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A Study of the Influence of People and Culture on the Acceptance of the Smart Factory System in PT. XYZ Group Company Using the Technology Acceptance Model (TAM)

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Abstract

This paper examines the people and cultural factors that may influence employee acceptance of the smart factory system at PT. XYZ Group company in order to support the achievement of INDI4.0 certification. A questionnaire was developed based on the extended technology acceptance model (TAM). A total sample of 407 employees involved both shopfloor and backoffice employees who interact directly with the smart factory system. After conducting reliability and validity checks, the hypothesized model was estimated using structural equation modeling. The findings of this study revealed that perceived ease of use (PEOU), culture (C), and facilitating conditions (FC) were significant determinants of behavioral intention (BI) and use (AU) of the smart factory system. While perceived usefulness (PU), perceived quality of work life (QWL), and computer self-efficacy (SE) did not have a significant effect..

Keywords: *Industry 4.0, People and Culture, Technology Acceptance Model.*

I. Introduction

The initial concept of Industry 4.0 is the existence of a production system where one machine/system with another machine/system is connected to each other so that they can communicate with each other. So that the production process can run flexibly, optimally, effectively and efficiently or often also called Smart factory (IEEE Conference, 2014), Smart factory has the following characteristics: Connected, between machines and/or systems within the factory and between factories are connected to each other, Self optimized, able to optimize the production process itself that will and is currently underway, Transparent, all machines/processes related to the production process can be monitored in real-time anywhere and anytime via computer devices. Agile, a factory that can easily and quickly configure itself according to environmental conditions and variations in products produced (Schumacher, A., Erol, S., & Sihn, W., 2016). Recent studies have shown that system implementation is not simply a technological solution, but a process involving many different factors, such as social factors (Tarhini, Hone & Liu, 2013c; Teo, 2010), organizational factors such as facilitating conditions (FC) (Sun & Zhang, 2006), and individual factors such as computer efficacy (Liaw, 2008), in addition to behavioral and cultural factors. These key factors play a crucial role in how systems are developed and used (Teo, Luan & Sing, 2008; Zhang, Zhao & Tan, 2008). The need to understand system acceptance and adoption in the context of PT. XYZ Group highlights the importance of investigating the factors influencing employee technology acceptance.

Various theoretical models have been developed (the theory of reasoned action, the theory of planned behavior, the diffusion of innovation theory, the unified theory of technology acceptance and use, and the technology acceptance model [TAM]) to investigate and explore the determinants of user behavior toward the adoption and use of information technology. This study uses TAM (Davis, 1989) because of its acceptable explanatory power and popularity in a number of application areas (Venkatesh & Bala, 2008). Since its development, TAM has been widely used, tested, and extended to explain the adoption and success of technology in a number of application areas (e.g., Bagozzi, 2007; Yousafzai, Foxall & Pallister, 2007) and in e-learning contexts (e.g., Park, 2009; Sánchez & Hueros, 2010; Teo, 2009b, 2011; Zhang et al, 2008). Teo et al (2008) emphasize the importance of testing TAM in different cultures because it is argued that when Davis developed TAM (Davis, 1989), he did not consider the unbiased reliability of TAM in cross-cultural settings. In this regard, Tarhani et al (2015) added new variables, namely social norms (SNs), quality of work life (QWL), computer self-efficacy (SE) and FCs, into the research model to investigate the extent to which these variables influence employees' willingness to adopt and use the system. In this study, the Social Noma variable was replaced with culture considering that the research was conducted in a company level.

This paper is structured as follows. The second section presents and explains our research model and explains the research hypotheses in detail. This is followed by the research method that guided the study in the third section. The fourth section presents the results of the proposed research model. Finally, the fifth section discusses the main research findings and conclusions.

Theoretical framework

This paper highlights previous literature that used TAM in an educational context and proposes an e-learning conceptual model based on extended TAM.The model includes Culture, QWL, SE and FC as additional predictor variables within the extended TAM. Figure 1 presents the overall conceptual model, and the sections that follow illustrate and explain all of the predicted relationships of the previous literature studies

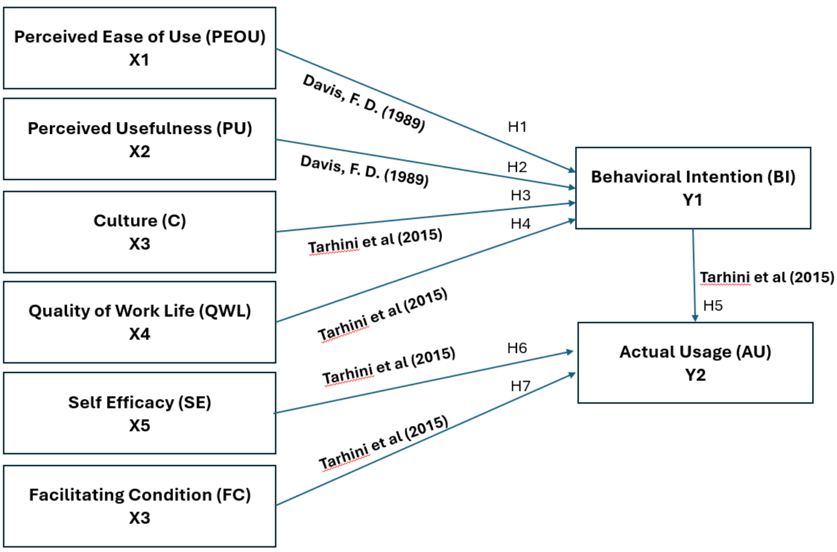


Figure 1: The theoretical framework

TAM model

Perceived ease of use (PEOU) is defined as "the degree to which a person believes that using a particular system will be effortless" (Davis, Bagozzi & Warshaw, 1989, p. 320). In TAM and TAM2, PEOU is theorized as a direct determinant of behavioral intention (BI). In the context of this study, the inclusion of Perceived Ease of Use (PEOU) is intended to investigate employees' beliefs about whether the system is easy to use with minimal additional knowledge. If employees perceive a smart factory system as easy to use, they are more likely to adopt and use it. Therefore, we propose the following hypothesis:

H1: PEOU (X1) will have a direct positive influence on employees' BI (Y1) for using the smart factory system.

Perceived usefulness (PU) is defined as "the degree to which a person believes that using a particular system will improve their job performance" (Davis, 1989, p. 453). In TAM, TAM2, and the augmented TAM, PU is theorized as a direct determinant of BI. In the context of this study, Perceived Use (PU) was used to

investigate employees' beliefs about the potential benefits of using a smart factory system. If employees perceive a smart factory system as beneficial and adding value to their work, they are more likely to adopt and use it. Conversely, employees may be resistant or skeptical. Therefore, we propose the following hypothesis:
H2: PU (X2) will have a direct positive influence on employees' BI (Y1) for using a smart factory system.

According to Hofstede (1991), culture is "the collective programming of the mind that distinguishes the members of one group or category of people from another"—meaning that culture shapes how people think, act, and respond to change. Tarhini et al. (2015) found that cultural factors significantly moderate the relationship between PU, PEOU, and technology use intention in educational settings in the Middle East. Therefore, we propose the following hypothesis:
H3: C (X3) will positively influence employees' BI (Y1) to use and accept smart factory technology.

Quality of Work Life (QWL) is the level of employee satisfaction with various aspects of the work environment that affect their physical, psychological, and social well-being (Walton, 1975). For this paper, QWL is defined in terms of employees' perceptions and beliefs that the use of technology will improve their QWL, such as saving costs and time and improving work quality. Therefore, we propose the following hypothesis:
H4: QWL (X4) will positively influence employees' BI (Y1) to use smart factory systems.

In TAM (Davis, 1989), behavioral intention is a user's intention to use a system or technology based on beliefs about its perceived usefulness and ease of use. Within the framework of the Technology Acceptance Model (TAM) and its derivative models (such as TAM2, UTAUT, etc.), behavioral intention plays a direct role in predicting actual technology use. This means that the stronger a person's intention to use technology, the more likely they are to actually use it. Therefore, we propose the following hypothesis:
H5: BI (Y1) will have a positive influence on the actual use of AU (Y2) in the smart factory system.

Self-efficacy (SE) has been defined as the belief "in one's ability to organize and execute the actions necessary to produce a given outcome" (Bandura, 1997, p. 2). SE is a type of self-assessment that helps understand human behavior and performance in specific tasks (Bandura, 1997). It is expected that users with high SE are more likely to accept and use the smart factory system than those with low SE. Therefore, we propose the following hypothesis:
H6: SE (X5) will have a positive influence on AU (Y2) of the smart factory system.

Facilitating Conditions are defined as the degree to which an individual believes that there is organizational and technical infrastructure that supports system use (Venkatesh et al., 2003). Venkatesh et al. (2003) in UTAUT stated that facilitating conditions significantly influence the actual use of technology systems. Alrawashdeh et al. (2019) in the higher education sector stated that facilitating conditions have a strong influence on e-learning system acceptance. Oliveira et al. (2014) in the mobile banking context showed that supporting conditions such as infrastructure and technical assistance encourage wider technology adoption. Therefore, we propose the following hypothesis:
H7: FC (X6) will have a positive influence on AU (Y2) of the smart factory system.

II. Methods

In this research domain, validity testing is implemented through convergent validity and discriminant validity tests. Convergent validity assesses the strength of indicators in reflecting la-tent constructs [45]. An indicator is considered valid if it has a loading factor > 0.50 towards the intended construct. Validity can also be observed through Average Variance Extract-ed (AVE), where a good model has AVE values for each construct > 0.50. If the loading factor is < 0.50, the indicator should be removed. Discriminant validity aims to verify that a reflective con-struct shows stronger correlations with its own indicators than with indicators from other con-structs in the PLS path model [46]. This indicates that each construct has its own identity and is not highly correlated with other constructs in the study.Reliability is interpreted as the extent to which measurement scores are free from errors. Reliability testing can be conducted using Cronbach's Alpha method. The decision rule in testing reliability using Cronbach's Alpha is if the value of $\alpha > 0.60$, then the items can be considered reliable [47]. In addition to using Cronbach's alpha, in evaluating the reliability of indicators in a variable, researchers can also utilize the concept of composite reliability. Composite reliability is a useful tool for measuring the reliability of indicators within a variable. A variable is considered to have adequate reliability if the composite reliability value > 0.7 [48].

Structural Equation Modeling (SEM) is a multivariate statistical approach that requires the formation of measurement and structural models. The process involves three simultaneous steps, namely validity and reliability examination (confirmatory factor analysis), testing the rela-tionships between variables (path analysis), and forming a suitable model for structural analysis and regression [19].There are two types of SEM, namely covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM). According to Ghozali & Latan [48] in the book "Partial Least Square Concept Techniques and Applications Using Smart PLS 3.0 Program. 2nd Edition", CB-SEM aims to calculate a structural model based on a strong theoretical foundation, to test cause-and-effect relationships among structures, and to assess the validity of the model through empirical evidence. CB-SEM is considered suitable for testing and confirming theories through several stag-es of complex analysis, while PLS-SEM is more suitable for research focusing on theory development. PLS-SEM aims to evaluate the potential relationships or impacts between variables. In PLS-SEM analysis, examination can be conducted without relying entirely on a solid theoretical foundation, does not require the assumption of normal data distribution, and can estimate parameters without requiring Goodness of Fit (GoF) assessment. The accuracy of the model's predictions is examined through the coefficient of determination values [48].

Hypothesis testing technique in this study involves the T-test. The T-test will be conduct-ed using bootstrapping method. Bootstrapping is a nonparametric procedure that allows for testing the statistical significance of various PLS-SEM results such as path coefficients, Cronbach's alpha, HTMT, and R^2 values [49]. According to Bahri [50], the T-test statistical technique is utilized to evaluate the individual impacts of each independent variable on the dependent variable. This study aims to assess whether electronic wallet, lifestyle, and financial literacy variables have significant partial impacts on consumptive behavior as the dependent variable. Testing is also conducted considering the significance determined by values ≤ 0.05 to indicate significant impacts of independent variables on the dependent variable.Evaluation of predictive relevance through the Q Square Test is fundamental in structural modeling, assessing the concordance between observed values and parameter estimations. A Q2 value surpassing 0 indicates the model's predictive relevance, while a negative Q2 value signifies its inadequacy in predictive relevance [51].There are specific criteria in this study, namely Generation Z individuals who are within the working age range, born between 1995 and 2008, residing in DKI Jakarta, who have worked or are currently working, and already have an e-wallet. The sample size for this study is 407 respondents, and questionnaire responses are measured using a 4-point Likert scale. Data analysis technique employs PLS-SEM with SmartPLS software. The examination of inter-variable relationships has been supported through the application of SmartPLS, as demonstrated in the research endeavors of Hutami et al. [52], Putra & Pasaribu [53], and Umar & Pasaribu [54].

III. Result And Discussion

Evaluation of measurement models

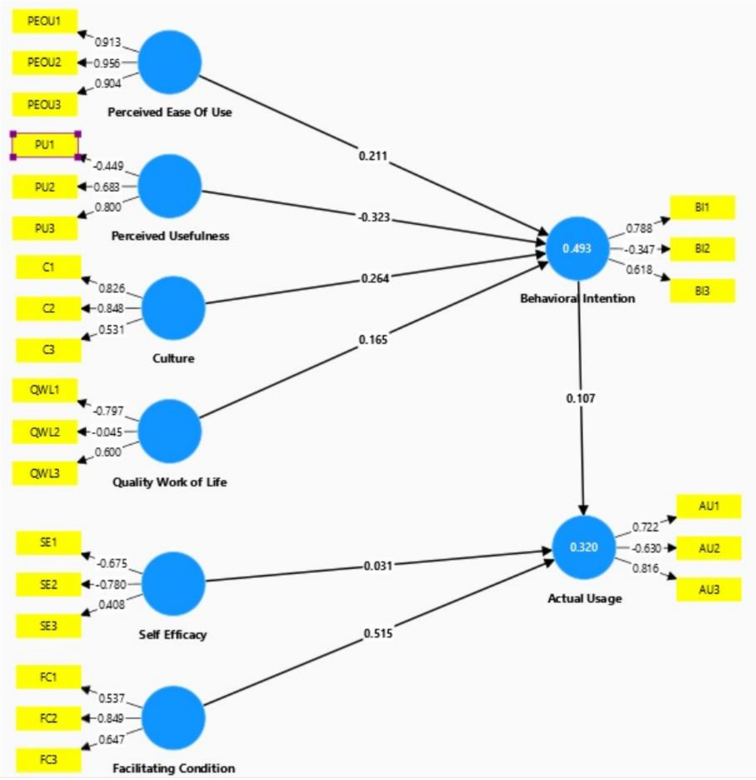
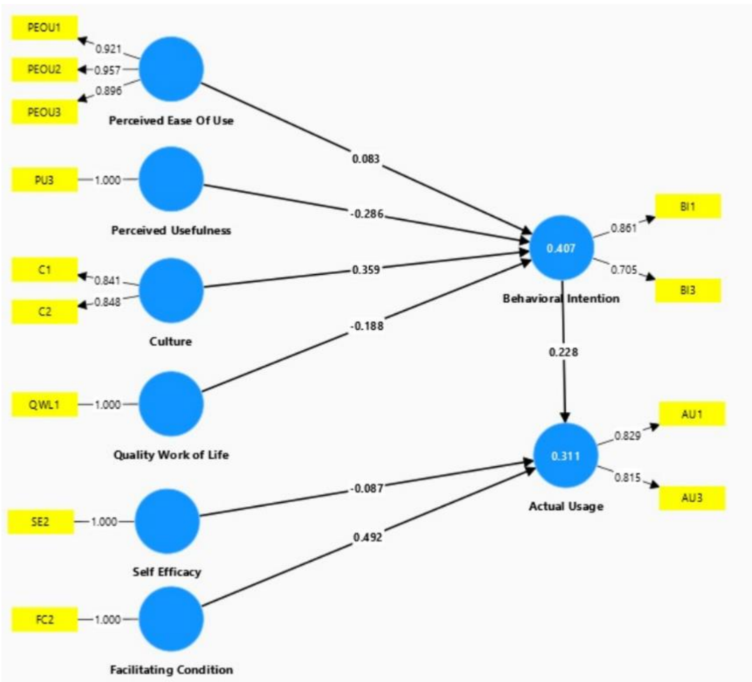


Figure 2: Initial Testing Result

In the Initial Testing results, indicators with loading values below 0.70 were eliminated, namely Perceived Usefulness (PU1 and PU2) and Culture (C3), Quality of Work of Life (QWL2, QWL3), Behavioral Intention (BI2), Self-Efficacy (SE1, SE3), Facilitating Condition (FC1, FC3), and Actual Usage (AU2). Furthermore, recalculations were carried out without changing the existing data and parameters. The results of the model improvement evaluation calculations can be seen in Figure 3

Figure 3: Final Testing Result



Reliability and construct validity were also met with a rho A value of more than 0.7 and an AVE value greater than 0.5. The discriminant validity value for this improvement also reached a valid value, with all values obtained being less than 0.85.

Structural Model Analysis

A structural model illustrates the relationships between constructs or variables. Below are the R^2 values generated by the Behavioral Intention and Actual Usage variables. The R^2 value for the behavioral intention variable is 0.311, meaning that 31.1% of the variability or diversity of the behavioral intention construct can be explained by other constructs within the model, while the remaining 68.9% is explained by variables outside this study. For the Actual Usage variable, the R^2 value is 0.407, meaning that 40.7% of the construct's diversity can be explained by other constructs within the model, while the remaining 59.3% is explained by variables outside this study.

R-square - Overview

	R-square	R-square adjusted
Actual Usage	0.311	0.306
Behavioral Intention	0.407	0.401

Table 1: R Square Value

Furthermore, the Path Coefficient value describes the strength of the relationship between constructs or variables. In this study, the variables with negative correlation coefficients were Perceived Usefulness to Behavioral Intention, Quality of Work Life to Behavioral Intention, and Self-Efficacy to Actual Usage as figure 5.

	Actual Usage	Behavioral Intention	Culture	Facilitating Condition	Perceived Ease Of Use	Perceived Usefulness	Quality Work of Life	Self Efficacy
Actual Usage								
Behavioral Intention	0.228							
Culture		0.359						
Facilitating Condition	0.492							
Perceived Ease Of Use		0.083						
Perceived Usefulness		-0.286						
Quality Work of Life		-0.188						
Self Efficacy	-0.087							

Table 2: Path of coeffisien value

Furthermore, the T-Statistic value for each relationship between variables is obtained with a value of more than 1.96 as a significant value as shown in table 4.10.

Hipotesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Keterangan
Behavioral Intention -> Actual Usage	0.228	0.229	0.047	4.869	0.000	Signifikan
Culture -> Behavioral Intention	0.359	0.358	0.039	9.258	0.000	Signifikan
Facilitating Condition -> Actual Usage	0.492	0.495	0.056	8.715	0.000	Signifikan
Perceived Ease Of Use -> Behavioral Intention	0.083	0.084	0.042	1.965	0.049	Signifikan
Perceived Usefulness -> Behavioral Intention	-0.286	-0.287	0.055	5.223	0.000	Signifikan
Quality Work of Life -> Behavioral Intention	-0.188	-0.187	0.055	3.408	0.001	Signifikan
Self Efficacy -> Actual Usage	-0.087	-0.089	0.059	1.482	0.138	Tidak Signifikan

Table 3: T-Statisic Value

Hypothesis Testing

Hypothesis testing in this study was conducted using a bootstrapping process in the SmartPLS application, which generated values from the direct effect of the research model. Based on the t-statistics and path coefficient values obtained, the hypotheses with a positive and significant relationship are listed in Table 4.11. Hypotheses H1, H3, H5, and H7 were accepted due to their positive and significant relationship. Meanwhile, H2, H4, and H6 were not positively related.

Hipotesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Behavioral Intention -> Actual Usage	0.228	0.229	0.047	4.869	0.000
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Perceived Usefulness -> Behavioral Intention	-0.286	-0.287	0.055	5.223	0.000
Quality Work of Life -> Behavioral Intention	-0.188	-0.187	0.055	3.408	0.001
Self Efficacy -> Actual Usage	-0.087	-0.089	0.059	1.482	0.138

Table 4: T-Statisic Value

Based on the interpretation of the model, the following is a discussion of each variable in the resulting model:

1. There is a positive and significant relationship between the Percieved Ease of Use variable and Behavioral Intention, thus the first hypothesis of this study is accepted. This means that employees' belief in using the system easily with minimal effort results in a desire to use the system.
2. There is no positive and significant relationship between the Percieved Usefulness variable and Behavioral Intention, therefore the first hypothesis of this study is rejected. This means that employees' level of belief that the system improves performance does not influence their desire to use the system.
3. There is a positive and significant relationship between the Culture variable and Behavioral Intention, therefore the third hypothesis of this study is accepted. This means that the work culture in the company results in a desire to use the system.
4. There is no positive and significant relationship between the Quality of Work Life variable and Behavioral Intention, therefore the fourth hypothesis of this study is rejected. This means that the level of comfort, physical, and psychological well-being does not influence the desire to use the system.
5. There is a positive and significant relationship between the Behavioral Intention variable and Actual Usage, therefore the fifth hypothesis of this study is accepted. This means that employees' desire to use the system influences their actual daily use of the system.
6. There is no positive and insignificant relationship between the Self-Afficacy variable and Actual Usage, therefore the sixth hypothesis of this study is rejected. This means that employees' confidence in their ability to use the system does not influence their actual daily use.
7. There is a positive and significant relationship between the Facilitating Conditions variable and Actual Usage, therefore the seventh hypothesis of this study is accepted. This means that the support of the system's infrastructure and technical team influences the actual daily use of the system.

IV. Conclusion

The purpose of this study was to determine the influence of a system's perceived ease of use (Ease of Use), its usefulness (Percieved Usefulness), the work culture in which the system operates, and its well-being (Quality of Work Life) on employees' behavioral intention to use the system. Furthermore, the study aimed to determine the influence of this intention, along with self-efficacy and infrastructure and technical team support (Facilitating Condition), on actual, ongoing, daily system use.

Based on the questionnaire data obtained and analyzed, it can be concluded that perceived ease of use and culture have a significant positive influence on behavioral intention. Percieved Usefulness and Quality of Work Life did not significantly influence actual system use. Actual system use, however, was positively and significantly influenced by behavioral intention and facilitating conditions. Self-efficacy did not significantly influence actual system use.

For further research, it is interesting to find out the reasons why Percieved Usefulness, Quality of Work Life, and Self-Efficacy do not have a positive and significant influence on Behavioral Intention and Actual Usage in the work environment of PT. XYZ.

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