Econometric Evaluation of Influential Factors to Increasing Labor Efficiency in Textile Enterprises

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Abstract

This article analyzes the content of the concept of labor productivity in textile enterprises, the factors influencing its increase, using the methods of "correlation" and "regression" analysis, as well as the forecast indicators of labor productivity.

Keywords and Phrases

Labor Efficiency, Textile Enterprises, Industrial Enterprises, Decent Work, Labor Cost Reduction, Innovative Economy, Modeling, Correlation, Regression.

Introduction

The main purpose of labor activity is to achieve a result, for example, the production of a product or the provision of quality service. For any worker or group of workers, the efficiency of this result, that is, the more quality product produced with less time and labor, is important, and the higher the result, the lower the cost per unit of product.

Similarly, as labor productivity increases, so does the cost of the product as the volume and quality of the product increase.

Improving labor efficiency in further increasing the pace of socio-economic development of our country is the most important issue today. In this regard, as noted by President Sh.M.Mirziyoev, "... modernization and diversification of the economy, ensuring high economic growth through increasing labor productivity" [1] is an important task.

Increased labor productivity leads to an increase in labor productivity at the micro level and a decrease in labor costs to obtain the required quality of labor, an increase in product quality and profitability, and at the macro level to the development of material production, curbing prices and inflation, increase the income and welfare of the population and ensure innovative economic development.

The development of a society and the level of well-being of all its members depends on the level of labor productivity and its growth. In addition, the level of labor productivity determines both the production of goods and even the socio-political system itself. Currently, as a result of reforms in the innovative development of the economy, work is underway to increase labor productivity.

Literature Review

Some Uzbek economists, as well as Khodiev B. Y. [12], Mustafakulov Sh. I., [17] and others proposed evaluation methodology for integrated assessment of production capacity management, which is based on qualitative and effective indicators of production capacity management. Methodology for assessment the efficiency of production capacities management at textile enterprises were investigated by B.O.Tursunov in other works [10;20;21], but they have not investigated factors including increased labor efficiency in enterprises.

The contribution of V.V.Novojilov in the study of the concept of labor efficiency as an economic category is significant, in his opinion, “... the useful properties of a product do not depend on its quantity. The product may be useful or unnecessary, necessary or redundant. An increase in over production can lead to an increase in labor, but this has a negative impact on its efficiency ”[2]. The concept of labor efficiency by O.I.Volkov is "... labor productivity associated with the reduction of labor costs for the result of labor performed per unit of time" [3], by A.I.Rofe "labor efficiency is productivity, the efficiency of human activities" [4]. By L.A. Kostin: "labor efficiency means the improvement of social aspects of labor, including working conditions and its safety" [5], V.F.Potudanskaya: "labor efficiency is the achievement of the goal at the level of rational use of resources" [6] , A.S.Volchyonkova: “labor efficiency is the efficiency of using the labor potential of workers” [7], Academician K.H.Abdurahmanov: “labor efficiency characterizes the productivity in the field of material production, as well as in other spheres of human labor” [8] , I.T. Abdukarimov and others: "labor efficiency is measured by its efficiency, ie the result corresponding to one employee (one labor potential) per unit of time" [9], [10].

In our opinion, the above tariffs complicate the possibility of fully understanding the essence of labor efficiency, so it is expedient to give a broad authorial tariff on the concept of labor efficiency. Labor productivity is a socio-economic category, which is to achieve high labor productivity by reducing the cost of labor in the production (non-production) process on the basis of decent labor principles and improving the quality of labor.

Labor productivity in textile enterprises reflects both the economic and social aspects of workers, and describes its results in quantitative and qualitative terms. [21] The general indicator of labor efficiency is the degree to which the requirements and pre-defined obligations of the employee correspond to the results of work, as well as the quality of work, efficient and rational use of working time, saving labor, full mobilization of their capabilities. Its quantification depends not only on the product of the labor results of the worker, but also on the action of the factors influencing it. It is important to develop an analysis model to analyze the main factors that directly affect the labor productivity of textile enterprises, using the general indicator of labor productivity.

Methodology

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The development of a society and the level of well-being of all its members depends on the level of labor productivity and its growth. In addition, the level of labor productivity determines both the production of goods and even the socio-political system itself. Currently, as a result of reforms in the innovative development of the economy, work is underway to increase labor productivity.

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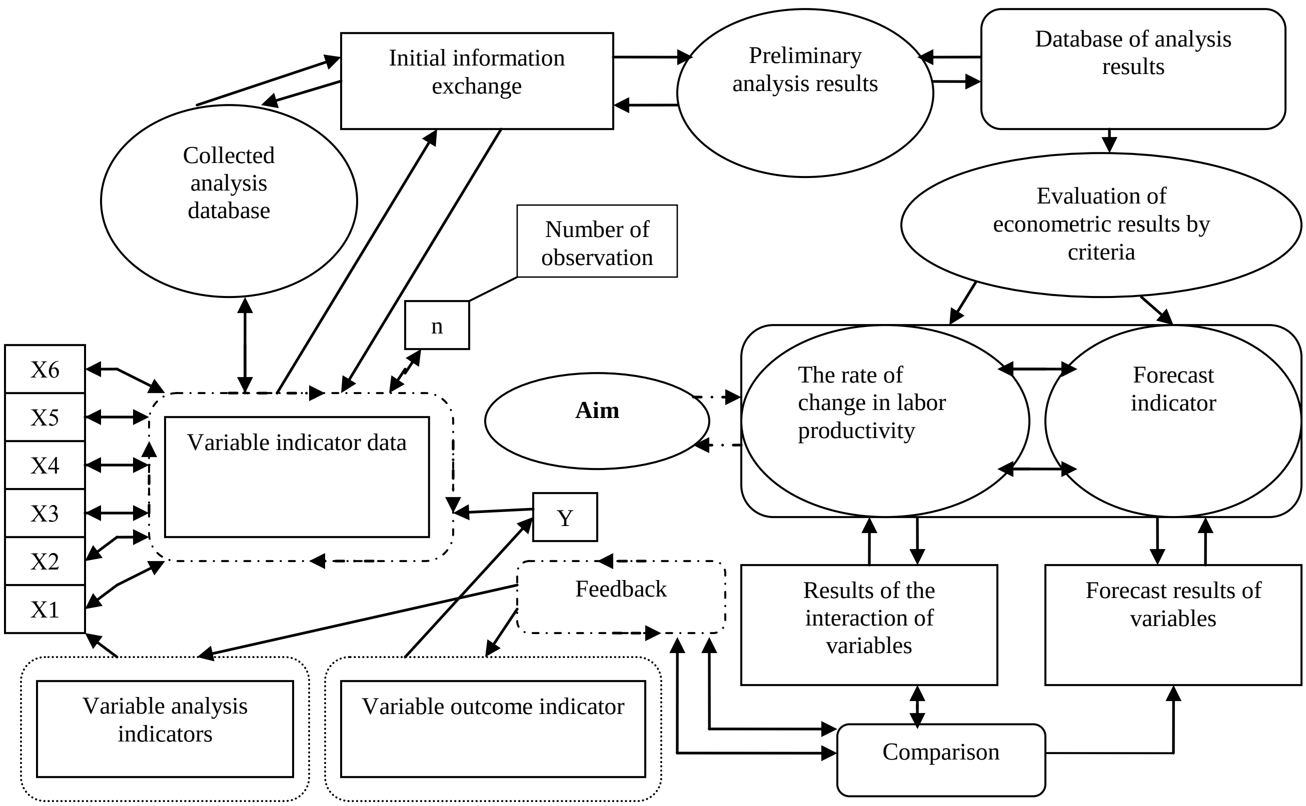

Figure 1 A model of multifactor analysis of labor efficiency
Source: Author`s elaboration

In this model, the indicators required for factor analysis of labor efficiency are initially identified, these indicators are entered into a database, on the basis of which a database for factor analysis is formed. In obtaining the results of the analysis, information is exchanged on the accuracy of the database and the initial analysis data. "If the results of the analysis do not reflect the necessary analytical data (uncertainty, unreliability, error), the variables are re-entered into the database using the initial information exchange" [12]. The results of the analysis allow to compare the results of the analysis with the initial required indicators, expressing the degree of change of the indicators and the forecast indicators of the increase in the resultant sign.

In the process of transition to innovative development using the model of multivariate analysis of labor efficiency, it is important to develop and implement effective economic and management decisions to increase labor productivity in textile enterprises. Modern management systems require the use of reliable methods and tools to determine the future state and scale of economic processes and events. In the econometric assessment of the main factors influencing the increase of labor productivity in textile enterprises, it is possible to study the power of complex socio-economic phenomena through economic-mathematical methods, to determine their laws and to observe them experimentally. To date, a large number of computer programs have been developed that speed up the process of applying these methods and allow the selection of a significant model of evaluation. [13], [14], [15], [16], [17], [20] made extensive use of their scientific research.

Based on the analysis of labor productivity improvement using correlation-regression analysis methods, the strength of the relationship between the factors is determined and the directions of measures for the correct organization and regulation of labor in industrial enterprises are determined, taking into account each factor. In this case, the most important stage of the model structure is the selection of the econometric expression, which describes the dependence of the resulting, predicted indicator on the selected factors. The clearer and more detailed the scope of the forecast of labor productivity improvement, the higher the level of management of achieving this result and ensuring its efficiency.

At present, the identification of the main factors influencing the increase of labor productivity in textile enterprises using correlation-regression methods, forecasting the prospects of its development through the development of a multi-factor regression model is an urgent problem. Therefore, this study begins with the identification of all factors affecting labor productivity and the selection of the most important of them using correlation-regression methods.

In order to create an econometric model of labor productivity in industrial enterprises, the analyzed enterprise [18] used the economic results of economic activity, taking into account the nature of labor productivity indicators and the specifics of the industry, the final product (total labor productivity).) volume (million soums) - Y (t) was selected. The related variables that affect the outcome trait, ie the “decent work criteria” [19] that are important in the enterprise: factors that create favorable production and social and working conditions, wages that improve quality of life, personal development and work capacity and other factors were selected:

X_1 - is the number of workers employed in production.

X_2 - commodity production as a result of structural shifts (at the expense of one worker).

X_3 - unproductive time consumption of workers.

X_4 - information support costs.

X_5 - is the average duration of the working day.

X_6 - is the number of days worked by one worker.

X_7 - is the labor cost per employee.

X_8 - expenditures for labor incentives.

X_9 - Expenditures for staff qualifications and professional development.

X_{10} - spending on improving working conditions and job creation.

X_{11} - costs for technological armament.

X_{12} - is the result of technological modernization.

The effect of these factors on the outcome factor is determined by calculating the double correlation coefficients. This method allows us to exclude from the econometric model being constructed factors that are repetitive and have a weaker relationship with the resulting factor.

A feature of multivariate correlation is that several important factors are involved in its regression equation. It is important to choose the most important of these factors correctly and include them in the regression equation. It is based on a theoretical analysis of factor selection and quality, and is conducted in three stages. In the first stage (initial analysis), the factors are selected without any conditions. In the second stage, they are analyzed using double correlation coefficients. To do this, a matrix of double correlation coefficients between the symbols y_1, x_1, x_2,..., x_n is constructed. In the third stage of factor analysis, the regression equation is determined and its parameters are evaluated on the basis of specific criteria. Correlation analysis methods can be used to determine the effect of these factors on the outcome mark.

To determine which factors should be included in the regression equation, a matrix of double correlation coefficients between the factors was constructed (Table 1).

Table 1 Matrix of mutual pair correlation coefficients of influencing factors

	Y(t)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
Y(t)	1												
X_1	0,86	1											
X_2	0,98	0,89	1										
X_3	-0,80	-0,77	-0,83	1									
X_4	0,94	0,90	0,96	-0,87	1								
X_5	0,80	0,77	0,83	-1,00	0,87	1							
X_6	-0,19	-0,11	-0,15	0,23	-0,18	-0,23	1						
X_7	0,27	0,33	0,33	-0,35	0,32	0,35	0,83	1					
X_8	0,94	0,89	0,94	-0,87	0,98	0,87	-0,22	0,28	1				
X_9	0,89	0,75	0,87	-0,77	0,94	0,77	-0,30	0,15	0,93	1			
X_{10}	0,95	0,82	0,98	-0,80	0,93	0,80	-0,07	0,39	0,89	0,86	1		
X_{11}	0,83	0,73	0,82	-0,72	0,90	0,72	0,03	0,44	0,85	0,89	0,83	1	
X_{12}	0,92	0,82	0,90	-0,74	0,87	0,74	0,14	0,56	0,87	0,78	0,90	0,78	1

In this Table 1, r_{ij}, x_i and x_j are the double correlation coefficients between the factors. It is well known that "in a multivariate regression equation, strongly linearly correlated correlated factors should not be present simultaneously" [13]. The table shows that the mutual correlation coefficient (r_{ij}) of some factors (x_i and x_j) is smaller than its critical value in absolute value, ie $\left|r_{ij}\right| < r_{kr}$. Therefore, only 6 of all factors in the analysis were planned to be included in the econometric model, with $r_{kr} = 0.9$ as the critical value of the correlation coefficient.

If we analyze this Table 2, we see that there are strongly correlated factors where r_{kr} is greater than the critical value. Therefore, we found it necessary to exclude factors x4, x10 and factors x6, x7 from the regression equation, since the relationship of factors x3, x5 is fully functional, factor x5, from the condition $\left|r_{Yx_i}\right| \geq 0{,}5$ of weakly bound to Y (t).

The most important step in the analysis of labor efficiency in an industrial enterprise selected using the method of correlation-regression analysis is the selection of an econometric expression that describes the dependence of the outcome indicator on the selected factors. We evaluate the quality, significance and reliability of the structured econometric expression on the basis of the following criteria:

1. The overall quality of the econometric model is assessed using a multifactor correlation coefficient and a determination coefficient.
2. the significance of econometric models is assessed using the Fisher criterion and approximation error.

3. The significance of the parameters of the econometric model is assessed using the Student Criterion.

In determining the overall quality of the determined regression equation, using the coefficient of determination (R^2), this value is calculated using the following formula:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2} \tag{1}$$

Where: yi - is the observed quantity of the resultant indicator; $\bar{y}$ - arithmetic mean of the result; $\hat{y}$ - determined, forecasted, flattened quantities of the result indicator; n is the number of observations.

The coefficient of determination indicates the proportion of the variance of the resulting variable, which is explained by the effect of the determined model, i.e. the factors under consideration. This indicator takes values between "0" and "1". The closer its value is to the value "1", the more the factors included in the regression equation justify the actions of the resulting indicator.

The analysis of the significance of the identified model is performed by examining the “zero hypothesis”. Represented as a “zero hypothesis” $H_0 : \beta_1' = \beta_2' = ... = \beta_k' = 0$, it represents the general significance of the regression coefficient. If the results of the analysis do not refute the "zero hypothesis", then it is concluded that the effect of the factors on the resultant indicator "y" is insignificant, the overall quality of the regression equation is low. The "zero hypothesis" is tested using variance analysis, and the "zero hypothesis" is expressed as N0: Dfact = The alternative hypothesis against : H0 : Dfact = Deq H1 : Dfact > Deq. The F-Fisher criterion is used to test these hypotheses.

In this case, the actual value of the criterion is determined by the following formula:

$$F = \frac{\sum_{i=1}^{n}(\hat{y}_i - \bar{y})^2 / k}{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 / (n-k-1)} = \frac{R^2}{1-R^2} * \frac{(n-k-1)}{k} \tag{2}$$

Here: $\sum_{i=1}^{n}(\hat{y}_i-\bar{y})^2/k$ - factor variance corresponding to one degree of freedom (number of degrees of freedom γ 1=k); $\sum_{i=1}^{n}(y_i-\hat{y}_i)^2/(n-k-1)$ - residual variance corresponding to one degree of freedom (number of degrees of freedom γ 1=n-k-1); k is the number of factors (parameters) in the multivariate regression equation.

The true value of the F-Fisher criterion (True) is compared with the critical value of the criterion (F_{table} *(a; k; n-k-1)). If* $F_{real} > F_{table}$, then the defined model is statistically significant.

Analysis and Results

In the model developed by analyzing the factors influencing the change in labor productivity in the selected industrial enterprise (Table 2), the actual value of the F-Fisher criterion is F_{real} = 47.89, as well as the number of degrees of freedom surat 1 = 6 on the figure and max 2 = 11 on the denominator. when equal, F_{table} = 3.09 for the table value of the Fisher criterion (significance level at p = 0.95). Hence, our generated multifactor regression equation is statistically significant.

Table 2 Results of test of the model

Multifactor correlation coefficient R	Multifactor determination coefficient R-квадрат	Correction-resurrected R-квадрат	Standard error	F-real	P-value	DW
0,985	0,97	0,949	510,335	47,89	$1{,}2*10^{-6}$	1,648

The importance of individual parameters of multivariate regression in the analysis is assessed using the Student Criterion (T-statistic). The t-statistic determined for the corresponding parameters of the estimated regression equation is compared with the critical point t *(a; n - k - 1)* of the Student's distribution. Agar | *t* | *If> t (a; n - p - 1),* the corresponding parameter is significant and the “zero hypothesis” expressed as N_0*:* $b_j = 0$ *or* N_0*: a = 0 is* rejected. Hence, we separate the important factors included in the regression equation (Table 3).

Table 3 Significant factors in the model

Significant factors	Non-standardized coefficients		Standardized coefficients	t-criteria	P-value
	β	Standard error	β		
const	1557,664	4949,668	-	0,315	0,0076
X_1	-28,604	90,087	-0,043	-0,318	0,0075
X_2	96,054	29,576	0,721	3,248	0,0101
X_3	25,902	47,485	0,059	0,545	0,0499
X_9	130,780	85,197	0,246	1,535	0,0159
X_{11}	-1,153	1,760	-0,089	-0,655	0,0429
X_{12}	0,809	0,512	0,220	1,582	0,0148

In the studied processes, the presence of autocorrelation in the remnants of the resultant factor (y) series was checked. The Darbin-Watson (DW) criterion was used for this and was calculated according to the following formula:

$$DW = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2} \qquad (3)$$

The calculated DW is compared with the DW in the table. If there is no autocorrelation in the residuals of the resulting factor, then the value of the calculated DW criterion will be around 2. The value of the DW criterion calculated in our example is 1,648. This indicates that there is no autocorrelation in the resulting factor residues. Thus, the linear regression model developed by estimating the coefficient of the analysis results has the following form:

$$Y = 1557{,}664 - 28{,}604 \times X_1 + 96{,}054 \times X_2 + 25{,}902 \times X_3 + 130{,}780 \times X_9 - 1{,}153 \times X_{11} + 0{,}809 \times X_{12}$$
$$R^2 = 0{,}97;\ F_{real} = 47{,}89;\ DW = 1{,}648$$

Analyzing the results of the identified factor analysis, the weight of R2 in the total variance analysis is 97.0% (product production, Y (t)), which is the variational dependence of the analyzed factors, the remaining 3.0% are random variables without taking into account the variational dependence. forms. From this, it can be noted that the selected variables are the factors that directly affect the resulting character change. The change in the regression coefficient per unit of variable represents the average change in the resulting sign.

In constructing a prospective model of factors influencing labor productivity using the above methods (using exponential and hierarchical function), using the statistics of the selected industrial enterprise for 2001-2017, the following prospects for factors influencing labor productivity X1, X2, X3, X9, X11 and X12 created a model (Table 4).

Table 4 Prospective model on key factors influencing labor productivity

№	Model	$F-$ The calculated value of the Fisher criterion
1.	$X_1 = 51{,}186\,e^{0{,}015t}$	28,148
2.	$X_2 = 1{,}211 + 4{,}34t - 0{,}439t^2 + 0{,}026t^3$	302,267
3.	$X_3 = 12{,}948 + 2{,}793t - 0{,}325t^2 + 0{,}08t^3$	20,329
4.	$X_9 = 0{,}211\,e^{0{,}28t}$	81,374
5.	$X_{11} = 17{,}334\,e^{0{,}205t}$	53,014
6.	$X_{12} = 1000{,}096 - 134{,}126t + 24{,}369t^2 - 0{,}651t^3$	22,009

Our regression analysis allowed us to develop future prospects for labor performance in the analyzed industrial enterprise using the identified results. Accordingly, the forecast parameters of each factor analyzed in the enterprise for 2020-2022 (Table 5) and the change in total labor efficiency by summarizing them were calculated.

Table 5 Forecast parameters of the factors involved in the regression analysis (million soums)

№	Variables	Years										In 2022 to 2017 year, in %
		2010	2014	2015	2016	2017	2018	2019	Forecast period			
									2020	2021	2022	
1.	Number of workers employed, person (X1)	56	58	62	66	66	67	68	69	70	70	106,1
2.	Commodity production as a result of structural shifts (per worker) (X2)	27,9	48,7	49,4	66,3	75,9	88,7	103,5	120,4	139,5	146,5	193,0
3.	Inefficient time spent by workers, daily (X3)	13	9	7	6	3,5	1,9	0,4	0,9	1,9	1,5	42,9
4.	Expenditures for staff training and professional development (X9)	1,91	9,45	12	9,65	24,7	32,7	43,3	57,3	75,8	92,4	374,1
5.	Expenditures for technological armament (X11)	45,5	356,7	650	370	567,5	696,8	855,5	1050,4	1289,6	1138,2	200,1
6.	Result achieved due to technological modernization (X12)	1360	1910	2354	2581	2566,5	2687,4	2786,8	2860,8	2905,4	3361,1	140,0

From the data in Table 5, it can be seen that the number of workers employed in production has not changed, unproductive time consumption has decreased by 1.8 times, staff training by 3.1 times and technological armament by 2.3 times, commodity production as a result of structural reforms 2 As a result of the increase, the total labor productivity in 2020 will increase by 19714.6 million soums or 168.5% compared to 2017 (actually 11697.8 million soums). In the coming periods, in 2020 it will reach 23677.5 million soums and in 2022 - 24762.3 million soums (Figure 2).

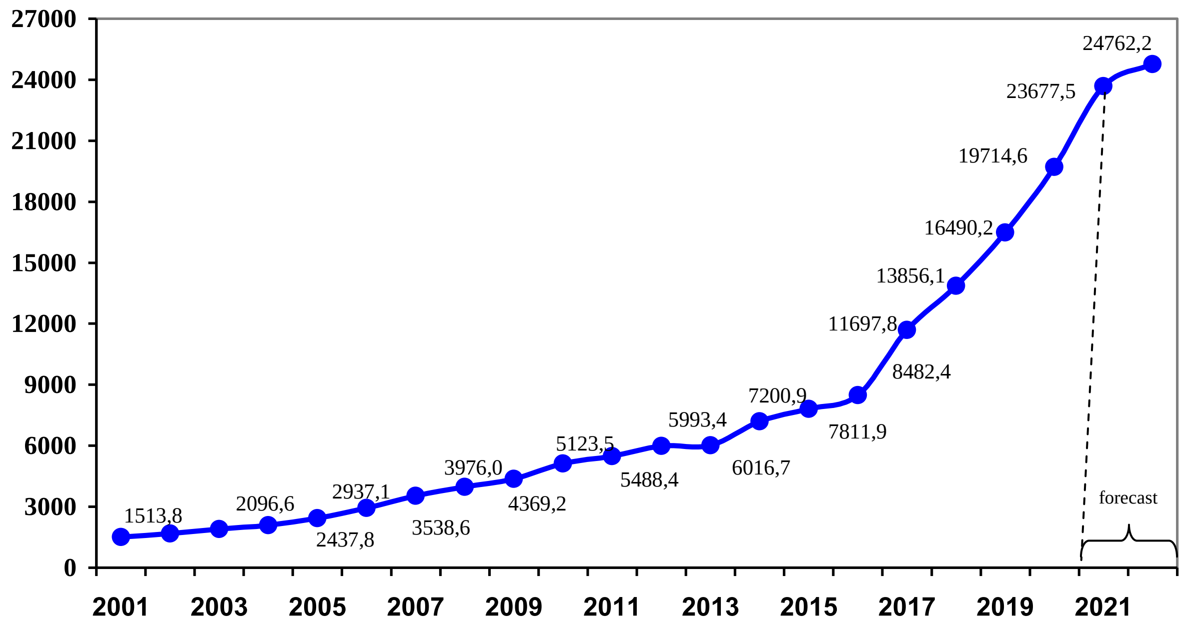

Figure 2 Performance indicators of the analyzed industrial enterprise for 2001-2019 and forecast indicators for 2020-2022, (million soums)

If we compare the final result of the work achieved with the previous periods, in 2022 we will be able to increase the forecast by 16.4 times compared to 2001 and 4.8 times compared to 2010. Of course, in order to achieve such economic efficiency, first of all, it is important to properly organize and manage labor, taking into account the main factors, the continuous introduction of innovative development principles in the enterprise, effective mobilization of identified resources in the production process.

Conclusions

The results of the above multi-factor analysis provide an opportunity to determine the level of labor productivity and scientific analysis of the effective use of labor by workers involved in the production of the product. On this basis, it will serve as a scientific basis for the development of effective management decisions in the future to improve the efficient use of labor in industrial enterprises and increase the efficiency of labor expended.

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