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ANALYSIS OF FACTORS AFFECTING THE SUCCESSFUL IMPLEMENTATION OF KESELAMATAN KONSTRUKSI APPLICATIONS

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ABSTRACT

Occupational safety problems in Indonesia are still neglected, causing a high number of work accidents. One of the factors causing the accident is the lack of knowledge, utilization and supervision of Personal Protective Equipment (PPE). Efforts to overcome these problems are by developing information systems, especially mobile-based applications called Keselamatan Konstruksi applications. This study aims to examine the factors that affect the acceptance and use of this information system using the Technology Acceptance Model (TAM) model. These factors include the influence of perception of ease of use, perception of utility, attitude of use, behavior to continue using and the level of user understanding on the successful implementation of the Keselamatan Konstruksi application. The data for this study was collected through a questionnaire given to construction workers who used the Keselamatan Konstruksi application. The data that has been collected is then analyzed for multiple linear regression. The findings in this study reveal that the attitude of use in using the application and the influence to continue using the application have a positive effect on the successful implementation of the Keselamatan Konstruksi application.

KEYWORDS *Personal Protective Equipment (PPE), Mobile Application, Occupational Safety, PPE Supervision, PPE Knowledge, PPE Use*

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INTRODUCTION

The potential increase in the number of occupational accidents in Indonesia may be due to the lack of awareness among workers of the importance of Occupational Safety and Health (K3). Construction service companies must pay attention to the role played by their workforce, because the workforce has a very significant role in the continuity of the company's operations (Rahmawati et al., 2019).

The top priority for workers and companies is occupational safety, which is regulated in the Labor Law. A common understanding of occupational safety based on applicable regulations needs to be possessed by companies and workers. Using Personal Protective Equipment (PPE) based on established guidelines is one of the important aspects, where this PPE includes various equipment that must be worn by workers based on the type of hazards and work risks faced. The main function of PPE is to keep workers and people around them safe. In addition, companies also have an obligation to provide PPE in accordance with the Indonesia National Standard (SNI) to their workers (Gaol et al., 2022; Rizqa et al., 2023).

Awareness in using PPE and occupational safety behavior is still lacking due to a low occupational safety culture, and other problems are that government regulations related to K3 are not adequate enough in overcoming several accident incidents and their implementation in construction projects is still inadequate (Park & Park, 2020). Many construction workers today often ignore the use of PPE because they feel that the use of PPE can hinder their productivity because they feel uncomfortable. However, PPE actually has a very crucial role in protecting workers from potential hazards or accidents during construction work (Irzal, 2016).

The lack of implementation of the use of Personal Protective Equipment (PPE) by workers can be caused by various factors and one of them is the lack of careful supervision from company management, especially related to the use of PPE. Although the company has issued regulations related to the use of PPE, if there is no effective supervision, the regulations may not be followed by workers. Therefore, direct supervision from the company's management is needed so that this regulation can be implemented properly. To achieve effective supervision, the management of the company needs to carry out activities such as inspections, checks, inspections and similar actions. The goal is to prevent undisciplined behavior from workers related to the use of PPE and reduce the risk of work accidents that may occur (Liu et al., 2018).

Personal Protective Equipment (PPE) is a device that has the capability to protect individuals by isolating part or all of the body from potential hazards in the work environment. Construction workers and other people who are in the work area must and are obliged to wear PPE at all times. In order for PPE to be effective in protecting safety, the use of PPE must be in accordance with standards and refer to the Indonesia National Standard (SNI). Types of PPE used in the construction sector include:

1. Head Protector
2. Eye and Face Protection
3. Ear Protectors
4. Respiratory Protection

5. Foot Guard
6. Hand Protectors
7. Protective Clothing
8. Individual Fall Protective Equipment

According to researchers, there are obstacles in the use of PPE that affect workers who do not use PPE when doing construction work or who are at construction project sites which often occur to this day. Based on the results of observations in the field, there are obstacles in the use of PPE, namely:

1. Workers find it difficult to use PPE, feel uncomfortable or find it difficult to do work using the PPE available.
2. Workers are not disciplined in using PPE when doing construction work.
3. Workers do not demand work safety guarantees because the quality of workers' Human Resources (HR) is still low.
4. Workers' knowledge about the importance of using PPE is still low.
5. Less strict supervision by the company's management or construction service providers in the use of PPE for workers.
6. Lack of supervision and sanctions from the government against construction companies or service providers that are proven not to supervise construction workers on the use of PPE during construction work.

Construction service companies with small to medium scale are still experiencing the problem of undisciplined behavior of workers in using PPE. The lack of firmness and supervision problems against the indiscipline of workers in using PPE still occurs today. The knowledge factor of the importance of using PPE also has a great influence on the indiscipline and motivation of workers in using PPE while carrying out construction work will have an impact on the work safety culture (Elshafey et al., 2020; Fassa, 2020; Hasibuan et al., 2020).

The implementation of an effective occupational safety culture has the potential to reduce the likelihood of occupational accidents caused by individual workers' errors. This will increase awareness of potential risks, encourage workers to follow every procedure in each stage of work and report any errors or shortcomings that may occur. The purpose of implementing occupational safety is to prevent and reduce the possibility of occupational accident risk (Bilqis et al., 2021).

An effort to overcome the current problems that occur in small to medium-scale construction companies or service providers to several PPE problems in this study, by creating and developing an information system in the form of a mobile-based application or smartphone with an Android operating system developed based on the current problems. The Keselamatan Konstruksi Application was created and developed as one of the occupational safety management applications, which at the time of this research had two services that focused on occupational safety issues, namely PPE (Arifuddin et al., 2020; Fenelia & Herbawani, 2022;

Mola & Herlina, 2020). These services are in the form of e-learning services which are learning and training services for construction workers on work safety in the use of PPE and e-controlling services which are monitoring and reporting services for construction service providers on work safety in the use of PPE.

The development of smartphone-based mobile applications has also had an impact on the construction industry, including several smartphone-based mobile applications in the construction industry that can help in terms of productivity, inspection, and construction management. Examples of smartphone-based mobile applications in the construction industry are:

Table 1. **Smartphone-Based Mobile Application**

t	App Name	About the App
1	Raken Construction Management	A daily construction and field management report app. With the services provided including daily reporting, time cards, toolbox talks, and construction photos that can save time and costs for the field reporting process.
2	Safety Culture (iAuditor)	An inspection application that allows users to conduct safety inspections and audits more quickly, consistently, and accurately. The app is designed to streamline communication, so all necessary parties are immediately notified if a safety risk is found.
3	Safesite Safety Management App	A safety management system application for teams and individuals who want to prioritize safety. Allows teams and individuals to easily conduct paperless safety inspections, audits, incident reports, toolbox discussions and more through the app.
4	Construction Safety	A construction industry occupational safety application in Indonesia that is being developed by researchers that allows application users to learn, train, supervise, report and evaluate occupational safety, especially PPE management through the application.

Table 1 above can explain some examples of the development of smartphone-based mobile applications in the construction industry today which are quite popular on Google Play services in Indonesia, in addition to that researchers have created, developed and published Keselamatan Konstruksi applications on Google Play services that can be accessed by smartphone application users based on android nationally and added a list of applications regarding Occupational Safety and Health in the construction industry that can be accessed through Google Play services.

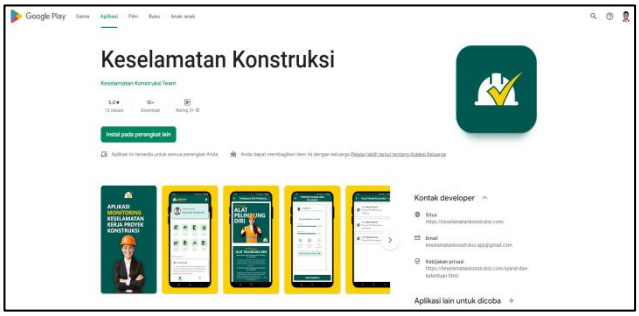

Figure 1. Researchers Develop Keselamatan Konstruksi Applications

Figure 1 above can explain the page on Google Play about the application that the researcher has developed, namely the Keselamatan Konstruksi application on Google Play services. The Keselamatan Konstruksi Application that has been developed by researchers is a mobile-based work safety application that focuses on occupational safety in the construction industry, especially in terms of knowledge, use and supervision of Personal Protective Equipment (PPE). The Keselamatan Konstruksi Application was created and developed based on several findings or problems related to the knowledge, use and supervision of PPE in the construction industry that has occurred to date (Romandhon et al., 2022; Sehsah et al., 2020; Syakti, 2019; Wong et al., 2021). Factors such as the lack of knowledge and motivation in the use of PPE, the limitation of the provision of PPE, the lack of supervision, and the lack of sanctions from the management of the company or service providers, have an influence on the level of compliance of construction workers in using PPE during the implementation of construction projects.

The development of the Keselamatan Konstruksi application is an effort to realize the safe behavior of workers when carrying out construction project work and become a solution to problems that occur regarding work safety, especially in PPE problems through the development of information systems in the form of mobile or smartphone-based applications.

The objectives of the development of the Keselamatan Konstruksi application carried out by the researcher include:

1. As one of the efforts to support the implementation of PPE management as stated in the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No. PER.08/MEN/VII/2010 concerning Personal Protective Equipment which is the government's effort to minimize various failure factors in the implementation of PPE in companies.
2. As one of the efforts to provide services for construction workers in work safety knowledge and/or the use of PPE through a mobile-based Keselamatan Konstruksi application that can be accessed anywhere as an effort to improve the quality of Human Resources (HR) of construction workers through e-learning services on the Keselamatan Konstruksi application.

3. As one of the efforts to provide services for company management in supervising the use of PPE to workers and to determine the level of compliance of workers in using PPE through e-controlling services on the Keselamatan Konstruksi application.

In the implementation of the Keselamatan Konstruksi application, users will face several obstacles, one of which is the acceptance of information system technology, especially for workers and companies or service providers. The implementation of the Keselamatan Konstruksi application will trigger both positive and negative responses from application users, so analysis is needed to determine whether users will accept or reject the application. One of the models used to illustrate and predict technology acceptance by users is the Technology Acceptance Model (TAM). The purpose of TAM is to explain and estimate how users will receive a technology, in this context a Keselamatan Konstruksi application.

This study will explore the factors that affect the successful implementation of Keselamatan Konstruksi in construction workers who use the application. In accordance with the TAM indicators that have been presented, such as the perception of ease of use, the perception of usefulness, the attitude of use and the behavior to continue using the application and add one additional indicator outside the TAM theory, namely the level of user understanding. This indicator is considered to have an important impact on the successful implementation of the Keselamatan Konstruksi application.

The purpose of this research is to be able to improve occupational safety, especially in facing problems in the knowledge, use and supervision of Personal Protective Equipment (PPE) by utilizing the development of information system technology in the form of Keselamatan Konstruksi applications and to find out what factors affect the success of the implementation of Keselamatan Konstruksi applications based on the technology acceptance model, namely the Technology Acceptance Model (TAM). the influence of perception of ease of use, perception of usefulness, attitude of use, behavior to continue using and the level of user understanding on the successful implementation of the Keselamatan Konstruksi application.

With a research hypothesis which is a temporary answer to a problem that is still prejudiced or conjecture because it needs to be proven true with data collected through research. These problems will be formed into a question so that the truth will be tested. Based on the above descriptions, the following hypotheses can be formulated:

1. Hypotheses 1 (H1)
   The perception of ease of use of the application has a positive effect on the successful implementation of the Keselamatan Konstruksi application.
2. Hypotheses 2 (H2)
   The perception of the usefulness of using the application has a positive effect on the successful implementation of the Keselamatan Konstruksi application.

3. Hypotheses 3 (H3)
   The attitude of using the application has a positive effect on the successful implementation of the Keselamatan Konstruksi application.
4. Hypotheses 4 (H4)
   The behavior to continue using the application has a positive effect on the successful implementation of the Keselamatan Konstruksi application.
5. Hypotheses 5 (H5)
   The level of understanding of application users has a positive effect on the successful implementation of the Keselamatan Konstruksi application.

RESEARCH METHOD

This research examines the implementation of Construction Safety applications on small to medium-sized construction projects that face challenges in the use of Personal Protective Equipment (PPE). This study uses a quantitative method based on a positivistic approach, where data is collected through questionnaires and analyzed using statistical techniques (Sugiyono & Lestari, 2021). The research data consisted of primary data, which was collected directly from respondents through questionnaires, as well as secondary data obtained from various sources such as books, journals, and company data. The research population includes construction workers who work in various projects and use the Construction Safety application, with a target number of respondents between 50 to 100 people.

To measure the effectiveness of this application, the multiple linear regression analysis method was used, which aims to assess the influence of various factors on the successful implementation of the application (Ghozali, 2018). The independent variables tested included perceived ease of use of the application, perceived usefulness, attitude towards use, intention to continue using the application, as well as the level of user understanding. Validity and reliability tests were conducted to ensure the consistency of the research instruments, with Cronbach's Alpha measurement used as the reliability indicator. A Likert scale was applied in the questionnaire to assess respondents' responses related to the effectiveness of the application (Sugiyono, 2018).

In the data analysis process, a classical assumption test was conducted to ensure the regression model used met the criteria for valid statistics. The normality test is applied with the Kolmogorov-Smirnov (K-S) method to determine whether the data distribution is normal or not. Multicollinearity test is used to identify the possibility of strong relationships between independent variables that may interfere with the accuracy of the regression results. In addition, the heteroscedasticity test is conducted to assess whether the residual variance remains consistent across the data. To test the hypotheses simultaneously and partially, the F test and T test were used, where the results of the analysis showed that the attitude of using the

application and the intention to continue using the application had a significant influence on the success of the implementation, while the ease of use factor, application benefits, and the level of user understanding did not show a significant influence.

RESULT AND DISCUSSION

Quantitative Data Analysis

In this study, quantitative data was used to analyze the results of the assessment of each application variable using a simple method, namely the mean value.

Table 2. Quantitative Data Analysis

Variable	Mean
Perception of Ease of Use of the Application	4.40
Benefits of Using the Application	4.35
Attitude of Application Usage	4.40
Influence to Keep Using the App	4.31
Level of Understanding of Application Usage	4.25
Average of all variables	4.34

Based on Table 2 above, it shows that the mean value for all variables gets a value of 4.34. Based on the average value, the interpretation used in determining the level or size of influence with a value of 4.34 has a very strong influence.

Validity and Reliability Test

Validity and reliability tests are carried out to determine how accurate a measuring instrument is that is able to perform functional analysis from research questionnaires or questionnaires. The measuring instrument used in testing the validity of a questionnaire or questionnaire is the correlation between the overall value of the respondent's question and related information.

The respondent's question is said to be valid if the calculation is greater than the table. To find the value of the table with a value of N of 50 at a significance of 5% in the distribution of the value of the statistical table, then the value of the table is 0.279. The question is said to be reliable, then the answer given by the respondent must be consistent or Cronbach's alpha value > 0.60.

Table 3. Validity Test

Indicator	Calculate	Table	Information
X1.1	0.609	0.279	Valid
X1.2	0.644	0.279	Valid
X1.3	0.641	0.279	Valid
X2.1	0.649	0.279	Valid
X2.2	0.631	0.279	Valid
X2.3	0.652	0.279	Valid
X3.1	0.671	0.279	Valid
X3.2	0.671	0.279	Valid

X3.3	0.597	0.279	Valid
X4.1	0.646	0.279	Valid
X4.2	0.543	0.279	Valid
X4.3	0.750	0.279	Valid
X5.1	0.793	0.279	Valid
X5.2	0.743	0.279	Valid
X5.3	0.659	0.279	Valid
Y1	0.558	0.279	Valid
Y2	0.658	0.279	Valid
Y3	0.504	0.279	Valid
Y4	0.643	0.279	Valid
Y5	0.606	0.279	Valid
Y6	0.621	0.279	Valid

Based on the test results in Table 3 above, the observation from the table shows that the value of the N sample of 50 is 0.279. Therefore, the results of the validity test show that all instruments consisting of the indicators in the table above, as a whole, produce a calculated value > the table so that it can be concluded that all questions are valid.

Table 4. Reliability Test

Variable	Croncbach's Alpha	Coefficient value r	Information
X1	0.725	0.60	Reliable
X2	0.851	0.60	Reliable
X3	0.676	0.60	Reliable
X4	0.610	0.60	Reliable
X5	0.891	0.60	Reliable
And	0.725	0.60	Reliable

Based on the results of the test in Table 4 above, the processing shows that the Cronbach's alpha value of variable X1 gets a value of 0.725 > 0.60, variable X2 gets a value of 0.851 > 0.60, variable X3 gets a value of 0.676 > 0.60, variable X4 gets a value of 0.610 > 0.60, variable X5 gets a value of 0.891 > 0.60 and variable Y gets a value of 0.801 > 0.60. All variables in this study have a Cronbach's alpha value of > 0.60, so the results of this study have met the requirements of the reliability test to then be used as a measuring tool and all variables are declared reliable.

Classical Assumption Test

Normality Test

The purpose of the normality test is to find out how each variable is distributed whether it is normal or not. The following normality test results can be seen in the following table:

Table 5. Normality Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		50
Normal Parameter[a,b]	Mean	.0000000
	Std. Deviation	1.63694774
Most Extreme Differences	Absolute	0.79
	Positive	0.62
	Negative	-0.79
Test Statistic		0.79
Asymp. Sig. (2-tailed)		0.200
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		
d. This is a lower bound of the true significance.		

Based on the test results of Table 5 above, it shows that the results of the normality test are known to get a significance value of 0.200 > 0.05 so that the data used has a normal distribution.

Multicollinearity Test

The purpose of the multicollinearity test is to find out whether the regression model in this study can be found to have a correlation between independent variables or independent variables. To find out whether or not there is multicollinearity, the results of the multicollinearity test can be seen in the following:

Table 6. Multicollinearity Test

Model	Tolerance	Variance Inflation Factor (VIF)
X1	0.476	2.099
X2	0.581	1.720
X3	0.464	2.156
X4	0.387	2.583
X5	0.471	2.123

Based on the results of the test in Table 6 above, it shows that the results of the multicollinearity test are known that the X1 model gets a tolerance value of 0.476 > 0.10 and a VIF value of 2,099 < 10, X2 has a tolerance value of 0.581 > 0.10 and a VIF value of 1,720 < 10, X3 gets a tolerance value of 0.464 > 0.10 and a VIF value of 2,156 < 10, X4 gets a tolerance value of 0.387 > 0.10 and a VIF value of 2.583 < 10 and X5 gets a tolerance value of 0.471 > 0.10 and a VIF value of 2.123 < 10. So that the processing results are free from multicollinearity.

Heteroscedasticity Test

The heteroscedasticity test aims to test whether in the regression model there is a variance inequality from the residual of one observation to another. The results of the heteroscedasticity test can be seen in the following Table 7:

Table 7. Heteroscedasticity Test

Model	t	Mr.
X1	-.258	.798
X2	-1.803	.078
X3	.052	.958
X4	.204	.839
X5	-.621	.538

a. Dependent Variable: ABS

Based on the test results of Table 7 above, it is known that the test results in the table (glacier test) show that the variables X_1, X2, X3, X4 and X5 have a significant value > 0.05. So it can be concluded that the regression model used does not have Heteroscedasticity.

Multiple Linear Regression Analysis

In this study, the multiple linear regression analysis that will be tested, namely the T test (partial regression test) and the F test (simultaneous regression), aims to find out whether each of these variables has an effect on the dependent variable or not.

F Test (Simultaneous Regression Test)

The purpose of the F test is to find out whether all the independent variables used in this regression model together have an effect on the dependent variables. With the help of using SPSS software, we obtained an Fcal value that will be compared with the Ftabel value of 2.43, and compared the significance value. The results of the F test (simultaneous regression test) can be seen in the following Table 8:

Table 8. F Test (Simultaneous Regression Test)

Pleading				
	Model	**df**	**F**	**Mr.**
1	Regression	5	12.910	.000
	Residual	44		
	Total	49		

a. Dependent Variable: Y

b. Predictors: (Constant), X1, X2, X3, X4, X5

Based on the results of the test in Table 10 above, it can be explained that the results of the F test (simultaneous regression test) can be explained that the variables X1, X2, X3, X4, X5 simultaneously affect the variable Y. The results of the five

variables show that the value of Fcal 12,910 > Ftable 2.43 and the significance value of 0.000 < 0.05 then the independent variables simultaneously have a significant effect on the dependent variable. It can be explained that X1, X2, X3, X4, X5 simultaneously affect Y.

T Test (Partial Regression Test)

The purpose of the T test is to find out whether the independent variable affects the dependent variable. The T-test by looking at the tcount compared to the t-table T-test with a ttable value of 2.015 H0 is accepted if the tcount value < ttable and vice versa. The results of the T test can be seen in the following Table 9:

Table 9. T Test (Partial Regression Test)

Model		Unstandarized Coefficients B	t	Mr.
1	(Constant)	5.743	2.157	.037
	X1	-.034	-.145	.885
	X2	-.155	-.845	.403
	X3	.784	3.060	.004
	X4	.625	2.082	.043
	X5	.335	1.586	.120
a. Dependent Variable: Y				

Based on the results of the T test (partial regression test), the regression equation can be formulated as follows:

$$Y = 5.743+(-0.034)*X1+$$
$$(-0.155)*X2+0.784*X3+0.625*X4+0.335*X5$$

Based on the test results of Table 11 above, it can be explained that variables X3 and X4 partially affect variable Y. While X_1, X2 and X5 partially have no effect on Y.

From the results of variable X1 showing a tcal value of -0.145 < ttable 2.015 with a significance value of 0.885 > 0.05, the results of variable X2 showing a tcal value of -0.845 < ttable 2.015 with a significance value of 0.403 > 0.05, the results of variable X3 showing a tcal value of 3.060 > ttable 2.015 with a significance value of 0.004 < 0.05, the results of variable X4 showing a tcal value of 2.082 > ttable 2.015 with a significance value of 0.043 < 0.05 and variable results X5 shows a tcal value of 1,586 < a ttable of 2,015 with a significance value of 0.120 > 0.05.

Multiple Correlation Analysis

The multiple correlation test aims to determine the high and low relationship of independent variables to dependent variables. The multiple correlation test serves to find the magnitude of the relationship and contribution of two or more independent variables (X) simultaneously (together) with the dependent variable (Y).

The value of the coefficient that will be shown to the extent to which the model is formed will explain the actual condition. The results of the multiple correlation test can be seen in the following Table 10:

Table 10. Multiple Correlation Test

Model	R	R Square	Adjusted R Square	Durbin-Watson
1	0.771	0.595	0.549	1.840
a.	Predictors: (Constant), X1, X2, X3, X4, X5			
b.	Dependent Variable: Y			

Based on the test results of Table 12 above, the results of the multiple correlation test show that the R value is 0.771 or 77.1%. This figure shows that there is a strong and positive correlation between the variables X1, X2, X3, X4, X5 to Y. The R Square value is 0.595 or 59.5%, this shows that from the variable Y it can be explained by the variables X1, X2, X3, X4, X5 by 59.5% while the remaining 40.5% is explained by other factors outside this study.

CONCLUSION

The Keselamatan Konstruksi Application is a mobile-based work safety tool designed to enhance occupational safety in the construction industry, particularly in the knowledge, use, and supervision of Personal Protective Equipment (PPE). Developed to address common issues faced by workers and construction service providers, especially small to medium-scale companies, this application aligns with Indonesia's Ministry of Manpower and Transmigration Regulation No. PER.08/MEN/VII/2010 on PPE management. The objectives of this application include supporting PPE implementation, providing safety knowledge and training through e-learning for workers, and assisting company management in monitoring PPE compliance using an e-controlling feature. By making safety knowledge more accessible and strengthening oversight, the application aims to improve human resource quality in the construction sector and ensure better adherence to safety regulations.

The effectiveness of the Keselamatan Konstruksi Application depends on various factors influencing user acceptance, assessed through the Technology Acceptance Model (TAM). Findings indicate that ease of use and perceived usefulness do not significantly impact the application's success, suggesting that user-friendly design and apparent benefits alone do not ensure adoption. However, users' attitudes toward the application and their commitment to continued use positively influence its success, highlighting the importance of behavioral factors in implementation. Surprisingly, the level of user understanding does not contribute to the application's success, implying that familiarity with the system does not necessarily lead to consistent utilization. These insights emphasize that while technological tools can facilitate workplace safety, their adoption largely depends on user engagement and sustained usage behavior.

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