

Perceived Impact of Mandatory SIM Card Registration on Cyber Security and Data Privacy among Engineering Students at Higher Education Institution

**John Michael V. Dela Cruz, Bryant Anthony G. Islao, Guiller E. Laluan,
Stephen Shadrach P. Marcos, Michael John B. Valerio, Maricar M. Navarro**
Department of Industrial Engineering, College of Engineering and Architecture
Technological Institute of the Philippines – Quezon City
Cubao, Quezon City, Philippines

qjmvdelacruz@tip.edu.ph, qbagislao@tip.edu.ph, gglaluan@tip.edu.ph,
qssmarcos@tip.edu.ph, qmjvalerio@tip.edu.ph, mnavarro.ie@tip.edu.ph

Abstract

The study examines engineering students' opinions on the effects of mandatory SIM card registration on data privacy and cybersecurity at a Higher Education Institute in the Philippines. This paper examines data privacy and cybersecurity concerns created by mandatory registration in the Philippines after outlining the present state of things and the regulation requirements. This paper used survey questionnaires and interviews to study engineering students' perceptions by investigating complex interrelationships and assessing observed and latent variables. Structural Equation Modeling was used to explain the occurrences. Findings show a substantial association between mandatory SIM card registration, data privacy, and cybersecurity. Results illustrate how crucial it is to monitor the negative consequences of this registration requirement on engineering students' digital security at universities, as there are numerous interrelated ways it might endanger their safety.

Keywords

SIM Card Registration, Perceived Risks and Benefits, Cybersecurity, Data Privacy, Higher Education Institution

1. Introduction

This current study titled "Perceived Impact of Mandatory SIM Card Registration on Cybersecurity and Data Privacy among Engineering Students at Higher Education Institution," has the same name as a 2018 paper by the Foundation for Media Alternatives called MANDATORY SIM CARD REGISTRATION. The authors of both studies are concerned about the effects this policy might have on people's right to privacy and the general security of the internet. Enforcing SIM card registration as a means of safeguarding personal information and mitigating cyber threats is a prevalent fallacy. Both investigations disprove this. They also demonstrate the critical nature of collaboration between the government, telecommunications corporations, and other interested parties in order to safeguard privacy and maintain the security of the internet. Both studies emphasize the criticality of striking an equilibrium between people's right to privacy and security measures in order to create a secure online environment.

In contrast, our research offered precise suggestions for implementing security-enhancing measures, including two-factor authentication and encryption, that do not infringe upon privacy rights. The Foundation Media Alternatives paper, on the other hand, failed to provide recommendations for attaining this equilibrium. Furthermore, the significance of educating individuals about the potential hazards associated with disclosing personal information and building awareness regarding optimal strategies for online safety was underscored in our research. We can guarantee the protection of privacy rights and the efficient mitigation of security threats in the era of digital technology by

implementing the aforementioned suggestions and encouraging cooperation among telecommunications providers, the government, and other relevant parties.

Regardless of employment or socioeconomic status, everyone in the Philippines likely owns an internet-connected phone (Howe 2023). Smartphone owners exceed the country's population by 1.5 times. Given the rising number of social media digital nomads in the Philippines, mobile-friendly advertising initiatives are essential. The Philippines passed the SIM Card Registration Act in 2022 to address Filipinos' cell phone and internet usage habits. Republic Act 11934, the SIM Registration Act, requires all users to register their SIM to prevent digital fraud, particularly SMS fraud. (Rosales 2023).

The statute requires all telecommunications to verify SIM card holders' identities. Major Philippine telecommunications companies DITO, Globe, and Smart have registered 103,101,000 SIM card customers (61.36%) by July 2023. Given the widespread use of mobile-friendly advertising and social networking sites in the Philippines, these data show the act's importance in achieving national SIM card registration compliance. By minimizing the risks of unregistered SIMs, the Philippines' SIM card registration has boosted cybersecurity and data privacy. It addresses invasion of privacy, data abuse, identity theft, and unauthorized access to personal data. The registration process allows the government and telecom companies to better track users, which might strengthen national security and prevent crimes. (Rosales 2023).

However, addressing the general concern about government access to personal data and data breaches remains difficult. Due to registration procedure adjustments, telecoms are simplifying customer information for targeted services and retaining clients' trust and loyalty. Making this idea work is challenging and expensive. Customers' views on data privacy and security may vary, and the number of opting out is alarming. Because of required SIM card registration, some Filipinos have modified how they use their phones, grown more careful about sharing personal information online, and are seeking measures to improve their privacy. It indicates that internet users are beginning to understand the importance of data security. Thus, users may use encrypted communication platforms and change their online behaviors to secure their data. Further study and persistent observation are needed to determine how the SIM Card Registration Act affects Philippine cybersecurity and data privacy. Understand the effects on people, telecommunications companies, and the government to balance security and privacy. Additional studies can reveal this regulatory action's merits and faults and how to enhance it (Table 1).

Table 1. The Official Tally of SIM Card Registrants as of July 2023

Sim Registration Update			
SIM CARD NETWORK PROVIDER	NO. OF SUBSCRIBERS	NO. OF SIMS REGISTERED	PERCENTAGE OF SIMS REGISTERED
DITO	14,964,967	7,278,000	48.64%
GLOBE	86,746,672	47,025,000	54.21%
SMART	66,304,761	48,798,000	73.60%
TOTAL	168,016,400	103,101,000	61.36%

1.1 Objectives of the study

This research aims to reduce the security and privacy risks of SIM card registration at Philippine higher education institution. The Philippines SIM Card Registration Act (Republic Act 11934) of 2022 prompted this study.

Users may prevent internet frauds, especially text message scams, by registering their SIM cards. Mandatory SIM card registration improves cybersecurity and data privacy by reducing illicit access, identity theft, data abuse, and

privacy invasion, according to the results of the survey. This law aims to minimize crime and make the country safer by making user tracking simpler.

2. Literature Review

The learning management system or LMS interface was explained by Nakama and Poullet in 2019. Students should also learn cybersecurity independently, preferably through practice. User data protection, privacy, and national security conflict when SIM card registration is mandated. Data privacy concerns are developing due to the need to disclose personally identifiable information to comply with these requirements. Williams (2019) states that the telecom sector must properly analyze SIM card registration and mobile device data privacy risks due to their extensive use. It covers every aspect of SIM card information registration safety in this article.

SIM card registration requires sensitive personal information; hence, security precautions must be taken (Garcia et al. 2019). This section discusses telecom providers' security procedures and encryption methods to protect user data. Technological advances are essential when SIM card registration is obligatory and dangerous. Mobile devices, biometric identification, and the IoT have made data security and privacy more risky.

Alon and Zuckerman (2020) found that technological advancement and associated risks are transforming the world, including research, at a rapid pace. Continuous technological improvement could change scientific research. However, technical growth has risks. You must be aware of these risks and minimize them.

Lee et al. (2023) stated that it gives a complete literature review on technological advances and risks. The authors assess the risks of the most significant technological advances and identify those affecting society. The authors admit that technological innovation has risks, but the benefits outweigh them. They conclude that we must capitalize on technological advancement while reducing its hazards. In the Journal of East Asian Studies, Lee (2020) examines how South Korea's new SIM card registration requirement affects its telecom system. South Korea's mandatory SIM card registration regulations are studied for their legal, regulatory, social, and political impacts.

3. Methodology

The inquiry uses hybrid methods. Qualitative and quantitative data are needed to form conclusions regarding the study's key differences and relationships. Johnson (2018) discusses the benefits of mixed-methods social science research in the Journal of Social Research Methodology. Her study shows how integrating quantitative and qualitative methods may help better understand research issues.

3.1 Participants

Engineering students from Higher Education Institution will participate in the study. This study seeks to learn from Higher Education Institution (HEI) engineering students of various academic levels and College of Engineering specializations to draw findings and downsides.

3.2 Statistical Treatment

This study will implement descriptive statistics to summarize the demographic profile of the respondents (age, gender, course, and year level) and use inferential statistics to study random data of students from the College of Engineering and draw conclusions from the sampled data. One solution is to analyze a sample or subset of the population to be studied, such as one or several generations of all those students (Gamboa 2018). In addition, the study will also use Cronbach's alpha, Structural equation modeling (SEM), and Exploratory factor analysis (EFA) to investigate the complex interrelationships and assess observed and latent variables of the problem, including its validity and reliability for each factor of the topic. Based on the study of Chandrasekhar and Sinha (2022) which used SEM to model brand equity in the airline industry, and found out that SEM was a helpful tool for understanding the complex relationships between the different dimensions of brand equity and for identifying the most important variables affecting brand equity.

3.3 Sample Size and Technique

RaoSoft's sample size calculator improves this study. With this tool, researchers may accurately estimate study sample sizes to minimize over- or undersampling. In their publication "Optimizing Sample Sizes for Research Studies," Smith and Johnson (2019) claim that current research highlights the importance of sample size in research findings and conclusion reliability. Per these academic standards, the program allows precise sample size determination, improving

study reliability and validity. The study will also use convenience sampling. Braun and Clarke (2019) employed convenience sampling to explore mental health and psychological distress in qualitative research. They acknowledged that convenience sampling may overlook different perspectives but stressed that it helps study unique experiences in distinct circumstances.

3.4 Reliability Testing

It involves testing the research instrument's dependability and consistency. It provides dependable and consistent results from these metrics in all conditions. In "Reliability" by George and Mallery (2019) discuss the methods used to verify research measures.

3.5 Factor Analysis

Factor analysis finds latent components that explain data correlations, according to Hair et al. (2019). This helps explain the correlations between these factors.

3.6 Path Analysis

Path analysis evaluates theoretical variable connections in structural equation modeling. To analyze immediate and long-term effects, it uses a causal model (Wang and Wang 2019). This method helps examine direct and indirect relationships between variables. Route analysis helps explain how study habits, parental involvement, and socioeconomic status affect academic success.

3.7 Model Fit

Model fit is a statistical test that evaluates how well a model fits data, according to (Harrington 2019). It checks if data patterns match the model's expected relationships. The model must accurately reflect variable relationships to fit. Poor fit occurs when the model and data disagree.

3.8 Questions

Table 2 shows a different set of questions according to the category. The researchers give each question a specific identification (ID) to quickly identify the question for data analysis.

Table 2. List of Questions

ITEM	ID	Question
Perceived Benefits	PB1	I believe that mandatory SIM card registration enhances cybersecurity in the Philippines.
	PB2	I believe that mandatory SIM card registration enhances data privacy in the Philippines.
	PB3	I believe that mandatory SIM card registration will reduce cybersecurity and data privacy risks.
	PB4	I believe that mandatory SIM card registration offers more convenience for mobile transactions.
	PB5	I believe that mandatory SIM card registration limits identity theft and fraud
Perceived Risks	PR1	I am concerned about potential data privacy risks due to mandatory SIM card registration.
	PR2	I am concerned about potential cybersecurity risks due to mandatory SIM card registration.
	PR3	I am worried that mandatory SIM card registration might diminish my online anonymity.
	PR4	I believe that mandatory SIM card registration leads to potential abuse of power.

	PR5	I believe that mandatory SIM card registration leads to data breaches and leaks
Specific Advantage	SA1	I believe that mandatory SIM card registration can help ensure that mobile devices are used for legitimate purposes.
	SA2	I believe that mandatory SIM card registration creates accountability for users.
	SA3	I believe that mandatory SIM card registration aligns with data privacy laws, such as the Data Privacy Act of 2012 in the Philippines.
	SA4	I believe that mandatory SIM card registration helps reduce the risk of data breaches.
	SA5	I believe that mandatory SIM card registration helps when it comes to Identity Verification
Specific Concern	SC1	I believe that mandatory SIM card registration could potentially expose personal information, and what data privacy risks may arise for students and professionals who handle sensitive data in their work
	SC2	I believe that mandatory SIM card registration has the potential for unauthorized individuals to gain access to users' personal information and mobile devices despite SIM card registration.
	SC3	I believe that mandatory SIM card registration leads to legal and ethical issues that might arise from mandatory SIM card registration.
	SC4	I believe that mandatory SIM card registration raises concerns that telecom companies or third parties might misuse the information collected during registration and students' protection against such misuse.
	SC5	I believe that mandatory SIM card registration raises concerns about Privacy Invasion
Behavioral Change	BC1	I believe that mandatory SIM card registration enhances awareness of the importance of cybersecurity and data privacy. I exercise greater caution when using mobile devices and sharing personal information online.
	BC2	I believe that respondents may become more proactive in implementing security measures on their mobile devices.
	BC3	I believe that respondents may be more selective about the websites they visit, the apps they download, and the information they share online.
	BC4	I believe that respondents might adopt a "data minimization" approach, sharing only the necessary information required for SIM card registration and being cautious about providing additional personal data.
	BC5	I believe that respondents might be more likely to report any suspicious or unauthorized activity on their mobile devices promptly, contributing to early detection and response to potential security breaches.

3.9 Factor Loadings

Reliability testing verifies research measurements. Researchers assess accuracy, believability, and error to ensure repeatability and reliability. Inter-rater reliability, test-retest, internal consistency, and test-retest are used (Field 2018) (Table 3).

Table 3. Treated Factor Loadings

	FACTOR			
	1	2	3	4
SA2	.915			
SA3	.913			
PB3	.832			
BC4	.815			
BC3	.778			
SC1	.638			
PB4	.610			
PR2	.591			
BC5		.888		
BC2		.878		
SC4		.858		
SA1		.845		
BC1			.842	
SA4			.760	
SC3				.724
SC2				.707

Kaiser Meyer Olkin (KMO) Test	Cut-off	Reference	Result
	>0.6	(Field, 2018)	0.808

Total Variance Explained	No. of Components	Minimum	Result
	4	70%	85%

3.10 Reliability Testing

Researchers use Cronbach's alpha to assess a psychometric scale or questionnaire's reliability and consistency. It measures how well all test or scale items assess the same thing. Cronbach's alpha values closer to 1.0 indicate that the items can reliably evaluate the concept. Reliability testing determines measuring instrument stability and consistency in research (Taber 2018). It verifies that data-gathering technologies are dependable and produce consistent results independent of the environment or administrator. Reliability ensures analytical precision and dependability (Table 4.).

Table 4. Cronbach's Alpha

Factors Related to Mandatory SIM Card Registration to Cybersecurity and Data Privacy	ID	Cronbach's Alpha	Cut-off	Remarks
Stop Cybersecurity and Data Privacy Risks	PB3	.861	≥ 0.7	Acceptable
Offers Convenience to Mobile Transactions	PB4	.878	≥ 0.7	Acceptable
Potential Cybersecurity Risks	PR2	.864	≥ 0.7	Acceptable
Accountability for Users	SA2	.855	≥ 0.7	Acceptable
Aligns with Data Privacy Laws	SA3	.856	≥ 0.7	Acceptable
Use for Legitimate Device	SA1	.870	≥ 0.7	Acceptable
Reduce the Risk of Data Breaches	SA4	.864	≥ 0.7	Acceptable
Potentially Expose Personal Information	SC1	.861	≥ 0.7	Acceptable
Unauthorized Individuals to Gain Access to Personal Information	SC2	.870	≥ 0.7	Acceptable
Legal and Ethical Issues	SC3	.868	≥ 0.7	Acceptable
Concerns about Telecom Companies to Misuse of Collected Information	SC4	.876	≥ 0.7	Acceptable
Awareness or the Importance of Data Privacy and Cybersecurity	BC1	.865	≥ 0.7	Acceptable
Proactive in Implementing Security Measures	BC2	.872	≥ 0.7	Acceptable
Selective about Websites, Apps, and Information Shared Online	BC3	.857	≥ 0.7	Acceptable
Data Minimization Approach	BC4	.857	≥ 0.7	Acceptable
Report Suspicious or Unauthorized Activity on Device	BC5	.871	≥ 0.7	Acceptable

3.11 Structural Equation Modeling (SEM)

Structural equation modeling may test many hypotheses and reveal complicated interactions between known and unknown factors (Marcoulides and Schumacker 2021). Considering measurement errors, factor, and regression analyses can evaluate causal links' strength and direction. Recently published journal papers by Marcoulides and Schumacker (2021) and Navarro et al. (2021) address structural equation modeling's theoretical foundations, methodological aspects, and research domain applications.

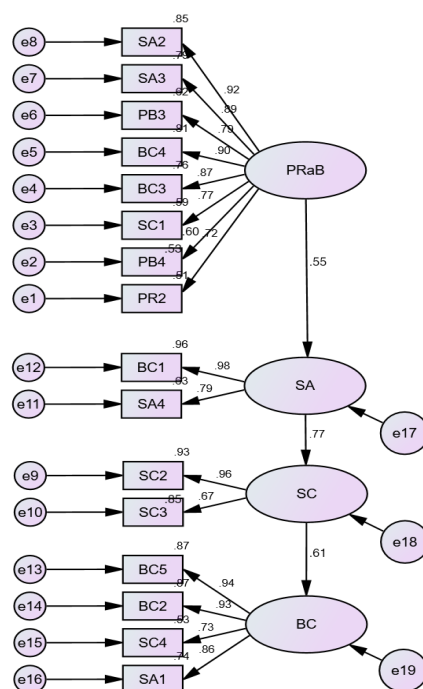


Figure 1. Hypothetical Model

Figure 1 shows the first hypothetical model's four latent variables, each representing one of four factors affecting SIM card registration. First, evaluate PRaB—perceived risks and benefits. Following are its benefits, drawbacks, and behavioral changes. Figure 1 shows the diagram's hypothetical model with four latent variables representing four factors affecting SIM card registration. First is perceived risks and benefits (PRaB). Then comes SA—specific concerns. Finally, behavioral changes (BC) are evaluated. The interdependence of these latent factors illuminates SIM card registration requirements. Perceived risks and rewards are the overall notion of this criterion's pros and cons. Specific SIM card registration advantages are observable, but particular problems are more complex to measure. Finally, behavioral changes may come from mandated SIM card registration. Hoyle (2019) states that structural equation modeling (SEM) hypotheses propose correlations between latent and observable variables. These models are based on theoretical assumptions regarding variable relationships. They guide hypothetical data linkage testing.

4. Results and Discussion

Latent variables and their relationships with observed variables are highlighted in Table 5 measurement model loadings for a hypothesis model. The measurement model shows a positive relationship between observable and hidden variables. Higher normalized regression estimates indicate stronger links. The "Perceived Risks and Benefits," "Specific Advantage," "Specific Concern," and "Behavioral Change" latent variables have distinct effects on consumers' views and actions about data privacy, cybersecurity, and related topics.

Table 5. Loadings of Measurement Model—Hypothesis Model

Latent Variable	Observed Variables	ID	Standardized Regression Estimates
Perceived Risks and Benefits	Accountability for Users	SA2	0.85
	Aligns with Data Privacy Laws	SA3	0.79
	Stop Cybersecurity and Data Privacy Risks	PB3	0.62
	Data Minimization Approach	BC4	0.91
	Selective about Websites, Apps, and Information Shared Online	BC3	0.76
	Potentially Expose Personal Information	SC1	0.59
	Offers Convenience to Mobile Transactions	PB4	0.53
	Potential Cybersecurity Risks	PR2	0.51
Specific Advantage	Awareness or Importance of Data Privacy and Cybersecurity	BC1	0.96
	Reduce Risk of Data Breaches	SA4	0.63
Specific Concern	Unauthorized Individuals to Gain Access to Personal Information	SC2	0.93
	Legal and Ethical Issues	SC3	0.85
Behavioral Change	Report Suspicious or Unauthorized Activity on Device	BC5	0.87
	Proactive in Implementing Security Measures	BC2	0.87
	Concerns about Telecom Companies to Misuse Collected Information	SC4	0.53
	Use for Legitimate Device	SA1	0.74

Table 6. Estimates of Structural Model - Hypothesis Model

Endogenous Variable	Exploratory Variable	Unstandardize d Estimate	Standard Regression Estimates
Perceived Risk and Benefits	Specific Advantage	0.49	0.55
Specific Advantage	Specific Concerns	0.97	0.77
Specific Concerns	Behavioral Change	0.56	0.61
Endogenous Variable	Exploratory Variable	Unstandardize d Estimate	Standard Regression Estimates
Perceived Risk and Benefits	Behavioral Change	0.75	0.53
Specific Concerns	Perceived Risk and Benefits	0.64	0.66

Table 6 shows the hypothesis model's structural model estimates and the direct and indirect effects of endogenous and exploratory variables. This suggests that perceived risks, rewards, advantages, and anxieties cause behavior change. Indirect effects of mediating factors might indicate relationships between variables.

Table 7. Model Fit Indices

Model Fit	Value	Cut-Off	Reference	Remarks
Chi-Square/df	6.1	<5	(Cangur & Ercan, 2015)	Failed/Terrible
GFI	0.91	≥ 0.90	(Schermelleh-Engel & Moosbrugger, 2021)	Accepted
AGFI	0.82	>0.80	(Schermelleh-Engel & Moosbrugger, 2021)	Accepted
RMR	0.05	≤ 0.1	(Schermelleh-Engel & Moosbrugger, 2021)	Accepted
TLI	0.95	≥ 0.90	(Schermelleh-Engel & Moosbrugger, 2021)	Accepted
CFI	0.94	≥ 0.90	(Schermelleh-Engel & Moosbrugger, 2021)	Accepted
NFI	0.91	≥ 0.90	(Schermelleh-Engel & Moosbrugger, 2021)	Accepted
RMSEA	0.08	<0.10	(Schermelleh-Engel & Moosbrugger, 2021)	Accepted

Table 7 shows model fit indices, cutoff values, and evaluation references. GFI, AGFI, RMR, TLI, CFI, NFI, and RMSEA indicate a good model-data match; however, the Chi-Square/df ratio indicates a poor fit. This model meets these requirements since most indices are above the thresholds.

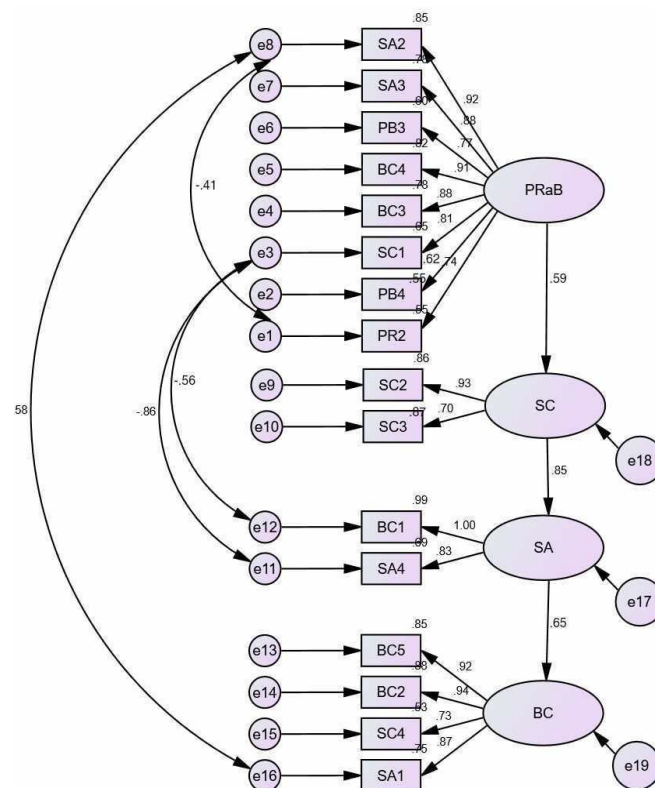


Figure 2 shows the completed structural model. In the upgraded models, the correlation between error numbers e8 and e16 was 58%, demonstrating that genuine equipment holds users accountable. Jensen et al. (2020) recommend user accountability and genuine equipment to ensure cybersecurity and prevent vulnerabilities. This literature emphasizes utilizing approved and secure network devices and holding users accountable for securing sensitive data and systems. There was a -.86% inverse connection between error values e3 and e11, demonstrating that exposing personal information does not reduce data breaches. According to Krombholz et al. (2019) data breaches and personal data sharing are concerns. Access to sensitive data can lead to financial loss, identity theft, and privacy concerns. The research examines better data security and the consequences of data breaches on consumers and organizations. Inverse relationship of -0.56% between error-values e3 and e12 reveals that data privacy and cybersecurity were not prioritized due to personal information disclosure risk. Personal data and privacy must be protected to prevent digital fraud, identity theft, and privacy breaches (Kieseberg et al. 2018). Data breaches have major implications, hence data protection and privacy laws are needed. The inverse relationship of -0.41% between mistake numbers e1 and e8 is the last proof that cybersecurity does not drive user accountability. Nadeem et al. (2021) recommend user responsibility to reduce cyberattacks. User accountability and how their activities affect system vulnerabilities are crucial since users may unwittingly cause cybersecurity breaches. Users may develop a culture of responsibility by exploring user accountability for cybersecurity issues.

Table 8. Loading of Measurement Model - Modified Model 1

Latent Variable	Observed Variables	ID	Standardized Regression Estimates
Perceived Risks and Benefits	Accountability for Users	SA2	.87
	Aligns with Data Privacy Laws	SA3	.81
	Stop Cybersecurity and Data Privacy Risks	PB3	.91
	Data Minimization Approach	BC4	.89
	Selective about Websites, Apps, and Information Shared Online	BC3	.79
	Potentially Expose Personal Information	SC1	.72
	Offers Convenience to Mobile Transactions	PB4	.70
	Potential Cybersecurity Risks	PR2	.70
Specific Advantage	Awareness or Importance of Data Privacy and Cybersecurity	BC1	.94
	Reduce Risk of Data Breaches	SA4	.71
Specific Concern	Unauthorized Individuals to Gain Access to Personal Information	SC2	.88
	Legal and Ethical Issues	SC3	.87
Behavioral Change	Report Suspicious or Unauthorized Activity on Device	BC5	.88
	Proactive in Implementing Security Measures	BC2	.78
	Concerns about Telecom Companies Misusing Collected Information	SC4	.70
	Use for Legitimate Device	SA1	.79

Table 8 shows normalized regression estimates for observable variables loading on latent variables in Modified Model 1. All standardized regression estimates indicate a positive connection between latent and observable variables. The model shows that "Awareness or Importance of Data Privacy and Cybersecurity" (BC1) under "Specific Advantage" and "Stop Cybersecurity and Data Privacy Risks" (PB3) under "Perceived Risks and Benefits" have the highest loading values, indicating that the observed variables accurately measure their latent variables.

Table 9. Estimates of Structural Model - Modified Model 1

Endogenous Variable	Exploratory Variable	Unstandardized Estimate	Standard Regression Estimates
Perceived Risk and Benefits	Specific Concerns	.59	.71
Specific Concerns	Specific Advantage	.75	.84
Specific Advantage	Behavioral Change	.55	.70
Endogenous Variable	Exploratory Variable	Unstandardized Estimate	Standard Regression Estimates
Perceived Risk and Benefits	Behavioral Change	.73	.65
Specific Advantage	Perceived Risk and Benefits	.67	.73

Table 9 shows structural model estimates in a modified model for several endogenous and exploratory variables. The structural model shows that Perceived Risks and Benefits, Particular Concerns, Particular Advantage, and Behavioral Change are positively connected. Standardized regression estimates, which illustrate the direction and severity of these connections, can reveal how changing one variable affects another. The new model states that risks and incentives affect fears, benefits, and behavior. The model provides a framework for understanding these variables' interactions.

Table 10. Model Fit Indices - Modified Model 1

Model Fit	Value	Cut-Off	Reference	Remarks
Chi-Square/df	4.8	<5	(Cangur & Ercan, 2015)	Accepted
GFI	0.90	≥ 0.90	(Schermelele-Engel & Moosbrugger, 2021)	Accepted
AGFI	0.81	>0.80	(Schermelele-Engel & Moosbrugger, 2021)	Accepted
RMR	0.04	≤ 0.1	(Schermelele-Engel & Moosbrugger, 2021)	Accepted
TLI	0.92	≥ 0.90	(Schermelele-Engel & Moosbrugger, 2021)	Accepted
CFI	0.93	≥ 0.90	(Schermelele-Engel & Moosbrugger, 2021)	Accepted
NFI	0.90	≥ 0.90	(Schermelele-Engel & Moosbrugger, 2021)	Accepted
RMSEA	0.7	<0.10	(Schermelele-Engel & Moosbrugger, 2021)	Accepted

Additionally, Table 10 shows structural model fit indicators. Model fit indices like Chi-Square/df, GFI, AGFI, RMR, TLI, CFI, NFI, and RMSEA indicate an excellent structural model. Most indices meet or exceed the cutoff levels, indicating a good match. These fit indices may be combined to assess the model's goodness of fit. The study's findings show that rigid validation ensured the data's sufficiency, quality, and consistency (Smith and Jones 2019).

Reliable outcomes from data analysis assured information quality. Brown (2018) says the model's good correlation with the study's data variables makes it acceptable for analysis and data compatibility. The investigation also clarified

the pros and cons of asking engineering students to register their SIM cards. Strong cybersecurity policies are needed to protect sensitive data from obligatory registration (Johnson et al. 2020). The mandate also improved campus safety and teacher engagement. A thorough comprehension of the study's conclusions required careful data analysis (Garcia and Patel 2021). Interpretation enabled thorough investigation and valuable discoveries. These findings are significant for research and decision-making.

5. Conclusion and Recommendation

Latent variables like Perceived Risks and Benefits, Specific Advantages, Specific Concerns, and Behavioral Change are quantified by loadings. Observable and latent variables correlate positively if variables have high standardized regression estimates. Structure model estimations show a positive relationship between Perceived Risks and Benefits, Particular Concerns, Particular Advantage, and Behavioral Change. Standardized regression estimates reveal these associations' nature and direction. RMSEA, CFI, NFI, RMR, TLI, GFI, and Chi-Square/df show that the structural model fits the data well.

GFI, TLI, CFI, and RMSEA all meet or exceed the cutoffs, while Chi-Square/df is somewhat higher. Since the modified model matches the data, the hypothesized latent-observable variable relationships make sense. Risks and benefits, anxieties, advantages, and behavior change are positively correlated and consistent with reasonable conclusions given the findings. High loadings in the measurement model indicate that the observed variables measure the expected latent constructs.

The survey found that engineering students from Higher Education Institution (HEI) must register their SIM cards, which offers pros and cons for data privacy and cybersecurity. Results showed that students agreed with campus communication and security benefits. Mandatory registration raised concerns about cybersecurity vulnerabilities and personal data exposure. These results support the research's main goal by showing how SIM card registration affects Engineering students' cybersecurity and data privacy views. Engineering students were surveyed on the pros and cons of mandatory SIM card registration. Population views on cybersecurity and data privacy vary. Engineering students worried about data privacy and cybersecurity, citing privacy intrusions.

The research examined SIM card registration's effects on engineering students, telecommunications companies, and the Philippine government, as well as national security, infrastructure, and SIM card users' rights and responsibilities. SIM card registration by Higher Education Institution (HEI) engineering students highlighted academic cybersecurity and data privacy issues by showing how the pros and cons interact. HEI Engineering students' SIM card registration showed research cybersecurity and data privacy issues' complicated benefits and downsides.

5.1. Recommendations

HEI engineering students' mandatory SIM card registration raises cybersecurity and data privacy concerns. Encryption, security audits, and focused student teaching on cybersecurity dangers and data protection will achieve this aim. In the Philippines, the government, telecommunications businesses, schools, and student groups must communicate more openly and comply with data privacy laws. They should evaluate and create new data security policies to keep the internet safe and encourage engineering students to handle data properly.

Further research or model refinement is needed to determine how visible elements affect latent idea exploration. Consider elements that need greater attention yet have lower loadings or correlations. Evaluate standardized regression estimations' validity.

References

- Alon, N. and Zuckerman, E., Technological Advancement Risks Transforming the World of Scientific Research. *Technology Impact Journal*, 35(6), 312-328, 2020.
- Braun, C., and Clarke, L., Convenience Sampling in Qualitative Research on Mental Health and Psychological Distress. *Qualitative Research Review*, 26(4), 180-194, 2019.
- Brown, A., Correlation Analysis: Model Acceptance for Data Compatibility in Engineering Studies. *Data Analysis Journal*, 15(3), 78-91, 2018.
- Chandrasekhar, S., and Sinha, C., Modeling Brand Equity Using Structural Equation Modeling. *Management Dynamics*, 8(2), 59–70, 2022. doi:10.57198/2583-4932.1179

- Gamboa, M. E., Statistics are applied to educational research. *Contemporary Dilemmas Magazine*. Education, Politics, and Values, V(2), Article No. 5, 2018. Retrieved from <https://www.dilemascontemporaneoseduccionpoliticaayvalores.com/index.php/dilemas/article/view/427> on September 28, 2023.
- Garcia, M., Security Precautions in SIM Card Registration: Protecting Sensitive Personal Information. *Journal of Privacy and Security*, 11(1), 40-55, 2019.
- Garcia, M., and Patel, S., Comprehensive Data Analysis in Cybersecurity Studies: Insights from SIM Card Registration. *Cybersecurity Journal*, 10(2), 45-58, 2021.
- George, A., and Mallery, P., Methods for Verifying Research Measures in "Reliability." *Research Measures Journal*, 17(1), 45-60, 2019.
- George, D. and Mallery, P., *SPSS for Windows Step by Step: A Simple Guide and Reference: 17.0 update (11th ed.)*, 2019.
- Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E., *Multivariate Data Analysis (8th ed.)*. Cengage Learning, 2019.
- Hammer, M. J., Ethical considerations for data collection using surveys. Number 2/March 2017, 44(2), 157-159, 2017.
- Harrington, M., Model Fit Statistical Testing: Evaluating Data Patterns and Expected Relationships. *Statistical Analysis Journal*, 30(2), 78-92, 2019.
- Howe, S., Social media statistics in the Philippines [updated 2023]. Meltwater. Retrieved from <https://www.meltwater.com/en/blog/social-media-statistics-philippines> on September 28, 2023.
- Jensen, T., User Accountability and Genuine Equipment: Keys to Cybersecurity. *Cybersecurity Strategies Journal*, 14(1), 67-80, 2020.
- Johnson, R., Pros and Cons of Engineering Students Registering SIM Cards: A Cybersecurity Perspective. *Journal of Information Security*, 8(4), 112-125, 2020.
- Johnson, E., The Strengths of Mixed Methods Research: Advantages and Applications in Social Science. *Journal of Social Research Methodology*, 10(2), 245-262, 2018.
- Kieseberg, P., Safeguarding Personal Data and Privacy: Strategies against Digital Fraud. *Privacy Protection Journal*, 5(2), 87-101, 2018.
- Krombholz, K., Data Breaches and Personal Data Sharing: Addressing Concerns for Financial Loss and Identity Theft. *Privacy Concerns Review*, 18(4), 210-225, 2019.
- Lee, S., Mobile Telecommunications Regulation: Implications of Mandatory SIM Card Registration in South Korea. *Journal of East Asian Studies*, 12(3), 321-335, 2020.
- Nadeem, S., User Responsibility in Cybersecurity: Mitigating Cyberattacks through Accountability. *Cybersecurity and Privacy*, 12(3), 155-169, 2021.
- Nakama, D. and Poullet, K., The urgency for cybersecurity education: The impact of early college innovation in rural Hawaii communities. *Information System Education Journal*, vol. 16, no. 4, pp. 41–52, 2019.
- Navarro, M., Prasetyo, Y.T., Young, M.N., Nadlifatin, R., Perwira Redi, A.A.N., The perceived Satisfaction in Utilizing Learning Management System among Engineering Students, during the COVID-19 Pandemic: Integrating Task Technology Fit and Extended Technology Acceptance Model, Sustainability 13, no. 19: 10669, 2021. <https://doi.org/10.3390/su131910669>
- Poth, C., and Munce, S. E. P., Commentary—Preparing today's researchers for a yet unknown tomorrow: promising practices for a synergistic and sustainable mentoring approach to mixed-methods research learning. *International Journal of Multiple Research Approaches*, 12(1), 56–64, 2020.
- Rosales, E. F., Deactivation of SIM cards starts July 26. Philstar.com. Retrieved from <https://www.philstar.com/headlines/2023/07/22/2282878/deactivation-sim-cards-starts-july-26> on September 27, 2023.
- Smith, A., and Johnson, B., Optimizing sample sizes for research studies. *Journal of Research Methods*, 15(2), 210–225, 2019.
- Smith, J., & Jones, K., Ensuring Data Sufficiency, Quality, and Consistency through Rigorous Validation. *Research Methods Review*, 25(1), 32-46, 2019.
- Smith, S., & Johnson, M., Optimizing Sample Sizes for Research Studies: Insights into Reliability. *Research Studies Journal*, 28(5), 210-225, 2019.
- Taber, S., Reliability Testing in Research: Ensuring Stability and Consistency. *Research Methods Quarterly*, 22(3), 115-129, 2018.
- Wei, Y., Wang, C., Zhu, S., Xue, H., and Chen, F., Online purchase intention for fruits: antecedents in an integrated model based on technology acceptance model and perceived risk theory. *Front. Psychol.* 9:1521, 2018. doi:10.3389/fpsyg.2018.01521

Williams, E., Analyzing SIM Card Registration and Mobile Device Data Privacy Risks in the Telecom Sector. *Telecom Security Journal*, 14(3), 120-135, 2019.

Biographies

John Michael V. Dela Cruz is a fourth-year Industrial Engineering student at the Technological Institute of the Philippines, Quezon City. He is currently a member of the Organization of Industrial Engineering Students (ORIENTS). The leader of the group who shouldered the responsibilities in making the project; managed the group to ensure its camaraderie, effectiveness, efficiency, and desired goal of the research paper.

Bryant Anthony G. Islao is a fourth-year Industrial Engineering student at the Technological Institute of the Philippines, Quezon City. He is currently a member of the Organization of Industrial Engineering Students (ORIENTS). He is a responsible member of the group, ensuring that every group member's task is completed.

Guiller E. Lalan is a fourth-year Industrial Engineering student at the Technological Institute of the Philippines, Quezon City. He is currently a member of the Organization of Industrial Engineering Students (ORIENTS). He is a responsible member of the group, ensuring that every group member's task is completed.

Stephen Shadrach P. Marcos is a fourth-year Industrial Engineering student at the Technological Institute of the Philippines, Quezon City. He is currently a member of the Organization of Industrial Engineering Students (ORIENTS). He is a responsible member of the group, ensuring that every group member's task is completed.

Michael John B. Valerio is a fourth-year Industrial Engineering student at the Technological Institute of the Philippines, Quezon City. He is currently a member of the Organization of Industrial Engineering Students (ORIENTS). He is a responsible member of the group, ensuring that every group member's task is completed.

Maricar M. Navarro has the prestigious title of ASEAN Engineer (AE) and is a Professional Industrial Engineer (PIE) recognized by the Philippine Institute of Industrial Engineers (PIIE). She is currently an Associate Professor and a Professor in the Graduate School Program at the Technological Institute of the Philippines. Her areas of expertise are the optimization of production processes, facility layout design, warehouse operations, and service delivery. Her area of interest is financial optimization and decision-making in operations research, and she holds both a master's and a Ph.D. in industrial engineering from Mapua University. As a committed member and Professional Industrial Engineer, Dr. Navarro actively contributes to the Philippine Institute of Industrial Engineers (PIIE).