IT VALUE ESTIMATION USING PARTIAL ADJUSTMENT VALUATION WITH TOBIN'S Q DYNAMIC FACTOR

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ABSTRACT

The rapid development of Information Technology (IT) directly and indirectly forces companies to adopt IT in the company's work processes/systems. These developments and being followed by the Covid 19 pandemic directly demanded almost all lines of life, especially in companies, to utilize IT to support the continuity of processes/performance systems in the company. IT is a system used by companies to optimize company performance. To find out, it is necessary to measure IT performance in work units that adopt IT, which is called IT Value. The value of IT is a quantitative measure of the use of IT in the company whether it provides positive or negative optimization for the company. The value of IT can be used as a measure of a company's value in the market after and before using IT. Measurement of IT Value can be done in various ways, in this journal research the estimation of IT Value uses Partial Adjustment assessment with two-factor model (primary data K, L, Tobin's Q) and three-factor model (with primary data K, L, I, Q Tobin). The estimation results of the two-factor model and the three-factor model will be compared to calculate the Performance Measure of IT Value in terms of Performance Ratio (PR) in ratio units and Performance Value (PV) in rupiah. The results of the value of IT PV and PR can be used by companies as evaluation and decision-making materials for optimizing the use of IT in the company for the present and the future.

Keywords: IT Value, Partial Adjustment Valuation, Dynamic Speed Adjustment, Tobin's Q, SPSS

INTRODUCTION

The development of information technology is currently quite fast, even in everyday life cannot be separated from the use of IT. With these developments, it will have a positive and negative impact in dealing with various activities. For enterprise performance systems, the use of IT has become a trend, which is expected to have an influence on the effectiveness, efficiency, and productivity of the company's performance to achieve company goals. IT is a technology for managing, processing, obtaining, compiling, storing, and manipulating data into quality information (Sutabri, 2014). Utilization of IT to support systems performance will provide added value which is called IT Values. The value of IT can be calculated quantitatively in units of currency expressed in an index ratio as the benefit of spending IT resources managed to improve company performance (Adburrahman, 2019).

PT Telkom Indonesia (Persero) Tbk is one of the largest IT-based telecommunications companies in Indonesia, where this company uses IT to support the company's performance processes, ranging from transaction processing, buying, and selling, inventory, management of goods and data, corporate financial systems, etc. Because of this, the calculation of the value of IT in IT-based companies is very important to do, to find out whether the implementation of IT in the company's performance system has a positive or negative impact on the company, as well as material for evaluating and making company decisions.

The value of IT in the company can be done with various perspectives, in this journal the author conducts research on the value of IT at the company PT Telkom Indonesia (Persero) Tbk using the partial adjustment (PAV) valuation method with dynamic speed adjustment of the Tobin's Q factor estimation: two-factor model (with K, L, Tobin's Q data) and three-factor model (with K, L, I, Tobin's Q data) with the result of TI value in ratio index unit and TI value in currency unit. By using these estimation methods and models, it can show the value of IT as the value of the company whether it is in a high or low condition on the value of company assets.

LITERATURE REVIEW

(1) IT Value

Information Technology (IT) is a technology used to manage data into information (Kusmayadi, 2020). According to (Adburrahman, 2019) the reasons why it is important to implement IT in performance systems, namely increasing complexity, globalization, competition, needs. The application of IT in performance systems makes IT have its own value which is called IT Value. To obtain optimal IT Value, IT systems must support business processes that represent functions, systems to run the business and provide benefits to stakeholders such as customers and shareholders.

The value of IT is added value in quantitative terms when capital expenditures containing IT are compared to capital expenditures in the absence of IT. The basis for measuring the value of IT can be done in three categories, namely strategic, business and financial groups (Schniederjans, Hamaker, & Schniederjans, 2004), with the IT value conceptual model, where IT must be managed properly and correctly to generate organizational competition and will indirectly strengthen business competitive advantages, capabilities, and the flow of valuable resources (Abdurrahman, Suhardi, & Langi, 2016) show in figure 1.

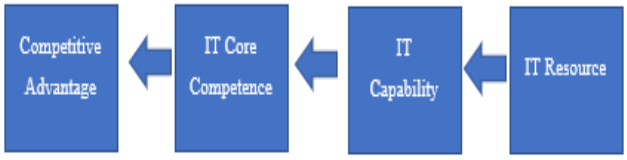


Figure 1. Conceptual Models IT Value

(2) Partial Adjustment Valuation

Partial Adjustment Valuation (PAV) is a method that can determine the value of IT in currency units and ratio units. Partial Adjustment illustrates those changes in results in a process are usually not the same as changes in desired results. The measurement of the current change at time t, compared with the measurement of the previous period t-1, with a change in time requires a coefficient called the constant speed of adjustment (Lin, Chuang, & Choi, 2010).

$$y_t - y_{t-1} = \mu(y_t^* - y_{t-1}) \qquad (t = 1,2,\dots,s) \text{ (1)}$$

Where, yt is the real output of a production process in that year, $yt-1$ is the real output of a production process in the previous year, y_t^* is the desired output in the year at that time, μ is the coefficient of the constant Speed of Adjustment. During the estimation process, errors will appear randomly (ϵ_t), then equation (1) will be (Adburrahman, 2019):

$$y_t = \mu\, y_t^* + (1-\mu)y_{t-1} + \epsilon_t \qquad (t = 1,2,\dots,s) \text{ (2)}$$

Then, (Sutabri, 2014) States that μ in equations (1) and (2) can be a dynamic variable, so that μ become μt where t shows fluctuations due to the dynamic nature at that time. The shift change makes changes to equations (1) and (2), so that it becomes (Schniederjans, Hamaker, & Schniederjans, 2004):

$$y_t = \mu_t f(X_t;\beta) + (1+\mu_t)y_{t-1} + \epsilon_t \qquad (t = 1,2,\dots,s) \text{ (3)}$$

$$\mu_t = g(S_t;\gamma), \qquad 0 \le \mu_t \le 1 \qquad (t = 1,2,\dots,s) \text{ (4)}$$

With f(Xt; β) is an alternative function of the output used, g(St;γ) is the dynamic speed of adjustment. In this study, only equation (3) is used, where the value of f(Xt; β) comes from the Cobb-Douglas function (CD). The value of μt in equation (3) is a function of St namely the vector of the variables that affect the speed of adjustment, γ is an unknown parameter, so according to PAV theory equation (3) can be written as follows (Adburrahman, 2019):

$$y_t - y_{t-1} = \mu_t f(X_t;\beta) - \mu_t y_{t-1} + \epsilon_t \qquad (t = 1,2,\dots,s) \text{ (5)}$$

Because f(Xt; β) function using only the CD function, then the equation will be (Sutabri, 2014):

$$f(X_t;\beta) = \alpha K_t^{\beta 1} L_t^{\beta 2} I_t^{\beta 3} e^{vt-\mu t} \qquad (t = 1,2,\dots,s) \text{ (6)}$$

With Kt is the equity value, Lt is labour expenditure, it is IT spending cost, α, β is a parameter whose value is unknown. Equation (6) is used for the estimation of the three-factor model with the value of IT spending costs (Adburrahman, 2019). Parameter α, β1, β2, and β3 is a parameter whose value is unknown. For the estimation of f(Xt; β) the two-factor model without the cost of IT spending is as follows (Adburrahman, 2019):

$$f(X_t;\beta) = \alpha K_t^{\beta 1} L_t^{\beta 2} e^{vt-\mu t} \qquad (t = 1,2,\dots,s) \text{ (7)}$$

Equation (4) speed of adjustment can be rewritten as follows (Sutabri, 2014):

$$\mu_t = \gamma_1 + \gamma_2 S_t \qquad with\ 0 \le \mu_t \le 1 \quad (t = 1,2,\dots,s) \text{ (8)}$$

With μ_t is the coefficient of the dynamic speed of adjustment constant, $\gamma_1 + \gamma_2$ is an unknown parameter, S_t is a vector of the variables that affect. To assess changes in the value of company performance using Dynamic Speed of Adjustment from the impact of IT spending by comparing the estimation of the three-factor model with the estimation of the two-factor model, the following equation can be used: (Adburrahman, 2019)

$$yt - yt\text{-}1 = (\gamma 1 \alpha Kt^{\beta 1} Lt^{\beta 2} It^{\beta 3} e^{vt - ut}) + (\gamma 2 St \alpha Kt^{\beta 1} Lt^{\beta 2} It^{\beta 3} e^{vt - ut}) - (\gamma 1 yt\text{-}1) - (\gamma 2 Styt\text{-}1) \ (t=1, 2, s) \text{ (9)}$$

$$yt - yt\text{-}1 = (\gamma 1 \alpha Kt^{\beta 1} Lt^{\beta 2} e^{vt - ut}) + (\gamma 2 St \alpha Kt^{\beta 1} Lt^{\beta 2} e^{vt - ut}) - (\gamma 1 yt\text{-}1) - (\gamma 2 Styt\text{-}1) + \epsilon t \ (t=1,2,..,s) \text{ (10)}$$

(3) Dynamic Speed of Adjustment

In PAV (Partial Adjustment Valuation) theory, there are two types of adjustments, namely static and dynamic. In this journal use the type of dynamic adjustment. Dynamic speed of adjustment has several theories that are more formulaic and focuses on calculating the estimated IT value by generating several unknown parameters parameter. Equation (9) is used for the estimation of the three-factor model and equation (10) is used for the estimation of the two-factor model. Equations (9) and (10) underwent changes to adjust the PAV theory for Dynamic Speed adjustments, to be as follows (Adburrahman, 2019):

$$yit = (\gamma 1 + \gamma 2\ Sit)\ (\alpha Kit^{\beta 1} Lit^{\beta 2} Iit^{\beta 3} e^{vit - uit}) - (\gamma 1 + \gamma 2 Sit\text{-}1)\ yi(t\text{-}1) + \epsilon it \qquad (i = 1,\dots,r \text{ dan } t=1,\dots,s) \text{ (11)}$$

$$yit = (\gamma 1 + \gamma 2\ Sit)\ (\alpha Kit^{\beta 1} Lit^{\beta 2} e^{vit - uit}) - (\gamma 1 + \gamma 2 Sit\text{-}1) yi(t\text{-}1) + \epsilon it \qquad (i = 1,\dots,r \text{ dan } t=1,\dots,s) \text{ (12)}$$

Equation (11) for the estimation of the three-factor model using the value of IT spending costs and equation (12) for the two-factor model not using IT spending costs. With yt is the real output of a process at time t, yt-1 is the real output of a process at time t-1, Kt is company equity, Lt is labor cost, It is IT spending cost, α, β is a parameter whose value is unknown, γ1, γ2 is an unknown parameter, μ is the coefficient of the constant Speed of Adjustment, ϵt is a conventional error, St is a vector of variables that affect the Speed of Adjustment.

(4) Tobin's Q

Tobin's Q is the market value of a company divided by the cost of replacing the company's assets, where the replacement of assets is expressed in terms of the present value of a positive relationship between the company's Tobin's Q ratio and the company's future cash flows with the following valuation (Sudiyatno & Puspitasari, 2010):

- Tobin's Q value is between 0 and 1, meaning that the company's market value is low, where the cost of replacing the company's assets is greater than the company's market value, in other words the market will judge the company's performance less.
- Tobin's Q value >1, means the company's market value is high and higher than the company's asset value, thus the market will judge that the company's performance is good.

According to (Haosana, 2012), When implementing the replacement cost of company assets, it is often not available and difficult to calculate, because financial analysts equate the replacement cost of assets with the book value of assets so that the Tobin's Q formula becomes:

$$\text{Tobin's Q} = \text{ME} + \text{PS} + \text{DEBT} / \text{TA} \quad (13)$$

To adjust to the conditions of financial transactions in Indonesia, several adjustments were made to the Tobin's Q formula in equation (13), so that the Tobin's Q formula applied to companies in Indonesia, namely (Haosana, 2012):

$$\text{Tobin's Q} = \text{ME} + \text{DEBT} / \text{TA} \quad (14)$$

Where ME is the number of outstanding shares of the company multiplied by the closing price of the shares, DEBT is the sum of total debt and inventories minus current assets, TA is the book value of the company's assets (total assets).

(5) SPSS (Statistical Product and Service Solutions)

SPSS is a computer program used to make statistical analysis [10]. Statistical analysis can be used to manage data by using Nonlinear functions to analyse statistics at the advanced level, data analysis with machine learning algorithms, string analysis and big data. The way SPSS works is divided into three parts, namely (Nazaruddin, 2014):

- Data input in SPSS is done like input data in data view and variable names in variable view.
- Data processing, the user chooses the method that will be used to process the data.
- Output is used to make decisions according to the method used.

METHOD

(1) Selecting and Collecting Data

The research in this journal is intended for IT-based companies with the chosen research object, namely PT Telkom Indonesia (Persero) Tbk. The data needed for the research process are equity data, labour costs, IT expenses, income, and previous year's income. The data needs are taken from annual reports for the last 15 years starting from 2004-2019 which were obtained from the official website of PT Telkom Indonesia (Persero) Tbk.

(2) Determining SoA and Estimating Parameter

For further estimations, the dynamic adjustment SoA used is Tobin's Q (Adburrahman, 2019) see equations (9) and (10). The Tobin's Q value of a company is obtained by calculating using equation (14) with data on the number of outstanding shares, stock closing prices, total debt, inventory, current assets, and total assets of the company (Haosana, 2012). The data is obtained from the annual report of PT Telkom Indonesia. The SoA value will be used to determine parameter estimates with two estimation models, namely by using a two-factor model (without I) using equation (10) and a three-factor model (using I) using equation (9) (Adburrahman, 2019). Estimation of parameter estimates using SPSS software.

(3) Estimating Dynamic Speed of Adjustment

Estimations with Dynamic Speed adjustment are carried out using equation (11) for the three-factor model, equation (12) for the two-factor model. Equations (11) and (12) produce several parameters whose values are unknown. The estimated value generated from equations (9) and (10) is the value used for parameters whose values are not yet known (A for α, B1 for $\beta 1$, B2 for $\beta 2$, B3 for $\beta 3$) and unknown parameters (C1 for $\gamma 1$, C2 for $\gamma 2$) on the Dynamic Speed of Adjustment equation.

(4) Valuating IT Value

To determine the value of IT, two performance measures are used, namely performance ratio (PR) with ratio index and performance value (PV) with currency (Adburrahman, 2019). The results of the estimation of the PV and PR of the three-factor model (with I) were compared with the PV and PR of the two-factor model (without I). The second TI value of the performance measure is said to be correct if the TI value is positive, the value is not below zero and more than one for the TI performance ratio value, the TI value is more than 1 for the IT performance value, the performance value and the three-factor model ratio must be greater than performance value and two-factor model ratio (Adburrahman, 2019).

RESULT AND DISCUSSION

To start the PAV estimation, first determine the SoA value of Tobin's Q, using equation (14) (Haosana, 2012), With the following estimation results:

Table 1. Value of Tobin's Q

Years	Tobin's Q
2004	1,731
2005	1,913
2006	2,710
2007	2,493
2008	1,502
2009	1,945
2010	1,594
2011	1,379
2012	1,638
2013	1,631
2014	1,996
2015	1,834
2016	2,194
2017	2,238
2018	1,801
2019	1,778

Source: Data processed in 2020

The data in table (1) is used as the SoA value for the PAV estimation by adjusting the Dynamic Speed of the two-factor model using equation (12) with data on Equity (K), Labor Expenditure (L) and the three-factor model using equation (11) with equity data. (K), Labor Expenditure (L), and IT Expenditure (I) (Lin, Chuang, & Choi, 2010). The results of estimations using equations (11) and (12) are estimated values for parameters whose values are not yet known (α, β, γ) with the estimation results in table (2).

Table (2) is the result of PAV estimation by adjusting Dynamic Speed with two estimation models called parameter estimation. It can be seen in table (2) in the two-factor model, the parameter 3 which is the power of I is zero, because the

estimation of the two-factor model does not use I. With these results the unknown parameter values in equations (11) and (12) have been found.

Table 2. Parameters Estimation

Firm	Three- factor model (with I)					
	α	β1	β2	β3	γ1	γ2
Telkom	6,324	0,478	0,431	0,039	-0,048	0,279
Firm	Two- factor model (without I)					
	α	β1	β2	β3	γ1	γ2
Telkom	6,375	0,489	0,459	-	-0,068	0,284

Source: Data processed in 2020

With the estimated value of these parameters, the estimation to determine the coefficient value of the dynamic speed of adjustment constant (μ) can be done using the equation (Adburrahman, 2019):

$$\mu = \gamma 1 + \gamma 2 * St \qquad (t = 1,..,s) \ (15)$$

With γ1 + γ2 is the unknown parameter (show in the table 2), St is the value of SoA (see table 1). Equation (15) can be used to calculate for the estimation of the two-factor model and the three-factor model. The results of the estimation of equation (15), are as follows:

Table 3. Value of μ

Dynamic Speed of Adjustment Tobin's Q PT Telkom Indonesia 2004-2019		
Years	Two-model Factor	Three-model Factor
2004	0,424	0,435
2005	0,475	0,486
2006	0,702	0,708
2007	0,640	0,648
2008	0,359	0,371
2009	0,484	0,495
2010	0,385	0,397
2011	0,324	0,337
2012	0,397	0,409
2013	0,395	0,407
2014	0,499	0,509
2015	0,453	0,464
2016	0,555	0,564
2017	0,568	0,576
2018	0,443	0,454
2019	0,437	0,448
Average	0,471	0,482

Source: Data processed in 2020

In table (3) shows that the value of three-factor model (with I) is greater than two-factor model (without I). From the table above shows that the value of μ on PT Telkom in the last 15 years has increased and decreased caused by Tobin's Q values (Table 1) are also increasing and decreasing every year. Although it increases and decreases every year, the value of the two-factor model and the three-factor model at PT Telkom Indonesia is still in accordance with the rule that has been set, which is not below 0 and not more than 1 (Adburrahman, 2019).

The next step is the estimation of the value of IT to the performance measure μ on two-factor model and three-factor model using the following equation (Adburrahman, 2019):

$$f(X, \beta) = \alpha * Kt \ \beta 1 * Lt \ \beta 2 * It \ \beta 3 \qquad (t = 1,..,s) \ (16)$$

$$f(X, \beta) = \alpha * Kt \ \beta 1 * Lt \ \beta 2 \qquad (t = 1,..,s) \ (17)$$

Equation (16) for a three-factor model and equation (17) for a two-factor model with $f(Xt; \beta)$ for the alternative function of the desired output, Kt for equity value, Lt for labor spending, it for the cost of IT spending, α, β for the parameter whose value is unknown (see Table 2). Value of $f(X, \beta)$ used for calculating the performance measure for Performance Value (PV), and the PV value used to calculate the performance measure for the performance ratio (PR), by the following equation (Adburrahman, 2019):

$$PV = \mu * f(X, \beta) \qquad (18)$$

$$PR = PV/yt \qquad (19)$$

With yt is income at time t, μ is the dynamic speed of adjustment constant. Equation (18) and (19) can be used for the estimation model of two-factor and three-factor model. The result of the estimation of the equation (16), (17), (18), (19) the estimation model of two factors and three factors, show in Table (4).

Table 4. Performance Measure

Years	Yt	Two- factor model (without I)			Three- factor model (with I)		
		f(x, β)	PV	PR	f(x, β)	PV	PR
2004	33.948	38.108	16.143	0,476	38.125	16.583	0,488
2005	41.807	49.215	23.391	0,56	49.526	24.056	0,575
2006	54.748	60.757	42.629	0,779	61.144	43.296	0,791
2007	62.683	66.418	42.508	0,678	66.481	43.049	0,687
2008	64.166	69.167	24.801	0,387	70.014	25.979	0,405
2009	67.678	70.415	34.108	0,504	70.943	35.092	0,519
2010	68.629	71.003	27.315	0,398	70.538	27.984	0,408
2011	71.253	78.762	25.490	0,358	78.288	26.363	0,37
2012	77.143	87.179	34.627	0,449	86.818	35.509	0,46
2013	82.967	93.711	37.035	0,446	94.512	38.471	0,464
2014	89.696	98.832	49.304	0,55	99.549	50.659	0,565
2015	102.470	114.554	51.876	0,506	114.879	53.268	0,52
2016	116.333	129.090	71.657	0,616	129.305	72.944	0,627
2017	128.256	134.792	76.507	0,597	135.570	78.143	0,609
2018	130.784	137.456	60.960	0,466	138.328	62.867	0,481
2019	135.567	137.098	59.905	0,442	138.462	62.039	0,458
Average			42.391	0,513		43.519	0,527

Source: Data processed in 2020

In Table (4) shows that the value estimation for the three-factor model is higher than the estimation of two-factor model and the value of each model of estimation has increased and decreased each year, but despite increasing and decreasing values in Table (3) is according to the rules of performance measure, namely the value in the three-factor model must always be higher than the two-factor model, the

PR value is not below 0 and not more than 1 in ratio units, PV is positive and more than 1 in currency units (Adburrahman, 2019).

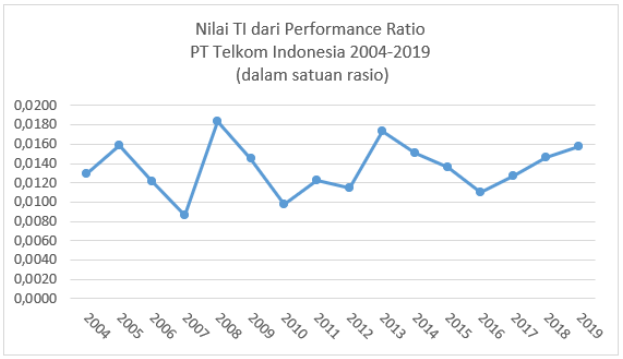
With an average value of IT PV 43 519 three-factor model, the average value of IT PV 42 391 two-factor model, the average value of IT PR 0.527 three-factor model, the average value of IT PR 0.513 two-factor model. The PV and PR values in Table (4) are the values used to determine the TI value by subtracting the value of the three-factor model from the two-factor model (show in Table 5).

Table 5. IT Value

Years	Performance Measure Tobin's Q PT Telkom Indonesia 2004-2019					
	Performance Ratio (PR)			Performance Value (PV)		
	Three-factor model	Two-factor model	IT Value	Three-factor model	Two-factor model	IT Value
2004	0,488	0,476	**0,013**	16.583	16.143	**440**
2005	0,575	0,56	**0,016**	24.056	23.391	**665**
2006	0,791	0,779	**0,012**	43.296	42.629	**666**
2007	0,687	0,678	**0,009**	43.049	42.508	**541**
2008	0,405	0,387	**0,018**	25.979	24.801	**1.178**
2009	0,519	0,504	**0,015**	35.092	34.108	**984**
2010	0,408	0,398	**0,01**	27.984	27.315	**670**
2011	0,37	0,358	**0,012**	26.363	25.490	**873**
2012	0,46	0,449	**0,011**	35.509	34.627	**882**
2013	0,464	0,446	**0,017**	38.471	37.035	**1.436**
2014	0,565	0,55	**0,015**	50.659	49.304	**1.355**
2015	0,52	0,506	**0,014**	53.268	51.876	**1.391**
2016	0,627	0,616	**0,011**	72.944	71.657	**1.287**
2017	0,609	0,597	**0,013**	78.143	76.507	**1.636**
2018	0,481	0,466	**0,015**	62.867	60.960	**1.908**
2019	0,458	0,442	**0,016**	62.039	59.905	**2.134**
Average	0,527	0,513	**0,014**	43.519	42.391	**1.128**

Source: Data processed in 2020

(a)



(b)

Figure 2 IT Value (a) PV; (b) PR

Figure (2) is a graph of the value of IT performance value in currency and the value of IT performance ratio with unit ratios from Tables (3) and (4) which are the fluctuations in the IT value of PT Telkom Indonesia in the last 15 years starting from 2004 -2019. The figure shows that the company's IT value in terms of performance ratio and value has increased and decreased significantly, this is influenced by the value of revenue, μ, f(x,β) PT Telkom Indonesia has also experienced significant increases and decreases every year for the last 15 years starting from 2004-2019. Even though there was a significant increase and decrease, from the point of view of the estimation of the PAV Dynamic Speed of Adjustment Tobin's Q factor, the value of TI PV and PR still met the requirements (Adburrahman, 2019) and proven to be calculated quantitatively.

CONCLUSION AND RECOMMENDATION

The journal study aims to prove that the impact of the use of IT in a company or organization can be calculated in quantitative terms the financial data sources with the company's financial annual report an appropriate method.

The research that has been conducted in this journal proves that the impact of the application of IT on a company can be calculated quantitatively using partial adjustment valuation by adjusting the dynamic speed factor of Tobin's Q two-factor model (Without I) and three-factor model (With I) with the same estimation results called the Value of IT. The IT value of the PT Telkom Indonesia company starting from 2004-2019 based on research is divided into two, namely the TI Performance Ratio value with an average TI value of 0.014 and the IT Performance Value with an average IT value of 1,128.

With the value of IT, it can be seen that IT has an impact on company performance systems that apply IT even though it has increased and decreased as seen from the graph in Figure (2), However, IT is able to increase the productivity of the company's performance well, as evidenced by the value of IT which is always positive and has a good impact on the company's defence system against all the bad factors from internal and external to the company.

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