THE ROLE OF DIGITAL TWIN IN OPTIMIZING SMART LAUNDRY SERVICES: ANALYZING CUSTOMER ACCEPTANCE AND LOYALTY THROUGH TAM AND IS SUCCESS MODEL

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ABSTRACT

Traditional laundry services often struggle with inefficiencies, high operational costs, and a lack of real-time monitoring. To address these challenges, this study examines the role of Digital Twin (DT) technology in optimizing smart laundry services. DT enables real-time data synchronization, predictive maintenance, and enhanced decision-making by creating a virtual replica of physical assets. This research adopts the Technology Acceptance Model (TAM) and the IS Success Model to analyze customer acceptance and loyalty toward DT-based laundry services. The findings confirm that Information Quality, System Quality, and Service Quality significantly influence Perceived Usefulness and Perceived Ease of Use, which in turn impact Customer Satisfaction and Customer Loyalty. The study also highlights that accurate information, a stable system, and high-quality service contribute to a positive user experience. By integrating DT, smart laundry services can improve operational efficiency, reduce downtime, and enhance customer trust. However, challenges such as limited market awareness and the adaptation of DT in service-based businesses remain. The results reinforce that DT is a promising innovation for modernizing laundry operations, making them more reliable, efficient, and customer-centric.

Keywords: *Digital Twin, Smart Laundry, Customer Satisfaction, Customer Loyalty TAM, IS Success Model*

1. INTRODUCTION

The service industry focuses on providing expertise, skills, and time to customers rather than physical products. Unlike tangible goods, services cannot be seen or touched but are directly experienced by consumers. In today's highly competitive business landscape, service differentiation and customer satisfaction are crucial for business sustainability. One essential sector within the service industry is laundry services, which offer practical solutions for washing and ironing clothes.

However, traditional laundry services face several operational challenges, including manual registration, paper-based record-keeping, and the absence of real-time tracking systems. These inefficiencies often lead to uncertainty regarding laundry completion times, causing inconvenience and dissatisfaction among customers. Moreover, service providers struggle with workflow management, transaction processing, and employee accountability, which impact overall business efficiency. To address these issues, digital transformation has become essential for enhancing operational effectiveness and improving the customer experience[1].

The advancement of Industry 4.0 and the Internet of Things (IoT) has enabled the integration of Digital Twin technology into service industries. A Digital Twin is a real-time digital representation of physical processes that allows for automated monitoring, predictive analytics, and operational optimization. By leveraging this technology, laundry businesses can enhance tracking transparency, streamline workflows, and strengthen customer trust.

PT. Wasis Jaya Sentosa, operating under the Washes Lifestyle Laundry brand, has introduced AWM Laundry, a Digital Twin-powered application designed to improve service efficiency.

The application enables customers to place orders, track laundry status in real-time, and manage their laundry remotely. This innovation bridges the gap between conventional laundry services and digital advancements, creating a seamless service experience that enhances customer satisfaction and loyalty.

This study aims to examine the impact of Digital Twin adoption in smart laundry services, particularly through the AWM Laundry application. Using the Technology Acceptance Model (TAM) and the DeLone & McLean IS Success Model, this research investigates how Information Quality, System Quality, and Service Quality influence Perceived Usefulness and Perceived Ease of Use, which ultimately contribute to Customer Satisfaction and Customer Loyalty. The findings of this study are expected to provide valuable insights for service businesses, technology developers, and industry stakeholders regarding the successful adoption of Digital Twin technology to optimize service efficiency and customer retention.

2. LITERATURE REVIEW
2.1 Digital Twin in Service Business

Digital Twin (DT) technology has become an essential innovation in improving operational efficiency and customer experience in various industries. Initially developed for manufacturing and industrial applications, DT has expanded into the service sector, including smart service businesses such as laundry services [2]. Digital Twin enables real-time monitoring, process optimization, and predictive analytics, allowing service providers to enhance efficiency, automate workflows, and improve customer interactions [3].

In the laundry service industry, Digital Twin-powered applications such as AWM Laundry integrate real-time tracking, automation, and customer engagement to improve service transparency and efficiency. Customers can monitor laundry progress, receive real-time notifications, and manage their service requests remotely, while laundry service providers benefit from automated scheduling and predictive maintenance [2]. Digital Twin implementation in service industries aligns with the Industry 4.0 transformation, where businesses integrate IoT, AI, and cloud computing to create smart service ecosystems [4]

2.2 Technology Acceptance Model (TAM)

Over the past two decades, the implementation of Information Technology (IT) has become a top priority for organizations. The success of information system adoption largely depends on user acceptance, which is explained by the Technology Acceptance Model (TAM) proposed by Davis (1989). Based on the Theory of Reasoned Action (TRA), this model describes how perceived usefulness (PU) and perceived ease of use (PEOU) influence an individual's acceptance of technology [5].

Perceived usefulness refers to the extent to which users believe that a technology enhances their performance, including factors such as work speed, productivity, efficiency, and overall benefits [6]. Perceived ease of use describes how effortlessly a system can be used without requiring excessive effort, encompassing aspects like system control, flexibility, and ease of acquiring necessary skills. Attitude toward technology reflects a user's positive or negative feelings about using a system, which are influenced by perceived usefulness and ease of use. Behavioral intention to use represents a user's willingness to adopt a system, shaped by both their attitude and perceived usefulness, while actual system use refers to the real adoption and utilization of the technology, influenced by user satisfaction and perceived benefits.

Several adaptations of TAM have been proposed. Linders modified the model by removing behavioral intention to use and actual system use, instead introducing user satisfaction as a key factor, particularly for mandatory-use systems where users have no choice but to adopt the technology. Supported this perspective, arguing that for mandatory-use environments, system success is better measured by user satisfaction rather than actual system usage.

2.3 DeLone & McLean Information System (IS) Success Model

The DeLone and McLean Model of Information Systems Success, first introduced in 1992, quickly gained recognition due to its simplicity and effectiveness in measuring the success of information systems. The model provided a structured framework for evaluating the implementation of technology in organizations. However, as information systems evolved, DeLone and McLean refined the model to better reflect the changing role of technology, particularly in e-commerce applications.

The model consists of six key dimensions. System quality evaluates the technical performance of a system, including ease of use, reliability, and response time. Information quality assesses the accuracy, completeness, and relevance of the data provided by the system [7] .

Service quality measures the responsiveness and competence of IT support. Use refers to the extent and depth of system adoption, while user satisfaction captures the degree to which users find the system beneficial and efficient. Finally, net benefits combine both individual and organizational advantages, such as improved productivity, efficiency, and decision-making.

In the updated version, service quality was added as a critical factor, use was replaced with intention to use, recognizing that intent is a strong predictor of actual behavior, and individual impact and organizational impact were merged into net benefits to simplify the model. Additionally, the revised model emphasizes the interconnections between these dimensions, highlighting how positive experiences with a system lead to higher satisfaction, increased usage, and greater perceived benefits [5].

2.4 Customer Satisfaction

Customer satisfaction depends on how well a product's performance meets buyer expectations [8]. The feeling that arises after comparing perceived performance with expectations. If a product or service falls short, customers feel dissatisfied. If it meets expectations, they are satisfied, and if it exceeds expectations, they are highly satisfied or delighted [9].

To achieve customer satisfaction, businesses must understand key contributing factors. Satisfied customers lead to long-term relationships, loyalty, and an improved company reputation. Zeithaml & Bitner state that customer satisfaction results from evaluating a product or service's characteristics in fulfilling their needs. The main factors influencing satisfaction include product quality, price, service quality, emotional factors, and additional costs.

To maintain customer satisfaction, strategies that foster loyalty. Word-of-mouth marketing is powerful; satisfied customers share positive experiences, attracting new customers. Brand image also influences loyalty, as a strong brand builds trust and encourages recommendations [10].

Customer satisfaction can be measured through low complaint rates, effective complaint resolution, overall satisfaction, expectation alignment, and exceeding customer expectations. Understanding these indicators allows companies to continuously improve, ultimately strengthening customer loyalty and business sustainability.

2.5 Customer Loyalty

Customer loyalty is crucial for business sustainability [11]. Loyal customers consistently choose a brand, contributing to financial stability and competitive advantage.

Loyalty involves both behavioral patterns and emotional commitment [12], [13]. It can be classified into brand loyalty (preference for a specific brand) and store loyalty (preference for a particular retailer). Dick and Basu categorize loyalty into four levels: no loyalty, spurious loyalty (habit-based but weak emotional connection), latent loyalty (high preference but low repeat purchases), and premium loyalty (strong commitment and advocacy).

Loyal customers provide benefits like repeat purchases, positive word-of-mouth, and reduced marketing costs. Factors influencing loyalty include customer satisfaction, emotional attachment, trust, convenience, and overall experience. Businesses can measure loyalty through purchase frequency, recommendations, and resistance to competitors [14]

2.6 Hypothesis Development

The implementation of Digital Twin technology in the service industry, particularly in the laundry sector, is an innovation that enhances operational efficiency and customer satisfaction. Digital Twin, combined with the Internet of Things (IoT), enables real-time monitoring and automation, optimizing the performance of laundry services. This study is based on the DeLone & McLean Information System Success Model (D&M IS SUCCESS Model) and the Technology Acceptance Model (TAM) to evaluate the effectiveness of AWM Laundry, a smart laundry application that integrates Digital Twin and IoT [5]

Information quality plays a crucial role in shaping users' perceptions of digital services. Accurate, timely, and relevant information enhances the user experience, contributing to greater perceived usefulness and ease of use. Previous research has identified information quality as a key factor influencing system success and user satisfaction. Therefore, the following hypotheses are proposed:

H1: Information Quality (IQ) positively influences Perceived Usefulness (PU).
H2: Information Quality (IQ) positively influences Perceived Ease of Use (EOU).

Moreover, system quality is another critical factor in user experience. The reliability, speed, security, and ease of interaction of a platform determine how comfortable users feel while using it. A well-designed AWM Laundry application ensures a seamless experience, enhancing perceived usefulness and ease of use. Prior studies

indicate that system quality significantly influences the perceived ease of use of mobile applications. Accordingly, the following hypotheses are proposed:

H3: System Quality (SQ) positively influences Perceived Usefulness (PU).

H4: System Quality (SQ) positively influences Perceived Ease of Use (EOU).

Service quality also plays a major role in user retention and satisfaction. Fast, reliable service with responsive customer support enhances user perception of the AWM Laundry system. Studies in service-oriented applications confirm that service quality is a key determinant of system acceptance and user experience. Therefore, the following hypotheses are proposed:

H5: Service Quality (SQ) positively influences Perceived Usefulness (PU).

H6: Service Quality (SQ) positively influences Perceived Ease of Use (EOU).

Perceived usefulness refers to the extent to which users believe that a system enhances their productivity. Useful technology increases user satisfaction and encourages continued adoption. Research in digital financial services supports this claim, demonstrating that higher perceived usefulness directly improves customer satisfaction. Hence, the following hypothesis is proposed:

H7: Perceived Usefulness (PU) positively influences Customer Satisfaction (CS).

Ease of use is another crucial factor that contributes to customer satisfaction. The simpler a system is to use, the more likely customers are to adopt and continue using it. In self-service applications like AWM Laundry, simplicity and efficiency enhance customer satisfaction. Prior studies on digital platforms suggest that ease of use is positively correlated with user engagement and satisfaction. Thus, the following hypothesis is proposed:

H8: Perceived Ease of Use (EOU) positively influences Customer Satisfaction (CS).

Finally, customer satisfaction is a key predictor of customer loyalty. Users who are satisfied with the performance, reliability, and benefits of the AWM Laundry application are more likely to continue using it and recommend it to others. Research indicates that satisfied customers develop trust and long-term engagement with a platform, reinforcing their loyalty. Therefore, the final hypothesis is proposed:

H9: Customer Satisfaction (CS) positively influences Customer Loyalty (CL).

3. METHODOLOGY

3.1 Research Model

This study applies the DeLone & McLean Information System Success Model (DM ISSM) and the Technology Acceptance Model (TAM), based on research by Laksono (2017) and Hidayah et al. (2020). The model evaluates the effectiveness of Digital Twin implementation in AWM Laundry, ensuring user acceptance and benefits for customers, employees, and business owner (Figure 1);
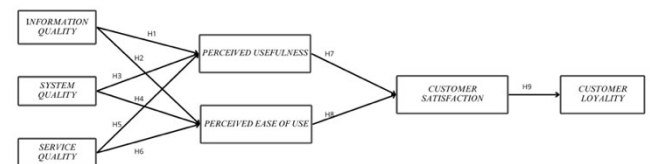

Figure 1. Research Model

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3.2 Sample and Data Collection

Sampling this research uses the probability sampling method with a simple random sampling technique, which is a sampling technique that provides equal opportunities for each member of the population to be selected as a sample. Determination of the sample size uses the provisions that state that the size that is considered feasible to use is 30 to 500, with a magnitude of 5 to 10 times the number of indicators [15]. This study uses 32 indicators with a minimum sample size of 5 so the total minimum sample size is 160 respondents. Data was obtained through a questionnaire in Google form with a 5-point Likert scale.

3.3 Measurement of Variable and Method of Analysis

This study uses Partial Least Square (PLS) for analysis based on an approach that maximizes variance with endogenous constructs as explanatory [16]. PLS-SEM emphasizes prediction in estimating statistical models with a structure designed to provide a causal explanation of SEM which is divided into inner and outer models and conducts hypothesis testing using SmartPLS software version 4.0.9.9.

Table 1. Variable Operationalization

Variable	Code	Indicator	Reference
Information Quality	IQ1	The information provided by AWM Laundry covers all aspects of the services needed by customers.	Alotaibi & Alshahrani, [17]; Delone & Mclean, [18];

	IQ2	The information presented by AWM Laundry is easy for customers to understand and access.	Walczuch et al., [11]			customer needs and preferences in choosing laundry services and provides suitable services.	Arifin et al., [19]; Walczuch et al., [11]
	IQ3	AWM Laundry provides service information in real-time or according to customer needs.			SEQ3	AWM Laundry provides real-time order status updates, demonstrating a quick response to my needs.	
	IQ4	The information delivered by AWM Laundry is valid, accurate, and free from errors.			SEQ4	There are sufficient and clear instructions on how to use the AWM Laundry application.	
	IQ5	The information in AWM Laundry is presented concisely, clearly, and well-structured.		Perceived Ease of Use	EOU1	AWM Laundry is easy to learn.	Al-hawari & Mouakket, [20]; Pour et al., [5]; Syaeful Anwar et al., [21]; Yum & Kim, [13]
	SQ1	The AWM Laundry application is stable, rarely experiences disruptions, and is reliable in providing services.			EOU2	AWM Laundry is easy to control.	
					EOU3	AWM Laundry is flexible in accommodating my various laundry needs.	
System Quality	SQ2	The AWM Laundry application can respond to user commands and requests quickly and efficiently.	Alotaibi & Alshahrani, [17]; Delone & Mclean, [18]; Walczuch et al., [11])		EOU4	With this application, I can easily monitor my laundry order status without needing to visit the outlet.	
	SQ3	AWM Laundry is easily accessible to users without significant technical barriers.			EOU5	AWM Laundry helps customers complete the laundry process more easily and efficiently compared to traditional methods.	
	SQ4	The features of AWM Laundry are designed to be user-friendly without requiring special technical expertise.		Perceived Usefulness	PUF1	Using AWM Laundry helps me complete my laundry tasks faster.	Mouakket & MohD Al-Hawari [20], Abber et al. (2024)[22], Tutut et al. [23]
	SQ5	AWM Laundry has strong security mechanisms to protect user data confidentiality.			PUF2	With AWM Laundry, I can order laundry services more efficiently, allowing me more time for other activities.	
Service Quality	SEQ1	AWM Laundry guarantees that my personal data will be well protected.	Alotaibi & Alshahrani, [17]; Delone & Mclean, [18]; Syamsul		PUF3	Using AWM Laundry increases my productivity by reducing the time and effort required for laundry.	
	SEQ2	AWM Laundry understands			PUF4	AWM Laundry provides convenience in	

		accessing and using laundry services anytime and anywhere.	
	PUF5	AWM Laundry helps me monitor transactions and laundry service status more transparently and accurately.	
Customer Satisfaction	CS1	AWM Laundry helps me complete my laundry needs more easily and practically.	DeLone & McLean [18], Uzir et al. [24], Douglas Legramante [25]
	CS2	I feel comfortable and enjoy the experience of using AWM Laundry services.	
	CS3	I am satisfied with the quality of services provided by AWM Laundry, including speed, cleanliness, and reliability.	
	CS4	Overall, I am satisfied with the services and experience of using AWM Laundry.	
Customer Loyalty	CL1	I am willing to recommend AWM Laundry to friends, family, or others.	(Yum & Kim, [13]
	CL2	I intend to continue using AWM Laundry services in the future.	
	CL3	I plan to keep using AWM Laundry as my primary solution for laundry needs.	

4. RESULTS & DISCUSSION
4.1 Respondent Profiles

Table 2. Respondent Profiles

Profile	Category	Number of Respondent	Presentage (%)
Gender	Male	74	36.1
	Female	131	63.9
Total		205	100

The respondent profile based on gender in Table 1 shows that out of 205 respondents, 74 respondents (36.1%) are male, while 131 respondents (63.9%) are female. Thus, it can be concluded that this study is dominated by female respondents, accounting for 63.97%.

Meanwhile, the profile of respondents based on age is described in table 3 below:

Table 3. Profile of Respondents

Profile	Category (years)	Number of Respondent	Presentage (%)
Age	18-23	42	20.5
	24-28	88	42.9
	29-33	67	32.7
	34-39	6	2.9
	>40	2	1
Total		205	100

The respondent profile based on age in Table 3 shows that most respondents belong to the millennial generation, with 42 respondents (20.5%) aged 18-23 years, 88 respondents (42.9%) aged 29-33 years, 67 respondents (32.7%) aged 34-39 years, 6 respondents (2.9%) aged 40 years, and 2 respondents (1%) aged above 40 years. Thus, this study is dominated by millennial respondents.

4.2 Measurement Of Variable
The outer model test aims to ensure that the research model is feasible to use after being declared valid and reliable. This test is carried out by looking at the outer loading value and average variance extracted (AVE) for the convergent validity test, while the composite reliability value for the reliability test. The test results are shown in Table 4.

Table 4. Construct Validity Using PLS-SEM

Scale Item	Outer Loading	Composite Reliability	AVE
Information Quality			
The information provided by AWM Laundry covers all aspects of the service that customers need.	0.7093	0.796	0.706
The information presented by AWM Laundry is easy to understand and accessible to customers.	0.738		
AWM Laundry provides real-time service information according to customer needs.	0.734		
The information provided by AWM Laundry is valid,	0.621		

accurate, and error-free.			
Information in AWM Laundry is presented concisely, clearly, and in a well-structured manner.	0.731		
System Quality			
The AWM Laundry application is stable, rarely experiences disruptions, and is reliable in providing services.	0.7093		
The AWM Laundry application can quickly and efficiently respond to user commands and requests.	0.738		
AWM Laundry is easily accessible to users without significant technical barriers.	0.734	0.761	0.706
AWM Laundry features are designed to be user-friendly without requiring special technical skills.	0.621		
AWM Laundry has a strong security mechanism to protect user data privacy and safety.	0.731		
Service Quality			
AWM Laundry guarantees that my personal data is well protected.	0.806		
AWM Laundry understands customer needs and preferences when selecting laundry services and provides appropriate service options.	0.745		
AWM Laundry provides real-time order status updates, demonstrating quick responses to my needs.	0.694	0.752	0.726
There are sufficient and clear instructions on how to use the AWM Laundry application.	0.732		
Perceived Ease Of Use			

AWM Laundry is easy to learn.	0,752		
AWM Laundry is easy to control.	0,737		
AWM Laundry is flexible in accommodating my diverse laundry needs.	0,759		
With this application, I can easily monitor my laundry order status without needing to visit the outlet.	0,797	0,818	0,759
AWM Laundry helps customers complete the laundry process more easily and efficiently than traditional methods.	0,754		
Perceived Usefulness			
Using AWM Laundry helps me complete my laundry tasks more quickly.	0,797		
With AWM Laundry, I can book laundry services more efficiently, giving me more time for other activities.	0,781		
Using AWM Laundry increases my productivity by reducing the time and effort required for laundry.	0,758	0,807	0,7492
AWM Laundry provides convenience in accessing and using laundry services anytime and anywhere.	0,747		
AWM Laundry helps me monitor laundry transactions and order statuses more transparently and accurately.	0,663		
Customer Satisfaction			
AWM Laundry helps me complete my laundry needs more easily and practically.	0,716		
I feel comfortable and enjoy my experience using AWM Laundry services.	0,752	0,739	0,762
I am satisfied with the quality of	0,810		

service provided by AWM Laundry, including speed, cleanliness, and reliability.		
Overall, I am satisfied with the service and experience of using AWM Laundry.	0,773	
Customer Loyalty		
I am willing to recommend AWM Laundry to friends, family, or others.	0,755	
I intend to continue using AWM Laundry services in the future.	0,797	
I plan to continue using AWM Laundry as my primary laundry solution.	0,774	0,782 0,786
I prefer using AWM Laundry over other laundry services or traditional methods.	0,819	

All indicators on all variables have outer loading values >0.708, so all indicators are declared reliable to measure the variable and all variables are declared valid with an AVE value >0.50.

Hypothesis testing is carried out to analyze the effect of the independent variable on the dependent variable by looking at the value of the path coefficients and the t-statistic value. The basis for decision-making based on the t-statistics value with a 100% confidence level is that the hypothesis will be supported if the t-statistics >1.645 and the hypothesis will be rejected if the t-statistics <1.645. Then the basis for decision making based on the p- value <0.05, the hypothesis will be supported and if the p-value >0.05, the hypothesis will be rejected. The results of the hypothesis test are shown in table 5 below:

Table 5. Hypothesis Testing Results

Hypothesis	Category	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values

Hypothesis	Category	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
H1	Information Quality -> Perceived Usefulness	0.284	0.301	0.114	2.492	0.006
H2	Information Quality -> Perceived Ease of Use	0.254	0.275	0.098	2.601	0.005
H3	Service Quality -> Perceived Usefulness	0.408	0.387	0.114	3.578	0.000
H4	Service Quality -> Perceived Ease of Use	0.368	0.351	0.103	3.574	0.000
H5	System Quality -> Perceived Usefulness	0.246	0.249	0.080	3.055	0.001
H6	System Quality -> Perceived Ease of Use	0.322	0.315	0.064	5.017	0.000
H7	Perceived Usefulness -> Customer Satisfaction	0.559	0.554	0.062	8.964	0.000
H8	Perceived Ease of Use -> Customer Satisfaction	0.301	0.301	0.064	4.677	0.000
H9	Customer Satisfaction -> Customer Loyalty	0.769	0.764	0.051	15.220	0.000

4.2.1 Information Quality (IQ) Positively Affects Perceived Usefulness (PU)

The test results show a t-statistic of 2.492 (>1.96) and a p-value of 0.006 (<0.05), confirming that Information Quality significantly influences Perceived Usefulness. This aligns with the DeLone & McLean IS Success Model and Technology Acceptance Models [5], [18] which indicate that information quality enhances system usefulness perception . Prior research found that accurate and structured information positively affects user satisfaction in e-learning systems [26]. However, in the context of AWM Laundry, which integrates Digital Twin technology, real-time updates on service status, pricing, and machine availability provide a more dynamic and precise user experience. Unlike conventional laundry

service apps, AWM Laundry offers predictive maintenance insights and machine performance tracking, further reinforcing the importance of information quality in increasing system adoption.

4.2.2 Information Quality (IQ) Positively Affects Perceived Ease of Use (EUO)

Information Quality (IQ) Positively Affects Perceived Ease of Use (EOU) with a t-statistic of 2.601 and a p-value of 0.005, this hypothesis is accepted, indicating that better information quality enhances ease of use. This supports the findings of DeLone & McLean and Davis, which state that clear and accessible information reduces complexity in system interactions [18]. Also emphasized that structured information improves user navigation. AWM Laundry, leveraging Digital Twin technology, not only provides real-time status updates but also offers a virtual representation of laundry processes. This allows users to visualize the entire washing cycle, making the system more intuitive and easier to use compared to traditional laundry service applications.

4.2.3 System Quality (SQ) Positively Affects Perceived Usefulness (PU)

The t-statistic of 3.055 and p-value of 0.001 confirm that system quality significantly influences perceived usefulness. According to the DeLone & McLean model, a stable, fast, and error-free system increases user satisfaction. Found that efficient system performance enhances perceived value [26]. AWM Laundry's integration with Digital Twin technology ensures a robust system, minimizing downtimes by predicting machine failures before they occur. This predictive capability differentiates AWM Laundry from previous laundry applications, making it more useful for users who seek a reliable and automated laundry experience.

4.2.4 System Quality (SQ) Positively Affects Perceived Ease of Use (EOU)

System Quality (SQ) Positively Affects Perceived Ease of Use (EOU) a t-statistic of 5.017 and a p-value of 0.000 validate the hypothesis. A high-quality system, characterized by reliability and intuitive design, improves ease of use [26]. AWM Laundry's Digital Twin integration enables seamless monitoring of laundry machines, helping users track machine availability and status remotely. This level of system transparency and interactivity enhances ease of use compared to conventional laundry services that lack real-time system synchronization.

4.2.5 Service Quality (SQ) Positively Affects Perceived Usefulness (PU)

The hypothesis is supported with a t-statistic of 3.578 and p-value of 0.000. Service quality, including reliability and responsiveness, significantly influences perceived usefulness, aligning with DeLone & McLean and TAM. System quality enhances perceived usefulness in digital platforms [27]. Unlike traditional laundry services, AWM Laundry's Digital Twin model enables predictive analytics for service optimization, allowing users to anticipate service completion times with high accuracy. This predictive capability enhances the usefulness of the application by minimizing uncertainty in laundry management.

4.2.6 Service Quality (SQ) Positively Affects Perceived Ease of Use (EOU)

With a t-statistic of 3.574 and p-value of 0.000, this hypothesis is confirmed. High service quality reduces user frustration and enhances system usability. Responsive service increases perceived ease of use. AWM Laundry's AI-driven chatbot and automated customer support, powered by its Digital Twin framework, offer real-time solutions and troubleshooting, ensuring a more user-friendly experience compared to traditional laundry applications [21].

4.2.7 Perceived Usefulness (PU) Positively Affects Customer Satisfaction (CS)

A t-statistic of 8.964 and p-value of 0.000 indicate a significant positive relationship. When users find a system beneficial, their satisfaction increases [13]. The DeLone & McLean IS Success Model confirms that a system providing real benefits enhances satisfaction [22]. AWM Laundry stands out by offering data-driven laundry insights, including estimated completion times, machine efficiency reports, and cost breakdowns. These advanced features, enabled by Digital Twin technology, significantly improve the user experience and satisfaction levels.

4.2.8 Perceived Ease of Use (EOU) Positively Affect Customer Satisfaction (CS)

The hypothesis is accepted with a t-statistic of 4.677 and p-value of 0.000. Users prefer a system that is easy to navigate and understand [4]. AWM Laundry's user interface, enhanced with Digital Twin-based visualization, provides real-time tracking of laundry processes, making the application more engaging and interactive [24]. This advanced visualization sets it apart from previous laundry service applications that rely solely on textual updates.

4.2.9 Customer Satisfaction (CS) Positively Affects Customer Loyalty (CL)

A t-statistic of 15.220 and p-value of 0.000 confirm the strong impact of customer satisfaction on loyalty. Satisfied users are more likely to remain loyal to a service. DeLone & McLean emphasize that a well-functioning system enhances user retention [19]. AWM Laundry differentiates itself by offering a Digital Twin-powered loyalty system, where users can track and optimize their laundry habits through usage analytics. This unique approach enhances customer engagement and long-term loyalty, making it superior to traditional laundry services that lack personalized insights.

4.3 Managerial Implication

The findings of this study provide key insights for AWM Laundry in optimizing Digital Twin technology within its smart laundry system. Improving information quality through real-time updates, transparent pricing, and structured service details enhances user decision-making and experience. System stability, responsiveness, and security are crucial for increasing perceived usefulness, requiring a seamless, error-free platform with predictive maintenance capabilities [28].

Service quality plays a vital role in customer satisfaction and loyalty. AWM Laundry should enhance responsiveness through AI-powered support and automated notifications while ensuring efficient issue resolution. Additionally, streamlining booking, tracking, and payment features will improve convenience and usability. Leveraging Digital Twin simulations and data analytics allows for service personalization and operational efficiency [29].

Ultimately, aligning technological advancements with user expectations will strengthen AWM Laundry's competitive edge, driving sustainable growth and customer retention in the smart laundry industry.

5. CONCLUSION

This study investigates the role of Digital Twin technology in optimizing smart laundry services by analyzing customer acceptance and loyalty using the Technology Acceptance Model (TAM) and the Information System (IS) Success Model. The primary objective was to determine how Information Quality (IQ), System Quality (SQ), and Service Quality (SQ) influence Perceived Usefulness (PU) and Perceived Ease of Use (EOU) and how these factors impact Customer Satisfaction (CS) and Customer Loyalty (CL) within the AWM Laundry application.

The findings confirm that all proposed hypotheses are supported. Information Quality significantly influences both Perceived Usefulness and Ease of Use, highlighting the importance of providing accurate, real-time, and well-structured information to users. This aligns with previous research, which emphasizes that high-quality information enhances decision-making and user satisfaction. In the context of AWM Laundry, real-time service updates and transparent pricing structures contribute to a more informed and seamless user experience.

Similarly, System Quality positively affects Perceived Usefulness and Ease of Use, reinforcing the need for a stable, fast, and error-free system. A well-designed digital infrastructure with minimal downtime and intuitive navigation enhances the usability of AWM Laundry, making it more accessible for customers. This finding is consistent with the IS Success Model, which asserts that a high-performing system increases user engagement and adoption rates.

Furthermore, Service Quality plays a critical role in shaping user perceptions, with significant positive effects on both Perceived Usefulness and Ease of Use. The responsiveness and reliability of customer support services within AWM Laundry ensure that user concerns are promptly addressed, thereby fostering trust and confidence in the application. This supports the IS & TAM model, which suggests that service quality is a key determinant of customer satisfaction in digital platform.

The study also confirms that Perceived Usefulness and Perceived Ease of Use significantly influence Customer Satisfaction, emphasizing that users are more likely to engage with and appreciate a service when it is both functional and easy to navigate. Higher satisfaction levels directly contribute to Customer Loyalty, as satisfied users are more inclined to continue using the service and recommend it to others. This aligns with the TAM framework, which suggests that perceived benefits and usability drive long-term technology adoption.

In conclusion, Digital Twin technology enhances smart laundry services by improving operational efficiency, user experience, and customer engagement. The integration of real-time data analytics, predictive maintenance, and automated service tracking ensures that AWM Laundry remains competitive, reliable, and highly efficient. These findings highlight the necessity of advanced digital transformation in the laundry service industry, positioning Digital Twin technology as a key innovation for optimizing customer satisfaction, resource utilization, and

business sustainability. Future research should explore additional moderating factors, such as user trust and technological readiness, to further refine the adoption model in the context of smart laundry services.

5.1 Limition

The limitations of this study are as follows:

1. The model effectively predicts customer acceptance and loyalty in AWM Laundry, but it does not account for psychological and behavioral factors like trust and perceived risk. Future research should explore these aspects for a more comprehensive analysis.
2. The study is limited to a specific region, making the findings less generalizable. Since AWM Laundry operates in a localized market, further research should examine different geographical and cultural contexts.
3. The sample consists mostly of millennials, which may not reflect the preferences of older users with varying digital literacy. Future studies should include a more diverse demographic.
4. The study does not differentiate between users familiar with Digital Twin-based laundry services and new users, which may affect perceptions of ease of use and usefulness. Future research should consider prior experience as a factor.
5. Due to time constraints, the study focuses on Digital Twin in a smart laundry service. However, as Digital Twin is traditionally used in manufacturing, its adoption in service-based small business remains underexplored. Theoretical frameworks like TAM and IS Success Model may not fully capture its impact, requiring further study on tailored models for service industries.

5.2 Future Research Recommendation

Future research should explore additional factors to enhance the understanding of customer acceptance and loyalty in AWM Laundry, aligning with this study's objective of optimizing smart laundry services through Digital Twin technology.

1. Expanding the model by integrating factors such as trust, security, and behavioral influences would provide a more comprehensive view of customer adoption.
2. Cross-regional studies could validate the model's applicability in different market environments and technological infrastructures, ensuring broader relevance beyond the study's limited scope.
3. Since this study focuses on millennials, future research should investigate generational differences in Digital Twin adoption, assessing whether older users perceive and interact with the technology differently.
4. A comparison between experienced and new users of Digital Twin-based laundry services would clarify how prior familiarity impacts perceived usefulness, ease of use, and customer loyalty.
5. Conducting a longitudinal study could track customer perceptions over time, analyzing how continued engagement with AWM Laundry influences trust, satisfaction, and long-term loyalty.

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