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Unveiling critical factors of test automation adoption in software testing

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ABSTRACT

This paper aims to observe the adoption of test automation in Indonesia and examine the determining factors that influence the use of this technology in organizations. The study focuses on five critical factors: technology acceptance model, task-technology fit, managerial support (MS), individual performance, and organizational performance. A survey of 109 QA community members was conducted to collect data, and partial least squares structural equation modeling was used for data processing. Based on the study, Selenium is the top test automation framework used for organizations in Indonesia, followed by Appium and Postman. The result showed that out of twelve (12) examined relationships, nine (9) of them were accepted. This data indicates the strong influence of task technology fit (TTF), computer self-efficacy (CSE), perceived ease of use, perceived usefulness, and MS towards behavioral intention and actual use of test automation. Additionally, the actual use of test automation was found to have a positive impact on individual and organizational performance. The study contributes valuable insights for decision-makers by identifying critical factors influencing automation adoption and offers a replicable methodology for evaluating similar technologies.

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1. INTRODUCTION

The adoption of test automation has been increasing over the past decades in IT organizations [1]. This adoption is driven by its benefits such as increasing testing efficiency, coverage, time, and costs. Test automation is well-suited to cover the regression test that commonly has a bigger scope than other testing practices. This not only improves the accuracy but also shortens the tester's time and saves organization's money [2]. However, organizations frequently fail to achieve the benefits due to unrealistic goals, lack of management support, unclear testing approach, and insufficient resources [3]. In a recent survey among practitioners, it was stated that test automation was considered the most challenging testing activity. According to the survey of testing practices published by International Software Testing Qualification Board (ISTQB), around 65% of the 2000 worldwide software firms strive to mature their test automation processes, but only half consider their efforts effective. In the continuous integration (CI) context, an immature test automation process could lead to negative outputs, such as failed to detect integration effects effectively, higher costs, schedule overruns, and slow feedback loops, thus affecting product quality and release delay [4].

While maturing test automation remains a challenge, previous studies had discussed and observed regarding this technology adoption within organizations and their approach to maturing this adoption. This literature highlighted both from the academic perspectives and practitioners to evaluate this technology and how it affects the organizations. From the academic's perspective, Wang *et al.* [4], developed a self-assessment framework for evaluating test automation maturity through a literature review of 25 sources to initialize the instrument. Throughout the assessment, Wang discovered 15 key areas indicate where an organization should focus to assess test automation maturity: test automation strategy, resources, test organization, knowledge transfer, test tool selection, test tool usage, test environment, rest requirements, test design, test execution, verdicts, test automation process, software under test, measurement, and quality attributes [5].

To obtain the insight regarding the best practices to maturing test automation from practitioners' perspectives, Wang [3] were doing a survey in the current industry with 151 practitioners participating in the study coming across 101 organizations and 25 countries. Through the survey, they found out that the level of automation maturity in each organization might be different based on the practices they adopt. Another study by Wang *et al*. [4] examined the influence of test automation maturity towards the quality of product, test automation effort and release cycle in CI area from 37 open sources projects. The study discovered that the greater levels of test automation maturity, the greater of its influence on product quality and shorter release cycle [4].

When evaluating technology adoption in general, including test automation, most recent studies were integrating task technology fit (TTF) with the technology acceptances model (TAM). TAM developed by Davis, has two big concepts, perceived ease of use (PEOU) and perceived usefulness (PU). These two were proven to be affecting attitudes towards the technology and the use of it [6]. While TTF refers to the degree to which a technology helps an individual in doing his or her task. This theory drives the employment of information system (IS) and obtaining execution outcome are effective when there is a match between the characteristics of the IS and the task that should be carried out [7]. The study by Meskaoui and Elkharraz [8] aimed to recommend an extensive model that connects TAM with TTF approach, information quality, security, trust, and managerial support (MS) to find out the indented utilization of big data analytics (BDA) in banking and insurance firms. By integrating these two models, they found that TTF and trust influence the intention to use BDA. Information Quality positively influenced PU and PEOU. As for MS proven to be the mediator between PU and intention to use (IU) BDA, while security has not significantly affected the IU, and MS was not mediator of PEOU [8].

Another study by Kamdjoung [9] has examined the utilization of ICT in remote working environments during pandemic by integrating TTF theory with TAM and the diffusion of innovation (DOI) theory. The results discover that TAM strongly correlated with TTF. Moreover, there is a positive influence of the use of ICT on individual and organizational performance with user satisfaction has highly influences individual performance (IP), organizational performance (OP), and IS continuance intention. In regards of the realm of software testing, Ong *et al*. [10] observed and examined determinant factors influencing a career switcher in using software testing artifacts and its impacts on perceived performances during Covid-19 by extending the use of TAM integrated with TTF frameworks. Ong discovered that TTF had more influence on perceived performance impact. Computer self-efficacy (CSE) was highly predicting the PEOU. PEOU affirmed TAM as a strong predictor of actual system use (AU). While IU, PU, AU, and subjective norms were also significant factor influencing the impact of perceived performance [10].

While previous studies have explored test automation maturity and best practices, limited research focuses on the factors influencing its initial adoption. This study addresses this gap by examining determinants affecting test automation adoption in Indonesia's IT industry using the TAM-TTF approach. Hence, the objective of this study is to examine the determinant factors that might affect the adoption and use of test automation in IT industry in Indonesia using TAM-TTF approach moderated by external variables such as MSs, individual, and organizational performances.

2. METHOD

2.1. Research model

Figure 1 offers a model of this paper that integrates TAM, TTF, and external variables such as MS, IP, and OP. This integration offers a comprehensive clarity on the use of information systems, in this context test automation, satisfied the perceived needs of users [9]. This also the most frequently used models to observe the acceptance of technology, utilization, willingness, and motivation to use [11].

TTF is the model for measuring the degree to which a technology able to support a person to complete their work [8]. TTF is also utilized to evaluate the extent to which technology enhances task performance [9]. In this research, TTF could be referred to as the state to which users (software tester) could benefit from test automation to accelerate their task in testing a particular software more efficiently. Previous

findings have shown that TTF has a significant effect on PU and PEOU [10], [12]. For this concept, it could be hypothesized that:

- H1: TTF has a positive influence on the PU.
- H2: TTF has a positive influence on the PEOU.

CSE is the reaction of the person regarding his or her capability to complete works by utilizing a software package. In regards of this study, CSE can be declared as the user's perception in the ability to perform testing in the support of test automation. Previous findings have shown that CSE has positive influence on individual's PEOU and PU [10], [12]–[14]. Thus, the following hypotheses are made.

- H3: CSE has a positive influence on the PU.
- H4: CSE has a positive influence on the PEOU.

PU is an individual perception in the state of belief that using a system or application will develop his or her work. PU has been demonstrated to have a positive impact on the intention to use technology. PU of test automation can be defined as the factor that form the behavioral intention to use this technology. Hence, the hypothesis is constructed that:

- H5: PU has a positive influence on the IU of test automation.

PEOU is an individual's confidence in his or her ability to complete a certain work by utilizing a specific system [10]. PEOU of test automation can be defined as the user's belief in his or her capability in performing testing by using test automation. The previous findings shown that PEOU has positively influenced on the intention of using certain technology [10], [12]–[14]. It was constructing the following hypothesis:

- H6: PEOU has a positive influence on IU of test automation.

Prior research has emerged the importance of MS role as a main construct identifying the success of IS adoption. Top management support positively influences the adoption of mobile payment [14], [15]. MS mediated the impact on behavioral intention in adoption of big data analytics. Conversely, the result did not support the theory that MS highly mediates the perceived ease of use on behavioral intention [8], [16], [17]. Hence, this study would examine the below hypotheses in the context of the intention to use test automation in software testing:

- H7: The relationship between the PU and IU of test automation positively moderated by MS.
- H8: The relationship between the PEOU and IU of test automation positively moderated by MS.
- H9: MS has a positive influence on the AU of test automation.

IU is the people's intention in applying the technology. Prior studies have identified a favorable impact of IU on the actual use of technologies. The previous study presented that intention to use a certain technology have positive influence on actual usage of it [10]. This study would examine the relationship between the intention to use test automation and the actual use of it, thus it was constructed that:

- H10: IU has a positive influence on the AU of test automation.

The previous study showed that the use of technology has positive influences on both individual and organization performance [9]. In addition, an actual utilization of the software testing artifacts has positive influence on perceived performance individual [10]. This study would examine the impact of the actual use of test automation on both individual and organization performance, hence it was hypothesized that:

- H11: AU of test automation have positively influenced IP.
- H12: AU of test automation have positively influenced on OP.

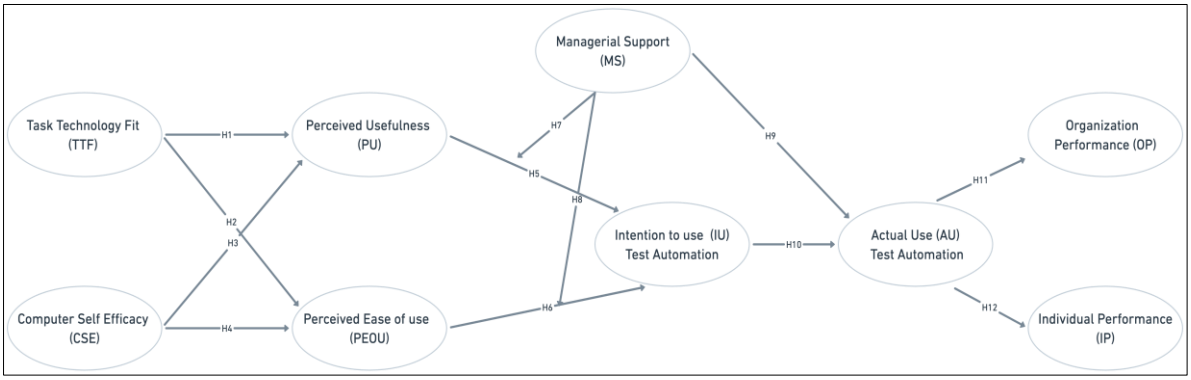

Figure 1. Research model

2.2. Survey design and execution

The study had distributed the questionnaire to discover the determinant factors that influence the use and adoption of test automation in IT company in Indonesia. Convenience sampling as a non-probabilistic sampling technique is used in this survey to gather respondents based on their interest in the survey. This technique is widely used in survey and empirical research in Software Engineering area [4]. The target population used in this study is the practitioners who work and experienced as software quality assurance (ISQA), specifically in automation role in the IT service industry in Indonesia. As the exact number of quality assurance (QA) population in Indonesia remain unknown, hence the sample size presented in this paper is determined by Lemeshow's formula with 95% confidence level. Based on the given formula, obtained min 95 respondents for this study [18], [19].

The survey in this study is documented using Google Forms. The survey consists of three sections. Section I is an introduction to the survey, including information and background of the researcher, details about the survey content, and the objective. Only respondents who admit that they are the right audience based on the given criteria and willingly to be participant in the study are directed to section II, otherwise, the survey is closed. Based on Table 1, section II presents 37 questions regarding determinant factors that affect the user in adopting and using test automation in software testing. The respondent should answer each question using a Likert scale; 1. strongly disagree, 2. disagree, 3. neutral, 4. agree, 5. strongly agree. Section III presents background questions to collect demographic information related to respondent and their organization which they conduct the test automation.

Table 1. Survey design

Variable	Indicator	Reference
TTF	The use of test automation is fit for my job role as QA	[20]
	Test automation can help me accomplishing my tasks	[20]
	Test automation is necessary for my work tasks	[20]
	Test automation is fit to my job as QA	[20]
PU	Using test automation improve my job performance	[20]
	Using test automation increase my productivity	[20]
	Using test automation improve my effectiveness in my work	[20]
	test automation is useful in my work	[20]
PEOU	My interaction with test automation is clear and understandable	[20]
	I find test automation is easy to use	[20]
	I find it easy to make test automation do what I prefer to do	[20]
	Studying to execute test automation is easy for me	[20]
MS	Most of the time, manager entangle their staff in important decision-making process regarding test automation	[8]
	Staff learning in test automation has been viewed as an investment rather than an expense	[8]
	The management have a positive view at transformation in test automation to adjust to new changes and or to not left behind	[8]
	The employees learning curve in test automation is considered a key factor in the company	[8]
	Novel ideas regarding test automation are rewarded	[8]
CSE	I am confident in the utilization of test automation although no one would help me	[20]
	I have capability in using test automation	[20]
	I am confident in using software testing even if I only have limited resources	[20]
	I am confident in using the software testing tool's feature	[20]
IU	assuming I have test automation in place, I intend to use it	[20]
	Given I have test automation in place, I predict that I would use it	[20]
	I intend to use test automation in the future	[20]
	I will continue using test automation increasingly in the future	[20]
AU	I use test automation frequently	[20]
	I use test automation on daily basis	[20]
	I depend on test automation	[20]
	I use multiple features of test automation	[20]
IP	Test automation could help me in accomplishing my forthcoming target	[20]
	test automation supports me acquiring new knowledge	[20]
	test automation helps me acquiring new skills	[20]
	test automation will help me in completing my task easier	[20]
OP	Test automation helps the company accomplish task faster	[9]
	Test automation enables employees to complete their missions more easily	[9]
	Test automation improves communication among employees in the company	[9]
	Test automation helps the company to improve its operational management	[9]

2.3. Data analysis and validity

To analyze the collected data obtained from a questionnaire, the study will be employing partial least square structural equation modeling (PLS-SEM) with the support of SMART-PLS statistical tools. PLS-SEM method is widely used by prior studies as it empowers them to design a complicated model with many

constructs, indicator variables, and structural paths without impressing distributional assumptions on the data [20]. The Outer model is used to ensure that the used measurement is feasible to be used as a measurement (valid and reliable). There were two techniques used in this study namely, validity test and reliability test. The inner model is used to examine the relationship between independent and dependent variable. This study employed R square technique as the coefficient of determination on endogenous variable and path coefficient to evaluate the given hypotheses of the study. Bootstrapping is employed to validate the hypotheses.

3. RESULTS AND DISCUSSION

3.1. Participant demographic

The questionnaire has been distributed through google from to Indonesia ISQA community as representative of QA professional in Indonesia through direct messaging and broadcasting of the form to their social media (Telegram, Discord, and LinkedIn). There were 109 respondents have filled out the questionnaire from 29th of May – 5th of July 2024. Seven (7) of them did not pass the screening questions based on the given criteria, thus, their data was excluded from this study. The selected criteria were based on their working experiences in QA and test automation and have been developing and executing automation framework implemented in organizations located in Indonesia. Hence, there were 102 respondents have succeeded in completing the given questionnaire.

Table 2 provides the profile of the respondent based on their demographic. Table 3 provides the automation test tools and tech stack mostly used by the QA practitioner in Indonesia. In terms of its platform, web still being the top platform used to be automated, followed by services and mobile. For the tech stack, Selenium, which used to automate web platforms, being the automation framework mostly used for organizations and enterprises in Indonesia. Another framework such as Appium and Postman also still being mostly used in industry. This finding support by previous works which discovered Selenium to be the to be the better testing tools in terms of its adaptability and cross compatibility than others such as LoadRunner, Junit, Cypress, Rapise, Serenity, Galen, Avo Assure, Kobiton, and ZapTest [21], [22].

Table 2. Respondent demographic

Measure	Value	Percentage
Gender	Male	76.5%
	Female	23.5%
Age	17-20	1%
	21-29	57.8%
	30-39	39.2%
	> 40	2.0%
QA Working experience	Fresh graduate	3.9%
	1-2 years	30.4%
	3-5 years	30.4%
	5-10 years	30.4%
	>10 years	4.9%
Position/Role	Intern	3.9%
	Staff	67.6%
	Lead/SPV	20.6%
	Manager	6.9%
	Freelancer	1%
Education background	High school	5.9%
	Diploma	8.8%
	Bachelor (S1)	82.4%
	Master (S2)	2.9%
Company type	Start-up	41.2%
	IT consultant	21.6%
	Private owned	28.4%
	State owned	4.9%
	Government	2.9%
	Non-Profit Org	1%
Company business sector	Banking/Fintech	29.4%
	e-commerce	20.6%
	SaaS	17.6%
	Healthcare	2.9%
	Property	2.9%
	social media	3.9%
	Ride Hailing	4.9%
	Public Service	2.9%
	Others	12%

Table 3. Test automation tech stack

Measure	Value	Percentage
Platform	Web	87%
	API/Services	75%
	Mobile	71%
	Others	5.1%
Language programming	Java	74.51%
	Javascript	52.94%
	Phyton	36.27%
	Groovy	25.49%
	Ruby	8.82%
	No code (play & record)	7.84%
	Others	5.88%
Test automation framework	Kotlin	3.92%
	Golang	3.92%
	Ruby	8.82%
	Kotlin	3.92%
	Selenium	75.50%
	Appium	61.80%
	Postman	59.80%
	Katalon	49%
	Cypress	33.30%
	Playwright	33.30%
	Robot framework	30.40%
	RestAssured	26.50%
	Karate	6.90%
	webdriver.io	4.90%
	Others	8.82%

3.2. Outer model measurement

This study employed a convergent validity test to measure the respondent's understanding of the given statement with loading factor greater than 0.7 [11]. Table 4 describes the result of the convergent validity test from each indicator. The result shows that all indicators have a loading factor greater than 0.7, thus indicating the validity of this measurement.

Table 4. Convergent validity test

Latent variable	Indicator	Outer loading	Latent variable	Indicator	Outer loading
TTF	TTF1	0.901	AU	AU1	0.908
	TTF2	0.900		AU2	0.936
	TTF3	0.846		AU3	0.759
	TTF4	0.905		AU4	0.845
CSE	CSE1	0.865	MS	MS1	0.763
	CSE2	0.875		MS2	0.811
	CSE3	0.864		MS3	0.855
	CSE4	0.877		MS4	0.872
PU	PU1	0.886	IP	IP1	0.869
	PU2	0.878		IP2	0.880
	PU3	0.901		IP3	0.819
	PU4	0.915		IP4	0.846
PEOU	PEOU1	0.879	OP	OP1	0.845
	PEOU2	0.891		OP2	0.885
	PEOU3	0.907		OP3	0.829
	PEOU4	0.874		OP4	0.867
IU	IU1	0.909			
	IU2	0.943			
	IU3	0.872			
	IU4	0.898			

Besides the convergent validity test, the study also used a discriminant validity test (formell-larcker criteria) to ensure that the respondent's answer to the variable is not disturbed due to the perception of the previous variable. To evaluate the reliability of the construct, their square root values of the average variance extracted (AVE) should be greater than the inter-construct correlation [8]. Table 5 shows that all construct' AVE value were greater than their shared variant with other construct, hence all used constructs are valid.

Table 5. Discriminant validity test (formell-lacker criteria)

Construct	AU	CSE	IP	IU	MS	PEOU	PU	TTF
AU	0.865							
CSE	0.690	0.870						
IP	0.599	0.553	0.854					
IU	0.621	0.651	0.804	0.906				
MS	0.527	0.532	0.649	0.649	0.826			
OP	0.576	0.508	0.704	0.666	0.694			
PEOU	0.626	0.764	0.543	0.611	0.548	0.888		
PU	0.538	0.540	0.673	0.742	0.606	0.552	0.895	
TTF	0.625	0.563	0.700	0.776	0.591	0.526	0.750	0.888

To measure the reliability of the measurement, this study used composite reliability and Cronbach's alpha. Composite reliability is a measurement if the value is greater than 0.7, the value of the variable has a high reliability value. Cronbach's alpha is a calculation to prove the result of composite reliability where the minimum amount is 0.6 [23]. Table 6 shows that all constructs have composite reliability value greater than 0.7, and none of Cronbach alpha value less than 0.6. Thus, indicating all constructs are reliable to be used as measurement.

Table 6. Cronbach's alpha and composite reliability test

Construct	AVE	Cronbach alpha	(rho_a)	(rho_c)
AU	0.748	0.887	0.913	0.922
CSE	0.757	0.894	0.899	0.926
IP	0.729	0.879	0.906	0.915
IU	0.820	0.927	0.932	0.948
MS	0.683	0.844	0.853	0.896
OP	0.734	0.879	0.883	0.917
PEOU	0.788	0.911	0.917	0.937
PU	0.801	0.918	0.926	0.942
TTF	0.789	0.911	0.920	0.937

3.3. Inner model measurement

The R-squared values of the dependent variable quantify the explanatory power of the model. There are four (4) levels of R2 rating in the interpretation of this indicator in scientific research with management issue; R2 < 0.25 is very weak, 0.25 <= R2 < 0.50 is weak, 0.50 <= R2 < 0.75 is moderate, and R2 >= 0.75 is substantial [9]. Based on Table 7, the variance of PEOU, PU, and IU variables could be moderately explained by independent variables. While the AU, IP, and OP variables could be weakly explained by independent variables.

Table 7. Coefficient result

Dependent Variables	R2	R2 Adjusted	Interpretation
PEOU	0.597	0.589	Moderate
PU	0.583	0.574	Moderate
IU	0.686	0.668	Moderate
AU	0.385	0.379	Weak
IP	0.359	0.352	Weak
OP	0.332	0.325	Weak

3.4. Hypothesis testing

The bootstrapping method was employed to gauge the causal relationship between variables. Based on the hypothesis testing results from Table 8, the statistical significance of each relation could be determined by the T-statistics and P-value. If the T-statistics is greater than 1.96 and the p-value less than 0.05, then hypothesis is accepted. The result shows that nine (9) hypotheses have been proven statistically significant and accepted. While there are three (3) hypotheses that have less significant impact and were rejected. The three rejected hypotheses were having T-Statistics less than 1.96 and p-value greater than 0.05.

Table 8. Hypothesis testing

Path	Coefficient	T statistic	P value	Result
TTF ->PU	0.651	8.653	0.000	Significant
TTF->PEOU	0.140	1.696	0.090	Insignificant
CSE->PU	0.174	2.318	0.020	Significant
CSE->PEOU	0.686	9.202	0.000	Significant
PU->IU	0.477	3.446	0.001	Significant
PEOU->IU	0.215	2.598	0.009	Significant
IU->AU	0.621	10.811	0.000	Significant
AU->IP	0.599	10.993	0.000	Significant
AU->OP	0.576	7.040	0.000	Significant
MS -> AU	0.217	2.022	0.043	Significant
MSxPU->IU	-0.087	0.790	0.429	Insignificant
MSxPEOU->IU	-0.087	0.893	0.372	Insignificant

3.5. Discussion

The findings of this study highlight the integration of TAM-TTF framework in understanding the adoption of test automation within organization in Indonesia. TTF was found to significantly influence PU. This indicates that test automation is most beneficial when it aligns well with the tasks at hand, supported by previous works [10], [12]. This highlights the importance of selecting and customizing automation frameworks that fit an organization's specific testing requirements.

TTF was insignificantly influenced PEOU. Most of the users found test automation was challenging to use. Nevertheless, they still utilize it considered the fitness of this technology with the QA task. The finding contradicted with previous works that found TTF had a significant influence on PEOU [10], [12]. The differences might occur as this study observed the different technology adoption compared to the previous works. Based on this finding, the organizations should focus on conducting more training and develop a user-friendly framework to bridge this gap.

CSE emerged as a critical factor, demonstrating a strong positive influence on both PU and PEOU of test automation. The study reveals that testers with greater confidence in their technical skills perceive automation as more beneficial, supported by previous works [24], [25]. This validates the need for professional development initiatives, such as skill-based training, mentorship programs, and certification courses, to enhance self-efficacy among QA professionals.

PU and PEOU have shown significant influences on intention and actual use of test automation. This finding indicates that the ease of learning of test automation tools and how the users perceived the beneficial of this technology in their job as QA Engineer plays a crucial role in adoption decisions. These findings align with prior research in technology acceptance, emphasizing that usability and perceived benefits directly impact an individual's willingness to integrate new technologies into their workflow [8], [10], [12].

Furthermore, the study discovered that AU has a significant influence on both IP and OP, supported by previous work [9], [10]. Frequent use of test automation contributes to increased efficiency, accelerated testing phase, and enhanced bug detection capabilities at the individual level. These benefits extend to the organizational level, where automation facilitates faster software release cycles, improves product quality, and enhances overall team productivity [4]. These findings highlight the strategic importance of test automation in modern software development environments, reinforcing its role in driving efficiency and competitive advantage.

While MS is often considered a critical factor in technology adoption, this study found that MS did not significantly moderate the relationships between PU and IU, nor between PEOU and IU, opposed with the previous work [8]. This imply that while management backing is valuable, the decision to adopt automation is primarily driven by individual and team-level motivations. Based on the respondent feedback, the user, in this case, QA Engineer more likely considered other factors such as their confidences and technical expertise in utilizing test automation to get the job (software testing) done. The organizations, specifically higher-up management, should empower QA teams with their support in investment to this technology. This aligned with the study finding that MS has exhibited positive influences on AU of test automation in the organization.

Apart from identifying the critical factor in adopting test automation, this study also collected a valuable insight among QA respondents. Most of them addressed the importance of test automation in supporting QA activities in software testing such as regression tests. They also highlighted the benefits of test automation in accelerating release cycle, improving team productivity, and product quality. However, QA practitioners were not neglecting the needs of manual testing to cover certain areas that test automation struggles to address effectively. Areas such as user interface (UI), user experience (UX), as well as the enhancement of new features still require manual testing. As resulted, hybrid approach combining manual

and test automation is widely practiced in Indonesia. This accordance to a recent annual survey by ISQA in 2023, where 56.5% or 256 out of 453 respondents were practicing this approach in their organization.

This study revealed that while most of studies in western context found ease of use as strong predictor of the technology adoption, the usability remains a challenge even when automation aligns with task requirements in Indonesia. Respondents highlighted the gaps between test automation training and the real project application, making the adoption remain a challenge. Additionally, most of the QAs have lack knowledge of fundamental testing principal before migrating into automation, leading to suboptimal implementation within organization.

This study also highlighted another insight related to the different test automation approach in Indonesia. While global trends often emphasize a shift toward full automation, our study shows that Indonesian QA teams continue to rely on a hybrid model. In Indonesia, test automation was more likely used to support regression and sanity test, and not as the substitution of the whole testing process. This highlights the importance of maintaining a balanced testing strategy rather than striving for full automation adoption. Despite its advantages, test automation adoption presents challenges such as higher investment in the initial adoption, technical skill gaps among QAs, management misconceptions, and unstable automation [6], [26], [27]. To drive the benefits, organizations should enhance automation maturity by integrating it to CI/CD, leveraging AI, providing hands-on training by case studies from the real project, and allocating a sufficient budget for tools, test infrastructure, and maintenance.

4. CONCLUSION

The findings of this study highlight the critical factors influencing the adoption of test automation by providing actionable insights for researchers, QA practitioners, and high-level management within organizations in Indonesia. By recognizing the importance of task-technology fit, addressing usability challenges, and fostering individual confidence in automation, organizations can enhance their test automation strategies effectively. Future research could expand on these findings by exploring industry-specific challenges in test automation adoption in Indonesia. In addition, the organization should consider more training on case studies basis for QAs and top management should support the team for sufficient budget allocation and investment in automation to aid in maturing the system to drive its benefits.

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C : **C**onceptualization
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R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are openly available in the Zenodo repository at https://doi.org/10.5281/zenodo.15164966.

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