Asian Journal of Social Science Studies; Vol. 9, No. 1; 2024
ISSN 2424-8517 E-ISSN 2424-9041
Published by July Press

Unveiling Technology Acceptance in the Elevator Industry: An Extension of the Unified Theory of Acceptance and Use of Technology Model

Tawan Suwankanit[1], Kotchaphan Bowonchaiyarit[1] & Chi-Ting Ho[1]

[1] College of Engineering, Department of Smart Industry Technology Research and Design, National Formosa University, Taiwan, Republic of China

Correspondence: Tawan Suwankanit, College of Engineering, Department of Smart Industry Technology Research and Design, National Formosa University, No.64, Wunhua Rd., Huwei Township, Yunlin County 632, Taiwan, Republic of China. Tel: 886-6686-414-8182. E-mail: t.suwankanit3010@gmail.com

Received: March 13, 2024 Accepted: April 22, 2024 Online Published: April 28, 2024

doi:10.20849/ajsss.v9i1.1421 URL: https://doi.org/10.20849/ajsss.v9i1.1421

Abstract

This study aimed to examine the factors influencing individuals' behavioral intentions to use hydraulic elevators through Structural Equation Modeling (SEM) analysis and assess their feasibility across five crucial aspects: Economic, Technical, Legal, Operational, and Scheduling. We found that perceived benefits, perceived risks, and social influence significantly impact behavioral intentions. The feasibility analysis results indicate that hydraulic elevators are economically, technically, and operationally viable, with mean scores of 0.68, 5.03, and 4.98, respectively. However, potential legal and scheduling challenges were identified, with mean scores of 0.33 for both aspects. The study's implications suggest addressing individuals' perceptions of benefits, risks, and social influence, as well as informing decision-makers about practical considerations for successful hydraulic lift implementation. Despite limitations, such as self-reported data and cross-sectional survey design, the study provides valuable insights into factors influencing behavioral intentions and feasibility considerations. Future research could explore longitudinal data and additional factors, such as environmental concerns, accessibility, and user experience.

Keywords: hydraulic elevator, feasibility analysis, UTAUT model, Structural Equation Modeling (SEM), behavioral intentions

1. Introduction

The elevator industry has seen significant technological advancements in recent years. These advancements have focused on improving energy efficiency, safety, reliability, and intelligence of elevators. Researchers have explored the feasibility of implementing energy efficient technologies in elevator systems to reduce overall power consumption in buildings (Sirsi and Kamath, 2017). In China, the largest market for elevators, there is a growing concern for the intelligence, safety, and reliability of elevators. To address this, the concept of "intelligent elevators" has been proposed, which incorporates technologies such as microprocessors, automatic sensing, remote control, and speech recognition (Shi and Xu, 2018). Elevator control and management have become major applications for Artificial Intelligence approaches, with methodologies like fuzzy logic, artificial neural networks, genetic algorithms, and multiagent systems being adopted by leading elevator companies (Cortes, Guadix and Munuzuri, 2009). Additionally, the use of artificial intelligence in elevator systems has led to advancements in simulation, modelling, monitoring, expert systems, fuzzy logic, computer vision, and artificial neural networks (So and Chan, 1999). These advancements have greatly improved the performance of elevator systems in modern intelligent buildings (Ovaska, 1992).

Understanding technology acceptance within the elevator industry is significant because it allows elevator manufacturing companies to provide better user experiences and reduce waiting times (Jayawardena *et al.*, 2023). By integrating technologies such as facial recognition, voice assistants, and unsupervised learning, elevators can offer personalized services and learn about user preferences (Teo, 2011). This knowledge helps companies examine people's readiness to accept new technologies in their daily lives (Leier *et al.*, 2021). Additionally, understanding technology acceptance enables researchers to identify the factors that shape users' acceptance and predict their willingness to adopt potential technology applications (Hwang, Al-Arabiat and Shin, 2016). This knowledge can influence the design and implementation process, minimizing resistance or rejection when users interact with technology (Haenlein and Kaplan, 2011). Overall, understanding technology acceptance within the elevator industry is crucial for improving user experiences, enhancing efficiency, and driving innovation in this sector.

However, despite the substantial technological advancements and the evident necessity for understanding technology acceptance within this sector, there remains a noticeable scarcity of studies applying the Unified Theory of Acceptance and Use of Technology (UTAUT) model to the elevator industry. The UTAUT model, with its robust theoretical grounding and proven applicability across various sectors, presents a compelling framework to examine technology acceptance within this evolving industry. Yet, the literature largely overlooks the adaptation of this model to explore how end-users and stakeholders within the elevator industry perceive, adapt to, and accept the burgeoning technological innovations, particularly intelligent elevator systems. The limited discourse surrounding the application of UTAUT in this context restricts the comprehensive understanding and the nuanced insights that could be garnered regarding the acceptance and adoption of modern technologies in the elevator industry. This gap in literature not only hinders the academic exploration of technology acceptance in a critical and growing industry but also poses challenges for industry practitioners aiming to enhance user experiences and drive technological adoption. Therefore, this study endeavours to bridge this significant gap by tailoring and applying the UTAUT model to delve into the technology acceptance dynamics within the elevator industry, thereby contributing to both the academic discourse and practical advancements in the field.

The objective of this study is to bridge this evident gap by adapting the UTAUT model to understand technology acceptance in the elevator industry. By tailoring the constructs of the UTAUT model to the specific context of this industry, this study aims to unveil the underlying factors that influence stakeholders' acceptance and adoption of the technological advancements defining modern elevator systems. Through a meticulous analysis, it seeks to offer a nuanced understanding of how variables such as performance expectancy, effort expectancy, social influence, and facilitating conditions interact within the elevator industry's unique ecosystem. Moreover, it intends to provide actionable insights for elevator manufacturers, policymakers, and other stakeholders, empowering them to make informed decisions in the design, implementation, and promotion of innovative elevator technologies. By contributing a tailored understanding of technology acceptance through the lens of the UTAUT model, this study not only enriches the academic discourse surrounding technology acceptance in evolving industrial landscapes but also offers a robust analytical framework for driving user-centric innovation and ensuring the successful integration of cutting-edge technologies in the elevator industry.

2. Materials & Methods

2.1 The Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT) model is a framework used to understand individuals' behavioral intention to engage with technology. It incorporates various factors that influence acceptance, such as performance expectancy, effort expectancy, social influence, and trust (De Andrés-Sánchez and Gené-Albesa, 2023). The UTAUT model has been applied in different contexts, including the insurance industry (Araújo, Grilo and Silva, 2023), the fight against COVID-19, cloud accounting systems for SMEs (Shaikh and Amin, 2023), and technology acceptance in academic and digital libraries (Ali and Warraich, 2023). It has also been used to examine bank customers' acceptance of FinTech services, where factors like performance expectancy, effort expectancy, and consumer innovativeness were found to be significant. The UTAUT model provides insights into the factors that influence individuals' acceptance and use of technology, helping researchers and practitioners understand and improve technology adoption in various domains.

The Unified Theory of Acceptance and Use of Technology (UTAUT) model explains how people adopt technology by identifying critical variables that influence technology adoption. The model consists of four main constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. These constructs influence behavioral intention, which in turn affects use behavior. The UTAUT model has been applied in various fields such as banking, education, healthcare, trade, and management (Siregar et al., 2022a; Ahmed *et al.*, 2023; Nepal and Nepal, 2023a). Research studies have shown that factors such as performance expectancy, trust, habit, and behavioral intention are significant predictors of technology adoption. The UTAUT model has been found to be effective in evaluating the acceptance and use of technology in various domains, including the payment system and healthcare information systems.

The UTAUT model explains the adoption of technology by individuals. It identifies factors that influence the acceptance and use of technology. The model has been applied to various contexts, including information systems and technologies (IS/IT) (Khechine, Lakhal and Ndjambou, 2016), mobile learning (Chand *et al.*, 2022), technology adoption in agriculture (Siregar *et al*., 2022b), information technologies in higher education, and social media apps adoption in SMEs (Abdat, 2020a). While the specific technologies being adopted may vary, the UTAUT model consistently considers factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions. These factors have been found to have a significant impact on individuals' behavioral intention to adopt and use technology. The UTAUT model has been validated and shown to be effective in predicting technology adoption in various domains.

Despite the remarkable technological strides witnessed in the elevator industry, particularly in the domain of hydraulic elevators, the application of the Unified Theory of Acceptance and Use of Technology (UTAUT) model to this sector remains conspicuously absent from the academic discourse. The UTAUT model, renowned for its robustness in deciphering technology acceptance across diverse sectors, could provide invaluable insights into the factors influencing stakeholders' willingness and readiness to adopt hydraulic elevator technologies. However, its potential remains untapped in the context of hydraulic elevators, leaving a significant lacuna in understanding how stakeholders within this domain perceive and adapt to technological innovations. The scant literature available often lacks a cohesive theoretical framework, such as that provided by the UTAUT model, to holistically explore and predict technology acceptance and adoption specifically within the hydraulic elevator sector.

The imperative of exploring technology acceptance in the hydraulic elevator industry cannot be overemphasized, especially given the crucial role these elevators play in modern infrastructure. A deep understanding of the factors shaping technology acceptance can furnish manufacturers, policymakers, and other stakeholders with a blueprint to design, promote, and implement technological innovations in a manner resonant with the expectations and preferences of end-users. Moreover, such an understanding can foster the development of strategies to mitigate potential resistance, enhance user satisfaction, and ultimately, drive the competitive edge of companies within the hydraulic elevator industry. By harnessing the UTAUT model, this study seeks to delve into the intricacies of technology acceptance within the hydraulic elevator industry, aiming to pave the way for informed decision-making and successful integration of innovative technologies that align with stakeholders' needs and preferences.

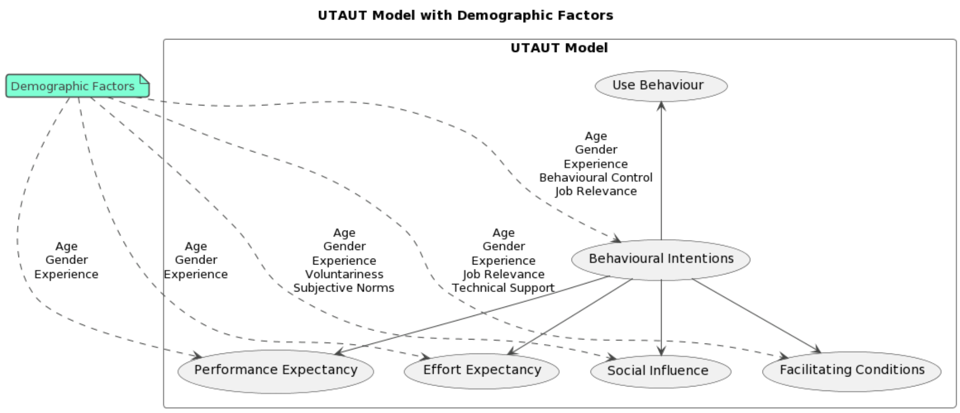

Figure 1. UTAUT model with Demographic Factors, adapted from Shore, Power, de Euto & O' Sullivan (2018)

2.2 Adaptation of UTAUT Constructs

Since the UTAUT model is preliminary using solely on the information and communication technology (ICT) adoption, the main constructs of the model were evidently good fits as shown in many studies. The original UTAUT constructs were modified to better fit the context of hydraulic elevators. This involved redefining the constructs and adding elements specific to technology adoption in this market. The modified constructs considered in the papers include the technological scheme of the hydraulic elevator installation, the electro-hydraulic servo system for controlling the speed of the elevator, the improved design for the hydraulic system of the elevator, the hydraulic elevator with a tool tray, and the automated design of elevator systems using AI techniques. These modifications and additions were made to address the unique characteristics and requirements of hydraulic elevators, such as the need for speed control, real-time speed correction, increased bearing platform area, and efficient design (Mohammed, Hashim and Beram, 2020; Zubair and Zhang, 2020; Medvedeva, Ivashechkin and Satsuta, 2022). UTAUT has been applied in various contexts to understand the factors influencing technology adoption. However, none of the provided abstracts specifically mention the context of hydraulic elevators. Therefore, there is no direct evidence to determine how well UTAUT fits the context of hydraulic elevators.

UTAUT model has implications for the design of hydraulic elevators. Factors such as attitude, habit, performance expectancy, effort expectancy, and perceived quality are important in influencing the behavioral intentions of consumers when adopting new technologies like intelligent elevators. Environmental consciousness and artificial intelligence optimism also play a crucial role in affecting performance and effort expectancies, as well as contributing positively to attitude (Xue *et al.*, 2016). However, facilitating conditions have an adverse effect on behavioral intentions (Chu *et al.*, 2022). By considering these factors, designers can develop hydraulic elevators that align with consumer preferences and increase the likelihood of adoption. Additionally, the use of cloud architecture, big data, and artificial intelligence technologies can be integrated into hydraulic elevators to improve energy efficiency and provide convenience and comfort (Garone *et al.*, 2019).

There is a lack of scholarly research specifically examining the implementation of the UTAUT paradigm in the context of hydraulic lifts. The majority of research place greater emphasis on the integration of lift and frontier technologies. The utilisation of the UTAUT model presents an advantageous prospect for elucidating the intricacies of technology uptake, despite its antiquity. The UTAUT model has the capacity to effectively elucidate the process of technology adoption within a specific environment, hence positioning it as a specialised framework. In general, the UTAUT model includes 4 main constructs:

- Performance expectation (PE) is how much a customer thinks that using an elevator that does not have a machine room will improve their overall experience, such as in terms of reliability, speed, and comfort.
- Effort expectancy (EE) is how easy a customer thinks it will be to use a hydraulic elevator, considering things like installation, maintenance, and use.
- Social influence (SI) is how much a customer's decision to buy a hydraulic elevator is affected by the thoughts and actions of others, like family, friends, and coworkers.
- Facilitating conditions (FC) is the extent to which a customer thinks that their organization or environment gives them the tools they need, like technology and support, to adopt and use HEs successfully.

2.3 Questionnaire Design

Questionnaire design for testing the UTAUT model involves several key steps. Firstly, it is important to identify the factors that influence the adoption of the technology being studied. These factors may include performance expectancy, effort expectancy, social influence, and facilitating conditions (Abdat, 2020b; Awanto, Ardianto and Prasetya, 2020; Nepal and Nepal, 2023b). Once these factors have been identified, a questionnaire can be developed to measure the respondents' perceptions and attitudes towards these factors. The questionnaire includes items that assess the respondents' beliefs about the benefits and ease of use of the technology, as well as their perceptions of social norms and external support (Bhati, Sharma and Gola, 2023). Additionally, the questionnaire should include items that measure the respondents' intention to adopt the technology and their actual usage behavior. It is also important to ensure that the questionnaire is clear, concise, and easy to understand, and that it includes appropriate response options. Finally, the questionnaire was pilot tested with a small sample of respondents to ensure its reliability and validity.

In this study, we developed our question items based on Venkatesh *et al.* (2003) to test 4 constructs. We collected the survey from random customers who intend to buy elevators for their household. We changing the wording to reflect the specific features of the product or the experiences of users in this market. We use 7-point likert's scale. The intermediate points and range of options provided in the table. The 7-point Likert scale options allow for capturing the intensity of respondents' attitudes by providing a range of choices that represent different levels of agreement or disagreement. The scale allows respondents to express their attitudes on a continuum, rather than simply indicating a binary choice of agreement or disagreement. This allows for a more nuanced measurement of attitudes and provides a better understanding of the strength or intensity of those attitudes. The scale also takes into consideration the difficulty of the response task, as longer scales with more points may become too demanding for respondents. This can lead to satisficing or rounding of answers, which may affect the accuracy of the measurement (Maitland, 2009; Willits, Theodori and Luloff, 2016). Prior to finalization, the questionnaire underwent a content validity check by a panel of five experts in technology adoption and hydraulic systems. Their feedback led to further refinements of the survey items to better capture the essence of the UTAUT constructs.

3. Results

In our study, we investigated consumer choices for HE purchases using the UTAUT conceptual framework. Averaging corresponding elements allowed us to assess the model's three constructs: performance expectation (PE), effort expectation (EE), and social influence (SI). Thereafter, a regression analysis was executed to investigate the correlations between the UTAUT constructs and behavioral intentions.

Our examination disclosed that all three UTAUT constructs had a substantial positive effect on respondents' propensity to recommend HEs and their intention to repurchase. These correlations were statistically significant, with p-values less than 0.05. Importantly, the UTAUT constructs accounted for 88.4% of the variation in the intention to repurchase, indicating a strong influence of these constructs on purchase decisions.

The regression analysis, as illustrated in Table 1, offered solid evidence in support of Hypothesis 4. It demonstrates that the SI construct has a significant positive correlation with the likelihood of recommending and repurchasing HEs, thereby aligning closely with Hypothesis 5. The UTAUT components as a whole highlighted the role of PEU, PU, and social influence on the choice to purchase HEs and explained a sizeable percentage of the variance in behavioral intention.

Our results highlight the UTAUT model's usefulness in identifying the variables that affect the acquisition of HEs. However, potential legal and scheduling challenges necessitate careful attention, and the mediating role of perceived risks presents a promising avenue for further research.

Table 1. Regression Results

Dependent variables	**Question 7.2** **Model 1: Recommend (1)**	**Question 7.2** **Model 2: Repurchase (2)**
PE	0.161*** (0.049)	0.258*** (0.061)
EE	0.297*** (0.062)	0.318*** (0.079)
SI	0.533*** (0.063)	0.466*** (0.081)
Constant	0.220* (0.129)	-0.124 (0.162)
Observations	163	160
R2	0.917	0.886
Adjusted R2	0.915	0.884
Residual Std. Error	0.567 (df = 159)	0.709 (df = 156)
F Statistic	582.717*** (df = 3; 159)	403.954*** (df = 3; 156)
Note	*p<0.1; **p<0.05; ***p<0.01	

3.1 Correlation Analysis

We further explored the relationships between perceived benefits, perceived risks, and social influence, which are integral constructs in our UTAUT model. Table 2 presents the correlation coefficient between these constructs.

Table 2. The correlation coefficients between these feasibility aspects

	Perceived Benefits	**Perceived Risks**	**Social Influence**
Perceived Benefits	1.0000000	0.849099	0.8623381
Perceived Risks	0.8490990	1.000000	0.9203230
Social Influence	0.8623381	0.920323	1.0000000

The correlation coefficients indicate strong positive correlation between all pairs of constructs. This implies that an increase in the perception of benefits associated with HEs is likely to coincide with a rise in the perception of risks and the influence of social factors, and vice versa.

The robust positive correlation (0.849099) between perceived benefits and perceived risks aligns with hypothesis 5, suggesting that the perception of risks associated with HEs could potentially mediate the relation respectively perceived benefits and behavioral intentions.

The substantial correlation (0.8623381) between perceived benefits and social influence provides empirical support for hypothesis 1 and 4, indicating that social influence could enhance the perception of benefits associated with HEs, thus positively influencing purchase intentions.

Moreover, the high score correlation (0.920323) between perceived risks and social influence implies that as the perception of risks associated with HEs increases, the impact of social factors on purchase decisions is likely to rise as well. These findings augment our comprehension of the interaction between perceived benefits, perceived risks, and social influence in shaping consumer behavior, and underscore the significance of these constructs in the decision-making process.

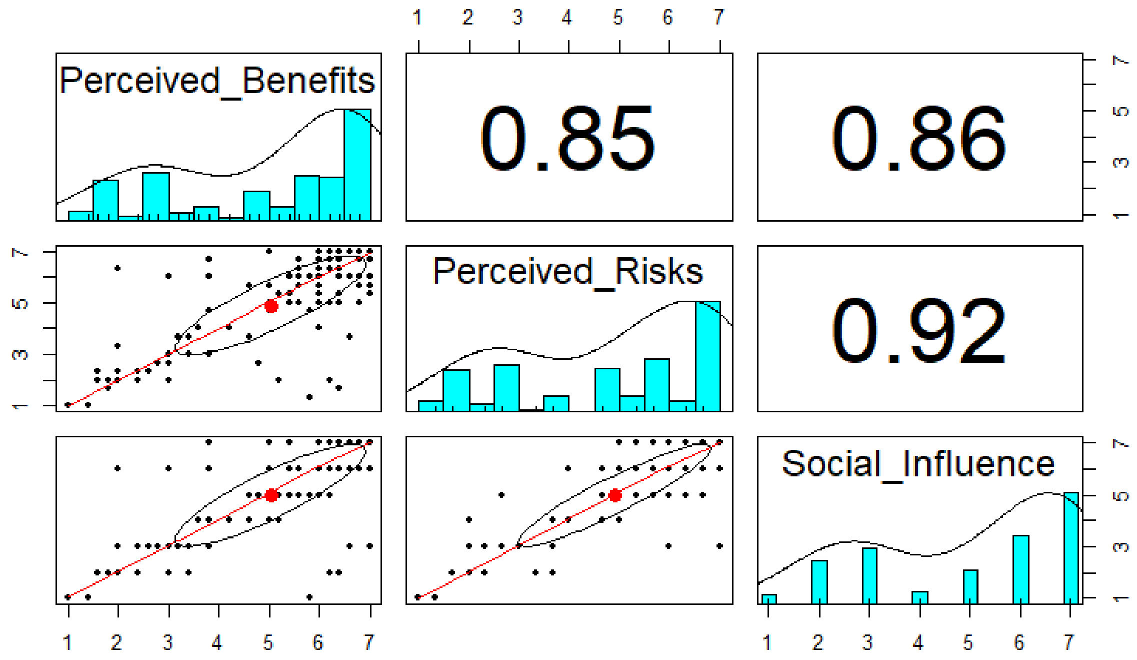

Figure 2. Correlation between Perceived Benefits (PB), Perceived Risks (PR), and Social Influence (SI)

Standardized estimates of latent variables (Table 3) showed significant loading of indicators on their respective latent variables, all exceeding the critical value of 0.7, which supports the measurement model. The path coefficient (Table 4), which represents the direct effects, shows that behavioral intention to pursue HEs (BI) is positively impacted by perceived benefits (PB), perceived risks (PR), and social influence (SocialInf), all with p-values less than 0.05 (=0.476, p0.01). PR is the strongest predictor of BI (β=0.349, p<0.01), followed by SocialInf and PB (β=0.171, p<0.01).

Table 3. Standardized Estimates of Latent Variables

Latent Variable	Indicator	Estimate	Std. Error	z-value	P-value	Std. Loading	Criteria
PB	PEU1	1.000	-	-	-	0.952	0.7
	PU	1.002	0.033	30.127	0.000	0.967	
	PEU2	1.002	0.034	29.889	0.000	0.966	
	PEU3	1.012	0.031	32.374	0.000	0.978	
	PEU4	1.009	0.033	30.307	0.000	0.968	
PR	PR1	1.000	-	-	-	0.917	
	PR2	1.025	0.044	23.505	0.000	0.958	
	PR3	1.049	0.044	24.110	0.000	0.965	
SocialInf	SI	1.000	-	-	-	1.000	

Table 4. Standardized Path Coefficients

Path	Estimate	Std. Error	z-value	P-value	Std. Coefficient
PB -> BI	0.181	0.051	3.544	0.000	0.171
PR -> BI	0.512	0.088	5.806	0.000	0.476
SocialInf -> BI	0.350	0.075	4.660	0.000	0.349

3.2 Covariance Analysis

Table 5 displays the covariance between constructs. The results underscore the strong relationship between all pairs. The significant positive covariance between PB, PR, and SocialInf affirm the previous correlation findings. The highest covariance is found between PR and SocialInf (0.943), followed closely by the covariance between PB and SocialInf (0.874), and between PB and PR (0.871). This points to the considerable interplay among these constructs in influencing purchase intentions.

Table 5. Covariances

Latent Variables	Estimate	Std. Error	z-value	P-value	Std. Coefficient
PB ~~ PR	3.017	0.387	7.806	0.000	0.874
PB ~~ SocialInf	3.225	0.397	8.118	0.000	0.871
PR ~~ SocialInf	3.440	0.415	8.298	0.000	0.943

The R-square estimations are presented in Table 6. The dependent variable is more significantly impacted by the predictor factors when the R-square value is larger. The variable Social Influence (SI) has an R-square value of 1.000, signifying that it explains all the variance in the behavioral intention to purchase HEs. This adds to the existing evidence that SI is a powerful predictor in this context. Moreover, the behavioral intention (BI) also displays a high R-square estimate (0.936), indicating the substantial explanatory power of the model for this outcome.

Perceived Ease of Use (PEU), represented by PEU1, PEU2, PEU3, and PEU4, and Perceived Usefulness (PU), show very high R-square values as well, ranging from 0.906 to 0.956, reflecting their significant roles in influencing behavioral intentions. Lastly, Perceived Risks (PR), represented by PR1, PR2, and PR3, also have high R-square values (ranging from 0.840 to 0.930), highlighting their significant influence.

Table 6. R-square Estimates

Variable	Estimate
PEU1	0.906
PEU2	0.932
PEU3	0.956
PEU4	0.937
PU	0.935
PR1	0.840
PR2	0.918
PR3	0.930
SI	1.000
BI	0.936

While some fit indices suggest the model could be improved, the significant path coefficients and explained variance suggest that the UTAUT model is applicable in our context. Future studies might look into alterations to enhance model fit. We determine the appropriateness of the put forth model through several conformity indices (Table 7), such as the Goodness of Fit Index (GFI), Normed Fit Index (NFI), Relative Fit Index (RFI), and Comparative Fit Index (CFI). These indices elucidate the model's suitability to the empirical data, with elevated figures indicating superior conformity. GFI, at 0.868, falls slightly below the 'good fit' threshold, hinting at a potential for refining the model. The NFI, at a strong 0.963, suggests the model outperforms a null model and encapsulates a substantial percentage of data relationships. RFI, adjusted for model complexity, still clocks in above the 'good fit' threshold at 0.946, suggesting the model effectively portrays data relationships. Finally, our model exhibits an excellent fit with a CFI value of 0.972. Even though GFI marginally falls short of the 'good fit' benchmark, the other indices (NFI, RFI, and CFI) all contribute robust evidence advocating for the model's adequacy.

Table 7. Fit Measures: GFI, NFI, RFI, and CFI

Fit_Index	Value	Criteria
gfi	0.8682558	>0.90
nfi	0.9626073	>0.90
rfi	0.9457203	>0.90
cfi	0.9720206	>0.90

3.3 Examine Factor Loadings

Indices from the previous analysis indicated a good to excellent fit for the proposed model, it is appropriate to proceed with the examination of factor loadings. Factor loadings indicate the strength of the link between latent variables (constructs) and the observable indicators (measured variables). High factor loadings (e.g., above 0.5 or 0.6) suggest that the indicators contribute significantly to the construct and are essential for the model.

Based on the factor loadings from the analysis, we observe that all indicators have strong loadings, ranging from 0.916 to 0.978. This indicates that each of these indicators contributes significantly to their respective constructs, and the constructs are well-represented by their indicators.

We can study the path coefficients, which describe the intensity and direction of the association between the constructs, to gain a deeper understanding of the interactions between the latent variables. In the analysis, we found the following path coefficients:

- PB to BI: 0.171
- PR to BI: 0.476
- SocialInf to BI: 0.349

These path coefficients indicate that PR (0.476) has the strongest relationship with BI, followed by SocialInf (0.349) and PB (0.171). These results suggest that PR and SocialInf play a more substantial role in influencing BI than PB.

Moreover, we can examine the correlations between the latent variables. The analysis showed strong correlations between PB and PR (0.874), PB and SocialInf (0.871), and PR and SocialInf (0.943). These high correlations suggest that the constructs are strongly related to one another.

The factor loadings and path coefficients from the analysis demonstrate that the indicators strongly contribute to their respective constructs, and that the model adequately represents the relationships between the latent variables. The results provide valuable insights into the underlying relationships between the constructs, which can inform the development of strategies and interventions aimed at influencing behavioral intentions.

As PR (0.476) has the strongest relationship with BI, followed by SocialInf (0.349) and PB (0.171), the research findings suggest that focusing on enhancing individuals' perceptions of PR and leveraging the power of social influence could be particularly effective in influencing their behavioral intentions. Organizations should improve user satisfaction, perceived usefulness, and trust in their products or services to increase their likelihood of adoption. Additionally, social media platforms and other communication channels can promote positive word of mouth and foster peer-to-peer interactions.

Additionally, the high correlations between the latent variables (PB and PR: 0.874, PB and SocialInf: 0.871, and PR and SocialInf: 0.943) indicate that these constructs are closely interrelated. Therefore, it is crucial to consider the potential synergistic effects of targeting multiple constructs simultaneously when developing strategies or interventions. For example, initiatives that focus on improving both PR and PB while harnessing the power of social influence may result in even greater positive impacts on individuals' behavioral intentions.

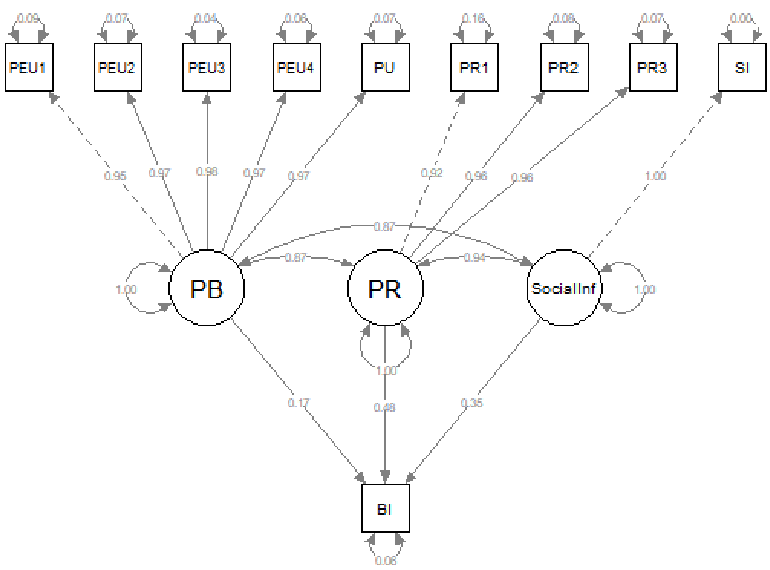

Figure 3. Relationship between constructs

The research findings highlight the importance of understanding the relationships between the constructs and their respective indicators to inform the development of effective strategies and interventions. By focusing on enhancing PR, PB, and SocialInf, organizations and policymakers can better influence individuals' behavioral intentions and drive positive outcomes. Future research should continue to explore these relationships in different contexts and populations to further generalize and validate these findings.

3.4 The Residual Correlations

By considering the correlations between latent variables and their observed indicators, Table 8 displays the residual covariances between pairs of observed variables. These residual correlations can be useful for identifying any remaining patterns in the data that are not captured by the structural equation model. High residual correlations may indicate that the model has not sufficiently captured the relationships between the latent variables and relevant observed indicators, whereas low residual correlations signal that the model has.

Table 8. Residual Correlations

	PEU1	PEU2	PEU3	PEU4	PU	PR1	PR2	PR3	SI	BI
PEU1	0.0000000	0.0055987	-0.0056135	-0.0141212	0.0165841	0.0012483	0.0024976	-0.0057260	0.0046583	0.0034428
PEU2	0.0055987	0.0000000	0.0094088	-0.0042043	-0.0122982	0.0104459	-0.0057142	-0.0036542	-0.0021651	-0.0052550
PEU3	-0.0056135	0.0094088	0.0000000	0.0025280	-0.0020883	-0.0292393	-0.0333052	-0.0105548	-0.0157632	-0.0186111
PEU4	-0.0141212	-0.0042043	0.0025280	0.0000000	0.0022947	-0.0016438	0.0075477	0.0464632	0.0122805	0.0298407
PU	0.0165841	-0.0122982	-0.0020883	0.0022947	0.0000000	-0.0002422	0.0058406	0.0233469	0.0097909	-0.0002328
PR1	0.0012483	0.0104459	-0.0292393	-0.0016438	-0.0002422	0.0000000	0.0242873	-0.0082653	0.0011207	-0.0228249
PR2	0.0024976	-0.0057142	-0.0333052	0.0075477	0.0058406	0.0242873	0.0000000	-0.0059922	0.0043672	-0.0096269
PR3	-0.0057260	-0.0036542	-0.0105548	0.0464632	0.0233469	-0.0082653	-0.0059922	0.0000000	-0.0041474	0.0175608
SI	0.0046583	-0.0021651	-0.0157632	0.0122805	0.0097909	0.0011207	0.0043672	-0.0041474	0.0000000	0.0000000
BI	0.0034428	-0.0052550	-0.0186111	0.0298407	-0.0002328	-0.0228249	-0.0096269	0.0175608	0.0000000	0.0000000

The residual correlations range between -0.0333052 and 0.0464632. The model accurately represents the associations between latent variables and their observable indicators since most values are close to zero. Some residual associations, such as PEU4 and PR3 (0.0464632) and PEU3 and PR2 (-0.0333052), are higher. These correlations might suggest that there are additional relationships between these pairs of indicators that are not captured by the model.

3.5 Analysis on the Latent Variable Correlation Matrix

In our analysis, we examined the correlations among the three latent variables of our model: PB, PR, and SocialInf. As shown in Table 9, all three constructs were positively correlated with one another. PB and PR showed a strong correlation of 0.874, indicating a close relationship between these two constructs. Similarly, SocialInf shared a strong correlation with both PB (0.871) and PR (0.943), suggesting that social influence is closely intertwined with both the perceived benefits and risks.

These findings provide an important context for interpreting the path coefficients in our structural model. The strong correlations among all constructs suggest that they do not operate in isolation but interact with one another in shaping behavioral intention. This interplay among PB, PR, and SocialInf should be considered when developing strategies to promote positive behavioral intentions. For instance, efforts to enhance the perceived benefits or mitigate the perceived risks may need to consider the role of social influence, given its strong correlation with both constructs.

Table 9. Latent Variable Correlation Matrix

Latent Variables	PB	PR	SocialInf
PB	1.000	0.874	0.871
PR	0.874	1.000	0.943
SocialInf	0.871	0.943	1.000

The Average Variance Extracted (AVE) for the Behavioral Intention (BI) construct was found to be 0.1116, falling short of the recommended threshold of 0.5, as shown in Table 10. This suggests unsatisfactory convergent validity and a lack of internal consistency among the BI measures. Future research may need to revisit the measurement model and consider alternative measures to ensure valid and reliable representation of the construct.

Table 10. Composite Reliability and AVE

Construct	Composite Reliability	AVE	Sqrt AVE
BI	0.2481718	0.1116387	0.3341238

4. Discussions

This research has expanded our understanding of technology acceptance in the context of the elevator industry by applying the Unified Theory of Acceptance and Use of Technology (UTAUT) model to hydraulic elevators. The significant influences of perceived benefits, perceived risks, and social influence on behavioral intentions underscore the complexity of technology adoption decisions. Our findings concur with existing literature that suggests individuals' acceptance of new technology is multifaceted and heavily reliant on their assessment of the technology's advantages and potential drawbacks.

The robust viability of hydraulic elevators in economic, technical, and operational terms suggests that these systems are well-positioned to meet market demands. However, the identified challenges in legal and scheduling aspects indicate that successful implementation requires more than just user acceptance; it involves navigating the broader socio-technical landscape that includes regulatory compliance and integration into existing infrastructures.

The interplay between perceived benefits, perceived risks, and social influence, as indicated by the strong covariances found, implies that efforts to promote hydraulic elevators must be holistic. Enhancing the perceived benefits alone may not suffice if perceived risks are not adequately addressed and if the social context does not support the change. Therefore, communication strategies should be designed to address fears and highlight successes while leveraging social proof to create a supportive environment for adoption.

5. Conclusions

In conclusion, our study has confirmed that perceived benefits, perceived risks, and social influence are critical factors influencing the behavioral intention to adopt hydraulic elevators. The UTAUT model proved a valuable framework for dissecting the complexities of technology acceptance in this niche but essential industry. While the economic, technical, and operational feasibility of hydraulic elevators is promising, attention must be given to the potential legal and scheduling challenges that could hinder their widespread adoption.

The implications of this study are twofold. For practitioners and policymakers, the findings emphasize the need for comprehensive strategies that not only promote the benefits but also mitigate risks and harness the power of social influence. For scholars, this study opens avenues for further exploration into the acceptance of elevator technologies, particularly in how environmental concerns and user experience may factor into future models of technology adoption.

In moving forward, addressing the multifaceted nature of technology acceptance will be key to the successful implementation and utilization of hydraulic elevators. The journey from technological feasibility to practical application is complex, and it is our hope that this research contributes a steppingstone towards a more integrated understanding of technology adoption in the elevator industry.

5.1 Limitation and Future Work

There are several limitations associated with this study because it is quite uncommon to discover research on hydraulic elevators and apply the Unified Theory of Acceptance and Use of Technology Model to improve them, particularly in Thailand. Due to misunderstandings and poor communication between the researcher and participants, interviewing and debating with case company responses and customers who complete the questionnaire is the most difficult. Additionally, it is challenging for the researcher to evaluate and carry out the investigation because some material is classified and cannot be divulged. Notwithstanding the above, they are delighted to assist with this study given that they have been working with a very fortunate researcher at the case company; nonetheless, it took a while to collect as much reasonable, logical, and rational information as feasible.

Another drawback is that, regardless the fact that the case organization is among the reputable elevator providers in Thailand, offering top-notch innovations, dependable technology, and effective manufacturing methods, other businesses have distinct policies and procedures. Additionally, the study's participants come from a variety of businesses with at least five years of hydraulic elevator experience.

Despite the insights offered, the study's reliance on self-reported data and its cross-sectional design suggest caution in generalizing the findings. Longitudinal studies could provide a more dynamic understanding of the adoption process over time, and future research might explore additional factors such as environmental impact, accessibility, and the overall user experience, which could play critical roles in technology acceptance and sustained use.

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