets;

- newly purchased assets will be appreciated so as to minimize the amount of depreciation in the initial period of asset usage.

The constraints will allow the enterprise to increase profit and property taxes after commissioning newly acquired assets that were reduced by applying methods maximizing the amount of depreciation in the initial period of depreciation of the equipment in use [4]. Thereby they will contribute to the return of profit and property taxes which are not paid in the first years of asset usage.

## 2. Materials and methods

In studying this issue, a comprehensive depreciation management system was analyzed. The methods used for studying theoretical material are analysis and synthesis. They help study facts, develop concepts, draw conclusions, make theoretical generalizations, and analyze a comprehensive depreciation management system [5].

## 3. Results

To prove the feasibility and expediency of the developed optimization method, we performed calculations. To this end, we constructed a mathematical model and performed calculations in the following sequence:

- depreciation of the operating fixed assets in a linear way;
- depreciation of the same fixed assets by the sum-of-the-years-digits method (a decreasing depreciation option) [6];
- calculation of the difference between the amount of profit and property taxes released as a result of applying various methods of depreciation;
- calculation of the amount of fixed assets that can be purchased at the expense of the released amount of taxes;
- calculation of the potential value of depreciated new fixed assets in a linear way;
- calculation of the potential value of depreciated new fixed assets by the the sum-of-the-years-digits method (an increasing depreciation option)
- calculation of the possible amount of profit and property taxes released as a result of using additional fixed assets;
- identification of an optimal method and a depreciation rate.

Let us formalize the profit and property tax calculation procedure.

$P_{1_t}$ – annual property tax when using a linear deprecation method;

$P_{1_t}^*$ - annual property tax when using a linear deprecation method for new assets purchased at the expense of deferred taxation;

$P_{2_t}$ – annual property tax when using the sum-of-the-years-digits method (a decreasing deprecation option);

$P_{3_t}^*$ – annual property tax when using the sum-of-the-years-digits method (an increasing deprecation option) for new assets purchased at the expense of deferred taxation.

The procedure and formula for calculating the amount of the property tax are based on Chapter 30 "Property Tax of Organizations" of Part II of the Tax Code of the Russian Federation which was enacted by by Federal Law No. 139-FZ of 11 November 2003. The property tax calculation procedure has changed. In accordance with Article 375, the tax base is an average annual value of the property recognized as an object of taxation. At the same time, when determining the tax base, the property recognized as a taxable object is taken into account according to its residual value, formed in accordance with the established accounting procedure of the organization [7].

The average value of assets deemed to be an object of taxation for an accounting period shall be determined as the quotient from dividing the sum obtained as a result of adding together the amounts of the net book value of the assets as at the 1stof each month of the accounting period and the 1stof the month following the accounting period by the number of months in the accounting period plus one (clause 4 of Article 376 of Part II of the Tax Code of the RF) [8].

Taking into account the given regulatory document, the formula should include the valuation of the property included into the taxable base minus depreciation charges accrued by one of the three selected methods: the linear method ($\beta_1$), the sum-of-the-years-digits method (a decreasing deprecation option) ($\beta_2$) and the sum-of-the-years-digits method (an increasing deprecation option) ($\beta_3$) [9].

Coefficients $\beta_i$ are the values of the depreciation rate calculated by the i-th depreciation method.

Let us introduce the following notation:

$\gamma$ - property tax rate;

$O_t$ – (initial) residual value of fixed assets in the t-th year (the residual value at the beginning of the first operation year is equal to the initial value);

$O_t^*$ – (initial) residual value of fixed assets purchased at the expense of deferred taxation in the t-th year;

$\beta_1$ - depreciation rate when using the linear method of depreciation in the i-th quarter of the t-th year;

$\beta_2$ - depreciation rate when using the sum-of-the-years-digits method (a decreasing deprecation option) in the i-th quarter of the t-th year;

$\beta_3$ - depreciation rate when using the sum-of-the-years-digits method (an increasing deprecation option) in the i-th quarter of the t-th year;

V– revenue;

S – production cost;

Z – the amount of costs, excluding depreciation;

A – the depreciation amount for fixed assets of the company;

D – pretax profit;

$\alpha$ – profit tax rate;

t – year digit;

k – the length of the deferred tax period (in years).

Let us calculate the amounts of profit and property taxes in the t-th year in the period of deferred taxation [10].

The profit tax:

$$H_t = D_t \cdot \alpha \tag{1}$$

The pretax profit:

$$D_t = V_t - S_t \tag{2}$$

The production cost:

$$S_t = Z_t + A_t \tag{3}$$

The depreciation amount when using the linear method of depreciation:

$$A_t = O_t \cdot \beta \tag{4}$$

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Using the above notation and formulas (1) - (4), we can calculate profit taxes using various depreciation methods [11].

The formula for calculating profit tax $H_{1_t}$ when using the linear method:

$$H_{1_t} = [V_t - (V_t + (O_t \beta_1)) - P_{1_t}] \cdot \alpha \tag{5}$$

The formula for calculating profit tax $H_{1_t}^*$ when using the linear method accounting for new assets:

$$H_{1_t}^* = [V_t - (Z_t + (O_t^* \beta_1)) - P_{1_t}^*] \cdot \alpha \tag{6}$$

The formula for calculating profit tax $H_{2_t}^*$ when using the sum-of-the-years-digits method (a decreasing deprecation option):

$$H_{2_t} = [V_t - (Z_t + (O_t \beta_2)) - P] \cdot \alpha \tag{7}$$

The formula for calculating profit tax $H_{3_t}^*$ when using the sum-of-the-years-digits method (an increasing deprecation option) accounting for new assets:

$$H_{3_t}^* = [V_t - (Z_t + (O_t^* \beta_3)) - P] \cdot \alpha \tag{8}$$

To determine the difference between the amounts of profit taxes, let us calculate:

$d_{1_t}$ - the difference between the amounts of profit tax at depreciation rates $\beta_1$ and $\beta_2$:

$$d_{1_t} = (H_{1_t} - H_{2_t}) \tag{9}$$

By inserting formulas (2.5) and (2.7) into formula (2.9), we have

$$d_{1_t} = [V_t - (Z_t + (O_t \beta_t)) - P_{1_t}] \cdot \alpha - [V_t - (Z_t + O_t \beta_2) - P_2] \cdot \alpha \tag{10}$$

It is clear that the final amount of profit tax is influenced by the amount of depreciation generated by the difference in depreciation rates when using the sum-of-the-years-digits (a decreasing deprecation option) ($\beta_2$) and linear ($\beta_1$) methods [12].

The amount of income tax is also influenced by property tax whose amount is equal to the difference in property taxes $P_{1_t}$ and $P_{2_t}$.

Formula (10) is used to calculate the amount of property tax released due to changes in the value of the cost using a combination of the linear and sum-of-the-years-digits (a decreasing deprecation option) methods.

Let us calculate $d_{2_t}$ - the difference between the amounts of property tax at the depreciation rates $\beta_1$ and $\beta_3$:

$$d_{2_t} = (H_{1_t}^* - H_{3_t}^*) \tag{11}$$

By inserting formulas (2.6) and (2.8) into formula (2.11), we have

$$d_{2_t} = [V_t - (Z_t + (O_t^* \beta_1)) - P] \cdot \alpha - [V_t - (Z_t - (O_t^* \beta_3)) - P] \cdot \alpha \tag{12}$$

In formula (12), there are the same regularities as in formula (10).

Formula (12) is used to calculate the amount of property tax released due to changes in the value of the cost using a combination of the linear and sum-of-the-years-digits (an increasing deprecation option) methods [13].

The amount of property and profit taxes in the period of deferred taxation $d_{3_t}$ can be calculated by formula

$$d_{3_t} = d_{1_t} + d_{2_t} \tag{13}$$

By inserting formulas (9) and (11) into formula (2.13), we have

$$d_{3_t} = \left(H_{1_t} - H_{2_t}\right) + \left(H_{1_t}^* - H_{3_t}^*\right) \tag{14}$$

Let us transform formula (2.14), by inserting expressions (5), (7) and (6), (8). We have

$$d_{3_t} = \left|V_t - \left(Z_t + \left(O_t\beta_1\right)\right) - P_{1_t}\right| \cdot \alpha - \left|V_t - \left(Z_t - \left(O_t\beta_2\right)\right) - P_{2_t}\right| \cdot \alpha + \left|V_t - \left(Z_t + \left(O_t^*\beta_1\right)\right) - P_{1_t}\right| \cdot \alpha - \left|V_t - \left(Z_t - \left(O_t\beta_2\right)\right) - P_{2_t}\right| \cdot \alpha \tag{15}$$

Let us simplify formula (2.15):

$$d_{3_t} = \alpha\left[\left(\beta_2 - \beta_1\right)C_t + \left(\beta_3 - \beta_1\right)O_t^* - \left(P_{1_t} - P_{2_t}\right) - \left(P_{1_t}^* - P_{3_t}^*\right)\right] \tag{16}$$

The formula can be used to calculate profit and property taxes both for the period of deferred taxation, and for the entire taxation period, until the value of fixed assets is fully depreciated. Formula (16) can be used to calculate the time for which the company will accumulate the amount of tax credit in order to purchase additional units of fixed assets.

It can be used to calculate the amount of tax deductions on profit and property taxes for newly purchased fixed assets [14].

Formula (16) shows the following regularities and relations. Formula (16) is used to calculate comparative characteristics of different methods of depreciation: the linear method through $\beta_1$, the sum-of-the-years-digits method (a decreasing deprecation option) through $\beta_2$, the sum-of-the-years-digits method (an increasing deprecation option) through $\beta_3$. Analysis of formulas (5), (7) and (6), (8) and formula (16) shows that with an increase in depreciation rates $\beta_2$ and $\beta_3$, the taxable base for profit tax decreases and the difference in profit tax amounts arising from the difference in the amounts of depreciation rates decreases as well [15]. If $\beta_2$ and $\beta_3$ decrease, there is a reverse increase in the difference of profit tax amounts. A decrease or increase in depreciation rates changes the property tax amount. In the period of deferred taxation when using $\beta_2$ instead of $\beta_1$, there is a decrease in the difference in property tax amounts between $P_{1_t}$ and $P_{3_t}$ which increases the taxable profit amount, while the use of $\beta_3$ instead of $\beta_1$ decrease the taxable profit amount as the difference in the property tax amounts $P_{3_t}$ and $P_{1_t}$ increases [16]. Formula (16) is universal. When inserting other values of $\beta i$ it can be adjusted to new methods for calculating depreciation, and, consequently, to new norms of depreciation charges. It helps predict the effect of these changes on the taxable base of property and profit taxes.

## 4. Discussion

Using the developed mathematical model, it is possible to calculate the amount of money released for renewal of fixed assets and the amount of profit and property taxes to be paid [17, 18].

The mathematical model allows for the conclusion that only the combination of the the sum-of-the-years-digits (a decreasing depreciation option) and sum-of-the-years-digits (increasing depreciation option) methods has the greatest economic effect, i.e. it allows for an increase in profit and property tax revenues to the budget. It should be noted that the use of a linear depreciation method decreases the budget revenues.

## 5. Conclusion

One can conclude that the method will increase the amount of depreciation charges which will create the opportunity for renewal of assets and confirm the need for a priority industry direction of updating

fixed assets due to the specification and capital intensity of production. However, given the value of this indicator (% of the available fixed assets), it becomes clear that the renewal process is at a very low level which does not ensure high efficiency of the measures [19]. Based on the study results, two main groups of problems preventing the fixed assets from being renewed can be distinguished:

- Internal problems: unwillingness of managers to use the large amount of money, the lack of new technologies and production spaces, etc.;
- External: high market prices, taxes, tough competition, etc.

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