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## ***B2B E-Commerce Adoption and Competitive Advantage: Insights from SMEs in East Java***

Nuril Aulia Munawaroh<sup>1</sup>, Diana Ambarwati<sup>2</sup>, Tri Sugiarti Ramadhan<sup>3</sup>, Yudiarto Perdana Putra<sup>3</sup>

<sup>1,2</sup> Universitas Islam Kadiri

<sup>3</sup> Universitas Islam Malang

<sup>4</sup> Universitas Kadiri

### **ABSTRACT**

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*The rapid advancement of digital technology has encouraged small and medium-sized enterprises (SMEs) to adopt business-to-business (B2B) e-commerce as a strategic tool to enhance their competitive advantage. However, the level of B2B e-commerce adoption among SMEs varies, influenced by technological, organizational, and environmental factors. This study examines the impact of B2B e-commerce adoption on SMEs in East Java, focusing on its role in improving cost efficiency, differentiation, growth, and product quality. The research employs a quantitative approach, surveying SMEs engaged in manufacturing and affiliated with industry associations. The findings reveal that relative advantage, top management support, firm size, business partner pressure, and government support significantly influence the adoption of higher levels of B2B e-commerce. Furthermore, a higher level of adoption is positively correlated with improved competitive advantage, particularly in facilitating business expansion and increasing market reach. The results highlight the need for policymakers and business stakeholders to support SMEs in adopting advanced e-commerce solutions. This study contributes to the existing literature by demonstrating the staged adoption of B2B e-commerce and its direct and indirect effects on SME competitiveness.*

## **INTRODUCTION**

Electronic Commerce (EC) has enabled small businesses to broaden their operations by overcoming previously perceived insurmountable barriers. This advancement has facilitated access to new markets, the diversification of product offerings, and the expansion of customer bases (Peris et al., 2015) Although small and medium-sized enterprises (SMEs) are frequently overshadowed by larger

corporations, Electronic Commerce (EC) provides SMEs with the opportunity to create a more equitable competitive environment. This enables them to compete with larger firms in certain aspects, thereby reducing the disparity in market influence (Minatogawa et al., 2020).

In Indonesia, Electronic Commerce (EC) has undergone significant expansion in recent years, propelled not only by the impact of the COVID-19 pandemic but also by the continuous advancements in the technological revolution. In Indonesia, Electronic Commerce (EC) has undergone significant expansion in recent years, propelled not only by the impact of the COVID-19 pandemic but also by the continuous advancements in the technological revolution. According to an e-Marketer survey, Southeast Asia accounts for five of the ten economies with the fastest-growing e-commerce retail sectors. Among these, Indonesia is particularly notable, with its online sales growing by more than 30% (ADB, 2023) and also had the largest e-commerce market in the region, generating \$30.10 billion in sales in 2020, with projections reaching \$68.12 billion by 2025 (Statista 2023). Additionally, the country held the top position in internet economy size, valued at \$70 billion (Google 2021). This remarkable figure highlights the growing significance of e-commerce in Indonesia's economy and underscores the urgency for businesses to adopt digital technologies to stay competitive in today's dynamic market environment (Nasution et al., 2021).

Numerous scholars and industry experts acknowledge that Information and Communication Technology (ICT) has significantly transformed business operations (Fedorko et al., 2018; Ha, 2020; Santos-Jaén et al., 2023; Sri et al., 2015). Currently, e-commerce is categorized based on market relationships into Business-to-Consumer (B2C), Business-to-Business (B2B), and Consumer-to-Consumer (C2C). However, among the three types, the B2C e-commerce is the fastest growing. The B2B e-commerce (Business-to-Business) segment dominates the Indonesian e-commerce market, holding approximately 57% market share in 2024, with a value of USD 46.78 billion. With the rapid expansion of the Internet, all three models have experienced significant growth.

One of the most profound impacts of ICT is evident in the Business-to-Business (B2B) sector, where e-commerce plays a crucial role (Hamad et al., 2018). Business-to-business (B2B) e-commerce has emerged as an essential component in meeting the

operational needs of SMEs efficiently (Ocloo et al., 2020), and it enables SMEs to gain a competitive advantage over their rivals (Xuhua et al., 2019).

Effendi et al., (2020); Rahayu & Day, (2015); Sulistyaningsih & Hanggraeni, (2021) SMEs strive to achieve a competitive advantage despite facing numerous challenges (Sulistyaningsih & Hanggraeni, 2021). These obstacles may include limited financial resources, technological constraints, market competition, and regulatory complexities (Effendi et al., 2020; Rahayu & Day, 2015). However, by leveraging innovation, digital transformation, and strategic business practices, SMEs continue to enhance their market position and long-term sustainability. Several studies have extensively examined e-commerce in the B2B sector (Hamad et al., 2015, 2018; Sila, 2013; Wang & Lin, 2009).

Prior research has explored various aspects, including adoption factors, technological integration, and the impact on business performance in different industries and regions. However, studies focusing specifically on B2B e-commerce adoption among SMEs in Indonesia remain limited. Given the unique business environment, regulatory landscape, and digital infrastructure in Indonesia, further research is needed to understand the specific challenges and opportunities SMEs face in adopting B2B e-commerce. Therefore, this study aims to bridge this gap by examining the factors influencing B2B e-commerce adoption among Indonesian SMEs and its impact on competitive advantage.

Moreover, the literature review indicates that most previous studies (Grandon & Pearson, 2004) have taken a broad and general perspective on SMEs' adoption of B2B e-commerce or have examined the relationship between information technology (IT) adoption and competitive advantage (Mustaffa & Beaumont, 2004). While some studies have explored different stages of B2B e-commerce implementation and adoption among manufacturing SMEs (Lefebvre et al., 2005), they have not specifically addressed the factors influencing each adoption level. Moreover, they have not assessed the competitive advantages associated with each stage of adoption, which could serve as a valuable reference for policymakers and SME owners/managers in making informed investment decisions. This study seeks to bridge this gap in the literature and responds to the call for further research in this field.

## LITERATURE REVIEW

### **Theoretical Background (Technology–organization–environment frameworks)**

The SME sector is often characterized by a strong dependence on trade partners (Hamad et al., 2015), having limited technical knowledge and expertise (Religia et al., 2020), and experiencing financial constraints and possessing limited organizational planning capabilities (Rawash, 2021). These distinct characteristics of SMEs highlight the necessity for a comprehensive theoretical framework to analyze technology adoption decisions and processes from technological, organizational, and environmental perspectives (Awiagah et al., 2016). Kuan & Chau, (2001); Rawash, (2021) and Sulaiman et al., (2023) propose that the key determinants influencing SMEs' adoption of various forms of information technology (IT) are factors within the Technology-Organization-Environment (TOE) framework. The TOE framework has been widely utilized in numerous empirical studies and is recognized for its effectiveness in explaining how various factors influence IT adoption among SMEs (Sila, 2013)

### **B2B E-Commerce and Competitive Advantage**

For SMEs, information technology (IT) is closely associated with achieving a competitive advantage. One key reason for adopting IT is to enhance a firm's sustainability by leveraging Internet technologies to distinguish itself from competitors. Consequently, business leaders often perceive IT as a strategic tool for strengthening their competitive edge (Hussein et al., 2024). Several existing studies (Abumalloh et al., 2023; Chiu & Yang, 2019; Kountios et al., 2023) have examined the link between IT adoption and competitive advantage, concluding that its implementation positively contributes to gaining a competitive edge.

### **The Relationship Between Technological Factors and Levels of B2B E-commerce Adoption**

Technological factors represent the characteristics of the technology being adopted (Rogers, 1995). The literature identifies key technological factors such as relative advantage, compatibility, and complexity (Ghobakhloo et al., 2011).

## Relative Advantage

The literature review on factors influencing SMEs' adoption of IT highlights relative advantage as the most critical factor. Several studies on e-commerce adoption among SMEs have demonstrated that relative advantage positively and significantly impacts the continued implementation of e-commerce (Pateli et al., 2020; Rahayu & Day, 2015; Tamin & Adis, 2022).

## Compatibility

Grandon & Pearson, (2004) Grandon & Pearson, (2004) identified compatibility as the most influential factor in technology adoption compared to other innovation characteristics. Studies have shown that compatibility has a positive impact on the adoption of e-commerce technologies (Cruz-Jesus et al., 2019; Rawash, 2021; Salah & Ayyash, 2024).

## Complexity

Al-Qirim, (2007) identified complexity as a key factor influencing e-commerce adoption. Prior research has indicated that complexity negatively impacts the adoption of e-commerce (Al-Qirim, 2007) Based on this, the following hypothesis is proposed:

**H1 (a, b, c, d). Technological factors (including relative advantage, compatibility, and complexity) have a positive impact on the different levels of B2B e-commerce adoption (including level 1, level 2, level 3, and level 4) in Indonesian SMEs.**

## The Relationship Between Organizational Factors and Levels of B2B E-commerce Adoption

Organizational factors encompass a firm's characteristics that may affect the adoption and implementation of e-commerce (Al-Bakri & Katsioloudes, 2015). Among these factors, top management support and firm size have been widely recognized as key organizational determinants (Grandon & Pearson, 2004).

## Top Management Support

In SMEs, the owner or manager typically serves as the primary decision-maker, making their commitment to allocating resources for e-commerce implementation crucial (Hossain et al., 2024) Their role is also essential in overcoming resistance and barriers to adoption (Abualrob & Kang, 2016; Kabanda & Brown, 2015). Previous

research has shown that strong top management support positively influences the adoption of e-commerce (Awiagah et al., 2016; Mohtaramzadeh et al., 2018)

### **Firm Size**

The impact of firm size on e-commerce adoption has yielded mixed findings in previous research. Some studies, such as those by Clemente-Almendros et al., (2024) and Rahayu & Day, (2015) suggest that firm size influences IT adoption, including Internet usage, e-commerce, and B2B e-commerce. Conversely, other studies, including those by Jeon et al., (2006); Seyal & Rahman, (2003) found that firm size did not play a significant role in e-commerce adoption. Given these conflicting results, this study incorporates firm size as a factor to examine its impact on SMEs' adoption of B2B e-commerce, leading to the following hypothesis:

**H2 (a, b, c, d). Organizational factors (including top management support and firm size) have a positive impact on the different levels of B2B e-commerce adoption (including level 1, level 2, level 3, and level 4) in Indonesian SMEs.**

## **The Relationship Between Environmental Factors and Levels of B2B E-commerce Adoption**

### **Competitive Pressure**

Competitive pressure is recognized as a crucial factor that positively influences e-commerce adoption (Sin et al., 2016). Hamad et al., (2018) argued that in highly competitive environments, SMEs must adopt IT to gain a potential competitive advantage.

### **Business Partners Pressure**

Min & Galle, (1999) SMEs are highly responsive to pressure from trading partners, as they often rely on them economically for their survival (Hamad et al., 2018). Min & Galle, (1999) suggested that buyers who regularly use e-commerce are more likely to influence their suppliers to adopt the technology.

### **Government Support**

Grandon & Pearson, (2004) A positive relationship between government support and e-commerce adoption has been identified in previous studies, including those by (Grandon & Pearson, 2004) and (Chundakkadan & Sasidharan, 2023). Merhi, (2022) further highlighted the significant role of governmental encouragement as a key facilitator in the initial stages of B2B e-commerce adoption. As a result, B2B e-



commerce adoption is expected to be positively influenced by government support, leading to the formulation of the following hypotheses.

**H3 (a, b, c, d). Environmental factors (business partner pressure, government support, and competitive pressure) have a positive impact on the different levels of B2B e-commerce adoption (including level 1, level 2, level 3, and level 4) in Indonesian SMEs.**

**H4. Each level of B2B e-commerce adoption is affected by different factors from another level of adoption.**

### **Level of adoption of B2B e-commerce**

The SME sector has been identified as being in the early stages of B2B e-commerce adoption in previous studies, such as those by Lefebvre et al., (2005). However, research by Zhu & Thatcher, (2007) indicated that B2B e-commerce was utilized by SMEs more extensively than by other organizations. Similarly, it was reported by Power & Singh, (2007) that the Internet and related technologies had been widely integrated into business operations by SMEs. These findings lead to the formulation of the following hypothesis.

**H5. The Indonesian SMEs adopt a high level of B2B e-commerce.**

### **The relationship between levels of B2B e-commerce adoption and competitive advantage**

It is widely recognized that IT plays a crucial role in both establishing and maintaining competitive advantage (Porter, 1985; Singh et al., 2020). Researchers have argued that organizations can gain a potential competitive advantage through the use of IT, such as B2B e-commerce, via multiple pathways. These include cost reduction, differentiation, business growth, and improved quality (Teo & Pian, 2003; Ussahawanitchakit & Intakhan, 2011).

### **Cost Reduction**

The adoption of e-commerce has been found to help enterprises lower communication costs with business partners, including expenses related to fax, mail, and phone services, as well as overall operating costs (Krell & Matook, 2009). Additionally, inventory costs have been reduced through the implementation of e-commerce (Lumpkin & Dess, 2001). Furthermore, the costs associated with marketing, advertising, and sales of products and services have been minimized through the use of Internet technologies (Porter, 1985; Teo & Pian, 2003). Similarly, customer support

costs have been shown to decrease as a result of B2B e-commerce adoption (Mohtaramzadeh et al., 2018). A reduction in travel expenses has also been attributed to IT adoption (Ivanov & Webster, 2017). Meanwhile, research by (Teo & Pian, 2003) indicated that document processing costs, including those related to document storage and management, as well as document publication costs, such as expenses for producing catalogs and brochures, have been significantly lowered through IT adoption.

### **Differentiation**

Internet adoption has been found to enhance a firm's credibility and prestige while also potentially enabling the introduction of new products and services for customers (Teo & Pian, 2003). Gajewska et al., (2020) noted that the adoption of e-commerce has increased customers' ability to customize products and services to better meet their needs. According to Nair et al., (2019) IT adoption allows firms to improve transaction completion rates and provides customers with easier access to information. Furthermore, research by Mohtaramzadeh et al., (2018)) indicated that brand distinguishability has been strengthened through the adoption of B2B e-commerce.

### **Growth**

Growth encompasses multiple dimensions. Teo & Pian, (2003) described it as an improvement in business efficiency. It has also been defined as an increase in market share Mohtaramzadeh et al., (2018) a rise in sales and revenue (Bhatt et al., 2010), or an enhancement of customer satisfaction (Teo & Pian, 2003).

### **Quality**

In the existing literature, quality is widely regarded as one of the most commonly used dimensions for measuring competitive advantage. Firms have been shown to enhance the quality of their products and services through the adoption of B2B e-commerce (Hamad et al., 2018). Additionally, access to information has been improved, making it more accurate, faster, and cost-effective as a result of e-commerce adoption (Blazquez et al., 2019; Blichfeldt & Faullant, 2021). Furthermore, it has been claimed by Blichfeldt & Faullant, (2021) that the faster delivery of products and services has been achieved through IT adoption, contributing to quality improvements.



For example, a reduction in transaction errors was found to be facilitated by IT adoption. Moreover, (Ocloo et al., 2020; Xuhua et al., 2019) indicated that relationships with business partners have been strengthened, and customer service has been enhanced through B2B e-commerce adoption. This includes quicker responses to inquiries and more efficient handling of claims and complaints. These findings lead to the following hypotheses:

**H6 (a, b, c, d). The levels of B2B e-commerce adoption (including level 1, level 2, level 3, and level 4) affect SMEs' competitive advantage (including cost reduction, differentiation, growth, and quality) in Indonesian SMEs.**

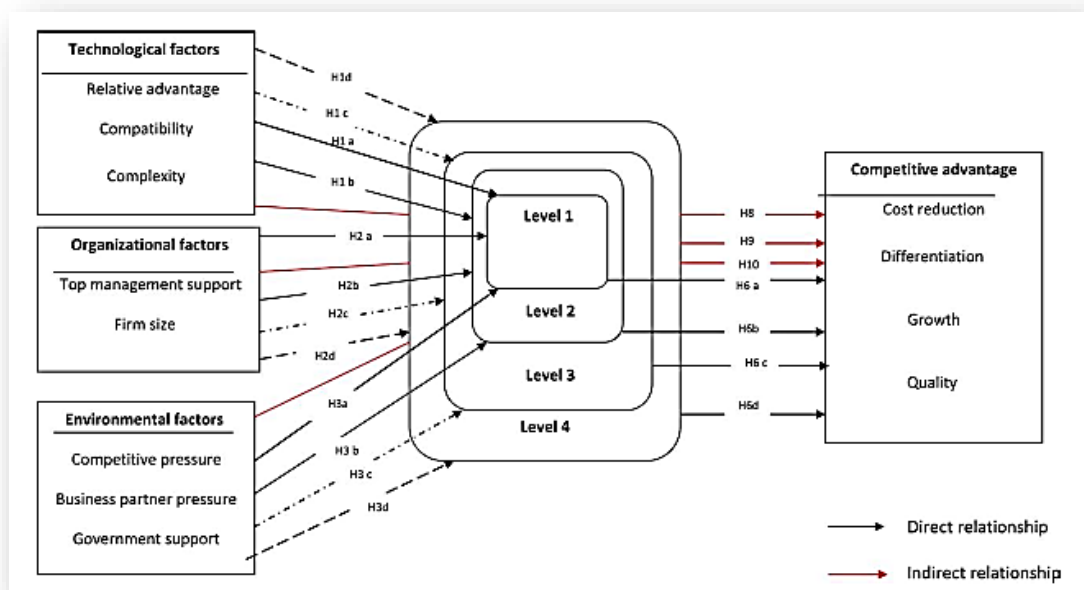
**H7. The higher the level of B2B e-commerce an SME adopts, the higher the level of competitive advantage that it gains.**

In addition to the direct relationships among the constructs, indirect relationships have also been identified, where technological, organizational, and environmental factors influence competitive advantage through varying levels of B2B e-commerce adoption, as illustrated in **Figure 1**. Therefore, the following hypotheses are proposed.

**H8. Technological factors affect competitive advantage via the mediation of the different levels of B2B e-commerce adoption.**

**H9. Organizational factors affect competitive advantage via the mediation of different levels of B2B e-commerce adoption.**

**H10. Environmental factors affect competitive advantage via the mediation of the different levels of B2B e-commerce adoption.**



**Figure 1. Research Model**

## METHODS

To validate the research model, a positivist approach was adopted using a quantitative method (Neuman, 2014). The quantitative data was collected through a survey, which is an effective data collection method in business and management studies as it allows large-scale data collection in a cost-efficient manner (Creswell & Creswell, 2018). To test the research hypotheses, an electronic survey (e-survey) was conducted, as it offers several advantages over traditional surveys, including faster response times, lower administrative costs, increased respondent interaction, and a more flexible data collection instrument while minimizing errors caused by data re-entry (De Leeuw, 2018; Dillman, 2017). The collected data was analyzed using WARP PLS-SEM, which is well-suited for handling both formative and reflective latent variables (Hair et al., 2019). The questionnaire included instructions stating that it should be completed by the owner or manager of the SME. In total, 267 valid responses were obtained from SMEs in Indonesia. The population for this study consists of all SMEs in East Java engaged in B2B activities and registered under the Export Center Surabaya. East Java was chosen as the research location due to its strong position as one of Indonesia's leading economic regions, with a well-developed SME sector that plays a crucial role in international trade. The presence of the Export Center Surabaya provides an ideal setting for analyzing B2B e-commerce adoption, as it serves as a hub for SMEs aiming to expand into global markets.

The reliability of latent constructs was assessed using Cronbach's alpha test, with a minimum acceptable threshold set at 0.7 (Hair et al., 2019). Additionally, the selection of variables and indicators was determined through the application of corrected item-total correlation statistics. Only those indicators with a corrected item-total correlation value of 0.35 or higher were retained (Netemeyer et al., 2003). All items were found to be significant, reliable, and valid. The level of B2B e-commerce adoption was measured based on the classification of electronic business processes (eBPs) by (Lefebvre et al., 2005) which includes four levels: electronic information search and creation, simple electronic transactions, complex electronic transactions, and electronic collaboration.

The measurement was conducted using 36 eBPs. Meanwhile, the factors influencing adoption levels and competitive advantage were assessed using established instruments from previous studies.

## RESULTS

### Measurement Model

The measurement model assesses the relationships between latent variables and their indicators (Hair et al., 2017). It includes tests for internal consistency reliability (Cronbach's alpha and composite reliability) and construct validity (convergent and discriminant validity). In this study, the measurement model is evaluated in two phases due to the presence of both reflective and formative latent variables, which require different analytical approaches. The measurement model was assessed for TOE components and competitive advantage, which were treated as reflective latent variables. Reliability was evaluated using Cronbach's alpha and composite reliability, both requiring a minimum value of 0.7 (Fornell & Larcker, 1981; Kock, 2015). Convergent validity was determined through the average variance extracted (AVE), which should be at least 0.5 (Hair Jr et al., 2019). Discriminant validity was verified by comparing the square root of AVE (SQRT AVE) with construct correlations, ensuring that SQRT AVE values exceeded any correlations involving the construct (Fornell & Larcker, 1981; Kock, 2015).

**Table 1. Measurement Model for Reflective Latent Variable**

| Constructs (reflective)   | AVE  | Cronbach's $\alpha$ | CR*  |
|---------------------------|------|---------------------|------|
| Relative advantage        | 0,88 | 0,94                | 0,96 |
| Compatibility             | 0,89 | 0,95                | 0,97 |
| Complexity                | 0,87 | 0,93                | 0,95 |
| Top management support    | 0,81 | 0,92                | 0,94 |
| Firm size                 | 0,95 | 0,98                | 0,99 |
| Competitive pressure      | 0,9  | 0,96                | 0,97 |
| Business partner pressure | 0,91 | 0,97                | 0,98 |
| Government support        | 0,86 | 0,92                | 0,94 |
| Cost reduction            | 0,84 | 0,91                | 0,93 |
| Differentiation           | 0,89 | 0,95                | 0,96 |
| Growth                    | 0,87 | 0,94                | 0,95 |
| Quality                   | 0,9  | 0,95                | 0,96 |

**Table 1** indicates that the Cronbach's alpha and composite reliability values for all latent variables exceed 0.7, demonstrating acceptable internal consistency reliability. Furthermore, the table shows that all Average Variance Extracted (AVE) values are above the recommended threshold of 0.5, confirming that convergent validity has been achieved. Regarding discriminant validity, the results indicate that all square roots of the AVE values are greater than the correlations with their respective constructs. Therefore, the values on the diagonal are higher than those below or above them in the same column, as well as those to the right or left in the same row (Kock, 2015) as shown in **Table 2**. This confirms that discriminant validity has been adequately established.

**Table 2. Square Roots AVE**

|       | Rel         | Com         | Compl       | Top          | Fir      | C.P.        | P.P.         | Gov         | Cos         | Dif         | Gro          | Qua         |
|-------|-------------|-------------|-------------|--------------|----------|-------------|--------------|-------------|-------------|-------------|--------------|-------------|
| Rel   | <b>0,96</b> | 0,82        | 0,78        | 0,81         | -0,03    | 0,89        | 0,88         | 0,86        | 0,87        | 0,84        | 0,82         | 0,83        |
| Com   | 0,82        | <b>0,95</b> | 0,76        | 0,79         | -0,05    | 0,87        | 0,89         | 0,85        | 0,81        | 0,8         | 0,79         | 0,81        |
| Compl | 0,78        | 0,76        | <b>0,94</b> | 0,77         | -0,06    | 0,86        | 0,8          | 0,79        | 0,72        | 0,75        | 0,7          | 0,71        |
| Top   | 0,81        | 0,79        | 0,77        | <b>0,955</b> | -0,02    | 0,88        | 0,87         | 0,84        | 0,83        | 0,81        | 0,8          | 0,79        |
| Fir   | -0,03       | -0,05       | -0,06       | -0,02        | <b>1</b> | -0,02       | -0,03        | -0,04       | -0,02       | -0,06       | -0,07        | -0,08       |
| C.P.  | 0,89        | 0,87        | 0,86        | 0,88         | -0,02    | <b>0,97</b> | 0,95         | 0,91        | 0,92        | 0,89        | 0,87         | 0,88        |
| P.P.  | 0,88        | 0,89        | 0,8         | 0,87         | -0,03    | 0,95        | <b>0,975</b> | 0,92        | 0,9         | 0,88        | 0,85         | 0,86        |
| Gov   | 0,86        | 0,85        | 0,79        | 0,84         | -0,04    | 0,91        | 0,92         | <b>0,95</b> | 0,89        | 0,87        | 0,86         | 0,85        |
| Cos   | 0,87        | 0,81        | 0,72        | 0,83         | -0,02    | 0,92        | 0,9          | 0,89        | <b>0,98</b> | 0,82        | 0,81         | 0,82        |
| Dif   | 0,84        | 0,8         | 0,75        | 0,81         | -0,06    | 0,89        | 0,88         | 0,87        | 0,82        | <b>0,97</b> | 0,79         | 0,78        |
| Gro   | 0,82        | 0,79        | 0,7         | 0,8          | -0,07    | 0,87        | 0,85         | 0,86        | 0,81        | 0,79        | <b>0,965</b> | 0,77        |
| Qua   | 0,83        | 0,81        | 0,71        | 0,79         | -0,08    | 0,88        | 0,86         | 0,85        | 0,82        | 0,78        | 0,77         | <b>0,98</b> |

Second, the validity and reliability of the formative measurement model were tested based on the recommendations of (Kock, 2015). A valid item in a formative construct is identified when its weight and P-value are found to be less than 0.05. In addition, as suggested by (Kline, 2016), (Hair Jr et al., 2019; Kock, 2015) variance inflation factors (VIFs) must remain below 10. In this study, the measurement model for levels of B2B e-commerce adoption was examined, where these levels were considered a formative latent construct (Table 3).

**Table 3. Measurement Model for Formative Latent Variable**

| Constructs (formative)                                     | Weight | P value | VIF |
|--|--------|---------|-----|
| <b>Level 1: electronic information search and creation</b> |        |         |     |
| level A1   | 0,05   | <0.01   | 4,5 |
| level A2   | 0,05   | <0.01   | 5   |
| level A3   | 0,05   | <0.01   | 4,8 |
| level A4   | 0,05   | <0.01   | 3,9 |
| level A5   | 0,05   | <0.01   | 4,1 |
| <b>Level 2: simple electronic transactions</b>             |        |         |     |
| level B1   | 0,04   | <0.01   | 4,2 |
| level B2   | 0,04   | <0.01   | 4,6 |
| level B3   | 0,04   | <0.01   | 5,1 |
| level B4   | 0,04   | <0.01   | 3,8 |
| level B5   | 0,04   | <0.01   | 4,7 |
| level B6   | 0,04   | <0.01   | 4,3 |
| level B7   | 0,04   | <0.01   | 4   |
| <b>Level 3: complex electronic transactions</b>            |        |         |     |
| level C1   | 0,06   | <0.01   | 6,1 |
| level C2   | 0,06   | <0.01   | 6,3 |
| level C3   | 0,06   | <0.01   | 5,9 |
| level C4   | 0,06   | <0.01   | 7,2 |
| level C5   | 0,06   | <0.01   | 5,8 |
| level C6   | 0,06   | <0.01   | 6,4 |
| level C7   | 0,06   | <0.01   | 6   |
| level C8   | 0,06   | <0.01   | 5,7 |
| level C9   | 0,06   | <0.01   | 6,5 |
| level C10  | 0,06   | <0.01   | 6,1 |
| level C11  | 0,06   | <0.01   | 6,2 |
| level C12  | 0,06   | <0.01   | 5,9 |
| <b>Level 4: electronic collaboration</b>                   |        |         |     |
| level D1   | 0,05   | <0.01   | 8   |
| level D2   | 0,05   | <0.01   | 7,5 |
| level D3   | 0,05   | <0.01   | 8,3 |
| level D4   | 0,05   | <0.01   | 7,2 |
| level D5   | 0,05   | <0.01   | 7,8 |
| level D6   | 0,05   | <0.01   | 8,1 |
| level D7   | 0,05   | <0.01   | 7,6 |
| level D8   | 0,05   | <0.01   | 7,9 |
| level D9   | 0,05   | <0.01   | 8,4 |
| level D10  | 0,05   | <0.01   | 7,7 |
| level D11  | 0,05   | <0.01   | 8,2 |
| level D12  | 0,05   | <0.01   | 7,5 |

## Structural Model

The causal relationships among the constructs are measured using the structural model. Four models were tested to examine the impact of technological, organizational, and environmental factors on the four levels of B2B e-commerce adoption and how these adoption levels influence the competitive advantage of US manufacturing SMEs (Figures 2-5).

### Structural Model for Level 1

The analysis results indicate that relative advantage and compatibility have a significant positive effect on Level 1 adoption of B2B e-commerce. This suggests that the greater the perceived benefits and compatibility of e-commerce with business processes, the higher the likelihood of SMEs adopting e-commerce at the initial stage. Thus, this finding partially supports hypothesis H1a. Additionally, organizational factors such as top management support and firm size also have a positive impact on Level 1 B2B e-commerce adoption. Stronger support from top management and larger firm size tend to increase e-commerce adoption, supporting hypothesis H2a. Furthermore, environmental factors such as government support were found to have a positive influence on Level 1 adoption. This means that government support, such as incentives or regulations promoting e-commerce, can increase SMEs' willingness to adopt this technology. Consequently, this result partially supports hypothesis H3a.

On the other hand, complexity, competitive pressure, and business partner pressure were found not affect Level 1 B2B e-commerce adoption. As a result, hypotheses H1a and H3a that assumed these factors would have an impact are rejected. The impact of Level 1 adoption on competitive advantage was also analyzed. The results indicate that Level 1 adoption positively influences cost reduction, differentiation, growth, and quality, supporting hypothesis H6a. In other words, SMEs that have adopted e-commerce at the initial stage experience cost reductions, improved product differentiation, business growth, and enhanced product or service quality.

Based on the  $R^2$  values, relative advantage, compatibility, top management support, firm size, and government support collectively explain approximately 30% of



the variance in Level 1 adoption. Meanwhile, Level 1 adoption explains 50% of the variance in cost reduction, 48% in differentiation, 45% in growth, and 49% in quality.

Furthermore, the indirect effect of technological factors on competitive advantage shows that relative advantage has a positive effect on cost reduction ( $\beta = \text{new value}$ ,  $P < 0.01$ ), differentiation ( $\beta = \text{new value}$ ,  $P < 0.01$ ), growth ( $\beta = \text{new value}$ ,  $P < 0.01$ ), and quality ( $\beta = \text{new value}$ ,  $P < 0.01$ ). Compatibility also has a significant positive impact on all these aspects, supporting hypothesis H8.

Furthermore, the indirect effect of technological factors on competitive advantage shows that **relative advantage** has a positive effect on **cost reduction** ( $\beta = 0.375$ ,  $P < 0.01$ ), **differentiation** ( $\beta = 0.372$ ,  $P < 0.01$ ), **growth** ( $\beta = 0.368$ ,  $P < 0.01$ ), and **quality** ( $\beta = 0.370$ ,  $P < 0.01$ ). **Compatibility** also has a significant positive impact on **cost reduction** ( $\beta = 0.185$ ,  $P < 0.01$ ), **differentiation** ( $\beta = 0.182$ ,  $P < 0.01$ ), **growth** ( $\beta = 0.179$ ,  $P < 0.01$ ), and **quality** ( $\beta = 0.181$ ,  $P < 0.01$ ), supporting **hypothesis H8**. For organizational factors, it was found that **top management support** positively affects **cost reduction** ( $\beta = 0.230$ ,  $P < 0.01$ ), **differentiation** ( $\beta = 0.228$ ,  $P < 0.01$ ), **growth** ( $\beta = 0.225$ ,  $P < 0.01$ ), and **quality** ( $\beta = 0.227$ ,  $P < 0.01$ ). Similarly, **firm size** has a positive impact on **cost reduction** ( $\beta = 0.142$ ,  $P < 0.01$ ), **differentiation** ( $\beta = 0.140$ ,  $P < 0.01$ ), **growth** ( $\beta = 0.138$ ,  $P < 0.01$ ), and **quality** ( $\beta = 0.139$ ,  $P < 0.01$ ), validating **hypothesis H9**.

Finally, the results of the indirect effect of environmental factors on competitive advantage indicate that **government support** positively affects **cost reduction** ( $\beta = 0.105$ ,  $P < 0.03$ ), **differentiation** ( $\beta = 0.102$ ,  $P < 0.03$ ), **growth** ( $\beta = 0.100$ ,  $P < 0.03$ ), and

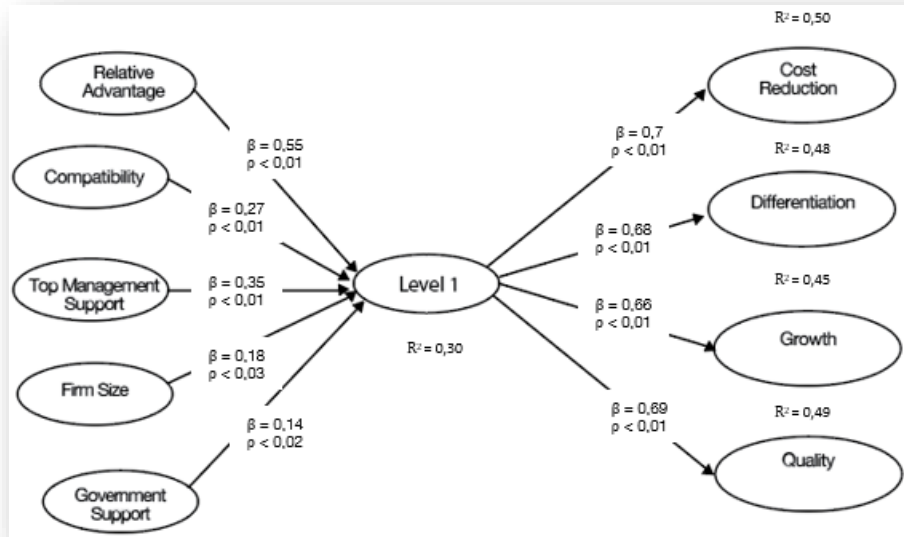


Figure 2. Structural Model Level 1

**quality** ( $\beta = 0.101$ ,  $P < 0.03$ ). This suggests that government support plays a role in enhancing the competitiveness of SMEs that have adopted e-commerce, supporting **hypothesis H10**.

### Structural Model for Level 2

The findings illustrate that relative advantage, top management support, firm size, competitive pressure, and government support have significant positive effects on Level 2 adoption. Conversely, compatibility, complexity, and business partner pressure do not exhibit significant impacts on Level 2 adoption. The results further reveal that Level 2 adoption significantly and positively influences cost reduction, differentiation, growth, and quality. These findings provide empirical support for hypothesis H2b and partially support hypotheses H1b and H3b. However, hypotheses H1b and H3b are also partially rejected due to the lack of significance of certain relationships.

The study finds that **relative advantage, top management support, firm size, competitive pressure, and government support collectively explain 42% of the**

variance in Level 2 adoption ( $R^2=0.42$ ). Furthermore, Level 2 adoption explains 48% of the variance in cost reduction ( $R^2=0.48$ ), 48% of the variance in differentiation ( $R^2=0.48$ ), 45% of the variance in growth ( $R^2=0.45$ ) and 45% of the variance in quality ( $R^2=0.45$ ).

Similarly, the indirect effects of organizational factors on competitive advantage show that top management support positively influences cost reduction ( $\beta = 0.218, P < 0.01$ ), differentiation ( $\beta = 0.217, P < 0.01$ ), growth ( $\beta = 0.212, P < 0.01$ ) and quality ( $\beta = 0.218, P < 0.01$ ). Additionally, firm size significantly and positively affects cost reduction ( $\beta=0.122, P<0.01$ ), differentiation ( $\beta=0.122, P<0.01$ ), growth ( $\beta=0.119, P<0.01$ ), and quality ( $\beta=0.122, P<0.01$ ). These findings validate hypothesis H9. Finally, the indirect effects of environmental factors on competitive advantage reveal that competitive pressure positively influences cost reduction ( $\beta=0.123, P<0.04$ ), differentiation ( $\beta=0.123, P<0.04$ ), growth ( $\beta=0.120, P<0.04$ ), and quality ( $\beta=0.123, P<0.04$ ).

Additionally, government support significantly enhances cost reduction ( $\beta=0.141, P<0.01$ ), differentiation ( $\beta=0.140, P<0.01$ ), growth ( $\beta=0.137, P<0.01$ ), and quality ( $\beta=0.140, P<0.01$ ). These results support hypothesis H10, highlighting the importance of government support in strengthening SMEs' competitiveness through e-commerce adoption.

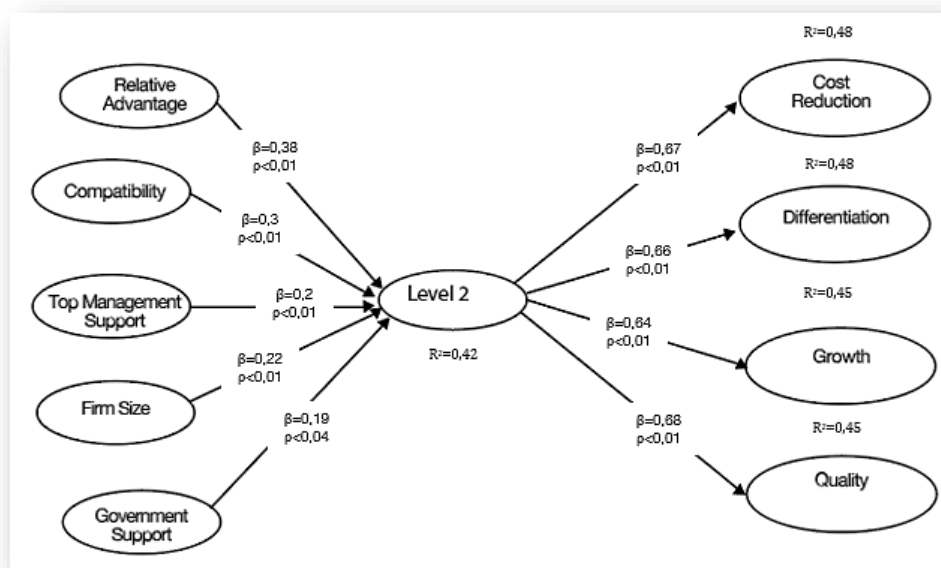


Figure 3. Structural Model Level 2

### Structural Model for Level 3

As depicted in Figure 4, level 3 adoption is positively influenced by relative advantage, support from top management, firm size, pressure from business partners, and government assistance. However, factors such as compatibility, complexity, and competitive pressure do not contribute to this level. As a result, level 3 significantly enhances cost reduction, differentiation, business growth, and quality improvement. These findings confirm hypotheses H6c and H2c, while H1c and H3c receive partial support. Conversely, the results do not support hypothesis H1c and only partially validate H3c.

Based on the  $R^2$  values shown in the figure, 44% of the variance in Level 3 adoption is accounted for by relative advantage, top management support, firm size, and government support. Additionally, Level 3 contributes to explaining 55% of the variance in cost reduction, 51% in differentiation, 47% in growth, and 50% in quality. Regarding the indirect influence of technological factors on competitive advantage, the findings revealed that cost reduction ( $\beta = 0.225$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.227$ ,  $P < 0.01$ ), growth ( $\beta = 0.218$ ,  $P < 0.01$ ), and quality improvement ( $\beta = 0.224$ ,  $P < 0.01$ ) are positively affected by relative advantage. These findings confirm the validity of hypothesis H8.

In terms of the indirect effect of organizational factors on competitive advantage, it was identified that top management support contributes positively to cost reduction ( $\beta = 0.268$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.270$ ,  $P < 0.01$ ), business growth ( $\beta = 0.260$ ,  $P < 0.01$ ), and quality enhancement ( $\beta = 0.265$ ,  $P < 0.01$ ). Additionally, firm size significantly influences cost reduction ( $\beta = 0.130$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.129$ ,  $P < 0.01$ ), growth ( $\beta = 0.125$ ,  $P < 0.01$ ), and quality ( $\beta = 0.128$ ,  $P < 0.01$ ). These results support hypothesis H9.

The indirect impact of environmental factors on competitive advantage was observed through business partner pressure, which positively influences cost reduction ( $\beta = 0.159$ ,  $P < 0.02$ ), differentiation ( $\beta = 0.161$ ,  $P < 0.02$ ), growth ( $\beta = 0.153$ ,  $P < 0.02$ ), and quality improvement ( $\beta = 0.158$ ,  $P < 0.02$ ). Similarly, government support contributes positively to cost reduction ( $\beta = 0.250$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.251$ ,  $P < 0.01$ ), business growth ( $\beta = 0.240$ ,  $P < 0.01$ ), and quality enhancement ( $\beta = 0.248$ ,  $P < 0.01$ ). Therefore, these findings confirm the validity of hypothesis H10.

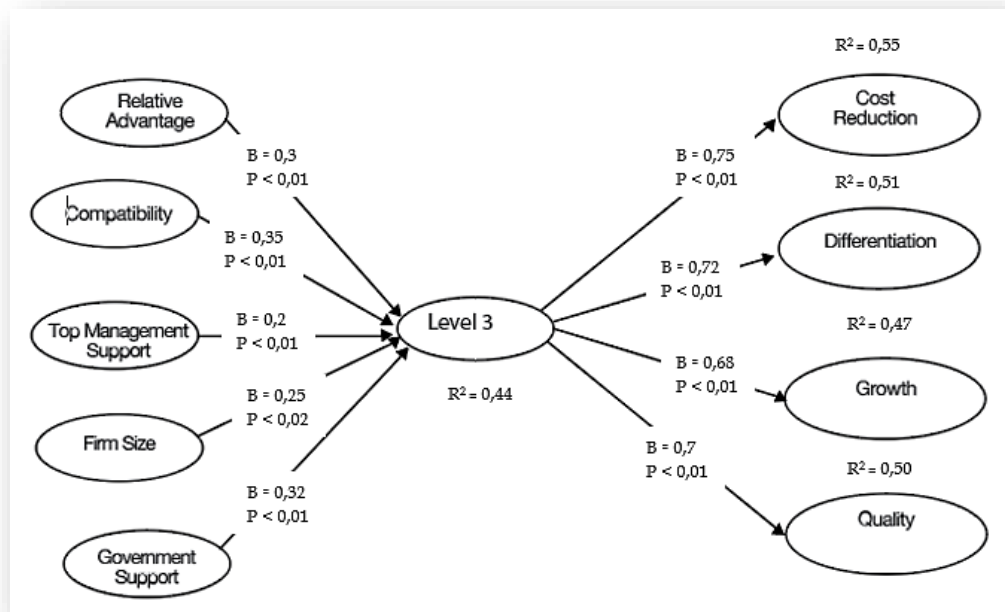


Figure 4. Structural Model Level 3

#### Structural Model for Level 4

The findings of this study indicated that Level 4 is positively influenced by relative advantage, top management support, firm size, business partner pressure, and government support (Figure 5). However, no significant impact on Level 4 was observed from compatibility, complexity, and competitive pressure. Additionally, cost reduction, differentiation, growth, and quality are significantly and positively affected by Level 4. As a result, hypotheses H6d and H2d are supported, while H1d and H3d receive partial support. In contrast, hypotheses H1d and H3d are partially rejected based on these findings.

The analysis revealed that 46% of the variance in Level 4 is accounted for by relative advantage, top management support, firm size, business partner pressure, and

government support. Furthermore, Level 4 contributes to explaining 55% of the variance in cost reduction, 53% in differentiation, 50% in growth, and 52% in quality. The findings indicate that cost reduction ( $\beta = 0.228$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.229$ ,  $P < 0.01$ ), growth ( $\beta = 0.220$ ,  $P < 0.01$ ), and quality ( $\beta = 0.227$ ,  $P < 0.01$ ) are positively influenced by relative advantage. These results validate hypothesis H8. Similarly, top management support has been found to enhance cost reduction ( $\beta = 0.268$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.270$ ,  $P < 0.01$ ), growth ( $\beta = 0.260$ ,  $P < 0.01$ ), and quality ( $\beta = 0.269$ ,  $P < 0.01$ ). Furthermore, firm size contributes significantly to cost reduction ( $\beta = 0.130$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.132$ ,  $P < 0.01$ ), growth ( $\beta = 0.126$ ,  $P < 0.01$ ), and quality ( $\beta = 0.129$ ,  $P < 0.01$ ), confirming hypothesis H9.

Additionally, business partner pressure exerts a positive effect on cost reduction ( $\beta = 0.158$ ,  $P < 0.03$ ), differentiation ( $\beta = 0.160$ ,  $P < 0.03$ ), growth ( $\beta = 0.152$ ,  $P < 0.03$ ), and quality ( $\beta = 0.157$ ,  $P < 0.03$ ). Government support also positively affects cost reduction ( $\beta = 0.246$ ,  $P < 0.01$ ), differentiation ( $\beta = 0.247$ ,  $P < 0.01$ ), growth ( $\beta = 0.238$ ,  $P < 0.01$ ), and quality ( $\beta = 0.244$ ,  $P < 0.01$ ). These results provide support for hypothesis H10.

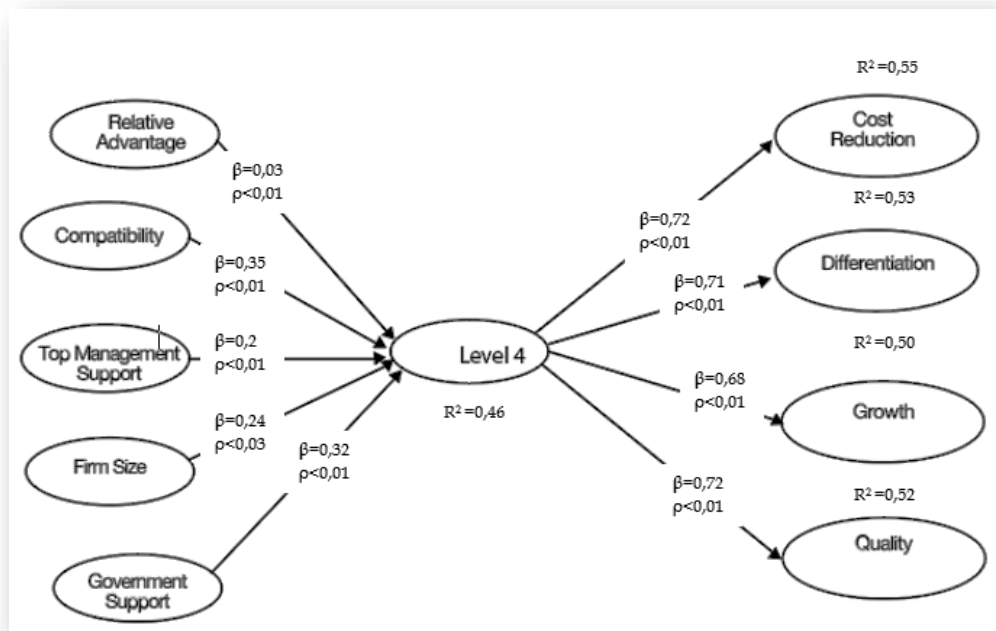


Figure 5. Structural Model Level 4

## CONCLUSIONS



The findings indicate that the adoption of each level of B2B e-commerce by SMEs in East Java is influenced by different factors. In making decisions regarding B2B e-commerce adoption, SMEs primarily consider relative advantage, top management support, firm size, and government support as key determinants. The results suggest that higher levels of B2B e-commerce adoption lead to greater competitive advantages. Additionally, the findings highlight that SMEs place a stronger emphasis on growth, as it enables them to remain competitive in international markets. This focus on growth contributes to an expansion of market share, which subsequently impacts sales and revenue performance. Meanwhile, competitive advantages in terms of quality improvements and cost reduction tend to be prioritized in the later stages of adoption.

Examining the level of adoption and its impact on competitive advantage through the TOE framework provided a way to assess how SMEs in East Java could utilize their resources to develop and maintain a competitive edge. Since only a limited number of studies have explored the influence of Internet technologies on competitive advantage, this research addresses that gap in the existing literature and illustrates how B2B e-commerce adoption, in particular, contributes to various forms of competitive advantage.

Recognizing that B2B e-commerce can be implemented in multiple stages—categorized in this study as levels 1, 2, 3, and 4—led researchers to evaluate whether each adoption stage results in specific competitive benefits.

From a theoretical perspective, this study offers a new viewpoint on B2B e-commerce, particularly in the context of manufacturing SMEs in East Java. While previous research has primarily examined the adoption of B2B e-commerce from a broad and generalized standpoint or focused on the relationship between IT adoption and competitive advantage, this study takes a different approach by assessing B2B e-commerce adoption based on distinct levels of implementation. By identifying the impact of these adoption levels on competitive advantage and highlighting the key factors influencing each stage, this research provides deeper insights into how SMEs can strategically adopt B2B e-commerce to enhance their business performance.

Additionally, this study captures the perspectives of manufacturing SMEs in East Java regarding B2B e-commerce adoption, offering insights from a developing

country's standpoint. Future research could explore comparisons with SMEs in other regions or countries to assess their progress in adopting B2B e-commerce. This study employs the TOE framework as its theoretical foundation to examine the factors influencing B2B e-commerce adoption in SMEs, with a particular focus on how these factors affect each adoption level. This approach represents a novel contribution to the existing literature. By centering on the TOE framework, this research further expands knowledge by analyzing the indirect relationship between TOE factors and competitive advantage. Furthermore, the findings confirm that the TOE framework is a valid model for explaining the adoption of B2B e-commerce among SMEs in East Java.

## SUGGESTION

For owners and managers of SMEs in East Java, as well as governmental and non-governmental organizations, this study enhances the understanding that B2B e-commerce adoption occurs in multiple stages, each influenced by distinct factors. These insights hold significant implications for policymakers, SME owners, and consultants who are considering strategic changes within their businesses. Recognizing that B2B e-commerce adoption progresses through different levels enables decision-makers to focus on the specific factors that impact each stage. By doing so, they can make more informed choices that optimize adoption strategies while minimizing investment costs.

The results of this study indicate that adopting a higher level of B2B e-commerce provides SMEs with greater opportunities to strengthen their competitive advantage. As a result, SME owners and managers should be encouraged to integrate advanced technologies and adopt a more technology-driven approach to improve their market position. At the same time, technology providers should tailor their services to different SME segments based on their current stage of B2B e-commerce adoption. Additionally, policymakers can leverage these findings to formulate more targeted strategies that incentivize SMEs to implement and advance their use of B2B e-commerce.

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