The European Proceedings of
Social and Behavioural Sciences
EpSBS
www.europeanproceedings.com
e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2020.10.03.149

ICEST 2020

International Conference on Economic and Social Trends for Sustainability of Modern Society

FIXED ASSETS TURNOVER RATIO FACTOR ANALYSIS FOR HI-TECH EQUIPMENT

E. I. Krylov (a), V. M. Vlasova (b), L. S. Vorobiova (c)*
*Corresponding author

(a) Saint-Petersburg State University of Aerospace Instrumentation, 67, Bolshaya Morskaia str., Saint-Petersburg, Russia, krylov.eduard2013@yandex.ru
(b) Saint-Petersburg State University of Aerospace Instrumentation, 67, Bolshaya Morskaia str., Saint-Petersburg, Russia, kafedra81@gmail.com
(c) Saint-Petersburg State University of Aerospace Instrumentation, 67, Bolshaya Morskaia str., Saint-Petersburg, Russia, vls.kafedra81@gmail.com

Abstract

The paper gives a brief description of an enterprise's fixed assets with its most essential component of the principal fixed assets group which embraces various machinery, equipment, installations and devices including hi-tech. Since improved efficiency of fixed assets used by an enterprise results in lower production costs, higher quality and profitability rates, analysis of those factors which affect such fixed assets efficiency indicator as Fixed Assets Turnover ratio (FAT ratio) acquires primary importance. The paper suggests methodology for the FAT ratio analysis if applied to hi-tech equipment. Among the factors which induce changes in FAT ratio the paper identifies how FAT ratio is affected by high-tech equipment: relative share, average productivity per hour, average cost of high-tech unit per year. Such analysis will allow the enterprise management to determine high-tech equipment efficiency, the factors affecting changes in high-tech equipment FAT ratio and any changes or improvements that are required to improve the FAT ratio values.

Keywords: Fixed assets turnover ratio, factor analysis, high-tech equipment efficiency.

https://doi.org/10.15405/epsbs.2020.10.03.149
Corresponding Author: L. S. Vorobiova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

High-tech equipment is typically listed as an item in the enterprise fixed assets list. Fixed assets are defined as a set of tangible assets (property, plant and equipment) that are operated for sufficient lengths of time (Musaev, 2014). During the whole term of operation fixed assets preserve their initial tangible form and transfer their value onto the products for manufacture of which they are used thus wearing down ("On the Accountancy Regulations in Accounting for Fixed Assets" Accountancy Regulation 6/01, 2016).

Currently, in Russian practice the fixed assets are classified into 21 types (Classifier of Fixed Assets in Russian Federation, 2018) to form 7 larger groups. Further we discuss some of those groups. The first group comprises housing, buildings and premises. The second group includes production site and structures, the main purpose of which is to provide for production process with all its operations, processes, technologies and conditions for them. The total value of items in the second group is calculated as the costs of construction and any improvements made to it added by the maintenance costs. Also the second group lists any structures not immediately involved in production process, but providing for it, such as roads, overpasses and the like, and any arrangements for transfer and transportation of energy and raw materials (electricity, gas, water, heating, steam, materials, etc.).

Major importance, among other types, is to be attributed to the third group to which refer machinery and equipment (Gulin, 2019). The group can be further subdivided into sub-groups of power machinery and equipment, technological machinery and equipment, measuring and control devices and equipment, other machinery and equipment. The group also includes any transportation means used for transporting both employees and loads within the production site and beyond it. To the latter refer automotive and water transport, rolling stock, etc.

2. Problem Statement

Improved efficiency of the fixed assets entails increased revenues from selling the enterprise products resulting from growing volumes of output (Gubanova & Nevskaya, 2011; Skvortcov et al., 2017), lowering costs, raising production quality, savings from lowered property taxes – all these finally make the overall profitability of enterprise also increase.

Enterprises in various industries of Russian national economy require efficient policies aimed primarily at increasing the rates of output per unit of fixed assets (Ananyev et al., 2018). Development of such policies, in its turn, will require adjustments in shares between active and passive fixed assets, in technological proportions of special- to general-purpose technological equipment and machinery, in relative shares per unit of fixed assets, and in degrees to which the machinery capacity is employed. It will also require combining extensive and intensive factors or extending the time periods when the production facilities are used, as well as modernization or re-equipment with more efficient automated machinery.

All manufacturing enterprises, especially fixed-asset-intensive ones, require continuously analysis of the rates of fixed assets efficiency (Lukmanova, 2018; Salimova, 2015; Shishelov, 2013). Typically, the main task of such analysis (Krylov et al., 2010) is to examine the effect rendered by the set of factors on the values and dynamics of FAT ratio. Among these factors we should identify the following: variations in relative shares of the active fixed assets in terms of their overall value and variations in relative shares of

https://doi.org/10.15405/epsbs.2020.10.03.149
Corresponding Author: L. S. Vorobiova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

equipment value to active fixed assets overall value. We may argue that currently enterprise is to determine the share of hi-tech equipment to active fixed assets in physical and monetary terms and to determine the relative share of hi-tech equipment in overall production facilities.

3. Research Questions

For enterprises with high relative shares of high-tech equipment to active fixed assets in monetary terms it seems reasonable to analyze the efficiency of its use based on technical and financial factors (Krylov et al., 2010). It requires preliminary analysis of how variations in relative shares of the active fixed assets value to their overall value affect FAT ratio (Formula 1).

$$\Delta\phi = y_{ач} \times \phi_{ач}, \quad (1)$$

where $\Delta\phi$ stands for variation in FAT ratio value;

$y_{ач}$ stands for relative shares of the active fixed assets value to their overall value;

$\phi_{ач}$ stands for FAT ratio value of the active fixed assets.

Hence, FAT ratio value will be determined by two first-order factors: variation in relative share of the active fixed asset to FAT ratio value of the active fixed assets. Their effect will be determined using the method of absolute differences calculated by the below formulas (Formula 2 and Formula 3). Indexes 0 and 1 indicate values given for the base and for the reporting periods.

$$\Delta\phi_{yач} = \left(y_{ач1} - y_{ач0}\right) \times \phi_{ач0} \quad (2)$$

$$\Delta\phi_{фач} = y_{ач1} \times \left(\phi_{ач1} - \phi_{ач0}\right) \quad (3)$$

4. Purpose of the Study

For financial function at the enterprises where fixed assets are partially formed of high-tech equipment, application of the factor analysis tools to calculate FAT ratio value of the active fixed assets which will account for the factors relevant for evaluating high-precision, CNC- and other high-tech-based equipment efficiency can be recommended (Poteeva & Kazarina, 2020).

5. Research Methods

Variations in FAT ratio value of the active fixed assets are affected by such factors as the number of units and structure of equipment, average productivity rates of such equipment per hour and the total time of the equipment operation during the period analyzed. These factors underlie the factor-based model of FAT ratio of the active fixed assets with its further possible extension (Formula 4).

$$\phi_{ач} = \frac{K_o \times T_{eo} \times B_{смч}}{C_{ачОПФ}}, \quad (4)$$

where K_o stands for the average number of active fixed assets in a given year;

T_{eo} stands for the total time of the equipment operation;

https://doi.org/10.15405/epsbs.2020.10.03.149
Corresponding Author: L. S. Vorobiova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

$B_{смч}$ stands for average output rate for each unit of equipment per machine hour;

$C_{ачОПФ}$ stands for the average value of active fixed assets in a given year.

The extended factor model will require calculation of the time-related indicators of equipment operation and its average cost in a given year. The time factor of machine unit operation can be calculated by multiplying the length of machine unit operation in days (t), by the equipment operation shift ratio $(k_{см})$ and by the average length of each shift ($t_{см}$). The average cost of active fixed assets in a given year is calculated by multiplying the average number of active fixed assets in a given year by the average cost of an active fixed assets unit in a given year $(c_{ед})$. Then the factor model for FAT ratio of the active fixed assets calculation will be as in the formula below (Formula 5).

$$ф_{ач} = \frac{K_о \times t \times k_{см} \times t_{см} \times B_{смч}}{K_о \times c_{ед}} = \frac{t \times k_{см} \times t_{см} \times B_{смч}}{c_{ед}} \quad (5)$$

The 5-factor model developed for variations in FAT ratio can be applied to calculating variations using the method of chain substitution. The components of Formula 5 are given as numeric units for the base year with a *0* index. Then sequentially, moving from quantitative indicators to the qualitative ones, we determine the conditional values for FAT ratio of the active fixed assets. In the final formula all values of all indicators will be given for the reporting year, i.e. with an index *1*.

$$ф_{ач0} = \frac{t_0 \times k_{см0} \times t_{см0} \times B_{смч0}}{c_{ед0}}$$

$$ф_{ач(усл1)} = \frac{t_0 \times k_{см0} \times t_{см0} \times B_{смч0}}{c_{ед1}}$$

$$ф_{ач(усл2)} = \frac{t_1 \times k_{см0} \times t_{см} \times B_{смч0}}{c_{ед1}}$$

$$ф_{ач(усл3)} = \frac{t_1 \times k_{см1} \times t_{см0} \times B_{смч0}}{c_{ед1}}$$

$$ф_{ач(усл4)} = \frac{t_1 \times k_{см1} \times t_{см1} \times B_{смч0}}{c_{ед1}}$$

$$ф_{ач1} = \frac{t_1 \times k_{см1} \times t_{см1} \times B_{смч1}}{c_{ед1}}$$

The first conditional indicator measures the effect on the active fixed assets FAT ratio of variations in an active fixed assets unit cost, all the other indicators are presumed to be base level. The second conditional indicator is calculated for the actual active fixed assets unit cost and the actual number of its operating days. The third conditional indicator is calculated for the actual active fixed assets unit cost, the actual number of its operating days and the equipment operation shift ratio. In calculating the forth conditional indicator, only the value of average output is given as the base level. The calculation of the fifth conditional indicator in fact means all the factors are given their actual values for the reporting year. The chain of subtractions, i.e. the first conditional indicator is subtracted from the second conditional indicator and so on, and multiplication of the value received in subtraction by the relative share of the fixed assets will present the changes in FAT ratio.

https://doi.org/10.15405/epsbs.2020.10.03.149
Corresponding Author: L. S. Vorobiova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

In case active fixed assets have a share of the high-tech equipment it will require for additional technical and financial factors in the above model of active FAT ratio variations (Pankratov, 2018). High-tech equipment is characterized by relevant relative shares in both the structure of average output values and in average active fixed assets unit cost per year. In the formula below the relative share of high-tech equipment is given as $y_{вто}$, and the relative share of the other fixed assets is given as y_o. The average output value for high-tech equipment is given as $B_{вто}$, and the average output value for the other fixed assets is given as B_o. The average cost of high-tech equipment unit per given year is given as $c_{едBTO}$, the average cost of the other fixed assets is given as $c_{едO}$. Then we account for these in Formula 6.

$$\phi_{ач} = \frac{t \times k_{см} \times t_{см} \times \left(B_{вто} \times y_{вто} + B_o \times y_o\right)}{c_{едBTO} \times y_{вто} + c_{едO} \times y_o} \quad (6)$$

Then we calculate the conditional indicators of influence as given in Formula 6 as the variation of FAT ratio of the active fixed assets.

The first conditional indicator shows how the FAT ratio of the active fixed assets is affected by changes in relative shares of traditional equipment, all other indicators are given for base year (Formula 7).

$$\phi_{ач(усл1)} = \frac{t_{(0)} \times k_{см_{(0)}} \times t_{см(0)} \times \left(B_{вто(0)} \times y_{вто(0)} + B_{о(0)} \times y_{о(1)}\right)}{c_{едBTO(0)} \times y_{вто(0)} + c_{едO(0)} \times y_{о(1)}} \quad (7)$$

The calculation of the second conditional indicator is added by the relative share of high-tech equipment, all other indicators are given for base year (Formula 8).

$$\phi_{ач(усл2)} = \frac{t_{(0)} \times k_{см_{(0)}} \times t_{см(0)} \times \left(B_{вто(0)} \times y_{вто(1)} + B_{о(0)} \times y_{о(1)}\right)}{c_{едBTO(0)} \times y_{вто(1)} + c_{едO(0)} \times y_{о(1)}} \quad (8)$$

The third conditional indicator shows how the FAT ratio of the active fixed assets is affected by the average active fixed assets unit value (Formula 9).

$$\phi_{ач3} = \frac{t_{(0)} \times k_{см_{(0)}} \times t_{см(0)} \times \left(B_{вто(0)} \times y_{вто(1)} + B_{о(0)} \times y_{о(1)}\right)}{c_{едBTO(0)} \times y_{вто(1)} + c_{едO(1)} \times y_{о(1)}} \quad (9)$$

The fourth conditional indicator allows analyzing how FAT ratio of the active fixed assets is affected by the average cost of high-tech equipment per year (Formula 10).

$$\phi_{ач(усл4)} = \frac{t_{(0)} \times k_{см_{(0)}} \times t_{см(0)} \times \left(B_{вто(0)} \times y_{вто(1)} + B_{о(0)} \times y_{о(1)}\right)}{c_{едBTO(1)} \times y_{вто(1)} + c_{едO(1)} \times y_{о(1)}} \quad (10)$$

The fifth conditional indicator shows how the FAT ratio of the active fixed assets is affected by changes in the number of operating days (Formula 11).

$$\phi_{ач(усл5)} = \frac{t_{(1)} \times k_{см_{(0)}} \times t_{см(0)} \times \left(B_{вто(0)} \times y_{вто(1)} + B_{о(0)} \times y_{о(1)}\right)}{c_{едBTO(1)} \times y_{вто(1)} + c_{едO(1)} \times y_{о(1)}} \quad (11)$$

The sixth conditional indicator allows analyzing how FAT ratio of the active fixed assets is affected by changes in equipment operation shift ratio (Formula 12).

https://doi.org/10.15405/epsbs.2020.10.03.149
Corresponding Author: L. S. Vorobiova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

$$\phi_{ач(усл6)} = \frac{t_{(1)} \times k_{см_{(1)}} \times t_{см(0)} \times \left(B_{вто(0)} \times y_{вто(1)} + B_{о(0)} \times y_{о(1)} \right)}{c_{едВТО(1)} \times y_{вто(1)} + c_{едО(1)} \times y_{о(1)}} \quad (12)$$

The seventh conditional indicator shows how FAT ratio of the active fixed assets is affected by the length of shift (Formula 13).

$$\phi_{ач(усл7)} = \frac{t_{(1)} \times k_{см_{(1)}} \times t_{см(1)} \times \left(B_{вто(0)} \times y_{вто(1)} + B_{о(0)} \times y_{о(1)} \right)}{c_{едВТО(1)} \times y_{вто(1)} + c_{едО(1)} \times y_{о(1)}} \quad (13)$$

The eighth conditional indicator of FAT ratio of the active fixed assets calculation allows accounting for the effect of the per-hour average output rate for traditional equipment (Formula 14).

$$\phi_{ач(усл8)} = \frac{t_{(1)} \times k_{см_{(1)}} \times t_{см(1)} \times \left(B_{вто(0)} \times y_{вто(1)} + B_{о(1)} \times y_{о(1)} \right)}{c_{едВТО(1)} \times y_{вто(1)} + c_{едО(1)} \times y_{о(1)}} \quad (14)$$

In calculation of the ninth conditional indicator, which is the average output rate of high-tech equipment, all indicators are given for the reporting year (Formula 15).

$$\phi_{ач1} = \frac{t_{(1)} \times k_{см_{(1)}} \times t_{см(1)} \times \left(B_{вто(1)} \times y_{вто(1)} + B_{о(1)} \times y_{о(1)} \right)}{c_{едВТО(1)} \times y_{вто(1)} + c_{едО(1)} \times y_{о(1)}} \quad (15)$$

The further level of analyzing the influence of technical and financial factors on variations in FAT ratio of the active fixed assets with a share of high-tech equipment is detailed examination of its operation in terms of operating days, number of shifts, length of each shift.

6. Findings

Deterministic factor analysis of the variations in the FAT ratio provides the enterprise’s management with a clear and proven evidence allowing determining which factors induce increased or decreased FAT ratios, assessing the efficiency with which high-tech equipment is used within the whole group of the enterprise’s fixed assets, and identifying which of the measures and actions will reduce negative impacts on FAT ratio and induce its raising (Pavlukova, 2011).

Of extreme importance here are the relative share of high-tech equipment in the enterprise’s fixed assets, the cost-value of such equipment, and the continuous monitoring the rates of high-tech equipment productivity exceeding the rates of its cost-value growth.

7. Conclusion

Development of the analytical base for FAT ratio promotes increased efficiency of high-tech equipment used by an enterprise. It is noteworthy, however, that currently high technologies are employed in the passive fixed assets as well, with the development of ‘smart’ engineering and digital technologies they are integrated into production process organization. This will require further developments and extensions in the factor analysis approach and developing new models of analysis.

Every measure and action aimed at improving efficiency of fixed assets is to be performed with the account of the enterprise's current reserves, such as technical and technological improvements in labor facilities, intensiveness-based modernization of the production facilities by purchasing or development of new high-tech equipment and improvements in production organization.

References

Ananyev, B., Sergi, B., & Vaslavskiy, Y. (2018). *The Impact of International Sanctions on Russia's Sustainable Development.* In B. Sergi (Ed.), *Exploring the Future of Russia's Economy and Markets* (pp. 201-218). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78769-397-520181011

Classifier of Fixed Assets in Russian Federation (2018). Into effect by the Rosstandart Russian Standardization Organization as of 12.12.2014 N 2018 (revised as of 08.05.2018).

Gubanova, E. N., & Nevskaya, O. A. (2011). Problemy vnedreniya elementov mezhdunarodnykh standartov finansovoy otchetnosti v praktike finansovogo analiza [The introduction of elements of international financial reporting standards in the practice of financial analysis]. *Oil industry, 1*, 16-17. [In Russ.]

Gulin, K. A. (2019). Revisiting the issue of the "initial accumulation of capital" in post-Soviet Russia. *Economic and Social Changes: Facts, Trends, Forecast, 12*(6), 276–291. https://doi.org/10.15838/esc.2019.6.66.16

Krylov, E. I., Vlasova, V. M, Ivanova, N. A., & Varfolomeeva, V. A. (2010). *Analiz khozyaystvennoy deyatel'nosti predpriyatiya: v 4 kn. Kn. 1. Proizvodstvennyye resursy: analiz effektivnosti* [Analysis of company's economic activities: Part 1. Productive resources: analysis of efficiency]. St. Petersburg State University of Aerospace Instrumentation. [In Russ.]

Lukmanova, I. G. (2018). Strukturno-sravnitel'nyy analiz pokazateley proizvoditel'nosti truda na predpriyatiyakh obrabatyvayushchey promyshlennosti [Structural-Comparative Analysis of Indicators of Productivity of Labor at the Enterprises of the Industrial Industries]. *Izvestiya Vysshikh Uchebnykh Zavedenii, Seriya Teknologiya Tekstil'noi Promyshlennosti*, *2*(374), 105-109. [In Russ.]

Musaev, H. A. (2014). Innovatsionnyye faktory razvitiya rossiyskoy promyshlennosti [Innovative factors of development of the Russian industry]. *TERRA ECONOMICUS, 12*(2-3), 136-141. [In Russ.]

"*On the Accountancy Regulations in Accounting for Fixed Assets" Accountancy Regulation 6/01* (2016). The Order of the Russian Ministry of Finance of 30.03.2001 N 26n (revised as of 16.05.2016).

Pankratov, O. E. (2018). O fundootdache v stroitel'stve i otsenke parametrov faktorov, opredelyayushchikh yeye uroven' [About fondootdacha in construction and methods of an assessment of the factors determining its level]. *Construction economics, 2*(50), 75-80. [In Russ.]

Pavlukova, A. V. (2011). Kachestvennyye kriterii innovatsionnogo razvitiya promyshlennykh predpriyatiy [Qualitative criteria for innovative development of industrial enterprises]. *TERRA ECONOMICUS, 3*(9), 63-66. [In Russ.]

Poteeva, M. A., & Kazarina, A. G. (2020). Osnovnyye fondy v tekhnologicheskom obnovlenii sovremennykh predpriyatiy [A enterprise fixed capital into technological renovation of contemporary undertakings]. *Vector economy, 2*(44), 37-44. [In Russ.]

Safarov, G. A., & Salimova, S. G. (2013). Obobshchayushchiye rezul'taty po primeneniyu metodicheskogo podkhoda k detal'nomu analizu fondootdachi po skvazhinam [Summarized results on application of methodical approach to detailed analysis of wells capital productivity]. *SOCAR Proceedings, 2*, 76-80. https://doi.org/10.5510/OGP20130200160

Salimova, S. G. (2015). K probleme detal'nogo analiza fondootdachi po gruppam skvazhin [On the problem of detailed analysis of capital productivity by well groups]. *SOCAR Proceedings, 4*, 61-66. https://doi.org/10.5510/OGP20150400262

Shishelov, M. A. (2013). Effektivnost' obespecheniya funktsionirovaniya lesopromyshlennykh kompleksov [The performance of regional timber industry complex*]. Regional economy, 2*(34), 114-119. https://doi.org/10.17059/2013-2-12

Skvortcov, E. A., Skvortcova, E. G., Nabokov, V. I., & Krivonogov, P. S. (2017). Primeneniye doil'noy robototekhniki v regione [Robotic Milking Implementation in the Sverdlovsk Region]. *Ekonomika regiona [Economy of Region], 13*(1), 249–260. [In Russ.]