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Analysis of User Behavior Intention Using UTAUT with Technology Readiness as a Moderator on Mitratel Digital Twin Technology

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ABSTRACT: Digital Twins technology can provide various benefits for a company, including asset management and operational efficiency. PT Dayamitra Telekomunikasi, Tbk (Mitratel) started a trial of using Digital Twins in its use faced with challenges in the adoption of digital twins. In adopting digital twins in the Mitratel company, this study explores the relationship between UTAUT-1 parameters, Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC) with Behaviour Intention (BI). In addition, this study will also look at the role of Technology Readiness (TR) parameters which consist of Optimism (OPT), Innovativeness (INN), Discomfort (DIS), and Insecurity (INS) parameters where these parameters moderate the relationship between UTAUT-1 parameters and Behaviour Intention (BI). The study used a Quantitative Method with a Likert scale on 307 random employee respondents who were processed using the Partial Least Square (PLS) model. The results showed that the Performance Expectancy (PE) parameter has a significant effect on Behavior Intention (BI) of using Digital Twins, while for other UTAUT-1 parameters it does not have a significant effect on Behaviour Intention (BI). Although the value of the Technology Readiness (TR) parameter is at the level of 3.21, the role of the Technology Readiness (TR) parameter does not significantly affect the relationship between the UTAUT-1 parameters on Behavior Intention (BI). The implication of the results of this analysis is that companies can develop the right Digital Twins features because the Performance Expectancy (PE) parameter has the most significant level of influence on Behavior Intention (BI). In addition, companies can also implement a training approach among employees to manage the level of Optimism (OPT) parameters while reducing the impact of high Discomfort (DIS) levels.

KEYWORDS: Behaviour Intention, Digital Twins, Technology Readiness, UTAUT.

1. INTRODUCTION

The telecommunications industry has become a pivotal sector with a significant impact on everyday life. However, telecommunications operators had experienced a downward trend in Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA) with a margin of 1.12% and Average Revenue Per User (ARPU) of 4.42% between 2008 and 2017 (Hendrawan & Nugroho, 2018)[1]. The decline in EBITDA Margin and ARPU experienced by operators had an impact on the disposal of telecommunications infrastructure assets, especially tower assets, most of which were acquired by Tower Provider Companies (Wellington Capital Advisory, 2021)[2]. As a consequence, the assets previously owned by each telecommunications operator become centralized in the Tower Provider Company. Telecoms tower providers are also starting to diversify their business by entering the Electric power supply business (TowerXchange, 2023)[3], active devices provider, fiber optic network provider (José Arias et al., 2022[4];[2] and many other businesses so that the number of assets managed by tower providers increases significantly.

This creates challenges for tower companies to improve asset management systems and operational efficiency to maintain business sustainability. Mitratel, as one of the telecoms tower providers, has experienced an increase in the number of tower assets, like many other tower companies. The number of Mitratel tower assets increased by 92% in just two years, which mostly came from high acquisition activity. The significant increase in the number of assets has become a challenge for Mitratel, especially in the process of validating its assets. In order to overcome this, a high cost re-survey process was carried out every year on all tower assets to determine the condition of existing assets.

Using Digital Twins Technology in asset management and operational efficiency has been constantly done since Digital Twins can represent complex civil infrastructure objects such as telecommunications towers (Medeisis & Radis, 2022)[5]. One application of Digital Twins in the Telecommunication Tower Provider Industry includes many features, such as Tower Scanning, 3D Reconstruction, 3D Business Information Modeling (BIM), Ground Cabinet Monitoring, and Automation Lifecycle Management

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(Alecio Binotto et al., 2023; Jack Haddon, 2022)[6]. PT Dayamitra Telekomunikasi as one of the Tower Provider Companies in Indonesia, also experiencing the impact of telecommunication asset centralization and business diversification trend, has also started adopting Digital Twins technology in collaboration with Digital Twins technology providers specialized for the Telecommunication Tower industry.

Mitratel has developed an application to carry out some of the functions of Digital Twins. However, not being integrated and disciplined in usage resulted in the data being less valid. To overcome these challenges, Mitratel has started using Digital Twins technology to manage its assets. Currently Digital Twins technology is in the process of being tested for implementation on 100 Towers owned by Mitratel. However, the possibility of problems arising in the technology adoption process remains exist.

Before wider implementation process is carried out, analysis is needed regarding Behavior Intention (BI) towards Digital Twin Technology. Researches on Technology Adoption, especially related to BI measurement, have been widely carried out. One approach taken is the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al., 2003)[7]. This theory was updated in 2012 with more in-depth understanding of technology adoption among consumers (Venkatesh et al., 2012) [8]. UTAUT is able to predict Intention to Use of a technology (Al-Riyami et al., 2023) [9]. Beside using UTAUT, Behaviour Intention is also measured through an understanding of Technological Readiness (TR) in Individuals, which provides a unique dimension of how Behaviour Intention (BI) is related to Technological Readiness (TR) in each individual within organizations (O'Hern & St. Louis, 2023) [10].

The combination of UTAUT and TR concepts to measure Behavioral Intention has been used by several researches (Sellywati Mohd Faizal & nor, 2022) [11]. Another method is used with the TR Dimension acting as an independent variable for UTAUT and (BI) (Reyes-Mercado et al., 2023; Seol et al., 2017) [12]. The model used included TR as a mediator for BI is also measured using UTAUT dimensions (Sukmana et al., 2019) [13]. The use of an application in construction field in which the use of UTAUT has a relatively higher accuracy level for TAM and TPB from Nnaji et al., (2023) [14]. Apart from that, in the context of internal company applications implementation, UTAUT has been used in SAP applications at KAI Zulaikah et al., (2023)[15].

Current researches related to the technology adoption towards the Implementation of Digital Twins in the Tower Provision Industry both in national and international scope, still have not provided a definite answer even though it could bring positive impact on tower provider companies. This is possibly done because the company is still taking into account the potential and challenges in the Digital Twins Implementation process. Studies on Digital Twins implementation have been widely carried out to specifically identify its opportunities as well as inhibiting factors. However, none has specifically discussed the Behavioral Intention Level of using Digital Twins.

1.1 Objectives

The study's goals derived from background information and problem formulation can be summarized as follows:

1. to identify conditions for the Technology Readiness Optimism, Innovativeness, Insecurity and Discomfort variables among Mitratel employees.
2. to analyse the influence of UTAUT model variables of Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions on behavioral intention to use Digital Twins technology.
3. to identify the influence of the Technology Readiness variable in relation between UTAUT model variables of Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions and Behaviour Intention of Digital Twin technology usage.

2. LITERATURE REVIEW AND HIPOTHESIS

2.1 Strategic Management

Strategic management is defined as a tool for achieving competitive advantage compared to rivals in similar industries. To do this, there are three stages (Fred R. David & Forest R. David, 2017); (Frank T. Rothaermel, 2017) [16][17]:

1. **Formulation Strategy**: the first step is action planning based on analysis of the Company's internal and external environment.
2. **Implementation Strategy:** focuses on implementing strategies that have been prepared previously through building an organization, resource allocation, motivation and else as part of implementing the strategy.

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3. **Evaluation Strategy**: the final stage related to monitoring and assessing the effectiveness of the strategy which includes the process of evaluating criteria and measuring performance.

Strategy making is not only the task of top executives but also involves middle level managers. In general, large companies implement four levels of strategy. They are corporate level, divisional level, functional level and operational level (Fred R. David & Forest R. David, 2017) [16].

2.2 Digital Transformation

Transformation is the key for an organization to be able to grow and develop, thus a transformation initiative will be considered successful if the initiative ultimately produces strategic results (Pradeep Henry,2022) [18]. Digital Transformation itself is a business transformation driven by the development of the latest technology which is expected to encourage revenue and net profit growth through cost savings (Tang, 2021)[19]. Digital Transformation will be difficult to succeed if it only emphasizes aspects of technology application and it will be more effective if it is supported through changes to organizational culture, capabilities and human resources to be able to optimize business processes to remain in harmony with the dynamics of the industrial environment. Technological developments have become the main drive in digital transformation. Technologies such as Artificial Intelligence (AI), Blockchain, and IoT enable changes into more autonomous business models, enabling digital transformation in companies to implement other more advanced technologies through Digital Twins and Autonomous Decision-Making technology (Singh et al., 2020) [20]. In an era of increasingly intense competition in the telecommunications industry, companies need to improve their competitive advantage through digital innovation and the use of the latest technology. VRIO analysis shows that competitive advantage can be generated by maximizing the company's resources and capabilities. However, in the midst of a competitive environment that is still dominated by non-digital innovation, the variables of resistance and digital innovation currently have an insignificant influence in building competitiveness (Butarbutar et al., 2017)[21]. Therefore, telecommunications companies need to adopt a more progressive approach in integrating digital innovation into their business strategy. One potential way to increase employee competitiveness level is through digital twins application implementation, which can help companies optimize operations, increase efficiency and create added value for customers(Wahyuningtyas et al., 2023)[22].

2.3 *Tecnology Readiness Index* (TRI)

Technology Readiness is defined as a user's desire to adopt new technology to increase user productivity both in life and business. This model is a scale for measuring individual readiness in accepting new technology through measuring the variables, such as optimism, innovativeness, insecurity and discomfort (Parasuraman & Colby, 2015) [23]. TRI is widely used to explain users' technological usage through four different dimensions: optimism, innovativeness, discomfort, and insecurity. Dimensions that have a positive connotation are called motivators and negative ones are called inhibitors (Blut & Wang, 2020) [24].

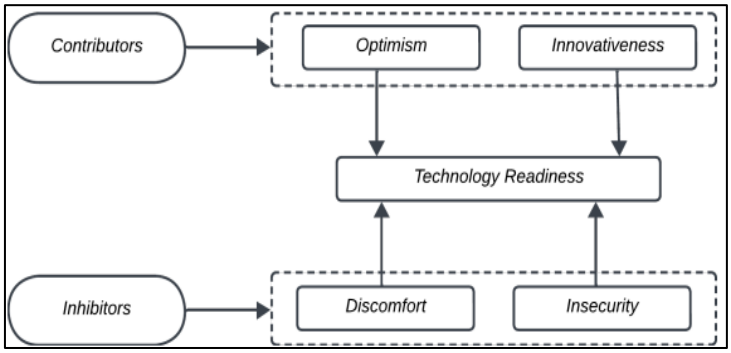

Figure 1. Framework Technology Readiness Index (TRI) (Parasuraman, 2000. [23])

2.4 Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) is a model developed by Vekantesh in 2003 to predict the acceptance and use of technology in various conditions. UTAUT integrates eight technology acceptance models resulting in a unique framework for understanding how individuals accept and use technology. This model consists of four dimensions that influence

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technology adoption process, namely Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC) (Venkatesh et al., 2003) [25].
UTAUT is a popular and accurate Technology Adoption Measurement Model for predicting technology acceptance and usage. UTAUT was previously updated to broaden its scope and improve the variances to measure behavioral intentions and the latest technological usage, namely UTAUT 2. The application of this model has expanded to various sectors, including higher education, health, and digital marketing, with several adjustments to suit specific contexts (Venkatesh et al., 2012)[26].

2.5 Hypothesis

A logically predicted relationship between several variables that are able to be stated into a written form then tested is the definition of a hypothesis. Connected variables are based on the relation specified in the theoretical framework formulated in the research plan. The formulated hypothesis will be tested to reaffirm the estimated relationship that has been made prior to the process, with the aim to find solutions to overcome the problems (Uma Sekaran & Roger Bougie, 2010) [27]. Based on the research framework statements, the following hypotheses in the research are concluded:
H1: Performance Expectancy (PE) positively affects employee Behavior Intention (BI) in using the Digital Twins application.
H2: Effort Expectancy (EE) has a positive relation with employees' Behavioral Intention (BI) to use Digital Twins.
H3: Social Influence (SI) has a positive relation with employees' Behavioral Intention (BI) to use Digital Twins.
H4: Facilitation Condition (FC) has a positive relation with employees' Behavioral Intention (BI) to use Digital Twins.
H1.1: Technology Readiness (TR) moderates the influence of Performance Expectancy (PE) on employee's Behavior Intention (BI) to use Digital Twins.
H2.1: Technology Readiness (TR) moderates the influence of Effort Expectancy (EE) on employee's Behavior Intention (BI) to use Digital Twins.
H3.1: Technology Readiness (TR) moderates the influence of Social Influence (SI) on employee's Behavior Intention (BI) to use Digital Twins.
H4.1: Technology Readiness (TR) moderates the influence of Facilitating Conditions (FC) on employee Behavior Intention (BI) to use Digital Twins.

3. RESEARCH METHOD

This study aims to determine the relationship between behavioral intention factors of digital twins technology on employees who use it. Based on the methodology, a quantitative method was chosen to investigate the relationship between the dependent variable, namely behavioral intention, and the independent variables from the UTAUT model, as well as examining the role of Technology Readiness as a moderator in this relationship. Based on the research objectives, it is categorized as Explanatory Research where logical reasoning regarding the occurrence of an event or symptom becomes the aim for this research to be carried out. The positivism research paradigm is based on the philosophy of positivism, collecting empirical data through surveys or observations of employees who use Digital Twins technology which influences employees' behavioral intentions. Quantitative methods are more often associated with deductive approaches, where theories and hypotheses are developed first and then tested through collecting measurable and objective data. This research uses a cross sectional type, to see the relationship between variables through an extensive dataset. This research uses independent variables, like Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Condition (FC), Social Influence (SI). The Dependent variable is Behavioral Intention (BI) and the Moderator Variables are Optimism (OPT), Innovativeness (INV), Discomfort (DIS), and Insecurity (INS).

4. DATA COLLECTION

The sample is planned to be calculated using the Slovin technique (Sugiono (2021)) [28], so 300 samples or 300 employees are necessary to be collected in order to fill out the questionnaire. This questionnaire is designed to collect information regarding respondents' perceptions, expectations and possible acceptance of technology. Questions in the questionnaire will cover aspects such as awareness of the technology, perceived potential benefits, as well as barriers or concerns that respondents may encounter in the technology adoption process.

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5. RESULTS

The Partial Least Squares (PLS) system model shown in Figure 2 shows the relationship between several variables within the theoretical framework. The variables Optimism (OPT), Innovation (INN), Insecurity (INS), and Discomfort (DIS) act as predictors of the Technology Readiness (TR) variable. In this context, TR represents employee technology readiness which is influenced by positive perceptions (OPT, INN) and negative perceptions (INS, DIS) towards technology acceptance.

In addition, variables in the Unified Theory of Acceptance and Use of Technology (UTAUT) framework, namely Performance Expectancy (FE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC), act as predictors of the Behavioral Intention (BI) variable. This relationship illustrates how UTAUT factors influence users' intentions to use a particular technology.

This model also shows that the TR variable will act as a moderator in the relationship between the UTAUT variables (FE, EE, SI, FC) and BI, which means that the technological readiness of an individual or organization can strengthen or weaken the influence of the UTAUT factor on the intention to use technology.

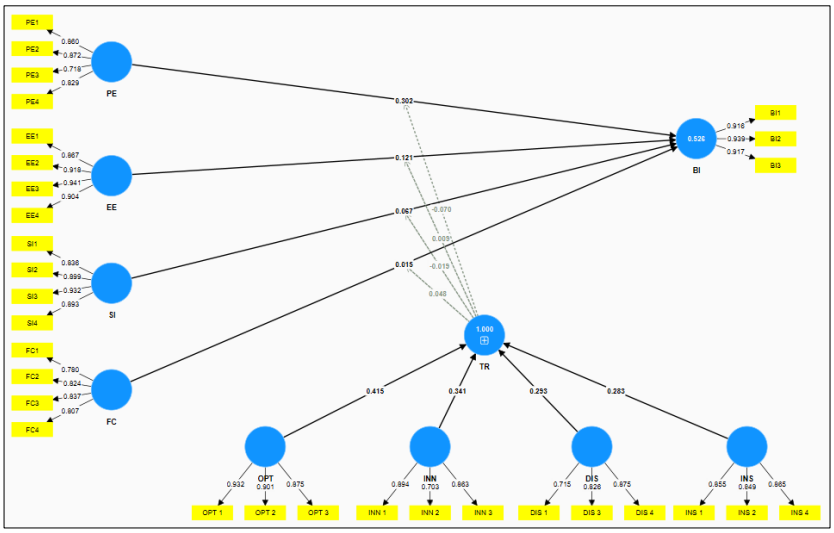

Figure 2. Research Model

5.1 Technology Readiness Measurement

The Technology Readiness Index (TRI) measurement in this study was carried out by evaluating four main dimensions, namely Optimism (OPT), Innovativeness (INN), Discomfort (DIS), and Insecurity (INS). Each dimension has the same contribution weight, which is 25%, thus calculated based on the number of questions in each dimension. The TRI value is determined by subtracting the total value of the driving factors (Contributors) from the total inhibiting factors (Inhibitors). Table 1 shows the overall TRI measurement based on questions in each dimension along with the percentage of the questionnaire weight values. In this study, the Contributor value was 42.16 (combined OPT and INN), while the Inhibitor value was 38.95 (combined DIS and INS), resulting in a TRI value of 3.21. Based on the TRI category, this value shows that the level of technology readiness is in the Medium Technology Readiness category.

Table 1. Technology Readiness Index (TRI) Measurement

Question	%	%*Weight
OPT 1	89.40%	7.45
OPT 2	89.80%	7.48
OPT 3	86.50%	7.21
OPT		**22.14**

Question	Value	%*Weight
DIS 1	73.60%	6.13
DIS 3	87.30%	7.28
DIS 4	81.60%	6.80
DIS		**20.21**

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INN 1	84.80%	7.07	INS 1	71.10%	5.93
INN 2	72.64%	6.05	INS 2	77.00%	6.42
INN 4	82.80%	6.90	INS 3	76.80%	6.40
INN		**20.02**	**INS**		**18.74**

5.2 Reliability Analysis & Convergence Validity

Outer Loading measures the contribution of each indicator to its construct. The standard used is an outer loading value of at least 0.7 to display the indicator validity. The higher the value indicates the level of validity. In this research, all Outer Loading values were above 0.7. Some values were even far above the standard, such as BI1 (0.915) and EE3 (0.941), indicating that these indicators were valid.

Average Variance Extracted (AVE) measures the quantity of the construct variance explained by the indicators. The AVE standard is a minimum of 0.5 to demonstrate convergent validity. In the table, all constructs have AVE values above 0.5, such as BI (0.854) and EE (0.824), which indicates that these constructs have a good convergent validity. All constructs have convergent validity above standard.

Composite Reliability (CR) measures the internal consistency of indicators within one construct. The CR standard is a minimum of 0.7 to indicate high reliability. In the table, all constructs have CR values above 0.7, such as BI (0.946) and EE (0.949), which shows

Table 2. Reliability Analysis and Convergence validity

Construct	*Measurement Items*	*Factor Loading/Coeficient (t-value)*	*AVE*	*Compoiste Reability*	*R Square*	*Cronbachs Alpha*
Behaviour Intention (BI)	BI 1	0.915	0.854	0.946	0.516	0.914
	BI 2	0.939				
	BI 3	0.917				
Effort Expectancy (EE)	EE 1	0.867	0.824	0.949	-	0.928
	EE 2	0.918				
	EE 3	0.941				
	EE 4	0.904				
Performance Expectancy (PE)	PE 1	0.860	0.676	0.893	-	0.839
	PE 2	0.872				
	PE 3	0.718				
	PE 4	0.829				
Facilitation Conditions (FC)	FC 1	0.780	0.659	0.886	-	0.833
	FC 2	0.824				
	FC 3	0.837				
	FC 4	0.807				
Social Influence (SI)	SI 1	0.836	0.793	0.939	-	0.913
	SI 2	0.899				
	SI 3	0.932				
	SI 4	0.893				
	OPT 1	0.932	0.815	0.930	-	0.886

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Optimism (OPT)	OPT 2	0.898				
	OPT 3	0.878				
Innovativeness (INN)	INN 1	0.891	0.685	0.866	-	0.767
	INN 2	0.715				
	INN 3	0.868				
Insecurity (INS)	INS 1	0.845	0.704	0.877		0.790
	INS 2	0.851				
	INS 3	0.822				
Discomfort (DIS)	DIS 1	0.720	0.653	0.849	-	0.731
	DIS 2	0.822				
	DIS 3	0.875				
Technology Readiness (TR)	OPT	0.758	0.574	0.843	-	0.755
	INN	0.806				
	INS	0.756				
	DIS	0.740				

5.3 Correlation Matrix

excellent internal consistency. The construct with the lowest CR value is TR (0.843) but is still within the minimum standards. In conclusion, all constructs have good reliability.

R Square measures the model's ability to explain the variance of the dependent variable. The R Square value ranges from 0 to 1; the higher the value the better the model identify the variance. The BI parameter has an R Square value of 0.516, indicating that the model is able to identify around 51.6% of the variance in BI. This value is classified as moderate in social research.

Cronbach's Alpha measures the reliability or internal consistency of a construct based on its indicators. Cronbach's Alpha standard is a minimum of 0.7 to indicate good reliability. In this table, all constructs have Cronbach's Alpha values above 0.7, such as BI (0.914) and SI (0.913). The construct with the lowest value is INN (0.767), but it still meets the minimum standards. In conclusion, all constructs have adequate internal reliability. Table 2 shows the Reliability Analysis and Convergence validity of the independent and dependent variables.

Correlation matrix is a table that shows the relationship between variables in a model using correlation values. Diagonal values (in bold) represent the square root of average variance extracted (AVE) of each variable, which indicates discriminant validity. The minimum standard for discriminant validity is that the diagonal value (AVE) must be greater than the correlation value between variables outside the diagonal. Based on Table 3, all diagonal values (BI: 0.924, EE: 0.908, FC: 0.812, PE: 0.822, SI: 0.891, TR: 0.757) are greater than the correlation values between other variables in the same row or same column. In conclusion, discriminant validity in this model still meets the minimum standards.

Table 3. Correlation Matrix

	BI	***EE***	***FC***	***PE***	***SI***	***TR***
BI	**0.924**					
EE	0.586	**0.908**				
FC	0.446	0.615	**0.812**			
PE	0.619	0.616	0.508	**0.822**		
SI	0.458	0.593	0.528	0.385	**0.891**	
TR	0.669	0.680	0.536	0.630	0.572	**0.757**

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5.4 Hypothesis Measurement

Hypothesis testing is a statistical method used to test assumptions on population parameters based on data sample. This process involves formulating a null hypothesis (H_0), which indicates zero effect or relationship, and an alternative hypothesis (H_1), which indicate the existence of an effect or relationship. The assessment standard usually uses a p value (probability of error) with a significance threshold of 0.05. If $p \leq 0.05$, H_0 is rejected, indicating the results are statistically significant. Based on the table data, only H1 (PE -> BI) is significant (p = 0.000), while the other hypotheses are not significant (p > 0.05).

Table 4. Hypothesis Summary

Hypothesis	*Path*	*t-value*	*p-values*	*Results*
H1	PE -> BI	5.424	0.000	Supported
H2	EE -> BI	1.534	0.125	Not Supported
H3	SI -> BI	1.298	0.194	Not Supported
H4	FC -> BI	0.179	0.858	Not Supported
H5	TR x PE -> BI	1.275	0.202	Not Supported
H6	TR x EE -> BI	0.226	0.821	Not Supported
H7	TR x SI -> BI	0.573	0.567	Not Supported
H8	TR x FC -> BI	1/003	0.316	Not Supported

Table 4. shows the overall conclusion of the hypothesis. H1 is supported where Performance Expectancy (PE) has a significant influence on Behavioral Intention (BI) in using the Digital Twins application, these results are the same as research from Hadi and siska 2025 [29]. The analysis shows a t-value of 5.424 and a p-value of 0.000, which means that the relationship is very significant. This happens because users believe that the Digital Twins application can increase their work productivity, simplify working process and complete tasks faster. New features, such as Predictive Maintenance and 3D Modeling Simulation provide significant added value compared to the previous application, thereby increasing user confidence in the application's contribution to their working performance.

On the other hand, the other hypotheses (H2 to H8) were not supported because they did not show statistical significance (p-value > 0.05). For example, Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC) are not significant to BI. This was caused by numerous factors, such as user experience with other applications whose features are similar, lack of direct support from superiors or colleagues, as well as concerns regarding data migration and system integration. In addition, moderation by Technology Readiness (TR) is also considered not significant in influencing the relationship between these variables and BI, which indicates that technological readiness is yet to strengthen the relationship in this context.

6. CONCLUSION

The analytical results lead to the following conclusions:

- Developing a collaboration program between employees to nurture the mentoring sessions where employees who have a high level of optimism can help alleviate anxiety coming from colleagues who have a high level of discomfort. This is in line with research results where the Optimism variable (OPT) tends to be high and can be used to weaken the Discomfort (DC) variable which also tends to be high due to indicators of concern regarding co-worker adaptation. Increasing the Innovativeness (INN) variable is also needed to be done, especially in the lack-of-initiative indicator in terms of disseminating or teaching Digital Twins technology among employees.
- Conduct regular evaluations based on user experience and make system adjustments based on feedback on the use of Digital Twins Technology. This is also in line with the positive correlation of the Effort Expectancy (EE) variable with Behavior Intention (BI).

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