

## EVALUATION OF CLOUD COMPUTING IMPLEMENTATION IN INDUSTRY 4.0 AT CLOUD INFRASTRUCTURE PT X

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**Abstract:** The research aims to analyse impact of digital transformation at PT X as cloud infrastructure provider. Digital transformation has been increased globally because they have their internet infrastructure well established, meanwhile in Indonesia still needs to develop which has 3% annually of development headway. The usage of internet increases every year in every activity so that it supports the digital transformation. This research conduct to analyse by using PESTEL analysis and TOE framework at PT X as cloud infrastructure provider. The issues are found, at first cloud is used as a massive storage for certain activity such as for office needs. However, currently activities have been changed to be daily activities in cyber world so that generates big data. The next issue, cloud has been considered as environmental friendly product because it reduces usage of resources meanwhile for data centre activity consumes massive amount electricity so that contributes to create carbon emission. Digital transformation forms from various kind of cyber activities, this could be as potential market for PT X to elaborate their business. Unfortunately PT X profitability has fluctuated in this 5 years when the demands of technology increase. This research is a qualitative method with case study approach and the instrument of research is by doing interview. Data were gained as primary and secondary data. Current research is using PESTEL analysis and TOE framework. This explains external factors which identified by PESTEL analysis could affect business strategy and TOE framework could determine kinds of innovation based on its character of technology so that these analysis could bring the decision of company strategy.

**Keywords :** Cloud computing, digital transformation, working capital, TOE Framework, PESTEL Analysis, green IT

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## INTRODUCTION

Industry 4.0 with more updated technology is able to change the journey of the industry from tradisional to transform towards digital. *The Internet of things* is applied in this transformation to increase efficiency and effectiveness in combining technologies in the wireless-based industrial 3.0 era (Elangovan, 2021). Industry 4.0 was first introduced in Indonesia in 2011. "The Industrial Revolution 4.0 is a transformation effort towards improvement by integrating the online with internet and production lines in the industry, all production processes run with the internet as the main support". There are several driving factors in industry 4.0 in Indonesia; first, increasing data volume, computing capabilities and connections (connections). Second, the priority of 5G networks for the benefit of the industry. Third, cooperate with the Ministry of Communication and Information Technology in

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optimizing *band width*, and the availability of the National Industrial Information System (SIINAS) for easy data integration in developing the electronics industry. Fourth, human resources with high skill vocational education and developing skills from *low / middle to high skills* (Kominfo, 2019). Therefore, internet infrastructure must be strengthened in industry 4.0.

Industry 4.0 emphasizes technological innovation, while industry 5.0 uses these innovations to integrate technology with human activities. With this innovation, *big data* and *Artificial Intelligent (AI)* are formed (Elangovan, 2021). Increasingly widespread digital technologies such as *big data*, *cloud* and *AI* mark the emergence of the digital economy. Digitalization helps companies improve performance for *the level of green innovation* by using available data (Hu et al., 2022). In implementing innovation, it can be determined by three factors Technology, Organization and *Environment*. Technology deals with internal and external technology infrastructure such as information technology for internal or external such as internet networks, communication networks, and so on. The organization includes the size of the company, the intensity of innovation and so on. *Environment* in the external scope includes government regulations, *green technology* that supports infrastructure, and others (Chege and Wang in (Alraja et al., 2022).

This research is based on previous research that looked at the user side using the TOE *framework*. The concept of *Technology* from the positive side provides benefits for users in the form of optimizing company performance, reducing IT costs, *with good Service Level Agreement (SLA) service quality*. But from the negative side there are security and data privacy risks. *Organization* Concept how management provides support in using the *cloud* so that organizational performance becomes efficient and supports the company's competitive advantage (Khayer et al., 2020).

*The concept Environment*, emphasizes the use of resources by companies. Users really need technology partners, in the form of *cloud services* because they are more profitable from the user side (Khayer et al., 2020). The competitive advantage of a cloud infrastructure *that recognizes the factors that influence* cloud success. Cloud infrastructure is influenced by the diverse nature of technology, but there are original characteristics of technology namely complexity, compatibility, configuration, and trialability that can affect the successful application of innovation. From the user side, this study suggests that the technology used is in accordance with the nature of the technology so as to provide ease of use and advantages in using cloud products. From the infrastructure provider side, the service is ensured to be understood by users. By the nature of technology can provide good service for customers (Luo et al., 2018). The next study looked at the user side with a sample of three companies in creating *green IT*. The result is that the use of the *cloud* supports *green IT* efforts and their impact by reducing energy consumption and costs, and reducing the number of servers and physical storage space. Develop environmentally friendly behavior as a form of cost reduction. Increase employee productivity and communication so as to create transparency in the organization. *Work culture is changing to be more flexible* (Scott & Watson, 2012).

The TOE concept describes *inputs* for *green practices* in company processes to produce *sustainability performance outputs* (Alraja et al., 2022). A few years ago, businesses ignored environmental conditions more, after seeing the impact of climate change, companies are now required to pay attention to the environment by innovating environmentally friendly so that companies can save costs in the future. There is pressure on businesses to reduce their environmental impact, especially energy and carbon consumption. The IT industry consumes more electricity especially related to data storage and processing, so this industry contributes to global warming by two percent equivalent to the aviation industry (Kaur, 2012).

*Cloud* consumes electricity consumption due to using *the data center as data storage so energy savings are needed in the data center* (Chopra, 2018). The use of electricity is very large due to the demand for services which if the provision of resources does not support it will affect the *Service Level Agreement* and have an impact on business revenue. (Linden in Paul et al., 2016). This indicates that the business revenue of service providers is highly dependent on *service response time* related to the resources available at a given moment (Barroso and Holzle in (Paul et al., 2016).

Based on a survey conducted by Frost & Sullivan, regarding *cloud service revenue share 2016*, PT X is one of the companies that dominate in *cloud infrastructure*.

**CLOUD SERVICE MARKET : SERVICE REVENUE SHARE 2016**

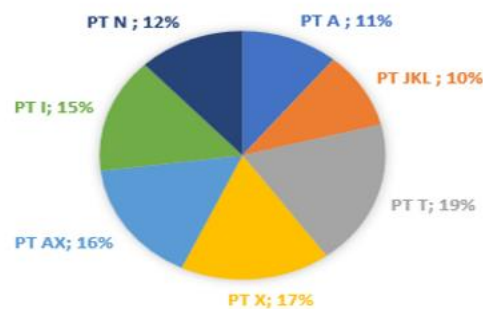


Figure 1. Cloud Service Market : Service Revenue Share 2016

Source : Frost & Sullivan (2018)

Cloud products offered by PT X as data storage support digital storage needs because they have the ability and always improve an established & stable network, and have data center infrastructure (Frost & Sullivan, 2018).

The object of this study focuses on the cloud *studied through the cloud infrastructure provider company* PT X. The problem found is that the cloud which was originally only used for storing certain big data has now changed as data storage for daily internet activities so that it changes activity habits from traditional to digital and requires large storage capacity. In addition, the *cloud* is considered an environmentally friendly

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product because it can save resource usage, but the use of electricity in its data center has a carbon impact. In responding to the need for cloud use *for PT X, of course, it can increase sales of PT X's cloud products so as to provide profits for the company.* However, PT X experienced a decline in its profit from 2018 to 2020, amid huge demand for products due to changes in activities during the pandemic and also the shift in lifestyle to digital (Respondent 1 & Respondent 2, 2023).

The decrease in profitability in PT X can be evaluated through strategy. In *Winner strategy*, there is a *performance test* that assesses the company's performance, which is a good improvement, indicating the success of the strategy with indicators of facing market competition stably and growing and resulting in increased profitability and financial performance (Thompson et al., 2022). PESTEL can provide new insights for companies in evaluating and making decisions for business strategies by looking at future market potential, the latest regulations, social trends and other factors (Elangovan, 2021).

## STUDY LITERATURE

### PESTEL Analysis

PESTEL advises on external factors that may affect the business and uses them as consideration of long-term business decisions, determining innovation, and sustainable investment strategies. PESTEL analyzes PT X's external factors and determines the factors affecting the *Cloud* (Song et al., 2017). External factors include Political, Economic, Social, Technological, Environmental (external factors), and Laws that underlie the industry directly and also the ability to compete in the business environment (Thompson et al., 2022). Politics, including Telecommunications and Data Storage Policy. Economy, including the digital economy. Social, including digital lifestyle. Technology includes technological change. Environment, including external factors of the business. Legal, including regulations & policies, data privacy certifications, and customer satisfaction (Thompson et al., 2022).

### TOE Framework

The TOE framework is a factor in the form of innovations such as technology, organization, external environment. Technology can come from the emergence of trends or innovations that are being developed by companies, in which there are innovation characteristics stated by Rogers, namely "*innovation: relative advantage, complexity, observability, compatibility and trialability are also include*" (Rogers, 2003). Organization is part of the characteristics of the business and the resources used. The environment can be interpreted as factors from outside the company such as consumers, regulators, and so on (Sastararuji et al., 2022).

In the context of technology, it is described as infrastructure that is used or available in the market but not used. This is able to make companies adjust and develop existing technology into innovations that are influenced by external factors so as to

produce new versions of previous technology. There are three types of innovation, first, innovation in the form of transition change, change in innovation can be measured. Second, innovation in the form of combining technology with new ways, such as conveying information on the internet, changes in measurable innovation. Third, innovation in the form of intermittent change. This innovation requires organizations to take quick decisions to increase their competitive advantage. In the context of *organization*, innovation is applied by connecting internal organizational sub-units and *top management behavior* so that it can encourage innovation through the company's vision and mission and the communication process to deliver innovation can be seen through corporate strategy. In the context of *environment*, innovation can be influenced by the growth phase of the company. If the company's growth is fast, the company uses innovation more often, but if there is a decline, innovation is used as a cost reduction and business expansion. Furthermore, it is influenced by the innovation phase supported by the availability of technological infrastructure. Then influenced by government regulations have a beneficial or detrimental impact on innovation (Dwivedi et al., 2013).

### **Cloud Computing**

*Cloud* computing is a problem solution service using computers (computing), whose *hardware and software resources terminate to large data centers* (big data centers) and *infrastructure such as the cloud or cloud* (Marinescu, 2022).

*Cloud technology* technically provides a hardware service in the storage and software space. *Cloud* provides services in three types; *Infrastructure as a service* (IaaS), services in the form of infrastructure where consumers can rent servers virtually according to the capacity of needs that can be increased or decreased according to usage, *Platform as a service* (PaaS) a service in the form of a platform where servers in the form of applications develop, test and adapt to the environment, this platform requires infrastructure, *Software as a service* (SaaS) a service in the form of software. Consumers use software by using devices (mobile phones) in the form of applications connected to the internet. Software-based internet is created by requiring a platform (Sendler, 2018).

In business, several factors must be considered in running an IoT (*cloud*) business rules related to industry standards or laws (Acts), financial performance, budgets, margins and profits, internal policies related to organizational mandates, and competitive advantages in the form of corporate strategy, intellectual rights protection, price and cost, product differentiation, and product automation (Macaulay, 2016).

Competitive advantage is indispensable given the response to rapid market changes. Therefore, risk management is needed that can manage the business by overcoming problems and pressures due to changing business needs. Market changes that occur must be budgeted properly to have operational control and business can continue to run, and develop according to market competitiveness (Macaulay, 2016).

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### Sustainability Performance

Technology leads to ways of using innovation, data, and new information to meet needs and desires that make work easier and more efficient but technology also presents challenges that are social or ethical. There are four types of technological impacts in business, namely environmental pollution, depletion of natural resources, technological unemployment, occurs when humans are replaced by machines, job creation is not suitable because jobs are broken down into smaller components (Carroll et al., 2022)

The sustainability performance dimension is based on the *triple bottom line of people, profit & planet*. *People* leads to activities between social and corporate in improving internal and external stakeholder relations, *profit* is not only how the company earns business profits but also the value of the company that incurs costs that must be incurred due to the impact of business on society and the surrounding environment. *The planet* leads to ecological and environmental impacts (Thompson et al., 2022).

In terms of environmental cost sustainability (*eco-efficiency*), is the ability of companies to reduce negative environmental impacts on resource use and costs, with four objectives, namely reducing resource use, reducing environmental impact, increasing product value, reducing environmental obligations (Hansen & Mowen, 2018).

### Financial Performance

Profitability is the ability to earn a profit based on the funds invested. The indicators are ROE (equity), ROA (assets), (ROS) to sales profit.

$$ROS = \text{Net} \frac{\text{Income}}{\text{Revenue}} \times 100\%$$

ROS calculates how efficient a company is in earning profits from its revenue (Hyblova & Skalicky, 2018).

$$ROA = \frac{\text{EBIT}}{\text{Total Aset}} \times 100\%$$

ROA is management's ability to profit from a company's total assets regardless of how it is funded.

$$ROE = \frac{\text{EAT}}{\text{Equity}} \times 100\%$$

ROE reflects the return to shareholders on their equity. (Blažková & Dvouletý, 2017).

Increased innovation activity and investments in new technologies increase capital requirements that can be manifested in higher debt, which leads to the risk of possible

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payment problems and bad financial risks. Another theory states that companies with high risk should on average achieve higher profits.

$$\text{Leverage} = \text{Total} \frac{\text{Liabilitas}}{\text{Total Aset}} \times 100$$

Higher debt (leverage) ratios are unprofitable and lead to decreased profitability (Blažková & Dvouletý, 2017).

Based on literature studies, there is a negative relationship between working capital and profitability. One way to determine managerial success is the management of operating capital (Kayakus et al., 2023).

Good working capital is to enable the company to respond to unexpected market changes. This relates to the company's liquidity ability to finance the company's operations. High liquidity negatively affects profitability, therefore companies are encouraged to invest more in current assets than fixed assets to maintain liquidity (Farhan et al., 2021).

### **Regulation**

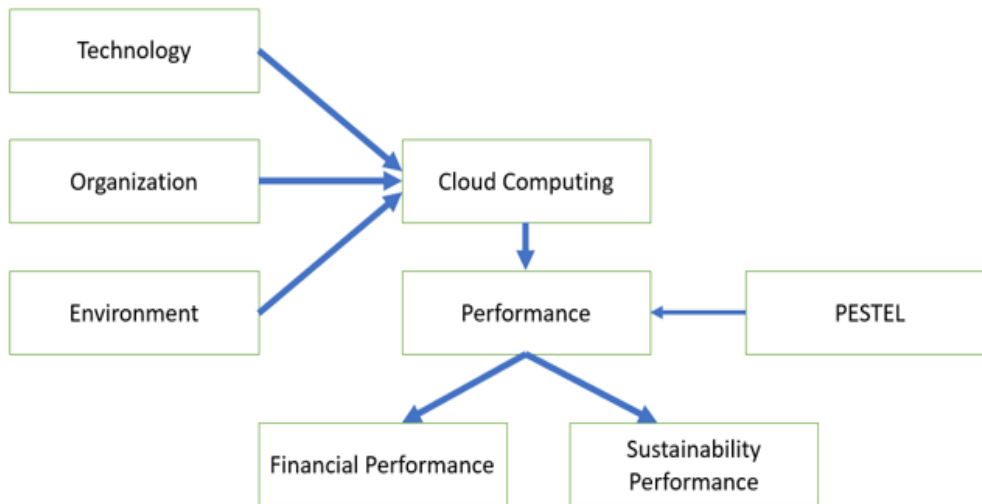
The regulations related to this study are:

Regulations regarding electronic systems and electronic data are regulated in PP no 71 of 2019 which was previously regulated in PP no 82 of 2012. This PP discusses electronic systems and data stored in Indonesian territory, while if there is no such service in the country, the data is allowed to be stored outside Indonesia (Peraturan Pemerintah No.71 tahun 2019).

Law Number 40 of 2007 concerning Limited Liability Companies which regulates procedures and governance in establishing and running a company (Undang – Undang No.40 Tahun 2007).

### **Research Framework**

In case study research in several companies it was found that the performance, scale of the entity and the ability to absorb resources have a positive relationship to innovation. Technology related to *Green IT* is expected to reduce the risk of environmental impacts that create sustainability performance and financial performance (Khayer et al., 2020).



**Figure 2. Research framework**

Source : Khayer et.al., (2020)

External factors affect company performance, therefore using PESTEL analysis can help companies determine strategies in their business to affect financial performance and also sustainability performance (Song et al., 2017).

New technology in the form of *cloud computing* provides benefits both operationally and the success of the company's strategy. In *cloud computing*, there are risks regarding data security that must be considered by companies. Organizations through top management as decision makers and facilitate infrastructure provide support for the use of *cloud computing innovations* to support company strategies and activities. In the environmental aspect, cloud computing *infrastructure providers* can provide services needed by users (consumers), especially a sense of security over their data storage. The location of the server where the data is stored, data privacy security, ease of access, service features that support data storage activities must be understood by the user. Services provided to users in terms of infrastructure will certainly affect the performance of *infrastructure companies in the form of financial performance and sustainability performance* (Khayer et al., 2020).

## METHODS

This research uses a qualitative approach with a case study approach. Qualitative research is research based on a detailed understanding of a problem to examine each problem that has a different nature from the other (Nurlina T. Muhyiddin et al., 2018). The approach used is a case study, a case of conducting in-depth research and using a real point of view (Yin, 2017).



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The object of this research is PT X which is a cloud infrastructure provider company located in Jakarta. This method uses PESTEL analysis and TOE *framework*. This research was conducted with interviews to collect information from respondents regarding the effect of *cloud* on financial performance and sustainability performance. Interviews were conducted with three (3) management teams with respondents Accounting support, CTO, HRD.

## RESULTS AND DISCUSSION

### PESTEL

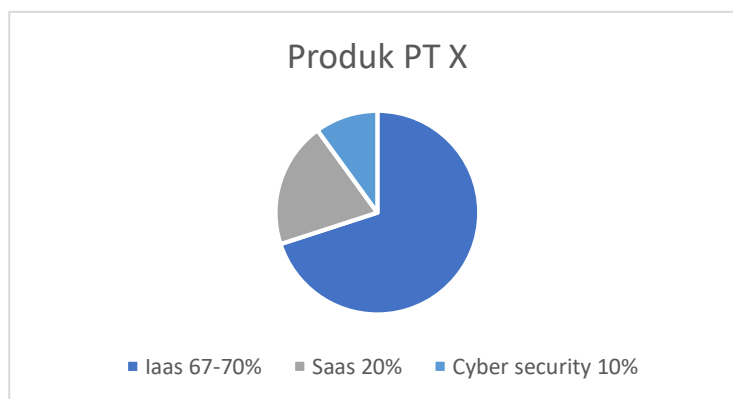
The results of the analysis using PESTEL, it can be concluded that PT X has the potential to develop products related to cybersecurity, or products related to social in the form of applications, *big data areas*, or other digital forms according to customer needs. PT X's cyber security products are still in the market by 10% when compared to *cloud* products. *Cyber security* products can be bundled with *cloud* products or other products so as to increase sales of PT X products.

### TOE *framework*

In terms of the development of cloud technology, *PT X started its business in the cloud field* because it saw customer needs for cloud services instantly. The products provided by PT X meet the characteristics of technology that are complex, compatible, configuration and trialability. This *cloud technology* is included in the category of the type of innovation, namely the transition from traditional to digital. Innovation in the form of combining technology, is combining the internet network with computers, smart phones, applications and other digital forms. Innovation in the form of intermittent changes that require quick decisions in increasing competitive advantage, in the midst of global market competition quick decisions in responding to product competition must be taken immediately in order to stay in the latest product trends with low production costs and affordable selling prices because consumers rarely buy premium types of goods. In addition, the strategy offered by PT X in its innovation is to sell new products in preventing cyber attacks (*cyber security products*).

From the organizational aspect, PT. X is an officially registered infrastructure provider company in the form of a closed company that is not listed on the IDX. *The dual system* consists of a supervisory board in charge of supervising and an executive board of management in charge of running the company's operations. Board members can occupy only one task thus creating control in management (Mallin, 2018). In Indonesia, the regulation of limited liability companies is regulated in Law No. 40 of 2007. The Board of Commissioners is tasked with supervising the board of directors during the management carrying out operational functions. In PT X's operations, top management facilitates all company needs. *Cloud* businesses need ISO 9001 & 27001 certification standards to govern product quality and safety.

Cloud products provide easy access for their users. The market experienced by PT X in the *cloud* industry is a highly competitive market where PT X has to face competitors not only local companies but also global (international) companies that offer advantages over their products.



**Figure 3. Product PT X**

Source : Respondent 1, (2023)

*Cloud* is a form of technology transition that makes it easier for users and is expected to become a *Green IT* technology. PT X products are IaaS, SaaS, *Cyber security*. IaaS products have the category of infrastructure providers will provide storage, networking, processors, power, heat, floor space for infrastructure. For PT X's heat room and floor, the infrastructure entrusts more to lease storage space to PT Y as a data center in addition to saving electricity usage but also reducing the risk of limited resources. For SaaS products, (IoT applications) are widely known and better known as SaaS applications, this application infrastructure is utilized by small banks in starting the digital transition and *start-up companies* that want to create digital applications by PT X.

*The cloud* built by PT X is used by many users such as MSMEs, personal, and government. PT X seeks to digitize companies that are not yet digital by creating *cloud* applications for small companies, this is because global business competition is quite tight.

For PT X organizations, this cloud *is their source of income which means that if the service is not good, it will have an impact on decreasing PT X 's revenue*. Customers do not need to spend capex in purchasing servers, simply with opex they can get servers according to their needs and we provide products at low prices according to their budget needs. Furthermore, for PT X's supply chain (vendor), every five years, software and IT hardware suppliers receive technology rejuvenation orders. PT. X as a cloud provider company has its own risks including:

1. Risk if the Internet goes out

2. Risk of exposure to the virus
3. Hardware risk, which must have a backup in case of risk of damage.
4. Risiko *downtime*.

### **Sustainability Performance**

The IT industry has two opposing sides, first creating green technology to capture commercial opportunities and allowing to reduce carbon emissions as a form of commitment support to the country, and on the other hand, green IT strategies and concepts have not been integrated with business strategies. In this case, the concept above shows that PT X supports in reducing carbon emissions, but its business strategy has not been integrated with the green *IT concept*. PT X has not been required to prepare a sustainability report because it is not a public company in accordance with OJK regulation 51 of 2017 and there are no standards in PSAK. It can be said that PT X has not run *Green IT*.

*In terms of the eco-efficiency category of reducing negative environmental impacts on the application of resources and costs, with four objectives, namely reducing resource use, reducing environmental impact, increasing product value and reducing environmental obligations, it can be said that PT X has implemented eco-efficiency.*

*For the concept of people, profit, & planet, PT X has not contributed to the surrounding community (people), the costs incurred for business impact are not there (profit), ecological and environmental impacts are not too significant PT X reduces environmental impact through data center rental (planet).*

The impact of *the cloud* on sustainability is significant. The infrastructure built is able to reduce the use of physical hardware and electricity usage. Data centers require greater electricity consumption for cooling systems to cool servers. The use of electricity needed by the data center is very large because it depends on a large source of power substations. Data center electricity needs, for example, can be changed by using renewable energy solar panels so that carbon emissions can be reduced.

### **Financial Performance**

Cloud infrastructure requires expensive investment costs due to technological developments. In terms of cost, PT X certainly incurs quite expensive costs due to technological updates. In the IT infrastructure business, there is an SLA (Service Level Agreement) that has an impact on company revenue in the form of customer restitution. If the Company uses servers with old technology, the risk of downtime will be higher, therefore the Company uses the latest technology to reduce the risk of lost revenue.

PT X's profitability decreased in 2018 due to too large operating expenses, while in 2019 it increased significantly and in 2020 decreased due to the impact of the

pandemic and also competition with other products.

Table 1.1 Rasio Profitability PT X

RASIO	2018	2019	2020	2021	2022
ROI	-0,01	0,04	-0,019	0,02	0,019
ROE	-0,02	0,08	-0,028	0,04	0,028
ROA	-0,025	0,1	-0,035	0,05	0,035
ROS	-0,29	1,16	-0,406	0,58	0,406

Sources : Data has been processed by author (2023)

PT X's ROS shows that the company's efficient condition in obtaining profits is in 2019. Revenue was generated higher so that it obtained a good profit, while in the previous year revenue decreased and increased again in 2022 & 2023. PT X needs to keep revenue at the highest level by selling more innovative products at a better market share and market size.

PT X's ROA shows the performance of assets in earning profits. The best investment asset performance was in 2019 while in other years the growth was very small but still showed asset performance. According to PT X, the constraint in *cloud* operations is fixed costs that must be utilized optimally.

PT X's ROE has decreased, this needs to be evaluated for operational performance. This relates to the level of liquidity of the company. However, due to limited data, this study has not been able to see the company's operations.

Leverage level PT. X in 2022 & 2023 shows a decline. In 2021 it was 43% while in 2022 it was 31%.

PT X's ROI is measured according to the investor's investment ROI, for them the rate of return has not been as expected. Investments in products are done very carefully because consumers prefer cheaper products. In addition, the development of business innovation needs to be carried out to meet the new target of investors.

PT X's working capital is related to the company's liquidity ability to finance the company's operations. High liquidity negatively affects profitability. This is reflected in declining leverage in 2022 & 2021 and potentially increased profitability.

## CONCLUSION

In answering these problems, *the cloud is* applied in the PT X organization and also as a product of PT X. The impact of sustainability performance on PT X's cloud that *ecco efficiency* is carried out as an effort to maintain sustainability. PT X's financial performance is highly dependent on innovation and good product sales. In addition, the company's debt ratio appears quite high and has decreased even though it has been described in the last two years. From this research it can be concluded that PT. X as a cloud infrastructure provider is faced with global market competition. Cloud products

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offered are relatively the same, namely on laas which is the provision of data storage services. From PESTEL's analysis, it can be concluded that PT X can develop its products in cybersecurity and other fields. In the TOE framework concept, it can be concluded that with the TOE concept, *the cloud* is categorized as an innovation that can become a business product by complying with legal regulations, company budgets, market competition, and customer trust. Research has limitations because it is only carried out on one company. For further research can be done with several companies to see future trends. It is expected to be able to see the trend of the influence and impact of digitalization, considering that digital development continues to grow for the next few years. Related to sustainability and reporting, it is hoped that with the new accounting standards regarding sustainability, it can make companies or business people more *concerned* about sustainability issues and not only green *washing*.

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