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Analysis of Navigation Technology Acceptance as a Supporting Facility in The Barito River Estuary Shipping Channel Using The Technology Acceptance Model (TAM)

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Abstract: The Barito River is a strategic shipping lane facing various safety challenges. The use of navigation technology such as the Automatic Identification System (AIS) can improve shipping safety and efficiency, but its adoption among ship operators is still limited. This study analyzes the acceptance of navigation technology in the Barito River Channel using the Technology Acceptance Model (TAM), which involves five variables: Perceived Usefulness (PU), Perceived Ease of Use (PEU), Attitude Toward Using (ATU), Behavioral Intention (BI), and Actual System Use (AU). The results of the analysis using PLS-SEM show that PEU has a positive effect on PU (t-statistic = 10.056, p-value = 0), PEU has a significant effect on ATU (t-statistic = 4.131, p-value = 0), and ATU has a significant effect on BI (t-statistic = 5.059, p-value = 0). PU has a significant effect on BI (t-statistic = 5.875, p-value = 0) and BI has a positive effect on AU (t-statistic = 8.898, p-value = 0). The results of the hypothesis test indicate that most of the relationships between variables in the TAM are significant, with positive influences between PEU and PU, PEU and ATU, ATU and BI, and BI and AU. However, the relationship between PU and ATU does not show significance, indicating that perceived usefulness does not directly influence attitudes towards technology use. This acceptance contributes to the development of policies and strategies for the acceptance of navigation technology in the shipping sector.

Keywords: Barito River Estuary, Navigation Technology, Technology Acceptance Model, Navigation Safety

INTRODUCTION

The Barito River Estuary Channel is a strategic shipping lane connecting the interior of Kalimantan to open waters, with a steadily increasing volume of ship traffic each year. This channel serves the transportation of essential commodities such as coal, forest products, and other necessities. However, the channel's frequent shallowing and limited width and depth add to the challenges of shipping safety. Furthermore, the increasing volume of ship traffic adds to the complexity of accident risks and exacerbates potential economic losses

Over the past five years, ship accidents in the Barito River Estuary Channel have remained a major concern. Based on available data, incidents such as ship groundings, collisions, and loss of direction frequently occur due to the lack of optimal use of navigation technology. One influencing factor is user perception and ease of use of the technology [2].

With technological advances, ships can utilize various navigation aids (NAVs) such as the Automatic Identification System (AIS), Electronic Chart Display and Information System (ECDIS), Global Positioning System (GPS), and radar to assist in navigation decision-making [3]. The use of this technology can reduce the risk of accidents due to human error, bad weather conditions, and unpredictable terrain.

Some ship operators still rely on conventional navigation methods, resulting in suboptimal adoption of modern technology. This increases the risk of accidents and hinders the operational efficiency of ships navigating the waterway. To understand the factors influencing the adoption of navigation technology among ship users, a sound analytical approach is required. The Technology Acceptance Model (TAM) is a model that can be used to evaluate the extent to which users accept and use a technology [4]. This model focuses on two main factors: Perceived Usefulness and Perceived Ease of Use, both of which influence users' attitudes and intentions in adopting a particular technology [5].

Through the application of TAM, this study aims to identify and analyze the factors influencing the adoption of navigation technology in the Barito River Estuary Channel, as well as to evaluate the extent to which this technology adoption can improve shipping safety in the area. It is hoped that the results of this study can contribute to the development of policies and strategies to increase the acceptance of navigation technology in the shipping sector, thereby reducing the risk of accidents and improving shipping operational efficiency in the Barito River Estuary Channel.

METHOD

The data collection method in this study was carried out using survey techniques through questionnaires and interviews. The questionnaires were distributed to three groups of respondents involved in the operation of the Barito River Barge shipping channel: channel users (ship crew), channel managers (radio operators, service staff), and regulators (employees from the Harbormaster's Office and Navigation District). This questionnaire consisted of 22 statements related to indicators in the Technology Acceptance Model (TAM), including the variables Perceived Usefulness (PU), Perceived Ease of Use (PEU), Attitude Toward Using (ATU), Behavioral Intention (BI), and Actual System Use (AU). A Likert scale was used to measure the level of respondent agreement with the statements in the questionnaire. Respondents were asked to provide an assessment ranging from strongly disagree (1) to strongly agree (5) for each statement in the questionnaire.

Additionally, interviews were conducted to gather more in-depth information from users, administrators, and regulators regarding the use and acceptance of navigation technology, as well as the obstacles or barriers they face in adopting it. Data from these interviews was used to complement the results of the questionnaire survey and provide deeper qualitative insights.

Data processing

The data processing in this study used a quantitative approach, where data obtained from the questionnaire was processed using Smart PLS 4.0 software. The collected data in the form of Likert scores were processed to evaluate the relationship between variables in the Technology Acceptance Model (TAM) and to test the formulated hypotheses.

After analysis, initial data processing was performed to ensure validity and reliability. Validity testing was conducted to ensure that the indicators used were capable of measuring the intended construct, while reliability testing was conducted to evaluate the internal consistency of the indicators that form the latent variables in the model.

Data analysis

Data analysis in this study was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM), processed using Smart PLS 4.0 software. This approach was chosen because it can handle non-normally distributed data and small sample sizes, as well as because of its ability to measure the relationship between latent variables and their indicators simultaneously. The analysis was conducted through two main stages: evaluation of the outer model to test the validity and reliability of the indicators, and evaluation of the inner model to test the relationship between the latent variables.

At the outer model analysis stage, convergent and discriminant validity tests were conducted, as well as construct reliability tests. Convergent validity tests ensure that the indicators in each construct have a high correlation with each other, while discriminant validity tests ensure that the indicators of each construct are more strongly correlated with their own construct than with other constructs. Reliability tests use Cronbach's Alpha and Composite Reliability values to ensure the internal consistency of the construct.

In the inner model analysis stage, an evaluation is conducted to determine the R^2 value, which describes the model's ability to predict the dependent variable. Furthermore, a significance test of the relationship paths between variables is performed using bootstrapping techniques to determine whether the relationships between variables in the model are significant.
Research Model
The following is a research framework which can be seen in the image below:

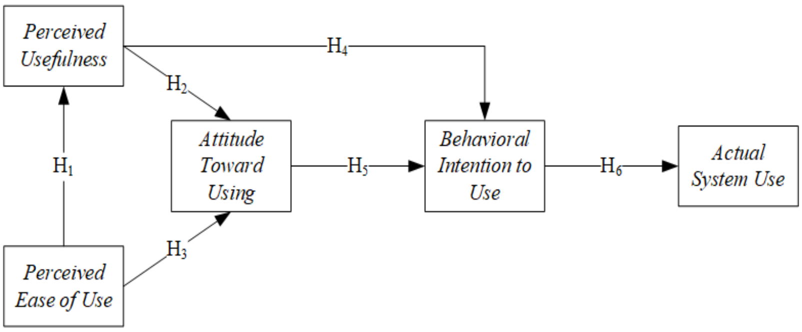

Figure 1 Research Model

The following is an explanation of each stage of the hypothesis that will be tested in this research as follows:

H1: Perceived Ease of Use has a positive effect on Perceived Usefulness in the use of navigation technology.
H2: Perceived Usefulness has a positive influence on Attitude Toward Using navigation technology.
H3: Perceived Ease of Use influences Attitude Toward Using in the use of navigation technology.
H4: Attitude Toward Using (ATU) has a positive influence on Behavioral Intention to Use in the use of navigation technology.
H5: Perceived Usefulness has a positive effect on Behavioral Intention to Use of navigation technology.
H6: Behavioral Intention (*Behavioral Intention to Use*) has an impact on the Actual System Use of navigation technology.

RESULTS AND DISCUSSION

Research Population and Sample

This study involved 67 respondents from three groups: channel users (30 respondents), regulators (24 respondents), and managers (13 respondents), all of whom were sampled using a saturated sampling technique, given the relatively small population size. The following Table describes the distribution of respondents:

Table 1. Role and Number of Respondents

No	Respondent Role	Respondent Description	Amount
1	Users	Users are crew members of the Company who use the channel.	30
2	Manager	The manager is PT. Ambang Barito, which manages the Barito River channel.	13
3	Regulator	The regulators are the KSOP and the Banjarmasin Navigation District	24

Measurement Model Analysis (Outer Model)

Outer model used to test the validity and reliability of indicators against latent variables.

Convergent Validity Test

The convergent validity test shows the extent to which indicators correlate highly with each other. In Table 2, all constructs meet the convergent validity criteria with loading factor > 0.70 and AVE > 0.50, indicating that the indicators consistently and accurately explain their latent variables.

Table 2. Convergent Validity Test Results

Variables	Indicator	*Loading Factor*	AVE	Conclusion
Perceived Ease of Use (PEU)	**PEU 1**	0.793	0.621	Valid
	PEU 2	0.74		Valid
	PEU 3	0.816		Valid
	PEU 4	0.789		Valid
	PEU 5	0.82		Valid
	PEU 6	0.769		Valid
Perceived Usefulness(PU)	**PU 1**	0.842	0.616	Valid
	PU 2	0.865		Valid
	PU 3	0.768		Valid
	PU 4	0.82		Valid
	PU 5	0.748		Valid
Attitude Toward Using (ATU)	**ATU 1**	0.822	0.687	Valid
	ATU 2	0.866		Valid
	ATU 3	0.858		Valid
	ATU 4	0.767		Valid
Behavioral Intention (BI)	**BI 1**	0.701	0.614	Valid
	BI 2	0.765		Valid
	BI 3	0.818		Valid
	BI 4	0.827		Valid
	BI 5	0.8		Valid
Actual Usage (AU)	**AU 1**	0.887	0.719	Valid
	AU 2	0.807		Valid

Discriminant Validity Test

Discriminant validity testing ensures that indicators of a construct are more strongly correlated with its own construct than with other constructs. Based on the cross-loading results in Table 3, all indicators have the highest loading values on their corresponding constructs, indicating that discriminant validity is met.

Variable Indicator	PEU	PU	ATU	BI	AU
PEU 1	0.793	0.705	0.629	0.654	0.494
PEU 2	0.74	0.387	0.492	0.335	0.268
PEU 3	0.816	0.566	0.603	0.583	0.448
PEU 4	0.789	0.583	0.686	0.631	0.491
PEU 5	0.82	0.538	0.678	0.574	0.529
PEU 6	0.769	0.449	0.624	0.415	0.302
PU 1	0.638	0.842	0.648	0.807	0.49
PU 2	0.577	0.865	0.576	0.674	0.352
PU 3	0.414	0.768	0.35	0.525	0.391
PU 4	0.615	0.82	0.506	0.574	0.367
PU 5	0.532	0.748	0.392	0.608	0.311
ATU 1	0.653	0.637	0.822	0.719	0.454
ATU 2	0.687	0.521	0.866	0.676	0.578
ATU 3	0.659	0.457	0.858	0.632	0.601
ATU 4	0.622	0.455	0.767	0.623	0.43
BI 1	0.462	0.488	0.577	0.701	0.393
BI 2	0.497	0.546	0.605	0.765	0.582
BI 3	0.486	0.616	0.612	0.818	0.589
BI 4	0.657	0.68	0.751	0.827	0.615
BI 5	0.586	0.783	0.581	0.8	0.477
AU 1	0.457	0.458	0.492	0.645	0.887
AU 2	0.479	0.339	0.579	0.504	0.807

Reliability Test

Reliability tests are used to measure the internal consistency of the indicators that form a latent variable.

Variables	*Composite reliability* (rho_c)	*Average variance extracted* (AVE)	Conclusion
PEU	0.908	0.621	Reliable
PU	0.905	0.656	Reliable
ATU	0.898	0.687	Reliable
BI	0.888	0.614	Reliable
AU	0.836	0.719	Reliable

Based on Table 4, all constructs in the model have Composite Reliability above 0.70 and AVE above 0.50, which means that the indicators for each construct are consistent and able to explain the latent variables well.

Structural Model Analysis (Inner Model)

The inner model examines the relationships between latent variables. Evaluation is performed using R^2, Q^2, and t-statistics to determine the strength and significance of the relationships between constructs.

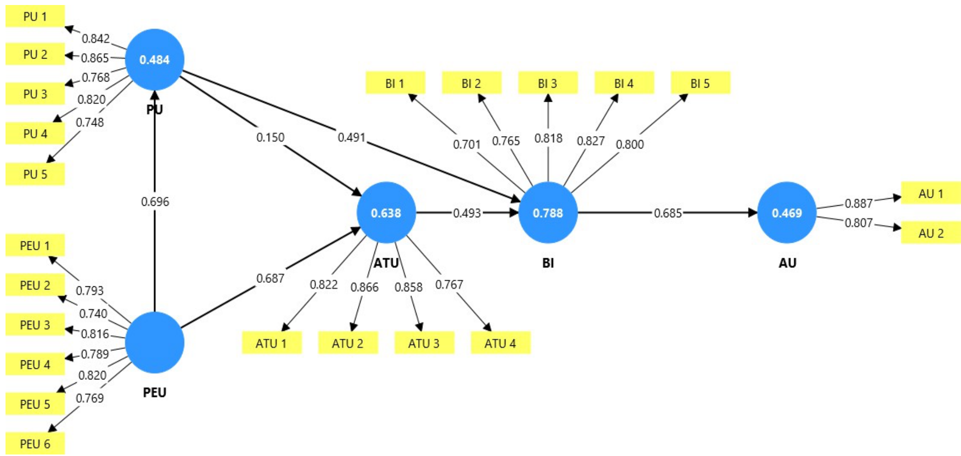

Figure 2 Model Quality Test Results

Figure 2 shows the results of testing the quality of the structural model using the PLS-SEM approach. The R-square values are displayed for each endogenous construct. Overall, the model demonstrates good predictive quality, and each relationship between variables will be further explained based on the R^2, Q^2, and t-statistic values.

***Table 3** R-square results*

Variables	R-square	R-square adjusted	Conclusion
PU	0.484	0.476	Weak
ATU	0.638	0.627	Currently
BI	0.788	0.782	Strong
AU	0.469	0.461	Weak

The R-square test results show that the Perceived Usefulness (PU) and Actual Usage (AU) variables have weak R^2 values, 0.484 and 0.469, respectively, meaning that their variability is only slightly explained by the independent variables. Meanwhile, Attitude Toward Using (ATU) has an R^2 value of 0.638, which is classified as moderate, and Behavioral Intention (BI) has the highest R^2 value, 0.788, which indicates the highest predictive power of the model in BI and the lowest in AU and PU.

***Table 4** Q-square results*

Variables	R-square	Q^2
PU	0.484	$Q2 = 1 - ((1 - 0.484)(1 - 0.638)(1 - 0.788)(1 - 0.469))$ $Q2 = 1 - ((0.516)(0.362)(0.212)(0.531))$ $Q2 = 1 - (0.021027549)$
ATU	0.638	
BI	0.788	
AU	0.469	
		Q2 = 0.978972451

A Q² value of 0.979 indicates excellent predictive ability, with predictive relevance to endogenous constructs. The higher the Q² value, the stronger the model's ability to predict latent variables, making this model reliable for drawing conclusions and decisions.

Table 5 T-statistic results

Relationships Between Constructs	***Originalsample*(O)**	***Sample mean*(M)**	***Standard deviation*(STDEV)**	**T statistics (|O/STDEV|)**	**Conclusion**
PEU -> PU	0.696	0.703	0.069	10,056	Significant
PU -> ATU	0.15	0.145	0.179	0.84	Not Significant
PEU -> ATU	0.687	0.695	0.166	4.131	Significant
ATU -> BI	0.493	0.486	0.097	5,059	Significant
PU -> BI	0.491	0.499	0.084	5,875	Significant

Based on the t-statistic test, of the six relationship paths between constructs, five showed a significant effect, while one did not. The path of PEU to PU was significant (t = 10.056), indicating that ease of use influences usefulness. However, the path of PU to ATU was not significant (t = 0.84), indicating that usefulness does not influence user attitudes. The path of PEU to ATU was significant (t = 4.131), indicating the effect of ease of use on user attitudes. The path of ATU to BI was significant (t = 5.059), indicating attitudes influence behavioral intentions. The effect of PU to BI was significant (t = 5.875), indicating usefulness shapes behavioral intentions. Finally, the path of BI to AU was significant (t = 8.898), indicating behavioral intentions influence actual use. Most paths proved significant, except the effect of PU to ATU.

Goodness of Fit

Goodness of Fit (GoF) is used to assess the overall model fit. A GoF value of 0.626 indicates a strong fit. GoF is calculated from the root mean square of AVE and R-square, and indicates the measurement quality and predictive ability of the model. According to Tenenhaus et al. (2005), a GoF value of 0.626 (> 0.36) indicates that this model demonstrates excellent overall quality and predictive power. for testing the relationships between constructs in the study.

Table 6 GoF Value

Variables	**AVE**	**R-square**
PEU	0.621	-
PU	0.656	0.484
ATU	0.687	0.638
BI	0.614	0.788
AU	0.719	0.469
Average	**0.6594**	**0.59475**
GoF	$\sqrt{0.6594 \times 0.59475}$	**= 0.6262412874**

Hypothesis Test Results

Hypothesis testing was conducted to determine the relationships between latent variables in the model by considering the path coefficients, t-statistic, and p-value as the basis for determining significance. These results are used to assess whether the proposed hypothesis is accepted or rejected.

H1: Perceived Ease of Use (PEU) has a positive effect on Perceived Usefulness (PU) in the use of navigation technology. Hypothesis H1 is accepted because PEU has a significant effect on PU, which means the easier the technology is to use, the greater the perceived usefulness, in accordance with the TAM theory.

H2: Perceived Usefulness (PU) has a positive effect on Attitude towards Behavior (ATU) in the use of navigation technology. Hypothesis H2 is rejected because the effect of PU on ATU is not significant, indicating that although users perceive the technology as useful, it does not directly influence their attitude toward its use.

H3: Perceived Ease of Use (PEU) influences Attitude Toward Behavior (ATU) in the use of navigation technology. Hypothesis H3 is accepted because PEU has a significant influence on ATU, which supports the TAM model that ease of use forms a positive attitude toward technology.

H4: Attitude towards Behavior (ATU) has a positive effect on Behavioral Intention (BI) in the use of navigation technology. Hypothesis H4 is accepted because positive attitudes influence behavioral intentions, strengthening the role of attitudes as a mediator in technology adoption.

H5: Perceived Usefulness (PU) has a positive effect on Behavioral Intention (BI) in the use of navigation technology. Hypothesis H5 is accepted because PU has a significant effect on BI, although it is not significant on ATU, but still influences user intention.

H6: Behavioral Intention (BI) influences the Actual Use of Navigation Technology Systems (AU). Hypothesis H6 is accepted because behavioral intention significantly influences the actual use of the system, indicating that the intention to use the technology is realized in real actions.

CONCLUSION

The results of the analysis using PLS-SEM show that PEU has a positive effect on PU (t-statistic = 10.056, p-value = 0), PEU has a significant effect on ATU (t-statistic = 4.131, p-value = 0), and ATU has a significant effect on BI (t-statistic = 5.059, p-value = 0). PU has a significant effect on BI (t-statistic = 5.875, p-value = 0) and BI has a positive effect on AU (t-statistic = 8.898, p-value = 0). The results of the hypothesis test show that most of the relationships between variables in TAM are significant, with positive influences between PEU and PU, PEU and ATU, ATU and BI, and BI and AU. However, the relationship between PU and ATU does not show significance, which indicates that perceived usefulness does not directly affect attitudes towards technology use. These findings contribute to the development of policies and strategies that promote the adoption of navigation technology in the shipping sector.

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REFERENCE

Ardianto, K., Azizah, N., Risiko, P., & Kegunaan, P. (2021). Analisis minat penggunaan dompet digital dengan pendekatan technology acceptance model (TAM) pada pengguna di Kota Surabaya. *Jurnal Pengembangan Wiraswasta*, *23*(1), 13.

Aulifin, S. A., & Dewi, A. S. (2022). Analisis penerimaan pengguna Shopeepay sebagai sistem pembayaran elektronik menggunakan Technology Acceptance Model (TAM) di wilayah Kota Bogor. *Jurnal Ilmiah Manajemen, Ekonomi, & Akuntansi (MEA)*, *6*(2), 138–152.

Ayu, R. K., & Wulida, Z. W. (2023). Kewenangan Bakamla dalam perlindungan keamanan lingkungan maritim menurut Undang-Undang Nomor 17 Tahun 2008 tentang Pelayaran. *WASAKA HUKUM*, *11*(2), 162–176.

Bachtiar, A., Trilia, D., Hia, H. A. F., Zafirawan, R. A., & Supriyadi, A. A. (2024). Pengawasan maritim efektif melalui implementasi Automatic Identification System (AIS) untuk jalur pelayaran Surabaya-Makassar. *Majalah Ilmiah Globe*, *26*(2), 57–66.

Bermana, K. R. G., Darlis, D., & Rusdinar, A. (2023). Rancang bangun sistem navigasi kapal autonomous berbasis ESP32 dan Raspberry Zero W guna mendukung penelitian Autonomous Fish Feeder Swarm Boat di Laboratorium Inacos Universitas Telkom. *Eproceedings Of Applied Science*, *9*(1).

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). Lawrence Erlbaum Associates.

Dalimunthe, A. R., Lestari, A. D., & Meirany, J. (n.d.). Manajemen risiko keselamatan pelayaran di alur pelayaran Sungai Kapuas dengan metode Formal Safety Assessment (FSA). *Jelast: Jurnal Teknik Kelautan, PWK, Sipil, Dan Tambang*, *10*(1).

Datep, D., & Datep Purwa Saputra, M. M. (2021). *Penerapan sistem manajemen keselamatan kapal sesuai ISM-Code*. Deepublish.

Febriandono, M. H., Mulia, F. H. N., & Iswara, N. H. (2019). Pengaruh kompetensi personal terhadap kesiapan perubahan dalam Industri 4.0. *Jurnal TAM (Technology Acceptance Model)*, *9*(2), 107–115.

Gugus Wijonarko, & Zulfadli Gazali. (2024). *Mengelola ambang Barito*. Sentra Edukasi Media.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)*. SAGE Publications.

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. *Advances In International Marketing*, *20*, 277–320.

Intansari, I., Rahmaniati, M., & Hapsari, D. F. (2023). Evaluasi penerapan rekam medis elektronik dengan pendekatan Technology Acceptance Model di Rumah Sakit X di Kota Surabaya. *J-REMI: Jurnal Rekam Medik Dan Informasi Kesehatan*, *4*(3), 108–117.

Jati, F. M. (2023). Upaya meningkatan pengetahuan dan keterampilan para perwira dan master dalam penggunaan ECDIS guna menunjang keselamatan pelayaran di kapal Gas Benua.

Jatnika, R. F., Kaniawulan, I., & Singasatia, D. (2023a). Analisis penerimaan aplikasi MyPertamina menggunakan metode Technology Acceptance Model (TAM). *Jurnal Teknologi Informasi Dan Komunikasi*, *14*(2), 347–357.

Jatnika, R. F., Kaniawulan, I., & Singasatia, D. (2023b). Analisis penerimaan aplikasi MyPertamina menggunakan metode Technology Acceptance Model (TAM). *Jurnal Teknologi Informasi Dan Komunikasi*, *14*(2), 347–357.

Lala, G. (2014). The emergence and development of the Technology Acceptance Model (TAM). *Marketing From Information To Decision*, *7*, 149–160.