

## **FACTORS INFLUENCING CLOUD COMPUTING ADOPTION : TECHNOLOGY, ORGANIZATIONAL AND ENVIRONMENT (TOE) FRAMEWORK APPROACH**

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**Abstract:** The latest technology that must be applied to prepare for modernity is based on information technology. This technology is not only used by large companies (enterprises) but can also be utilized by Micro, Small and Medium Enterprises (MSMEs). One of the utilization of technology is cloud computing by Micro and Medium Enterprises (MSMEs) which is increasingly widespread. This is reasonable because cloud computing technology provides benefits with a simpler process and relatively low costs. In line with this, this study aims to determine the factors that influence the adoption of cloud computing in MSMEs. An integrated model was developed based on the Technology, Organization, and Environment (TOE) framework. This research data was obtained through a structured survey questionnaire given to 150 MSME owners/managers in the Soloraya Region. The results obtained through SEM-PLS analysis show that factors such as organizational readiness and competitor pressure have a significant effect on cloud computing adoption in MSMEs in the Soloraya Region. However, factors of relative advantage, complexity, and top management support were found to have no significant effect on cloud computing adoption. This research provides a theoretical contribution to the expansion of the TOE Framework.

**Keywords** Micro Small Medium Enterprises (MSMEs), Cloud Computing Adoption, TOE, Information Technology

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### **1. Introduction**

The latest technology that must be applied to prepare for the free market era is information technology-based technology. This technology is not only used by large companies (enterprises) but can also be utilized by Micro, Small and Medium Enterprises (MSMEs). The development of information technology has a direct effect on the accounting information system in a company (Siregar, 2021). The rapid advancement of technology certainly has an impact on the business processes of MSMEs in Indonesia. Virtualization and cloud computing technologies have been widely adopted by MSMEs around the world (Alshirah et al., 2021; Ben-Daya dkk., 2019; Khayer dkk., 2020).

Cloud computing is one of the technologies that can be adopted by MSMEs, its application in Indonesia can provide benefits with a simpler process. Digitalization and automation provide agility, flexibility, and productivity. Many application developers in Indonesia offer cloud computing services for MSMEs, although not all MSMEs are willing to adopt the technology (Aligarh et al., 2023). According to a survey conducted World Economic Forum 2020 cloud computing ranks as the fourth most transformative technology in the trade sector at 53%. The data was obtained based on a survey conducted on 340 companies of various sizes and sectors. The Central Bureau of Statistics notes that in Indonesia MSMEs are one of the pillars of the country's economy, until 2024 MSMEs in Indonesia reach 64,2 million business actors. The contribution made has an influence on GDP of 60% which can absorb 99,9% of the workforce. This indicates that one of the elements that is the main driver of the economy in Indonesia is

MSMEs. Many roles of MSMEs are very important in Indonesia, especially in providing employment, reducing poverty, unemployment, and income distribution inequality.

Based on a survey conducted by the Ministry of Cooperatives and Small and Medium Enterprises of the Republic of Indonesia in 2022, it shows that only 20% of MSMEs in Indonesia have adopted digital. The main obstacles faced by MSMEs in adopting digital technology are as many as 40% of MSMEs claim to have limited access to technology, 30% claim to lack understanding of the benefits of digitalization, and 30% claim to have limitations related to resources (*Solopos.com*).

The Surakarta Prefecture or commonly referred to as the Solo Raya Region is an area in Central Java Province which includes 1 municipality, namely Surakarta City and 6 districts, namely Klaten Regency, Sragen Regency, Wonogiri Regency, Karanganyar Regency, Boyolali Regency, and Sukoharjo Regency. According to Nurmadi Harsa Sumarta (2021) Solo Raya is one of the regions with the largest number of MSMEs in Indonesia, which in 2022 amounted to 28.596 MSMEs. Most of the MSMEs in Solo Raya Regions have not digitized.

The digitalization in question is digitalization in the fields of marketing, capital management, revenue management, transactions, and also other financial activities. This happens because these MSME actors have not mastered technology and are also constrained by capital. Referring to data from the Ministry of Cooperatives and SMEs, digitalization can save time and operational costs for MSMEs by up to 50%. In addition, MSMEs that are connected to the go digital ecosystem have a 2,5 times greater chance of surviving in the market. In adopting cloud computing, there are several factors that are considered by MSMEs. Therefore, this study aims to analyze the factors that influence decisions based on aspects of Technology, Organization, and Environment (TOE) to adopt cloud computing in MSMEs in the Soloraya Region.

## **2. Literature Review**

### **2.1 Cloud Computing**

Cloud computing is one of the technological pillars of industry 4.0 which is a model that allows the provision of ubiquitous access (everywhere and from anywhere) comfortably and is based on an on-demand network access to certain media that can be used jointly to utilize its configured computing resources that can be set and released quickly with minimum management effort or service provider interaction (Hassan et al., 2017). Cloud computing technology has proven to be an important technical solution, especially for SMEs by providing many opportunities for companies to improve their performance by reducing costs, increasing flexibility, scalability, and making more effective use of technology (Yaseen et al, 2022).

The adoption of cloud computing in the MSME sector can have a good impact, this is because cloud computing is considered suitable for MSMEs that have limited human resources and information technology infrastructure. In addition, the concept of cloud computing adoption can be an information technology solution that is more practical and economical in its application in MSMEs. Cloud computing can help make it easier for MSME players to store important data. MSME actors do not need to bother to enter data again in the hardware they have or upgrade hardware at a high cost. Using cloud computing can cut costs to add or upgrade hardware.

Some cloud-based accounting software that can be used by MSMEs include Jurnal, FreshBooks, QuickBooks, Xero, Zahir, and Harmony. The distinctive feature of cloud computing is On Demand Service (ODS), which is a service based on customer or consumer requests. So that if there are consumers who need services, they can access these services. And one of the characteristics of the ODS application is that the application / access does not have

to be active continuously on the consumer device so that consumers can use it anytime and anywhere and within a certain time (Weking & Ndala, 2018).

## **2.2 Technology, Organization, and Environment (TOE) Framework**

The Technology-Organization-Environment (TOE) concept was first introduced by Tomatzky and Fleischer in 1990 which is used to describe the phenomenon of technology adoption in an organizational unit of analysis. The TOE framework explains that the conditions of technical progress, organizational structure, and industry environment affect how acceptable an information system is (Aligarh et al., 2023). The TOE framework is commonly used to examine the contextual basis of the organizational perspective for adopting technological innovations which aims to understand how the organizational context affects technology adoption (Chau et al., 2021).

The TOE Framework is a technology model at the organizational level that brings together three important constructs that can influence technology adoption (Setiobudi & Wiradinata, 2018). In addition, TOE is the only theoretical framework that takes into account all the driving forces that have an impact on information system adoption initiatives. Adoption of technology both from outside and from within the business is explained by technology variables, the variables used to explain the technology construct are relative advantage and complexity. There are several studies that also use other constructs, namely affordability of adoption costs, availability of source code, feature completeness, collaborative development, and so on (Bhardwaj et al., ; Haneem et al., 2019; Shree et al., 2021).

The organizational framework focuses on organizational characteristics that have an impact on technology adoption. Meanwhile, the environmental framework focuses on the surrounding environment that can result in technology adoption (Aboelmaged & Hashem, 2018). Research conducted by Tornatzky and Fleischer (1990) revealed that the constructs that are often used are the role of relationships and informal communication between employees, the quality of human resources, top management support (owners), internal resources, and organizational size. The variables used to explain organizational constructs are top management support and organizational readiness.

Environmental factors are factors related to facilities and factors that hinder company operations such as competitor pressure, customers, socio-cultural issues, government encouragement, and technological infrastructure. The variable used to explain the technology construct is competitor pressure.

## 2.4 Hypothesis Development

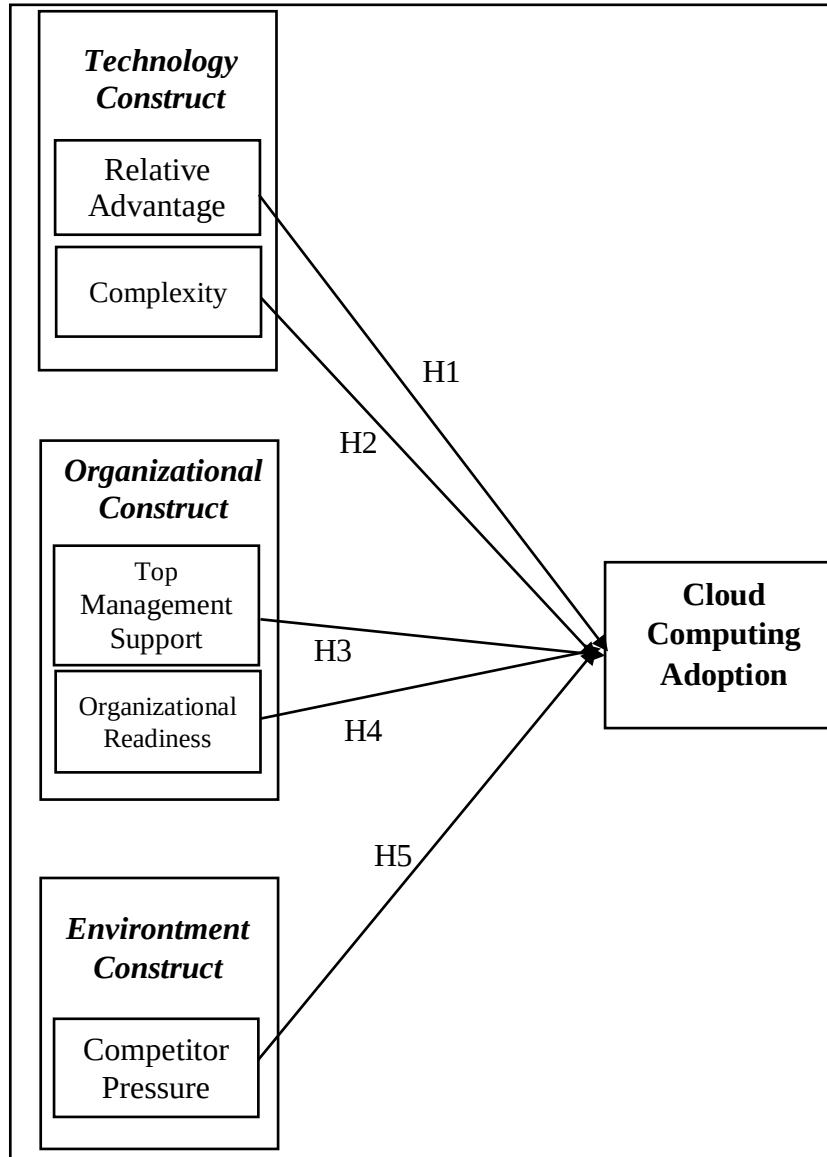


Figure 2: Hypothesis Models

Relative advantage is the extent to which innovation can offer many advantages for businesses to increase efficiency compared to previous innovations (Gui et al., 2020). Based on the results of research Gui et al., (2020) shows that relative advantage has a positive relationship to cloud computing adoption. Similar research was also conducted by (Aligarh et al., 2023) which showed positive results in the relationship between relative advantage and cloud computing adoption. Research conducted by (Chen et al., 2023), (Alqahtani et al., 2023), (Ilahi et al., 2024) also get the same research results, namely relative advantage has a positive effect on cloud computing adoption. Based on the results of this study, the hypothesis that can be formulated is as follows :

## **H<sub>1</sub> : Relative advantage has a significant effect on cloud computing adoption**

Complexity is the level of difficulty that will determine the level of adoption which has a negative relationship when adopting a new one, the lower the level of complexity, the faster the adoption will be. Top management support is a support that is one of the continuity of a business. Research conducted by (Aligarh et al., 2023) found negative results on cloud computing adoption. The same thing also results from research conducted by (Gui et al., 2021) which shows a negative relationship between complexity and cloud computing adoption. Based on the results of this study, the hypothesis that can be formulated is as follows :

## **H<sub>2</sub>: Complexity has an insignificant effect on cloud computing adoption**

Top management support is a support that is one of the continuity of a business. The management strategy chosen and designed by the owner can affect the performance of his employees (Qalati Yuan et al., 2021). Research conducted by (Masudur Rahman & Naveed Ahmed, 2022a) found that owner support is very important to influence MSME cloud computing adoption in Bangladesh. Similar research was also conducted by (Ali et al., 2023) whose results show that the relationship between owner support and cloud computing adoption is positive. Research conducted by (Amir Hamzah et al., 2023), (Gamage, 2019), (Alasady et al., 2023) found that owner support has a positive influence on cloud computing adoption. Based on the results of previous research, researchers can formulate the following hypothesis:

## **H<sub>3</sub> : Top management support has a significant effect on cloud computing adoption**

Organizational readiness is defined as a readiness and ability of organizational resources to adopt a new technology (Chau et al., 2021). Research conducted by (Aligarh et al., 2023) revealed that organizational readiness has a positive effect on cloud computing adoption. Research conducted by (Setiyani & Yeny Rostiani, 2021) found that organizational readiness has a positive effect on cloud computing adoption in MSMEs in Karawang Regency, Indonesia. Based on the results of previous research, the researcher can formulate the following hypothesis:

## **H<sub>4</sub> : Organizational readiness has a significant effect on cloud computing adoption**

Competitor pressure is the level of competition in the industry or market perceived by the organization (Seo et al, 2020). Research conducted by (Aligarh et al., 2023) revealed that competitor pressure has a positive effect on cloud computing adoption. Similar research was also conducted by (Masudur Rahman & Naveed Ahmed, 2022b) and found that competitor pressure has a significant effect on cloud computing adoption in MSMEs. Research conducted by (Al-Sharafi et al., 2023), (Gamage, 2019), (Chen et al., 2023) found that competitor pressure has a positive influence on cloud computing adoption. Based on the results of previous research, the researcher can formulate the following hypothesis:

## **H<sub>5</sub> : Competitor pressure has a significant effect on cloud computing adoption**

### **3. Method**

This study uses primary data, namely research data obtained directly from sources, while the population used is MSMEs in the Soloraya Region which has a diverse and significant MSME population of 150 MSME samples. In this study, data was collected through direct and online questionnaires. Respondents were selected based on their expertise and willingness to participate. This study uses the incidental sampling method, which is a non-probability sampling technique because some researchers on technology adoption use random sampling (Khayer et al, 2020).

## 3.1 Data Analysis

Descriptive statistical analysis was used in this study to explain the demographic characteristics of respondents. In this study, the demographics used are type of business, gender, age of business, and size of business turnover in one month. The variance-based Structural Equation Modeling (SEM) or Partial Least Squares (PLS) approach is considered the right approach because it has the ability to test the relationship between multidimensional constructs simultaneously (Hair Jr et al, 2021). Data processing in this study using the SmartPLS version 3.0 application is used to analyze data and modeling paths with latent variables (Ghozali and Latan, 2020).

## 4. Result and Discussion

This study uses a structural equation model to test the hypothesis, so the number of respondents that must be met is five times the number of all constructs used. The number of respondents collected was 150. The questionnaire was distributed to respondents who were in the Soloraya Region, Indonesia. Table 1 provides information about demographic data including type of business, gender, and so on. Respondents consisted of 60% men and 40% women. Based on the classification of culinary business type 45,8%, fashion 29,7% and others 24,5%. Based on position in the company, owner 51,6%, cashier operator (employee) 32,3% and others 16,2%. Based on the firm size, 1-4 employees 73,5%, 5-10 employees 23,2% and others. Based on length of business 1-5 years 48,4%, 6-10 years 22,6%, the rest less than one year and more than ten years. Business turnover in one month 1 million-10 million 55,5%, 11 million-20 million 22,6% and the rest more than 21 million.

**Table 1. Descriptive Statistics of Respondents**

| Description                                      | Category                    | Percentage |
|--------------------------------------------------|-----------------------------|------------|
| <b>Type of Business</b>                          | Culinary                    | 45,8%      |
|                                                  | Fashion                     | 29,7%      |
|                                                  | Other                       | 24,5%      |
| <b>Position in the company</b>                   | Owner                       | 51,6%      |
|                                                  | Cashier operator (employee) | 32,3%      |
|                                                  | Other                       | 16,1%      |
| <b>Gender</b>                                    | Male                        | 60%        |
|                                                  | Female                      | 40%        |
| <b>Firm Size</b>                                 | 1-4 people                  | 73,5%      |
|                                                  | 5-10 people                 | 23,2%      |
|                                                  | 11-99 people                | 2,6%       |
|                                                  | > 99 people                 | 0,6%       |
| <b>Length of business</b>                        | <1 year                     | 20,6%      |
|                                                  | 1-5 years                   | 48,4%      |
|                                                  | 6-10 years                  | 22,6%      |
|                                                  | >10 years                   | 8,4%       |
| <b>Have done company financial records</b>       | Yes                         | 79,4%      |
|                                                  | No                          | 20,6%      |
| <b>Ever used a cashier/financial application</b> | Yes                         | 55,5,%     |

|                                       |                       |       |
|---------------------------------------|-----------------------|-------|
|                                       | No                    | 44,5% |
| <b>Business turnover in one month</b> | 1 million-10 million  | 55,5% |
|                                       | 11 million-20 million | 22,6% |
|                                       | 21 million-30 million | 7,7%  |
|                                       | 31 million-50 million | 5,2%  |
|                                       | > 51 million          | 9%    |

**Source: Data processed by the author, 2024**

## Measurement Model

Table 2 illustrates convergent validity, reliability, and Average Variance Extracted (AVE). Convergent validity relates to the principle that the measures of a construct should be highly correlated, usually measured by a factor loading value > 0,7. Reliability refers to the extent to which the measuring instrument is trustworthy or reliable, value > 0,8. AVE is a coefficient that explains the variance in indicators that can be explained by the common factor, measured by a value > 0,5. Table 2 shows that the factor loading, Cronbach's Alpha, and AVE values meet the recommended criteria.

This study also tested discriminant validity by comparing the square root of the AVE and the correlation coefficient between constructs. Discriminant validity refers to the extent to which a construct is truly different from other constructs based on empirical standards. As Table 3 shows, the AVE root of each construct is greater than the correlation between construct coefficients, indicating that discriminant validity is acceptable.

**Table 2. Construct Reliability and Validity**

| Construct                       | Item | Factor Loading | Cronbach's Alpha | rho_A | CR    | AVE   |
|---------------------------------|------|----------------|------------------|-------|-------|-------|
| <b>Competitor Pressure</b>      | CP1  | 0,877          | 0,859            | 0,859 | 0,914 | 0,780 |
|                                 | CP2  | 0,902          |                  |       |       |       |
|                                 | CP3  | 0,871          |                  |       |       |       |
| <b>Complexity</b>               | CMX1 | 0,837          | 0,818            | 0,780 | 0,836 | 0,609 |
|                                 | CMX2 | 0,906          |                  |       |       |       |
|                                 | CMX3 | 0,945          |                  |       |       |       |
|                                 | CMX4 | 0,838          |                  |       |       |       |
| <b>Organizational Readiness</b> | OR1  | 0,778          | 0,854            | 0,859 | 0,896 | 0,632 |
|                                 | OR2  | 0,863          |                  |       |       |       |
|                                 | OR3  | 0,736          |                  |       |       |       |
|                                 | OR4  | 0,783          |                  |       |       |       |
|                                 | OR5  | 0,811          |                  |       |       |       |
| <b>Relative Advantage</b>       | RA1  | 0,766          | 0,851            | 0,856 | 0,894 | 0,630 |
|                                 | RA2  | 0,841          |                  |       |       |       |
|                                 | RA3  | 0,868          |                  |       |       |       |
|                                 | RA4  | 0,768          |                  |       |       |       |
|                                 | RA5  | 0,714          |                  |       |       |       |
| <b>Top Management Support</b>   | TMS1 | 0,867          | 0,885            | 0,892 | 0,920 | 0,744 |
|                                 | TMS2 | 0,809          |                  |       |       |       |
|                                 | TMS3 | 0,919          |                  |       |       |       |
|                                 | TMS4 | 0,850          |                  |       |       |       |

|                                 |      |       |       |       |       |       |
|---------------------------------|------|-------|-------|-------|-------|-------|
| <b>Cloud Computing Adoption</b> | CCA1 | 0,804 | 0,924 | 0,925 | 0,943 | 0,767 |
|                                 | CCA2 | 0,907 |       |       |       |       |
|                                 | CCA3 | 0,901 |       |       |       |       |
|                                 | CCA4 | 0,876 |       |       |       |       |
|                                 | CCA5 | 0,886 |       |       |       |       |

Source: Data processed by the author, 2024

From table 3 for each bolded number is the Fornell Larcker Criterion value of each construct. From the table above, it can be seen that the Fornell Larcker Criterion value of each construct has the highest value in each latent variable tested from other latent variables, meaning that each question indicator is able to be predicted well by each latent variable and the numbers that are not emphasized are the correlation values between constructs and other constructs.

**Table 3. Forner-Larcker Criterion**

|                                 | CCA          | CP           | CMX          | OR           | RA           | TMS          |
|---------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>Cloud Computing Adoption</b> | <b>0,876</b> |              |              |              |              |              |
| <b>Competitor Pressure</b>      | 0,738        | <b>0,883</b> |              |              |              |              |
| <b>Complexity</b>               | -0,179       | -0,136       | <b>0,780</b> |              |              |              |
| <b>Organizational Readiness</b> | 0,714        | 0,635        | -0,180       | <b>0,795</b> |              |              |
| <b>Relative Advantage</b>       | 0,527        | 0,610        | -0,322       | 0,398        | <b>0,794</b> |              |
| <b>Top Management Support</b>   | 0,591        | 0,587        | -0,399       | 0,654        | 0,579        | <b>0,862</b> |

Source: Data processed by the author, 2024

## Structural Model

This study tests the coefficient of determination to see how much the independent variable contributes in explaining the relationship with the dependent variable. According to Chin (1998), the R-Square value is categorized as strong if more than 0,67, moderate if more than 0,33 but lower than 0,67, and weak if more than 0,19 but lower than 0,33. Table 4 shows that the R-Square value is 0,654, this figure illustrates that the variables of relative advantage, complexity, top management support, organizational readiness, and competitor pressure have a contribution in explaining the cloud computing adoption variable by 65,4% while the other 34,6% is explained by other variables outside the model.

**Table 4. R-Square**

|                                 | R Square | R Square Adjusted |
|---------------------------------|----------|-------------------|
| <b>Cloud Computing Adoption</b> | 0,654    | 0,642             |

Source: Data processed by the author, 2024

In this study there are five hypotheses that will be developed. Table 5 explained the hypothesis testing in this study. According to Ghozali and Latan (2020), hypothesis testing is done by looking at the T-statistic value compared to the T-table value = 1,655 at the p value = 0,05 significance level. If the T-statistic value > T-table, it can be concluded that the independent variable has a significant effect on the dependent variable. As hypothesized, our data supports the significant effects of organizational readiness (H4, T-Statistic value 4,387,  $p < 0,05$ ) and competitor pressure (H5, T-Statistic value 4,551,  $p < 0,005$ ). However, relative advantage, complexity, and top management support were not supported (H1, T-statistic 1,160,  $p > 0,05$ ), (H2, T-statistic 0,133,  $p > 0,005$ ), and (H3, T-statistic 0,321,  $p > 0,05$ ).

**Table 5. Hypothesis Test Summary**

| H  | Path IC > DV | T-Statistics | P Values | Result        |
|----|--------------|--------------|----------|---------------|
| H1 | RA -> CCA    | 1,160        | 0,247    | Not Supported |
| H2 | CMX -> CCA   | 0,133        | 0,894    | Not Supported |
| H3 | TMP -> CCA   | 0,321        | 0,748    | Not Supported |
| H4 | RA -> CCA    | 4,387        | 0,000    | Supported     |
| H5 | CP -> CCA    | 4,551        | 0,000    | Supported     |

**Source: Data processed by the author, 2024**

This study examines the factors that influence cloud computing adoption in MSMEs in the Soloraya Region. Based on the research results obtained, relative advantage has no significant effect on cloud computing adoption. One possible explanation for this insignificant factor can be attributed to the immaturity of cloud computing and the technology used. If a company's previous experience with information systems is compatible and appropriate with the current information infrastructure, changes caused by cloud computing services will be consistent with current practices (AL-Shboul, 2019). Complexity has no effect on cloud computing adoption, MSMEs feel that cloud computing technology is very easy to use so they will not find it difficult to use this technology. Top management support has no significant effect on cloud computing adoption, it is suspected that MSMEs in Indonesia do not have a clear organizational hierarchy, so that owners, managers, and IT experts may be the same people in determining whether to adopt cloud computing or not. Organizational readiness has a significant effect on cloud computing adoption, the low costs required and the company's ability to provide this technology make MSMEs in Indonesia have a good level of acceptance of cloud computing (Alkhater et al., 2018; Haddara et al., 2022; Yoo & Kim, 2019). Competitor pressure has a significant effect on cloud computing adoption, conditions in MSMEs in Indonesia are relatively the same both in terms of size and income, which are located close to each other. Many MSME communities are found that have the same business characteristics to help each other, especially in the technology adoption process. The closeness between MSMEs is also a cultural feature in Indonesia (Mohammaed et al., 2022).

## 5. Conclusions

This research adds to the existing theory on the Technology-Organization-Environment (TOE) framework by considering individual factors in the context of cloud computing adoption. This research can expand the current understanding of how technological, organizational, and environmental factors relate to individual factors in the implementation and use of cloud computing. Cloud computing adoption has been significantly proven by organizational readiness and competitor pressure. The confidence and concern of MSMEs in adopting cloud computing is reflected in these two constructs. This can be seen from the coefficient of determination of 0,654 which shows that individual factors are proven to have the ability to influence cloud computing adoption. This study can be useful for MSMEs in identifying factors that influence cloud computing adoption. This research also has managerial contributions for MSMEs. MSMEs can benefit from cloud computing to provide more accurate financial information. Thus, they can create positive returns for creditors and investors. In addition, the use of cloud computing can cut employee monitoring costs and produce a more effective and efficient business that can add value to a business. The findings in this study can encourage other MSMEs to start implementing the use of digital-based technology in their business operations.

## Acknowledgements

The researcher would like to thank the Department of Sharia Accounting, Faculty of Economics and Islamic Business, Raden Mas Said State Islamic University Surakarta. The support of colleagues and prayers from parents so that this research can be carried out. Thank you to the supervisor who has provided direction and input in the course of the research.

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