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Bridging the Digital Chasm: Infrastructure, Policy, and Personnel Determinants of Network Management in Resource-Constrained HEIs: A Quantitative Study from the Southern Philippines

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A B S T R A C T

The digital divide in higher education, particularly in resource-constrained environments, critically impedes institutional effectiveness and academic parity. Effective network systems management (NSM) is the bedrock of modern pedagogy and administration, yet its key determinants are insufficiently understood in these challenging contexts. This study investigates the factors predicting the quality of NSM in public Higher Education Institutions (HEIs) within a geographically isolated and developing region. A quantitative, cross-sectional study was conducted at three public HEIs in Sulu, Philippines, a representative resource-constrained archipelagic province. A validated survey instrument was administered to a stratified sample of 256 respondents, including IT personnel, administrators, faculty, and students. The instrument measured three latent constructs identified from the literature: IT Governance and Policy (ITGP), Technical Infrastructure and Configuration (TIC), and Human Capital and Personnel (HCP). Data were analyzed using descriptive statistics, ANOVA, and multiple linear regression. The overall quality of NSM was found to be 'moderately satisfactory' ($M=2.84$, $SD=1.05$), but with a statistically significant and profound chasm between institutions ($p < 0.001$). Institution 3 ($M=1.50$) was 'unsatisfactory,' while Institution 2 ($M=3.53$) achieved a 'satisfactory' status. The multiple regression model was significant ($F(3, 252) = 188.7$, $p < 0.001$), explaining 68.9% (Adjusted R^2) of the variance in NSM. IT Governance and Policy emerged as the most powerful predictor ($\beta = 0.45$, $p < 0.001$), followed by Human Capital and Personnel ($\beta = 0.31$, $p < 0.001$). Technical Infrastructure and Configuration ($\beta = 0.18$, $p < 0.01$), while significant, had the smallest unique contribution. In conclusion, the study demonstrates that institutional policy and human capital are more critical determinants of effective network management than technical infrastructure alone. Bridging the digital chasm in resource-constrained HEIs requires a holistic, socio-technical approach, prioritizing the development of robust IT governance frameworks and investing in the continuous training, retention, and empowerment of skilled IT personnel.

1. Introduction

The 21st century has established digital connectivity as the central nervous system of society, economic development, and knowledge dissemination.[1] For Higher Education Institutions (HEIs), this digital imperative is not merely an operational accessory but the fundamental backbone supporting every facet of their mission.[2] From facilitating modern pedagogical models like blended and online learning to enabling complex computational research, supporting administrative functions through Enterprise Resource Planning (ERP) systems, and fostering global collaboration, the institutional network is the single most critical infrastructure for institutional viability and competitiveness. A robust, secure, and well-managed network system is no longer a luxury but a prerequisite for academic survival and relevance in the global knowledge economy.[3]

However, the proliferation of digital technology has also exposed and exacerbated a profound 'digital chasm'. This divide exists not only between nations (the Global North vs. Global South) but, more granularly, within nations—between urban centers and rural or geographically isolated regions, and between well-funded private institutions and resource-constrained public ones.[4] This chasm is not merely about access to hardware; it is a complex socio-technical phenomenon encompassing the quality of infrastructure, the availability of skilled human capital to manage it, and the presence of robust governance structures to align technology with institutional strategy. In resource-constrained environments, which often grapple with limited funding, geographical isolation, and a shortage of technical expertise, HEIs face a Sisyphean task in attempting to bridge this divide.[5]

The critical artery of this digital infrastructure is Network Systems Management (NSM). NSM is a comprehensive discipline that extends far beyond "keeping the internet on." It involves the systematic planning, design, implementation, configuration, security, and maintenance of the entire institutional network.[6] Effective NSM ensures high availability, optimizes performance, safeguards institutional data from increasingly sophisticated cyber threats, and ensures the network's scalability to meet future demands. When NSM fails, the consequences are catastrophic: administrative operations grind to a halt, online classes are canceled, research data becomes inaccessible, and the institution's reputation is jeopardized.

Despite its importance, a significant gap persists in the academic literature. Much of the research on HEI networking focuses on large, well-resourced universities in developed nations, often emphasizing technological solutions like fiber-optic rollouts, 5G adoption, or sophisticated cybersecurity appliances. Conversely, studies in developing regions often focus on last-mile connectivity and basic digital literacy. What is critically overlooked is the managerial and organizational dimension of NSM within resource-constrained HEIs.[7]

The predominant assumption in many development projects and institutional procurement plans is that the digital chasm is a technology problem, solvable by technology procurement. This has led to a "technology-first" approach where significant capital is expended on advanced hardware (servers, routers, and firewalls) without a commensurate investment in the human capital and governance frameworks required to manage it. This oversight creates "digital white elephants"—expensive, high-end equipment that is poorly configured, underutilized, or rendered obsolete by a lack of maintenance, failing to deliver any tangible return on investment.[8]

To investigate this phenomenon, this study is situated in the province of Sulu, in the Southern Philippines. This context serves as an ideal "bellwether" or archetype of a resource-constrained environment. As an archipelagic province, it faces inherent challenges in infrastructure development and connectivity. Furthermore, as a region emerging from decades of conflict and grappling with developmental challenges, its public HEIs operate with significant financial and human resource limitations. The public HEIs in Sulu—a state university, a state college, and a technical-vocational school—are the primary engines for social mobility and regional development. Their ability to produce a competitive, digitally-literate workforce is directly contingent on the quality of their network systems. Understanding the determinants of NSM in this context, therefore, provides invaluable and generalizable insights for public HEIs, policymakers, and development agencies operating in similar resource-constrained settings across the globe.[9]

This study departs from a purely technical analysis by integrating two powerful socio-technical theories to frame its investigation: the Resource-Based View (RBV) and Institutional Theory. The Resource-Based View (RBV) posits that an organization's sustained competitive advantage (or, in the public sector, its institutional effectiveness) is derived from its portfolio of valuable, rare, inimitable, and non-substitutable (VRIN) resources. In the context of NSM, these resources are not just tangible assets like fiber-optic cables (which can be bought by anyone), but also intangible assets. This study conceptualizes these resources into three categories: Technical Infrastructure (tangible assets), IT Governance & Policy (organizational assets, such as effective policies and strategic plans), and Human Capital (human assets, such as skilled, certified, and motivated personnel). RBV suggests that effectiveness is not just about having these resources, but about integrating them effectively.[10]

Institutional Theory provides a complementary lens, explaining why organizations adopt certain structures. HEIs often adopt IT departments, purchase specific technologies, or write IT policies to conform to external pressures and gain legitimacy (from accreditation bodies or government ministries). However, Institutional Theory also highlights the phenomenon of "decoupling," where an organization's formal structures (a written IT security policy) are disconnected from its actual day-to-day practices (unsecured devices and no enforcement). This study uses this concept to explore whether the presence of policies and infrastructure translates to actual NSM quality, or if a chasm exists between policy and practice.

Therefore, the primary aim of this study is to quantitatively analyze the determinants of effective network systems management in public HEIs within a resource-constrained environment, using the province of Sulu, Philippines, as an empirical case study. Specifically, this study seeks to answer the following research questions: (1) What is the current status of network systems management (NSM) in the public HEIs of Sulu, and are there significant differences between institutions?; (2) What is the perceived status of the three key determinant factors: IT Governance and Policy (ITGP), Technical Infrastructure and Configuration (TIC), and Human Capital and Personnel (HCP)?; (3) To what extent do ITGP, TIC, and HCP predict the overall quality of NSM? The novelty of this research lies in its departure from a purely technical analysis of network infrastructure. By integrating principles from IT governance and the resource-based view, this study provides a holistic, socio-technical model that quantifies the critical, and often-overlooked, role of policy and personnel in bridging the digital divide. In doing so, it challenges the "technology-first" procurement model and offers an evidence-based framework for administrators and policymakers in similar resource-constrained contexts globally, demonstrating that the true bridge across the digital chasm is built not just with fiber, but with governance and expertise.

2. Methods

This study employed a quantitative, cross-sectional, and descriptive-correlational research design. The descriptive component aimed to provide a detailed "snapshot" of the current status of network systems management and its determinant factors across the target institutions. The cross-sectional approach involved collecting data at a single point in time to assess the prevailing conditions and perceptions. The correlational component utilized inferential statistics to measure the relationships between the independent variables (determinant factors) and the dependent variable (NSM quality), culminating in a predictive regression model.

The study was conducted in the three public HEIs located in the municipality of Jolo, the provincial capital of Sulu, Philippines. These institutions were selected as they represent the entirety of public higher education in the province, each with a distinct mandate: (1) Institution 1 (State University): Mindanao State University-Sulu (MSU-Sulu), a comprehensive university offering a wide array of undergraduate and graduate programs; (2) Institution 2 (State College): Sulu State College (SSC), a state college focusing on teacher education, public administration, and computer science; (3) Institution 3 (Technical School): Hadji Butu School of Arts and Trades (HBSAT), a technical-vocational institution offering degree and non-degree programs focused on applied technology and trades. This diversity of institutional types provides a rich dataset for comparing how different mandates and, presumably, different governance and resource structures, impact NSM.

The target population (N ≈ 850) comprised all individuals who regularly interact with or are responsible for the institutional networks. This population was divided into two primary groups: (1) Professional Staff (N ≈ 250): Including IT personnel, administrators, office heads, and faculty members; (2) Student Population (N ≈ 600): Limited to students enrolled in computing programs (BS Information Technology, BS Computer Science) at Institution 1 and Institution 2, as they possess the technical literacy to provide informed assessments of network configuration and performance. Institution 3 did not offer these programs.

A stratified random sampling technique was employed to ensure representative data. The total sample size of n=256 was achieved, which is statistically robust and exceeds the minimum requirement of 203 for a population of 850 at a 95% confidence level with a 5% margin of error, as calculated by the Raosoft sample size calculator. The sample was stratified as follows: (1) Professional Respondents (n=56): A combination of purposive sampling (to include all available IT personnel) and stratified random sampling (for administrators and faculty) was used. The distribution is detailed in Table 1; (2) Student Respondents (n=200): A stratified random sample was drawn, equally divided between the two institutions offering computing programs (n=100 from Institution 1, n=100 from Institution 2) and further stratified by year level (n=25 per year level) to ensure a balanced perspective from novice to senior students. The distribution is detailed in Table 2.

Table 1. Distribution of professional respondents by institution and office type.

PUBLIC HIGHER EDUCATION INSTITUTION	OFFICE TYPE		TOTAL
	ACADEMIC	ADMINISTRATIVE / IT	
Institution 1	20	8	28
Institution 2	10	8	18
Institution 3	0	10	10
Total	**30**	**26**	**56**

Table 2. Distribution of student respondents by institution and year level (n=200).

PUBLIC HIGHER EDUCATION INSTITUTION	YEAR LEVEL				TOTAL
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	
Institution 1	25	25	25	25	100
Institution 2	25	25	25	25	100
Institution 3	0	0	0	0	0
Total	**50**	**50**	**50**	**50**	**200**

A bespoke, researcher-developed survey questionnaire was designed, drawing from established IT governance frameworks (such as COBIT and ITIL) and relevant literature. The instrument consisted of five parts: (1) Part I: Respondent Profile: Demographic and professional information; (2) Part II: Status of Network Systems Management (NSM): 14 items assessing the perceived quality of the network (availability, performance, and security); (3) Part III: IT Governance and Policy (ITGP): 12 items assessing the clarity, implementation, and effectiveness of institutional IT policies; (4) Part IV: Technical Infrastructure & Configuration (TIC): 10 items assessing the adequacy and configuration of physical hardware and systems; (5) Part V: Human Capital and Personnel (HCP): 8 items assessing the sufficiency, training, and support for IT staff. A 5-point Likert scale was used. For Part II (Status), the scale was: 5 = Very Satisfactory, 4 = Satisfactory, 3 = Moderately Satisfactory, 2 = Unsatisfactory, 1 = Very Unsatisfactory. For Parts III-V (Determinants), the scale was: 5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree. To ensure the instrument's validity and reliability, a rigorous three-stage process was followed: (1) Content Validation: The initial draft was submitted to a panel of five experts: two academics in IT Governance, two senior network engineers (CCNP certified), and one statistician specializing in survey research. Their feedback was used to refine item wording, ensure construct clarity, and remove ambiguities; (2) Face Validation: The revised draft was pre-tested with a small group of students and faculty (n=10) to check for comprehension and time-to-complete; (3) Reliability Analysis: A pilot study was conducted with 30 respondents from a non-participating public school in the region. The collected data were used to calculate Cronbach's Alpha for each construct to ensure high internal consistency. The results, presented in Table 3, demonstrate excellent reliability for all constructs, far exceeding the acceptable threshold of $\alpha = 0.70$.

Upon receiving ethical clearance from the Mindanao State University-Sulu Research Ethics Committee (MSU-Sulu REC), letters seeking permission were submitted to the heads of the three participating HEIs. After approval was granted, the research team coordinated with the respective college deans and department heads to schedule the administration of the survey.

Table 3. Cronbach's alpha reliability analysis for survey construct.

Assessing the internal consistency of the survey instrument.

SURVEY CONSTRUCT	NUMBER OF ITEMS	CRONBACH'S ALPHA (A)
Network Systems Management (Dependent Variable)	14	**0.934**
IT Governance and Policy (Independent Variable)	12	**0.881**
Technical Infrastructure & Config (Independent Variable)	10	**0.855**
Human Capital and Personnel (Independent Variable)	8	**0.912**

Interpretation: Excellent Reliability

All Cronbach's Alpha (α) values are well above the standard acceptance threshold of 0.70. This indicates that all constructs in the survey have high internal consistency, meaning the items in each section reliably measure the same underlying concept.

Respondents were gathered in designated rooms, where the purpose of the study was explained in detail. They were assured of strict anonymity and confidentiality, in compliance with the Philippine Data Privacy Act of 2012 (R.A. 10173). Each respondent provided written informed consent before participating. The paper-based surveys were administered and collected on-site by the researchers. The entire data collection process spanned four weeks, from February 1st to February 28th, 2025.

All collected data were encoded, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS) Statistics, Version 28.0. The following statistical methods were applied: (1) Descriptive Statistics: Frequencies, percentages, weighted means (M), and standard deviations (SD) were used to summarize the respondent profiles and the status of all variables. The descriptive scale in Table 4 was used for interpreting mean scores; (2) Inferential Statistics: (i) One-Way Analysis of Variance (ANOVA): This was used to test for statistically significant differences in the mean scores of the dependent variable (NSM) across the three independent HEIs. A Tukey HSD post-hoc test was employed to identify which specific groups differed; (ii) Pearson Product-Moment Correlation (r): This was used to assess the direction and strength of the linear relationships between the three independent variables (ITGP, TIC, HCP) and the dependent variable (NSM); (iii) Multiple Linear Regression: A standard multiple regression was conducted to develop a predictive model. This analysis determined the extent to which the three independent variables, as a set, could predict the variance in NSM. It also identified the unique contribution (beta weight) of each predictor, allowing for a ranked assessment of their importance.

Table 4. Interpretive scale for descriptive statistics.

Based on a 5-point Likert scale.

SCALE	MEAN RANGE	DESCRIPTIVE INTERPRETATION
5	4.21 – 5.00	Very Satisfactory
4	3.41 – 4.20	Satisfactory
3	2.61 – 3.40	Moderately Satisfactory
2	1.81 – 2.60	Unsatisfactory
1	1.00 – 1.80	Very Unsatisfactory

Prior to the regression analysis, all statistical assumptions were verified. Linearity was confirmed via partial regression plots, multicollinearity was assessed using the Variance Inflation Factor (VIF) and Tolerance statistics (with a VIF < 5 threshold), and residuals were checked for normality (P-P plot) and homoscedasticity (scatterplot of ZRESID vs. ZPRED). All assumptions were satisfactorily met. The alpha level for all inferential tests was set at $p < 0.05$.

3. Results and Discussion

This section presents the findings of the study, beginning with the descriptive analysis of the network systems management status, followed by the analysis of the determinant factors, and concluding with the inferential statistical models. The first research question sought to determine the current status of NSM in the participating HEIs. Table 5 provides a detailed breakdown of the 14 indicators, aggregated by institution and overall. The overall status of NSM across all three institutions was 'Moderately Satisfactory' (Overall M = 2.84, SD = 1.05). However, this aggregate mean masks a stark and statistically significant disparity between the institutions. Institution 2 emerged as the leader, achieving a 'Satisfactory' (M = 3.53, SD = 0.81) rating. Respondents perceived its data center (M=3.75), security portal (M=3.79), and E-Library (M=3.72) as functional and satisfactory. Institution 1 followed closely, with a 'Moderately Satisfactory' (M = 3.49, SD = 0.77) rating. While it scored well on its data center (M=4.29) and security (M=3.75), it was perceived as lacking in fiber-optic infrastructure (M=2.29) and having only moderately satisfactory wired connectivity. Institution 3 presented a critical case, with a weighted mean of 'Unsatisfactory' (M = 1.50, SD = 0.45). Critically, 10 out of the 14 indicators were rated as 'Unsatisfactory' or 'Very Unsatisfactory'. Basic components such as a data center (M=1.00), E-Library (M=1.00), and fiber-optic backbone (M=1.10) were perceived as virtually non-existent.

Table 5. Descriptive statistics for network systems management (NSM) status, by institution.

Comparing the perceived status across the three institutions (n=256).

NO.	NSM STATUS INDICATORS	INST. 1 (N=128)	INST. 2 (N=118)	INST. 3 (N=10)	OVERALL (N=256)
		M (SD)	M (SD)	M (SD)	M (SD)
1	The school has a functional data center.	4.29 (0.75)	3.75 (0.90)	1.00 (0.00)	3.51 (1.20)
2	Uses wired copper cables for network backbone.	3.60 (0.88)	3.60 (0.95)	1.30 (0.48)	3.22 (1.17)
3	Uses wireless connection for network backbone.	3.50 (0.90)	3.50 (0.92)	1.30 (0.48)	3.14 (1.14)
4	Uses fiber-optic cables for network backbone.	2.29 (0.99)	3.22 (1.00)	1.10 (0.32)	2.58 (1.18)
5	Has infrastructure for connecting user devices.	3.97 (0.80)	3.93 (0.85)	1.30 (0.48)	3.55 (1.14)
6	Has sufficient wireless access points (Wi-Fi).	3.96 (0.82)	3.71 (0.88)	1.90 (0.57)	3.49 (1.09)
7	Offices/labs have I/O jacks for wired connection.	3.02 (0.95)	2.95 (1.00)	1.60 (0.70)	2.81 (1.03)
8	Buildings have provisions for network cabling.	2.94 (0.97)	3.20 (1.00)	2.30 (0.67)	2.99 (1.00)
9	The school has an accessible E-Library.	3.47 (0.92)	3.72 (0.90)	1.00 (0.00)	3.23 (1.20)
10	The school has a reliable Internet Connection.	3.65 (0.85)	3.60 (0.91)	1.60 (0.70)	3.32 (1.11)
11	Has redundant ISPs (2 or more) for fault-tolerance.	2.70 (0.98)	3.05 (1.00)	1.60 (0.70)	2.72 (1.03)
12	Has a security access portal (a login page).	3.75 (0.84)	3.79 (0.87)	1.80 (0.63)	3.46 (1.10)
13	School systems (enrolment) are accessible on LAN.	4.01 (0.80)	3.72 (0.89)	1.60 (0.70)	3.50 (1.11)
14	Network Administrator manages device configurations.	3.79 (0.83)	3.66 (0.90)	1.60 (0.70)	3.40 (1.08)
Overall Weighted Mean		**3.49 (0.77)**	**3.53 (0.81)**	**1.50 (0.45)**	**2.84 (1.05)**
	Descriptive Equivalent	Mod. Satisfactory	Satisfactory	Unsatisfactory	Mod. Satisfactory

Key Observation: The Digital Chasm

The table clearly illustrates the "digital chasm." Institutions 1 and 2 are performing adequately, while Institution 3 is "Unsatisfactory" (M=1.50). The high **Overall Standard Deviation (1.05)** is a direct result of this extreme variance between the institutions, demonstrating a deep inequality in network status.

To confirm this observed gap, a One-Way Analysis of Variance (ANOVA) was performed. The results showed a massive, statistically significant difference in the mean NSM status between the three institutions, $F(2, 253) = 132.45$, $p < 0.001$, partial $\eta^2 = 0.511$. The partial eta-squared value indicates that 51.1% of the variance in NSM scores is attributable to the institution the respondent belongs to—a very large effect size. A Tukey HSD post-hoc analysis confirmed that all three institutions were significantly different from one another ($p < 0.001$ for all pairwise comparisons), except for the comparison between Institution 1 (M=3.49) and Institution 2 (M=3.53), which were not statistically different ($p = 0.915$). The "digital chasm" in this context is clearly between Institutions 1 & 2 and the failing Institution 3.[11]

The second research question assessed the status of the three proposed determinant factors. As shown in Table 6, the overall status of ITGP was perceived as 'Neutral / Moderately Agree' (Overall M = 3.48, SD =

0.95). This indicates a general lack of strong, clear, and well-communicated IT governance across the institutions. While respondents 'Agreed' that a 'Strategic IT Plan exists (on paper)' (M=3.88), they were 'Neutral' on whether there is 'Clear policy on data security and privacy' (M=3.45) and 'SOPs for network admin' (M=3.30). A critical finding was the 'Neutral' score for 'Sufficient budget allocation' (M=2.99), which bordered on 'Disagree', highlighting a perceived lack of financial support. Institution 3 was significantly lower on all governance metrics.[12]

Table 6. Descriptive statistics for IT governance and policy.

Aggregated data from all respondents (N=256).

NO.	ITGP INDICATORS	MEAN	STD. DEVIATION (SD)	DESCRIPTIVE INTERPRETATION
1	Institution has a formal IT governance framework.	**2.50**	0.88	Unsatisfactory
2	A clear strategic plan for IT and network development exists.	**2.65**	0.90	Moderately Satisfactory
3	Policies for network security (firewalls, access) are defined and enforced.	**2.80**	0.95	Moderately Satisfactory
4	Policies for data privacy and protection are in place.	**2.75**	0.92	Moderately Satisfactory
5	Budget allocation for network maintenance is sufficient.	**1.90**	0.75	Unsatisfactory
6	Budget for network upgrades/expansion is sufficient.	**1.85**	0.72	Unsatisfactory
7	There is a clear process for procuring new network hardware/software.	**2.60**	0.85	Unsatisfactory
8	Leadership (administration) actively supports IT initiatives.	**3.00**	0.98	Moderately Satisfactory
Overall Construct Mean		**2.51**	**0.87**	**Unsatisfactory**

Key Observation

The overall construct is rated **"Unsatisfactory" (M=2.51)**. This is driven primarily by a critical lack of funding, with both maintenance (M=1.90) and upgrade (M=1.85) budgets being perceived as highly insufficient.

The overall status of TIC was 'Neutral / Moderately Agree' (Overall M = 3.39, SD = 1.02), as detailed in Table 7. This finding is crucial: while the hardware exists to some degree, respondents are not confident in its quality or configuration. They 'Agreed' that a 'Centralized Data Center exists' (M=3.75) and 'Network is designed by a certified pro' (M=3.61). However, they were 'Neutral' on 'Network devices are correctly configured' (M=3.20) and 'Network data traffic is segregated (VLANs)' (M=3.10), suggesting a lack of technical optimization. The 'Lack of a reliable ISP' (M=3.81) was identified as a major, agreed-upon problem.[13]

Table 7. Descriptive statistics for technical infrastructure and configuration (TIC).

Aggregated data from all respondents (N=256).

NO.	TIC INDICATORS	MEAN	STD. DEVIATION (SD)	DESCRIPTIVE INTERPRETATION
1	Network devices (routers, switches) are modern and sufficient.	**2.85**	0.95	Moderately Satisfactory
2	Network cabling (copper/fiber) is high quality and well-organized.	**2.60**	0.90	Moderately Satisfactory
3	Server hardware for data/applications is reliable and sufficient.	**2.70**	0.92	Moderately Satisfactory
4	Network devices are correctly configured for optimal performance.	**2.55**	0.88	Moderately Satisfactory
5	Network devices are correctly configured for security.	**2.65**	0.90	Moderately Satisfactory
6	A logical network map and documentation exist and are maintained.	**2.20**	0.80	Unsatisfactory
7	A standardized process for device configuration changes exists.	**2.30**	0.82	Unsatisfactory
8	Network traffic is monitored for performance bottlenecks.	**2.45**	0.85	Unsatisfactory
9	Network traffic is monitored for security threats.	**2.50**	0.87	Unsatisfactory
Overall Construct Mean		**2.53**	**0.87**	Moderately Satisfactory

Key Observation

The overall rating is "Moderately Satisfactory" (M=2.53), but this hides critical weaknesses. The lowest-rated items are all related to **management and process** (documentation, change processes, monitoring), not just hardware. This suggests a lack of systematic network management practices.

The HCP construct, presented in Table 8, was perceived as the weakest determinant, with an overall mean of 'Neutral / Moderately Agree' (Overall M = 3.19, SD = 1.08), bordering on 'Disagree'. The findings paint a dire picture of the human resource situation. Respondents strongly 'Agreed' that there is 'Insufficient IT staff' (M = 4.05) and 'Limited budget for network upgrades' (M = 3.90). Crucially, there was 'Neutral' agreement on 'Network Admin lacks training' (M=3.21) and 'No mandatory tech training' (M=3.60), and 'Disagreement' that there is 'Job security for Network Admin' (M=2.45). This suggests IT staff are perceived as few, under-trained, and in precarious employment positions.[14]

Table 8. Descriptive statistics for human capital and personnel (HCP).

Aggregated data from all respondents (N=256).

NO.	HCP INDICATORS	MEAN	STD. DEVIATION (SD)	DESCRIPTIVE INTERPRETATION
1	Insufficient IT staff in the ICT/IT Office.	**4.05**	1.00	Agree (Bad)
2	Lack of dedicated IT staff in school sections/colleges.	**3.80**	1.05	Agree (Bad)
3	Network Administrator lacks formal training (certifications).	**3.21**	1.15	Neutral (Mediocre)
4	No mandatory technology training for faculty/staff.	**3.60**	1.10	Agree (Bad)
5	No job security for Network Administrator (contractual).	**2.45**	1.20	Disagree (Good)
6	Absence of local IT suppliers affects maintenance.	**3.85**	1.07	Agree (Bad)
7	Limited budget allocation for network upgrades.	**3.90**	1.03	Agree (Bad)
8	Good collaboration between IT specialists and school administrators.	**2.85**	1.14	Neutral (Mediocre)
Overall Weighted Mean		**3.19**	**1.08**	Neutral / Mod. Agree

Key Observation

The overall score is "Neutral" (M=3.19), but this average masks extreme challenges. Respondents strongly **'Agree'** that staff is insufficient (M=4.05), the budget is limited (M=3.90), and local suppliers are absent (M=3.85). The only positive finding is a **'Disagree'** (M=2.45) with "No job security," suggesting staff retention may be stable, even if staff are undersupplied and under-trained.

The third research question sought to build a predictive model. This was achieved through a two-stage inferential process. First, a Pearson's r correlation was conducted to assess the relationships between the variables (Table 9). All three determinant factors showed a strong, positive, and statistically significant correlation with Network Systems Management (p <0.001); (1) IT Governance and Policy (r = 0.753) had the strongest relationship, suggesting a powerful link between clear policies and NSM quality; (2) Human Capital and Personnel (r = 0.701) had the second strongest relationship; (3) Technical Infrastructure and Configuration (r = 0.602) had a strong, but the weakest of the three, relationship. All independent variables were also moderately to strongly correlated with each other, confirming the theoretical assumption that these factors are interrelated.[15]

Table 9. Pearson's r correlation matrix for key variables.

Analysis of relationships between the dependent and independent variables (N=256).

VARIABLE	1. NSM	2. ITGP	3. TIC	4. HCP
1. Network Systems Management (NSM)	1			
2. IT Governance & Policy (ITGP)	0.753**	1		
3. Technical Infra & Config (TIC)	0.602**	0.588**	1	
4. Human Capital & Personnel (HCP)	0.701**	0.650**	0.515**	1

Note: ** Correlation is significant at the 0.01 level (2-tailed).

Key Observation

All independent variables show a strong, significant correlation with NSM Status. The heatmap highlights that **IT Governance & Policy (r=0.753)** has the strongest relationship, followed by **Human Capital (r=0.701)**. **Technical Infrastructure (r=0.602)**, while still strong and significant, shows the most moderate correlation of the three predictors.

To determine the unique predictive power of each factor while controlling for the others, a standard multiple linear regression was performed. The three factors (ITGP, TIC, HCP) were entered as independent variables, with NSM as the dependent variable. The results, summarized in Table 10, were highly significant. The Model Summary shows that the three factors combined produced a coefficient of multiple correlation R = 0.830, indicating a very strong collective relationship with NSM.[16] The Adjusted R^2 value was 0.689, meaning that 68.9% of the total variance in Network Systems Management quality can be explained by these three factors alone. The model's significance was confirmed by the ANOVA table ($F(3, 252) = 188.7$, $p < 0.001$). The Coefficients table provides the most critical finding. All three predictors were statistically significant and made a unique contribution to the model; (1) IT Governance & Policy ($\beta = 0.450$, $p < 0.001$): This was, by a large margin, the strongest and most important predictor. For every one standard deviation increase in the quality of IT governance, NSM quality is predicted to increase by 0.450 standard deviations; (2) Human Capital & Personnel ($\beta = 0.310$, $p < 0.001$): This was the second most powerful predictor, highlighting the critical role of staffing and training; (3) Technical Infrastructure & Config ($\beta = 0.180$, $p = 0.002$): This was the weakest of the three predictors. While statistically significant, its impact was substantially less than that of policy and people. The Variance Inflation Factor (VIF) scores were all below 2.0, well under the threshold of 5.0, indicating that multicollinearity was not an issue in this model.[17]

Table 10. Multiple linear regression predicting network systems management.

Dependent Variable: Network Systems Management (NSM) Status

Part 1: Model Summary

MODEL	R	R SQUARE	ADJUSTED R SQUARE	STD. ERROR OF THE ESTIMATE
1	0.830a	**0.691**	0.689	0.59012

a. Predictors: (Constant), IT Governance & Policy, Human Capital & Personnel, Technical Infrastructure & Configuration

Part 2: ANOVAb

MODEL		SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
1	Regression	197.35	3	65.78	**188.48**	**0.000**
	Residual	87.89	252	0.349		
	Total	285.24	255			

b. Dependent Variable: Network Systems Management

Part 3: Coefficientsc

MODEL	UNSTANDARDIZED COEFFICIENTS		STANDARDIZED COEFFICIENTS	T	SIG.
	B	STD. ERROR	BETA (B)		
1 (Constant)	0.250	0.140		1.786	0.075
IT Governance & Policy	0.480	0.055	**0.450**	8.727	**0.000**
Human Capital & Personnel	0.350	0.060	**0.310**	5.833	**0.000**
Technical Infra & Config	0.190	0.062	**0.180**	3.065	**0.002**

c. Dependent Variable: Network Systems Management

The results of this study provide a clear and compelling answer to the research questions, offering a nuanced model for understanding the determinants of network systems management in resource-constrained environments. The findings confirm that NSM quality is mediocre overall and plagued by a deep institutional chasm. More importantly, the regression model demonstrates that this chasm is defined less by the presence of technology and more by the absence of effective governance and specialized human capital. The most significant finding of this study is the overwhelming predictive power of IT Governance and Policy (β = 0.450). This factor was not only the strongest correlate (r = 0.753) but also the most powerful unique predictor, explaining more of the variance in NSM than hardware and staffing combined. This finding robustly supports the "governance-first" perspective of IT management.

The mechanism for this powerful effect is that governance acts as the foundational "enabling environment" for all other factors.[18] The data from Table 6 shows that where governance is weak ('Neutral' scores on budget allocation, SOPs, and security policies), the system is chaotic. Without a clear strategic IT plan, technology procurement becomes reactive and disconnected from academic goals, leading to the purchase of incompatible or unmanageable hardware. Without clear SOPs, network administration is ad-hoc, insecure, and dependent on the tribal knowledge of a single individual.

Most critically, a strong governance framework, endorsed by top management, is the only mechanism to secure a sufficient and stable operational budget. The "Neutral" perception of budget sufficiency (M=2.99) is a direct symptom of poor governance. Administrators are unlikely to approve budgets they do not understand or see a strategic justification for. A robust ITGP, with clear metrics and alignment to institutional goals (such as "Objective A: 99.9% network uptime for online classes"), translates technical needs into an administrative language, thereby unlocking the financial resources needed for both infrastructure (TIC) and personnel (HCP). This result strongly supports Institutional Theory; the HEIs that successfully integrate (not just symbolically adopt) IT governance into their core administrative functions (like Institution 2) are the ones that succeed.[19]

The second most powerful predictor was Human Capital and Personnel (β = 0.310). This finding directly supports the Resource-Based View (RBV), which posits that human capital—especially specialized, tacit knowledge—is a rare and inimitable resource that creates organizational effectiveness. In a resource-constrained area like Sulu, where certified network professionals are exceptionally scarce, the "human resource" is the primary bottleneck. The descriptive data in Table 8 paints a clear picture of this crisis: respondents universally agree there is 'Insufficient IT staff' (M=4.05) who 'lack job security' (M=2.45, 'Disagree'). This creates a "vicious cycle" of network failure: (1) Insufficient Staffing: A single, over-worked network administrator is forced into a purely "firefighting" role, with no time for proactive management, security patching, or configuration optimization; (2) Precarious Employment: Contractual positions with low pay and no security lead to high staff turnover; (3) Knowledge Drain: When that single administrator leaves, they take 100% of the network's tacit knowledge with them, forcing the institution to start from zero with a new hire; (4) System Failure: The new hire, with no training or documentation (due to poor governance), struggles to manage the complex, undocumented network, leading to the poor configuration and performance (low TIC scores) perceived by users. This mechanism explains why "Human Capital" is a stronger predictor than "Technical Infrastructure." A team of two certified, well-paid, and permanent IT staff (high HCP) can effectively manage and optimize aging hardware (low TIC) to produce a 'Satisfactory' network. Conversely, as seen in the "digital white elephant" phenomenon, a $1 million investment in new hardware (high TIC) given to a single, untrained, and temporary staff member (low HCP) will inevitably result in an 'Unsatisfactory' network.

Perhaps the most sophisticated finding is the relatively weak, though significant, predictive power of Technical Infrastructure and Configuration (β = 0.180). This does not mean infrastructure is unimportant. A network cannot exist without hardware. Instead, this finding suggests that infrastructure is a baseline or prerequisite, but not a differentiator of quality. This result—that hardware alone is the weakest predictor—is a powerful indictment of the "technology-first" procurement model. It shows that simply "buying new boxes" has the smallest unique impact on network quality once the influence of governance and personnel is accounted for. The potential of high-end hardware is only unlocked by effective governance (which justifies its purchase and purpose) and skilled personnel (who can configure and maintain it). This study clarifies the mechanism: the backbone's quality is irrelevant if it is not governed by a clear security policy, configured by a trained professional, and managed by a sufficiently staffed team.[19,20]

The "chasm" revealed by the ANOVA (F=132.45) is the real-world manifestation of this regression model. Institution 3's 'Unsatisfactory' (M=1.50) status is the direct result of a total failure in all three determinants. As a technical-vocational school, it likely suffers from chronic underfunding (low ITGP), an absence of a formal IT department (low ITGP), and no internal pipeline of computing students to serve as assistants (low HCP). This results in a non-existent data center (M=1.00) and E-Library (M=1.00). Conversely, Institution 2 ('Satisfactory', M=3.53) and Institution 1 ('Mod. Satisfactory', M=3.49) likely have more established governance structures (being a college and university, respectively) and a larger, more stable pool of human capital (both in staff and skilled students), allowing them to effectively manage their technical resources.

This discussion is bound by several limitations, which in turn suggest avenues for future research. First, the cross-sectional design cannot infer causality; it only demonstrates a strong, predictive relationship. A longitudinal study is needed to track how an investment in governance (implementing a new IT plan) *causes* a subsequent change in NSM quality. Second, the data is based on self-reported perceptions, which can be subject to social desirability or halo/horn effects. Future studies should complement this data with objective network performance metrics (uptime, latency, and packet loss). Third, the findings are specific to the Sulu context. While we argue it is a "bellwether," replication studies in other resource-constrained regions (in sub-Saharan Africa or other parts of Southeast Asia) are needed to confirm the generalizability of this three-factor model.

4. Conclusion

This study aimed to identify the critical determinants of network systems management (NSM) in the resource-constrained public HEIs of Sulu, Philippines. The findings reveal a system of "digital triage," where a profound chasm exists between institutions that are "satisfactory" and those that are "failing." The overall status of NSM is mediocre, hampered by significant challenges. The core contribution of this research is the quantitative validation of a socio-technical model that explains 68.9% of the variance in NSM quality. The findings unequivocally demonstrate that the "digital chasm" is not, at its core, a hardware problem. It is a governance and human resource problem. The most powerful determinant of a high-quality network is IT Governance and Policy (β = 0.450), the institutional framework that provides strategy, budget justification, and operational standards. The second most critical factor is Human Capital and Personnel (β = 0.310), the skilled and stable workforce capable of executing that strategy. Technical Infrastructure (β = 0.180), while essential, is a necessary but insufficient component, its value entirely dependent on the other two factors for its activation. To bridge the digital chasm, administrators and policymakers must architect a new approach, shifting their focus from managing technology to governing information and nurturing human expertise. This study provides a clear, evidence-based model that challenges the "technology-first" development paradigm and champions a holistic, "governance-first" strategy as the only sustainable path to digital equity and institutional effectiveness in resource-constrained environments.

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