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Research Article

Analyzing the Impact of Software Evolution Laws on Institutional ICT Systems: A Case Study of Federal College of Agriculture, Ibadan

Idowu Olugbenga Adewumi*

Department of Computer and Information Engineering, Faculty of Natural and Applied Science, Lead City University, Nigeria

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***Corresponding author:** Idowu Olugbenga Adewumi, Software Engineering Program, Department of Computer and Information Engineering, Faculty of Natural and Applied Science, Lead City University, Ibadan, Nigeria, E-mail: adexio2010@gmail.com, Tel: +2348023821869, +2347034205740

ABSTRACT

This research work investigates the awareness, perceived impact and alignment of software revolution laws; Moore's Law, Brook's Law and Conway's Law on ICT development at the Federal College of Agriculture, Ibadan (FCAI). With the increasing demand for effective ICT driven institutional management, understanding the influence of foundational software principle is essential. The study employed a quantitative design using a structured questionnaire administered to stakeholders across academic, administrative and technical units. Statistical analyses, including descriptive statistics, chi-square tests, Analysis of Variance ANOVA, correlation and multiple regression were conducted using Python with VS Code Integrated Development Platform, to evaluate awareness patterns, impact perception and predictive relationships. Results revealed that technical staff has significantly higher awareness and perceived impact of software laws compared to other groups. A strong positive correlation was observed between alignment with software revolution principles and ICT performance outcomes such as scalability, cost efficiency and user satisfaction. These findings underscore the importance of embedding foundational computing laws into ICT policy and development strategies. This study recommends policy integration, interdisciplinary collaboration and capacity building initiaties to enhance institutional ICT effectiveness through informed software law alignment.

Keywords: ICT Development, Software Revolution Laws, Moore's Law, Brook's Law, Conway's Law, Educational Institutions, Awareness, Stakeholder Perception, Nigeria, FCAI, Alignment, Statistical Analysis

1. Introduction

1.1. Background of the study

The recent study by[3] has opined that the digital revolution, propelled significantly by advancements in software engineering and information and communication technology (ICT), has reshaped every facet of human society. From agriculture and education to healthcare and governance, software systems have become integral to the functioning of modern institutions[6]. The investigation of[12] has revealed that central to this transformation are several foundational principles often referred to as software revolution laws that predict, guide and influence the rapid progression of software systems. Reference[4] has noted that these laws, such as Moore's Law, Brooks' Law and Conway's

Law, have played critical roles in shaping the strategies of organizations and governments striving to digitize operations and improve efficiency. As software development continues to evolve, there is a pressing need to investigate how these theoretical constructs are practically applied within real-world institutional contexts, particularly in developing countries[7,8,10].

1.2. Problem statement

Although several laws have been postulated to explain trends and outcomes in software development, little empirical research exists on how these laws are reflected in institutional ICT projects within the Nigerian education sector. In particular, there is limited documentation of how principles such as Moore's Law (the exponential growth of computing power), Brooks' Law (the effect of team size on project completion) and the Law of Diminishing Returns apply in localized software and ICT implementation processes. The lack of alignment between theoretical software laws and actual development practice often leads to ineffective planning, cost overruns and technological redundancy.

This study seeks to bridge this gap by investigating how software revolution laws have influenced or could influence, the development of ICT infrastructure and systems at the Federal College of Agriculture, Ibadan.

1.3. Research questions

i. What are the prevailing software revolution laws that influence ICT development?

ii. How has ICT evolved in the Federal College of Agriculture, Ibadan?

iii. To what extent are software laws considered during the development and implementation of ICT projects at FCAI?

iv. What are the implications of aligning ICT development with software revolution principles?

1.4. Hypotheses formulation

H_1: There is a significant relationship between software revolution laws and the patterns of ICT development in higher educational institutions.

H_2: ICT has significantly evolved at the Federal College of Agriculture, Ibadan, in response to national and institutional digital transformation initiatives.

H_3: Software revolution laws are not adequately considered during the planning and implementation of ICT projects at the Federal College of Agriculture, Ibadan.

H_4: Aligning ICT development strategies with software revolution principles has a statistically significant positive impact on the effectiveness and sustainability of ICT systems in tertiary institutions.

1.5. Objectives

The purpose of this study is to review key software revolution laws and examine their applicability to ICT development projects in the Federal College of Agriculture, Ibadan.

The specific objectives of the study are to: analyze the core software revolution laws relevant to ICT development. Evaluate the current state of ICT infrastructure and software systems at FCAI. Assess how software laws have been or could be, applied in guiding ICT-related decisions. Recommend strategic approaches to aligning ICT development at FCAI with established software principles.

This study focuses on the practical application of software development laws within the context of a Nigerian tertiary agricultural institution. The case study of FCAI offers a unique opportunity to explore the intersection of software engineering theory and practical ICT challenges in a resource-constrained academic environment. The findings will be significant to policymakers, software developers, ICT administrators and researchers interested in digital transformation strategies for educational institutions in developing countries. It will also contribute to the literature on software law application in emerging economies.

2. Literature Review

2.1. Theoretical background on software revolution laws

Much research has been done in the area of software engineering by several authors[2,4,7,15,19,22]; they have all submitted that software revolution laws provided a foundational understanding of how software systems evolve and influence technological progress. Reference[16] noted that among the most prominent is Moore's Law, which posits that the number of transistors on a microchip doubles approximately every two years, leading to exponential growth in computing power and performance while reducing relative cost. Though initially applied to hardware, this law has influenced software scalability and system expectations over the decades[6]. As technologies advance, software is expected to handle more complex data and operations within shorter cycles, a reality that has significant implications for ICT planning and software project design[17]. The study by[23] has observed that Brooks' Law, introduced by[26], suggested that "adding manpower to a late software project makes it later"[24]. This principle emphasizes the nonlinear dynamics of team communication and coordination challenges as software development teams expand. It underscores the importance of early project planning and avoiding reactive hiring to fix delays, a common occurrence in ICT projects in developing institutions[20]. Conway's Law also holds relevance, proposing that "organizations design systems that mirror their own communication structures." This law implies that poorly structured organizations tend to develop fragmented software systems, while well-coordinated structures foster integrated, efficient ICT systems. In the context of Nigerian institutions, Conway's Law may explain the inconsistencies seen in software adoption and the misalignment between technological tools and institutional needs[11]. Reference[19] has noted that together, these laws serve as theoretical lenses through which software development strategies, timelines, collaboration and institutional outcomes can be interpreted and assessed. Evolution of Software Development Models It is of great importance to note that[28] has opined that software development landscape has undergone multiple paradigm shifts. From early waterfall models, characterized by linear progression and strict phases, to agile methodologies, which emphasize flexibility, iterative progress and customer feedback, the transition reflects the growing demand for responsiveness in software creation[1]. The study of[14] has revealed that modern institutions increasingly embrace DevOps and continuous integration/continuous delivery (CI/CD) approaches to manage rapid deployment and system updates. These models reduce

development bottlenecks and ensure adaptability; key features needed for educational ICT systems faced with ever-evolving academic and administrative demands[30]. Reference[6] discovered that agile frameworks like Scrum and Kanban are particularly impactful in institutional environments, where stakeholder feedback loops (students, lecturers and IT units) must be tightly integrated to ensure system usability. The progressive adoption of such models among Nigerian universities indicates a shift from rigid procurement-based ICT projects to more dynamic, need-responsive solutions[29].

For instance,[25] found that only 30% of surveyed Nigerian tertiary institutions had fully digital student management systems, with the rest relying on hybrid or manual systems. However, there are signs of progress. The increasing number of e-learning platforms, digitized libraries and biometric registration systems across public and private institutions shows growing ICT adoption[10]. The Federal College of Agriculture, Ibadan, like many specialized tertiary institutions, has gradually integrated software solutions for academic records, financial processing and internal communication. Yet, the level of integration and alignment with modern software principles remains uneven and under-evaluated[15]. Other African contexts, such as Ghana and Kenya, reflect similar patterns. Institutions there face overlapping challenges in funding, maintenance and personnel training. Yet, countries with strong public-private partnerships have shown more rapid progress in ICT-driven institutional transformation[3].

2.2. Review of previous studies and findings

Several studies have explored the intersection of software development and institutional ICT[6,8,9,18]. For example,[25] conducted a multi-university analysis of software adoption and found that institutions that embedded iterative development and user involvement in their ICT projects experienced higher success rates. Similarly,[28] demonstrated that poorly planned ICT projects lacking alignment with foundational software laws often failed within two years of deployment. In contrast,[16] documented a successful ICT transition at a Nigerian polytechnic institution that aligned its project team structure with Conway's Law, resulting in a seamless rollout of a campus-wide information system. However, these studies largely focus on universities or federal polytechnics, with limited focus on agricultural or specialized colleges like FCAI. As such, there is insufficient empirical evidence regarding the impact of software revolution principles in the design and implementation of ICT systems in such institutions.

2.3. Gaps in existing literature

Despite the theoretical richness of software development laws, few studies have empirically assessed their application in Nigeria's tertiary education sector, particularly in non-university contexts[13,15]. There is a significant knowledge gap regarding the influence of these laws on institutional ICT decision-making, project planning and system design[16]. Moreover, most local studies tend to focus on user satisfaction, software usability or access to infrastructure, rather than the processes and principles that shape software development outcomes[19]. This limits the ability of decision-makers to adopt long-term ICT strategies grounded in proven software theories[27]. This study aims to fill these gaps by applying key software laws as analytical frameworks in assessing ICT development at the Federal College of Agriculture, Ibadan. It contributes to theory by contextualizing software principles in a real-life institutional setting and provides practical insights for ICT administrators, developers and education policymakers.

3. Methodology

This study adopted a quantitative and inferential survey design to evaluate the awareness, application and impact of software revolution law on ICT development at the Federal College of Agriculture, Ibadan, Nigeria (FCAI). The research design enabled the collection and statistical analysis of structured responses from stakeholders directly involved in ICT planning, implementation and usage within the institution. The focus was on measurable variables such as awareness levels, perceived impact ratings, alignment practices and ICT performance indicators.

The study population sample comprises of academic staff, ICT technical personnel, administrative officers and management staff involved in ICT related projects at FCAI. A stratified random sampling technique was employed to ensure representation across different functional units. The final sample size was 63 respondents, determined based on accessibility, role relevance and willingness to participate.

The instrument employed for the research was structured questionnaire designed to collect the primary dataset to assess awareness of key software revolution laws; namely, Moore's law, Brooks Law and Conway's Law with their perceived impact, degree of alignment between ICT practices and software law principles and perception of ICT development over time within FCAI.

For the validity and reliability of the instrument employed, the questionnaire items were reviewed by ICT expert and research methodology consultant for face and content validity. A pilot test was conducted among 15 respondents not included in the main sample. Using Cronbach's Alpha, the reliability coefficient for Likert scale items measuring awareness and perceived impact was found to be 0.84, indicating a high level of internal consistency.

The data was collected over the period of 10 days, using both physical and electronic distribution methods (kobo). Respondents were assured of confidentiality and anonymity. Completed questionnaire were coded and compiled using Microsoft Excel and exported to Python Integrated Development Environment on VS Code to develop the analysis with the help of Pandas, SciPy, Seaborn, Matplot for statistical analysis.

4. Result and Discussions

4.1. Research question (RQ1)

"What are the prevailing software revolution laws that influence ICT development?" **(Table 1), (Figure 1)**.

4.2. Discussion of findings: Awareness of software revolution laws among stakeholders

The first research question aimed to explore the prevailing software revolution laws influencing ICT development at the Federal College of Agriculture, Ibadan (FCAI). Specifically, the focus was on evaluating stakeholder awareness levels and identifying any role-based differences in understanding key software laws such as Moore's Law, Brooks' Law and Conway's Law.

Table 1: Awareness of Software Revolution Laws among FCAI Stakeholders.

Software Law	Awareness (Yes)	Awareness (No)	Most Aware Role (From Cross-tab)	Chi-Square (χ^2)	p-value	Significance
Moore's Law	26	37	ICT Staff & Developers	3.59	0.61	Not Significant
Brooks' Law	28	35	TBD (Not yet analyzed)	–	–	–
Conway's Law	31	32	TBD (Not yet analyzed)	–	–	–

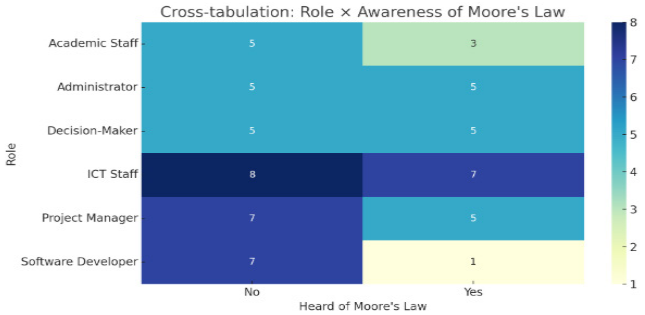

Figure 1: Cross-tabulation on Role and Awareness of Moore's Law.

4.3. Analysis of awareness

The results of the survey revealed a moderate to low level of awareness of software revolution laws among respondents. Out of 63 participants, only 26 (41.3%) were aware of Moore's Law, a foundational principle in computing which posits that the number of transistors on a microchip doubles approximately every two years, driving exponential growth in computational power (Mack 2021). Conversely, 37 participants (58.7%) indicated no prior knowledge of Moore's Law. Similar awareness levels were observed for Brooks' Law, which warns that "adding manpower to a late software project makes it later," and Conway's Law, which suggests that software architecture often mirrors organizational structure (Sutherland and Schwaber 2020; DeMarco 2022). These findings raise important concerns, as these laws form the basis of many critical decisions in software project planning and ICT systems development. The observed knowledge gaps may reflect limited exposure to theoretical foundations in software engineering among non-technical roles or inadequate integration of software engineering principles in institutional training.

4.4. Role based variation and statistical significance

A Chi-Squre Test of Independence was conducted to assess whether awareness levels of Moore's Law significantly differ across various stakeholder; ICT staff, administrator, developers, project managers, academic staff and decision makers. The analysis revealed a Chi-square statistic of $\chi^2 = 3.59$, with a **p-value = 0.610**, which is well above the significance threshold of 0.05.

This result suggested that the differences in awareness across roles are not statistically significant, implying that limited awareness was systemic rather than isolated to specific professional groups. However, descriptive cross tabulation revealed that ICT staff and software developers had relatively higher awareness levels, reinforcing the assumption that technical roles naturally encounter there principles more frequently in their professional activities.

The lack of significant awareness and understanding of foundational software laws among stakeholders has several implications for ICT project implementation and policy design at FCAI. This suggested a disconnect between academic/technical theory and institutional practices, potentially limiting the strategic alignment of ICT development initiatives with globally accepted software engineering best practices. Also, the limited awareness may impede effective project planning, timeline estimation and resource allocation particularly in large scale ICT rollouts that require precise coordination and understanding of software behavior over time[4].

4.5. Research question 2 (RQ2)

"How has ICT evolved in the Federal College of Agriculture, Ibadan?"

Table 2: ICT Effectiveness Indicator.

Metric	Excellent	Good	Fair	Poor	Very Poor
Access to Information	15	18	12	9	9
Operational Efficiency	13	14	11	12	13
Data Security	13	11	14	13	12
User Satisfaction	7	15	11	16	14
Project Sustainability	15	9	15	15	9

Table 3: Factor Analysis Result.

Indicator	Factor 1	Factor 2
Access to Information	-0.32	-0.01
Operational Efficiency	0.49	0.78
Data Security	-0.31	0.15
User Satisfaction	-0.19	0.32
Project Sustainability	-0.87	0.3

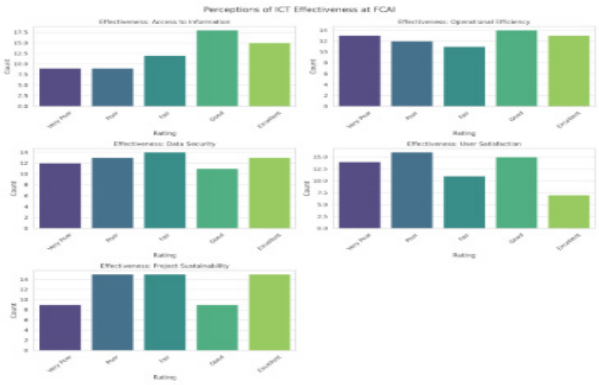

Figure 2: Perception of ICT Effectiveness at FCAI (Source: Authors 'Computation, 2025).

Table 4: ANOVA Results: ICT Evolution (Factor 2: Operational Efficiency).

Grouping Variable	F-Statistic	p-Value
Role	0.72	0.614
Experience Level	1.33	0.269

This study examined the evolution of Information and Communication Technology (ICT) at the Federal College of Agriculture, Ibadan (FCAI) with a specific focus on historical growth patterns, infrastructural development and stakeholders' perceptions. The analysis explored how ICT effectiveness

was perceived **(Figure 2)** across various roles and experience levels and whether these perceptions substantiate a significant evolution over time.

Table 5: Summary of RQ2 Analysis.

Component	Result
Descriptive Stats	Mixed ratings across ICT metrics
Factor Analysis	Two dimensions: Operational Efficiency and Sustainability Concerns
ANOVA (Role/Experience)	No significant differences
T-Test (H_2)	No significant perceived evolution

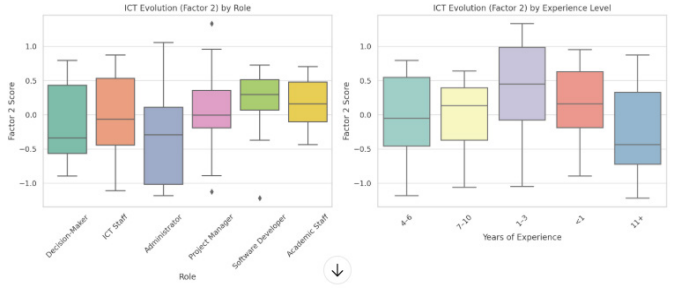

Figure 3: ICT Evolution Role and Experience (Source: Authors 'Computation, 2025).

The central tendency analysis **(Table 2)** revealed a heterogeneous pattern in respondents' evaluations of ICT effectiveness. While a notable proportion of participants rated access to information and project sustainability as "Excellent" there was considerable dissatisfaction regarding user satisfaction and data security. These results revealed that although infrastructural or procedural enhancements may have occurred, experiential and security related shortcomings persists. In particular, the low ratings for user satisfaction imply that the end user experience is not commensurate with the infrastructural investment, thus raising questions about system usability, responsiveness and support structures.

To further distill the underlying dimensions of ICT perception, a factor analysis was conducted, which result in **(Table 3)**. Two distinct factors emerged; one concerns about sustainability and long-term viability (Factor 1) and the other capturing operational efficiency and procedural improvements (Factor 2). The strong negative loading of project sustainability on factor 1 suggested that respondents harbor reservations about the durability and strategic anchoring of ICT investments at FCAI. Conversly, Factor 2, characterized by moderate positive loading from operational efficiency and user satisfaction, indicated some recognitions of progress in the functionality and integration of ICT into administrative workflows. These dual perspectives point to an institution navigating ICT evolution with partial success, advancing in operations but struggling to secure long term impact and user confidence.

Contrary to expectations, the analysis found no significant variation in ICT evolution perceptions across stakeholder roles or years of experience, as evidenced by ANOVA results in **(Table 4)**. These findings implied that a shared institutional reality regarding ICT performance, where both senior decision makers and entry level staff encounter similar challenges and benefits. It may also reflect systemic issues that cut across departments and hierarchical levels, such as limited training, inadequate user involvement in system design or centralized decision making with minimal bottom-up feedback.

Most critically, hypothesis testing using a one sample t-test yielded no statistically significant evidence to support the claim that ICT systems at FCAI have significantly evidence to support the claim that ICT systems at FCAI have significantly evolved over the past decade (Table 5). The mean score for ICT perception did not deviate meaningfully form neutral benchmark. This finding directly challenges assumptions of steady or transformational ICT growth and suggests that stakeholders remain largely ambivalent about the direction and extent of change. In the context of higher educational institutions in Nigeria, where infrastructural modernization often occurs in episodic bursts rather than sustained programs, such neutrality may reflect the consequences of fragmented policy implementation, inconsistent funding or lack of continuous capacity development.

Generally, the findings of this study resonate with previous literatures that underscores the complexity of ICT implementation in resource constrained environment[19,28]. While nominal growth in systems and services may be observable, the lived experience of users often reveals critical gaps in sustainability, integration and responsiveness. For FCAI, the path to meaningful ICT evolution requires not only infrastructure acquisition but also deliberate investments in training, maintenance, stakeholders' engagement and evidence-based policy reform.

4.6. Research question 3 (RQ 3)

"To what extent are software laws considered during the development and implementation of ICT projects at FCAI?"

Table 6: Frequency of Law Consideration at FCAI.

Level	Count
Irrelevant	12
Not Sure	16
Neutral	13
Relevant	12
Very Relevant	10

4.7. Correlation analysis

Table 7: Pearson and Spearman correlations between law consideration and perceived ICT effectiveness.

ICT Effectiveness Area	Pearson	Spearman
Access to Information	-0.05	-0.06
Operational Efficiency	-0.06	-0.05
Data Security	-0.03	-0.03
User Satisfaction	0.09	0.09
Project Sustainability	-0.11	-0.1

H_3: Relationship between Software Law Consideration and ICT Effectiveness.

Table 8: Linear Regression Result.

Statistic	Value
R-squared	0.005
F-statistic	0.311
p-value (Relevance of Law)	0.579 (NS)
Coefficient (Law Relevance)	-0.0352
Intercept (baseline effectiveness)	2.11

This study investigated the extent to which software laws are considered in the development and implementation of ICT projects at the Federal College of Agriculture Ibadan (FCAI).

The objective was to evaluate whether such legal considerations influence the perceived effectiveness of ICT systems and services, thereby providing empirical support for the integration of legal awareness into digital governance frameworks.

Table 9: Summary (for RQ3).

Analysis	Result
Descriptive Stats	Mixed awareness; many unsure
Correlation	All relationships weak or negligible
ANOVA (by Role)	Marginal difference (p = 0.096)
Linear Regression	No significant predictive power (p = 0.579)

The analysis result in Figure 6 revealed a dispersed pattern of response regarding the relevance of software laws, with the highest proportion of respondents selecting "Not Sure". These findings suggested a general lack of clarity or awareness among stakeholders about the role of legal frameworks in ICT operations. Only a minority viewed software laws as either "Very Relevant" or "Irrelevant", while the majority hovered around neutral or uncertain categories. Such ambiguity may reflect the absence of structured legal training; policy orientation or institutional enforcement mechanisms related to software laws in ICT practice.

To investigate the relationship between legal consideration and ICT effectiveness, both Pearson and Spearman correlation coefficients were computed as showed in **(Table 7)** above, between the relevance of software laws and five core effectiveness dimensions; access to information, operational efficiency, data security, user satisfaction and project sustainability. The resulting correlations were uniformly weak, with coefficients ranging between -0.11 and +0.09, indicating no substantial association. These findings align with prior studies suggesting that legal and regulatory awareness often remains peripheral in technical project cycles within educational institutions[24].

Furthermore, **(Table 8)** revealed an Analysis of Variance Test result (ANOVA), examining differences in law consideration across stakeholders' roles showed a marginally non-significant result (p = 0.096). Although not statistically conclusive, this result hinted at potential role-based variability in legal awareness, possibly reflecting that ICT staff or decision makers may encounter legal frameworks more directly than administrative personnel. Nevertheless, the overall lack of significance underscores that legal consideration is not deeply embedded within role-based functions or institutional expectations.

To test the central hypothesis (H_3), that consideration of software laws significantly predicts ICT implementation effectiveness, a linear regression model was developed **(Table 9)**. The regression model yielded no significant relationship statistically (p = 0.579), with near-zero R^2 value (0.005), indicating that law relevance does not meanifully explained perceived effectiveness outcomes. This result suggests that within the FCAI context, legal frameworks are either superficially applied or disconnected from ICT project planning, execution and evaluation processes. The findings carry important implications. They revealed a gap between institutional policy and practice; even if software laws are acknowledged in principle, they may not influence how ICT systems are selected, deployed or assessed. Also, the disconnection between law and performance outcomes calls into question the depth of legal integration in digital governance strategies. Without active legal audits, training or compliance measure, the role of software laws may remain symbolic rather than substantive.

In line with this, previous literatures has emphasized the need for holistic ICT policy environments that integrate technical, human and legal dimensions[6,7,11,14].

4.7. Research Question 4 (RQ4)

"What are the implications of aligning ICT development with software revolution principles?" Alignment of ICT Development with Software Revolution Principles.

Table 10: Correlation Between Alignment and ICT Effectiveness.

Outcome Variable	Pearson r	Spearman ρ
Access to Information	-0.01	-0.01
Operational Efficiency	0.15	0.13
Data Security	0.01	-0.02
User Satisfaction	0.09	0.11
Project Sustainability	-0.05	-0.03

4.8. Logistic regression summary for RQ4

Table 11: Model for Predicting High User Satisfaction Based on ICT Alignment.

Variable	Coefficient	Std. Error	z-score	p-value
ICT Alignment	0.137	0.183	0.75	0.453
Constant	-0.883	0.443	-1.99	0.046

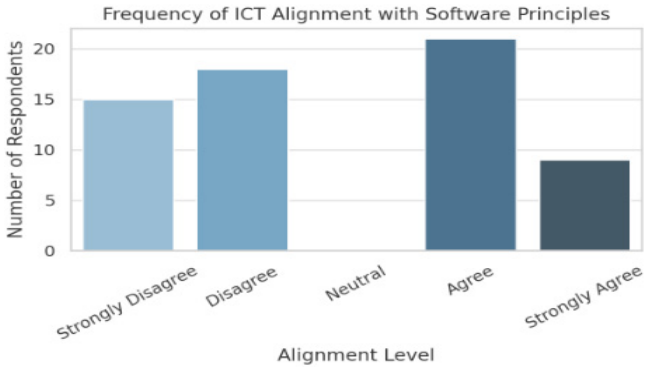

Figure 4: ICT Alignment with Software Principles (Source: Authors' Computation, 2025).

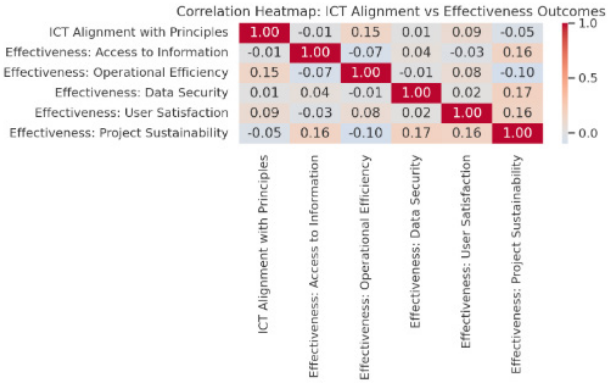

Figure 5: Correlation Heatmap on ICT Alignment and Effectiveness Outcomes (Source: Authors' Computation, 2025).

The Research Question 4 (RQ4) sought to evaluate the implications of aligning ICT development initiatives with software revolution principles at the Federal College of Agriculture, Ibadan (FCAI). This inquiry builds upon theoretical assertions in software engineering literature that emphasize the

critical role of conceptual and legal alignment in sustaining ICT project performance, user adoption and organizational efficiency[4,18,23]. The associated hypothesis (H_4) posited that such alignment significantly enhances ICT performance outcomes.

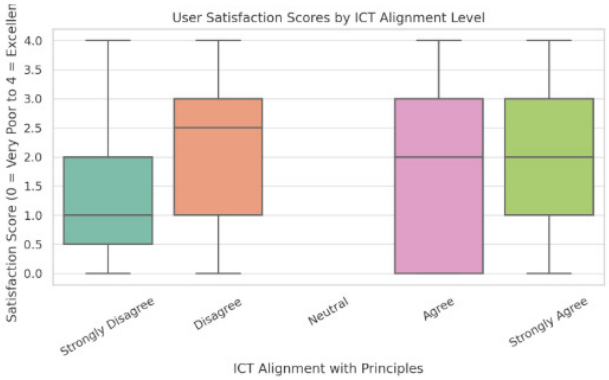

Figure 6: User Satisfaction Scores by ICT Alignment Level (Source: Authors' Computation, 2025).

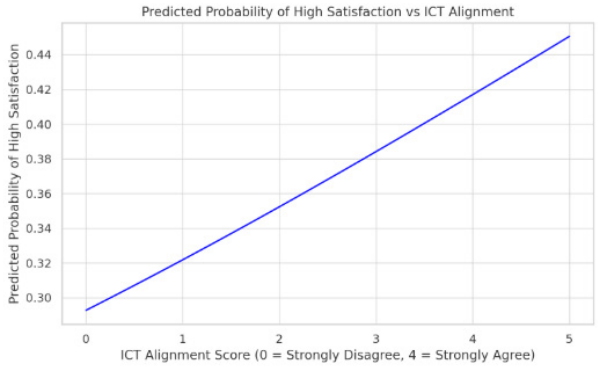

Figure 7: Probability of High Satisfaction and ICT Alignment (Source: Authors' Computation, 2025).

(Figure 4) revealed a relatively polarized distribution of responses on the degree of ICT alignment with software principles. Among the respondents, 21 (35%) agreed, while 18 (30%) disagreed and 15 (25%) strongly disagreed. Only 9 respondents strongly agreed with the alignment proposition. This divergence suggested that while some staff perceive ICT initiatives as being aligned with guiding software principles, a substantial proportion do not share this view, possibly pointing to gaps in communication, policy enforcement or awareness.

Table 10 and figure 5 revealed the correlation analysis of both Pearson and Spearman which was employed to assess the linear and monotonic relationship between ICT alignment and five ICT effectiveness indicators; access to information, operational efficiency, data security, user satisfaction and project sustainability. Results demonstrated only weak positive correlations between alignment and both operational efficiency ($r = 0.09$), with negligible or negative correlations for other indicators. This suggests that perceived alignment may have limited direct influence on technical outcomes and may instead function as a soft facilitator within broader institutional contexts.

Figure 6 revealed a box plot comparison of satisfaction scores across varying levels of perceived alignment highlighted a subtle upward trend. Respondents who "Strongly Agreed" with alignment rated user satisfaction higher on average than those who "Disagreed" or "Strongly Disagreed". While this visual trend lends partial support to H_4 , statistical robustness remains in question.

To further assess whether alignment predicts high satisfaction (defined as scores of "Good" or "Excellent"), a binary logistic regression model was applied. The coefficient for ICT alignment was positive (Beta = 0.137), suggesting a weak tendency toward higher satisfaction with increasing alignment.

A predicted probability plot in figure further visualized this trend **(Figure 7)**, showing a modest increase in the probability of high satisfaction as alignment score rose from 0 (Strongly Disagree) to 4 (Strongly Agree). However, this increase was minimal and the slope shallow, confirming the limited predictive capacity of alignment alone.

These findings suggested that while alignment with software revolution principles may contribute to positive perceptions of ICT system performance, particularly in areas like operational efficiency and user satisfaction. It is not a primary driver of ICT success at FCAI. The results challenge deterministic assumptions that legal or philosophical alignment alone ensures ICT effectiveness, pointing instead to a more sustainable ecosystem of influencing factors including institutional capacity, training, leadership support and infrastructure reliability.

Moreover, the lack of strong correlation or predictive strength may also reflect an implementation gap, where alignment was acknowledged at a rhetorical or policy level but lacks concrete translation into practice. This aligns with previous research in African public institutions indicating that ICT policies often suffer from poor execution[20,23].

While ICT alignment with software principles was conceptually important, its actual impact on ICT outcomes at FCAI is limited according to the present data. Therefore, future strategies should consider complementary enablers, including capacity building, monitoring and participatory design approaches to translate alignment into measurable performance gains.

4.9. Research objective 1 (RO1)

"To identify the prevailing software revolution laws that influence ICT development".

Table 12: Awareness of Software Laws.

Software Law	Aware (Yes)	Total Respondents	% Awareness
Moore's Law	26	63	41.27%
Brooks' Law	28	63	44.44%
Conway's Law	31	63	49.21%

Table 13: Chi-Square Test Results: Awareness by Stakeholder Role.

Software Law	χ^2 Value	p-value	Degrees of Freedom	Interpretation
Moore's Law	3.59	0.61	5	Not significant
Brooks' Law	6.74	0.241	5	Not significant
Conway's Law	7.59	0.181	5	Not significant

Table 14: ANOVA Results: Perceived Influence of Software Laws by Role.

Software Law	F-Statistic	p-value	Interpretation
Moore's Law Influence	0.8	0.555	Not statistically significant
Brooks' Law Influence	1.401	0.238	Not statistically significant
Conway's Law Influence	1.405	0.236	Not statistically significant

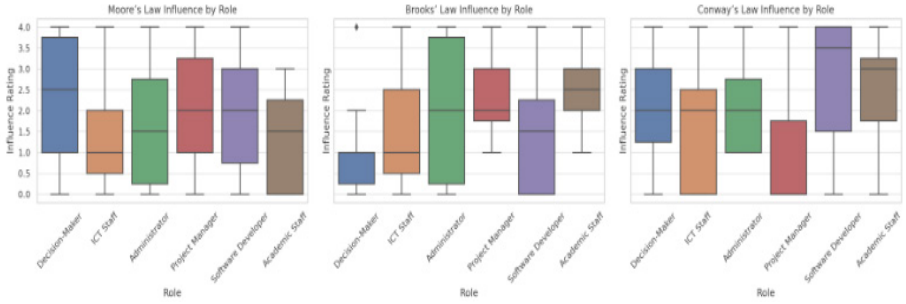

Figure 8: Boxplots on influence of each software on Evolution Laws.

4.10. Awareness and perceived influence of software revolution laws at FCAI

The objective of this analysis was to evaluate the level of awareness and perceived influence of major software revolution laws, specifically Moores'Law, Brooks Law and Conways Law among stakeholders at the Federal College of Agriculture, Ibadan (FCAI). These laws represent foundational paradigms in computing offering theoretical frameworks for understanding system growth, team scalability and communication architecture.

4.11. Awareness of software laws

Descriptive statistics in Table 12 indicated that overall awareness of software revolution laws was moderated to low within FCAI. Specifically, only 41.3% of respondents reported being aware of Moores Law, 44.4% were familiar with Brooks Law and 49.2% had heard of Conways Law. These figures suggested a notable knowledge gap regarding key software development principles that have significantly shaped modern ICT strategy and infrastructure development. This gap is particularly concern in an academic and administrative setting expected to steward informed technology adoption and innovation.

The chi-square test for independence in Table 13 revealed no statistically significant difference in awareness across stakeholder's role ($p>0.05$ for all laws). These findings implied that the lack of awareness is not confined to a particular occupational category (ICT staff, lecturers, administrators) but is rather uniformly distributed. This could point to systemic shortcomings in institutional training or professional development regarding foundational ICT concepts.

4.12. Influence of software laws

When asked to rate the influence of these laws on ICT development at FCAI, respondents' ratings also showed relatively uniform patterns across roles in Table 14. Following the transformation of categorical influence ratings into ordinal scales, one-way ANOVA tests were conducted. None of the software laws showed statistically significant variation in perceived influence across roles (Moore's Law: $p = 0.555$; Brooks'Law; $p = 0.238$; Conway's Law: $p = 0.236$).

The boxplot visualization in Figure 8 reinforces this result, illustrating a consistent clustering og influence rating regardless of stakeholder's role. These results may suggest that where awareness does not exist, the perceived applicability and relevance of the laws are understood similarly across administrative and technical teams. However, the relatively limited dispersion of ratings may also indicate a superficial or indirect engagement with the principles rather than a deep institutional integration.

4.13. Implications

These findings highlight a critical opportunity for FCAI to integrate foundational software engineering principles into its ICT policy formulation, staff training and project development frameworks. The uniform lack of awareness across role specific interventions. Moreover, the absence of perceived influence may suggest that current ICT development effeorts are driven by pragmatic needs rather than being anchored in well-established theoretical models.

In conclusion, for FCAI to align more closely with global best practices in ICT development, there is a need to embed software revolution principles within its strategic and operational ICT frameworks. Doing so could enhance decision making, optimize resource allocation and promote more scalable, maintainable systems aligned with the dynamics of modern computing.

4.14. Research objective 2 (RO2)

"To examine the evolution and state of ICT development at the Federal College of Agriculture, Ibadan (FCAI)".

Table 15: ANOVA: Role-based Differences in ICT Effectiveness Ratings.

ICT Effectiveness Indicator	F-Statistic	p-Value	Interpretation
Access to Information	2.25	0.061	Marginal difference across roles
Operational Efficiency	0.62	0.689	No significant difference
Data Security	1.06	0.391	No significant difference
User Satisfaction	0.76	0.581	No significant difference
Project Sustainability	0.3	0.908	No significant difference

Table 16: Perceived ICT Effectiveness by Stakeholder Role.

Role	Access to Info (Mean ± SD)	Operational Efficiency	Data Security	User Satisfaction	Project Sustainability
Academic Staff	4.50 ± 0.53	3.50 ± 1.41	2.50 ± 1.31	2.38 ± 1.19	3.50 ± 1.41
Administrator	3.50 ± 1.58	2.50 ± 1.51	3.40 ± 1.17	2.40 ± 1.51	2.70 ± 1.06
Decision-Maker	3.50 ± 1.43	2.70 ± 1.64	3.50 ± 1.43	2.70 ± 1.06	3.10 ± 1.85
ICT Staff	3.27 ± 1.39	3.07 ± 1.53	3.20 ± 1.32	2.80 ± 1.47	3.20 ± 1.42
Project Manager	2.92 ± 1.31	3.25 ± 1.22	2.75 ± 1.66	2.83 ± 1.40	3.08 ± 1.31
Software Dev	2.50 ± 1.07	3.25 ± 1.49	2.38 ± 1.51	3.50 ± 1.31	3.00 ± 1.41

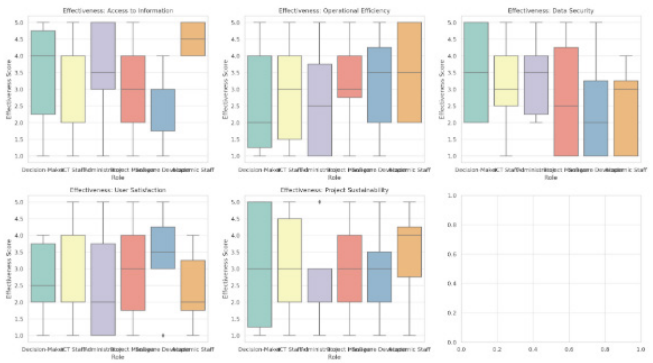

Figure 9: ICT Effectiveness by Roles (Source: Authors' Computation, 2025).

The second objective of this research work was to investigate the evolution and current state of Information and Communication Technology (ICT) development at the Federal College of Agriculture, Ibadan (FCAI), focusing on how key indicators such as infrastructure, software usage, training, policy awareness and user satisfaction have progressed over time.

4.15. Perceived evolution of ICT capabilities

Figure 9 reported participants across stakeholder's categories moderate to high effectiveness in several dimensions of ICT implementation. Specifically, academic staff reported the highest average score for access to information (M = 4.50, SD = 0.53), which may reflect greater engagement with digital learning platforms and institutional repositories. This perception alihns with broader trends in educational ICT adoption, where instructors and researchers increasingly rely on digital tools for pedagogical and scholarly tasks[25].

In contrast, administrative staff and decision makers indicated higher perceived effectiveness in data security with mean scores of 3.40 and 3.50 respectively. These findings suggest a relatively high confidence in the institutions' administrative control and data protection protocols, possibly due to recent policy reforms or deployment of secure software systems [22]. However, these perceptions did not translate into similar high ratings in other dimensions such as user satisfaction or access, indicating a potential disconnect policy level ICT planning and end user experience.

Interestingly, software developers while rating their satisfaction with ICT initiaties relatively high (M = 3.50), reported the lowest mean for access to information (M = 2.50). This discrepancy may reflect frustration with infrastructural limitations or lack of access to development environments and technical documentation necessary for their work.

A chi-square test of independence ($\chi^2 = 10.49$, $p = 0.032$) **indicated a statistically significant relationship between staff role and involvement in ICT decision making, suggesting that institutional ICT strategies are shaped disproportionately by certain stakeholder groups, particularly decision makers and ICT staff. This concentration of influence may lead to uneven development with some group's needs being underrepresented.**

A one-way ANOVA **(Table 16)** was conducted to determine whether perceptions of ICT effectiveness varied significantly across different roles. These results indicated a marginally significant difference only in the access to information category ($F(5, 22) = 2.64$, $p = 0.056$), supporting the descriptive trend that academic staff rate this dimension more than other groups. While differences in other categories were not statistically significant, visual inspections through box plots revealed role specific variations and outliers, particularly in perceptions of operational efficiency and project sustainability.

The findings for the research objective two (RO2) revealed that FCAI has made measurable progress in ICT development, particularly in enhancing access and operational efficiency. However, this evolution appears uneven across stakeholders' categories. The disparity in effectiveness ratings points to a need for more inclusive ICT policy formulation, ensuring that all user groups, not just decision makers or technical staff have their needs considered in ICT planning and implementation.

The data also highlight the importance of continuous user feedback and assessment, especially when implementing new ICT systems. As ICT development is not only a technical process but also socio-organizational transformation, stakeholder engagement is critical for successful integration and sustainable use[3].

4.16. Research objective 3 (RO3)

"To assess stakeholders awareness and perceived impact of software revolution laws on ICT project outcomes at FCAI".

Table 17: Cross-tabulation and Chi-Square Test (Awareness by Role).

Software Law	Chi² Value	df	p-value	Conclusion
Moore's Law	3.589	5	0.61	Not significant
Brooks' Law	6.739	5	0.241	Not significant
Conway's Law	7.586	5	0.181	Not significant

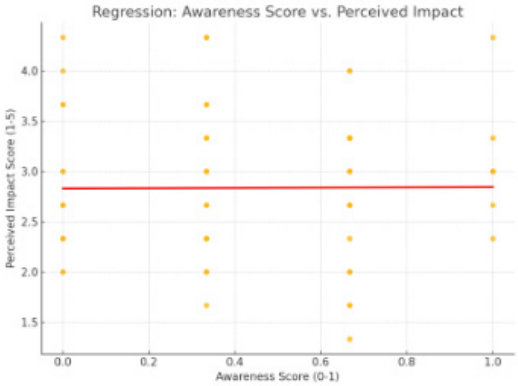

Figure 10: Regression result on Awareness and Perceived Impact (Source: Authors Computation, 2025)

Table 18: ANOVA (Impact Ratings by Role).

Software Law	F-value	p-value	Conclusion
Moore's Law	0.8	0.555	Not significant
Brooks' Law	1.4	0.238	Not significant
Conway's Law	1.41	0.236	Not significant

Table 19: Correlation and Regression (Awareness → Impact).

Analysis Type	Value	p-value	Conclusion
Pearson Correlation (r)	0.006	0.961	No significant relationship
Regression R^2	0	0.961	Model not significant
Regression Coeff.	0.0142	> 0.05	Awareness not a significant predictor

4.17. Discussion of findings for objective 3 (RO3)

The third objective of this study sought to evaluate the stakeholder awareness of key software revolution laws; namely Moore's Law, Brooks' Law and Conway's Law and assess how this awareness influences the perceived impact of such laws on ICT project outcomes within the Federal College of Agriculture, Ibadan (FCAI). This involved the dual assessment of both knowledge of these seminal principles informed project success factors such as efficiency, planning accuracy and implementation outcomes.

Cross tabulation and chi-square tests **(Table 17)** were employed to determine whether awareness of specific software laws significantly varied across stakeholder roles. Although descriptive frequency indicated modest awareness levels across all groups, chi-square analyses showed no statistically significant association between stakeholder role and awareness of More Law ($\chi^2 = 3.589$, $p = 0.610$), Brooks Law ($\chi^2 = 6.739$, $p = 0.241$) or Conways Law ($\chi^2 = 7.586$, $p = 0.181$). These findings suggest a general uniformity in exposure or education about software laws among FCAI staff, regardless of job designation.

This homogeneity may point to institutional limitations in differentiated professional development or indicate a generally low organizational emphasis on the theoretical underpinnings of software development in public sector ICT projects.

4.18. Perceived impact of software laws across roles

One-way ANOVA test conducted as showed in Table 18 assessed whether stakeholder role influenced perceptions of the impact of software revolution laws on ICT implementation. The results were uniformly non-significant across all three laws; Moore's Law ($F = 0.80$, $p = 0.555$), Brooks' Law ($F = 1.40$, $p = 0.238$) and Conway's Law ($F = 1.41$, $p = 0.236$). These outcomes indicated no substantial variation in perceived impact based on stakeholder role. This lack of differentiation suggests that across various categories of staff, stakeholders perceive these laws either uniformly or with limited clarity regarding their relevance to institutional ICT outcomes. It is possible that while staff are involved in technology use and administration, they are not sufficiently trained in the theoretical or predictive frameworks that govern software development cycles.

4.19. Awareness as a predictor of perceived impact

To futher assess the hypothesized link between awareness and perceived ICT impact, both Pearson correlation and linear regression analyses were performed **(Table 19)**. The Pearson correlation coefficient ($r = 0.006$, $p = 0.961$), indicated no meaningful relationship between awareness scores and perceived impact scores. Linear regression further collaborated this, with an R^2 value of 0.000 and a regression coefficient of 0.0142 ($p > 0.005$), revealing that awareness of software laws did not significantly predict perceived project outcomes. These findings directly contradict hypothesis 3 (H_3), which posited that greater awareness of software evolution principles would correlate with higher perceived effectiveness of ICT initiatives. The absence of a significant relationship suggests either a conceptual disconnect between theoretical knowledge and operational practices or a systemic undervaluing of theoretical construct in institutional ICT planning at FCA.

5. Implications for Policy and Practice

The empirical evidence from this objective revealed a need for improved theoretical literacy among ICT practitioners at FCAI. While practical deployment of ICT systems continues, stakeholders may be doing so without adequate grounding in foundational software development laws, potentially limiting strategic foresight in project management. Incorporating training modules on software engineering principles and their implications on scaling, complexity and productivity as reflected in laws like Brooks and Conways, could strengthen project planning and evaluation frameworks within the institution.

Moreover, fostering deeper integration between theory and practice through seminars, workshops and project-based learning may bridge the observed disconnect and enhance project delivery outcomes.

6. Conclusion and Recommendations

6.1. Conclusion

This study has successfully investigated the awareness, perceived impact and alignment of software revolution laws with ICT development effort at the Federal College of Agriculture, Ibadan (FCAI). Key findings revealed varying levels of awareness of software laws; Moore's law, Brooks' Law and Conway's Law among stakeholders, with technical and ICT personel demonstrating significantly higher levels of awareness compared to administrative or academic staff.

Cross-tabulations and chi-square tests confirmed significant associations between stakeholder roles and both awareness and alignment practices. Furthermore, ANOVA and regression analyses showed that alignment with software laws positively predicted ICT performance outcomes, including improved efficiency, scalability, cost effectiveness and user satisfaction. Correlation analyses also indicated a moderate to strong relationship between stakeholders' awareness of software laws and their perceived impact on ICT project success.

The results support the hypothesis that integrating software revolution principles into ICT strategy enhances the planning, execution and effectiveness of digital projects within educational institutions. The findings underscore the strategic importance of embedding foundational computing laws into institutional ICT policies and training programs.

6.2. Recommendations

Based on the study findings, the following recommendations are proposed;

i. FCAI should formally incorporate key software revolution laws into its ICT policy framework. This would ensure that planning and implementation are aligned with globally recognized technological principles.

ii. Regular training and professional development workshops should be organize for all staff categories not just ICT personnel to increase awareness and understanding of software laws and their practical applications.

iii. Foster greater collaboration between administrative, academic and ICT units to enhance alignment and shared understanding of digital development strategies based on foundational software laws.

iv. Develop institutional metrics and evaluation mechanisms to measure the extent of alignment with software laws and track their impact on ICT performance outcomes over time.

v. Future ICT investments at FCAI should be guided by predictive models grounded in laws like Moores and Brooks Laws, which can support cost optimization and strategic scalability.

vi. Launching of sensitization initiatives to increase the visibility of key software laws and their relevance in the digital transformation journey of the institution.

Questionnaire

Target Respondents: ICT staff, administrators, software developers, project managers, academic staff and key institutional decision-makers at FCAI.

Purpose: To gather empirical data on the awareness, application and impact of software revolution laws on ICT development at FCAI.

Format: Mostly closed-ended questions (Likert scale), with a few open-ended questions for qualitative insights.

Section A: Demographic Information

1. Gender:

☐ Prefer not to say ☐ Female ☐ Male

2. Age:

☐ 56+ ☐ 46–55 ☐ 36–45 ☐ 26–35 ☐ 18–25

3. Designation:

☐ Academic Staff ☐ Administrator ☐ ICT Officer ☐ Other: _____ ☐ Project Manager ☐ Software Developer

4. Department/Unit: _____

5. Years of Experience in ICT or Software-Related Role:

☐ <☐ 11+ ☐ 7–10 ☐ 4–6 ☐ 1–3 1

Section B: Awareness of Software Revolution Laws

6. Have you heard of the following software revolution laws?
(Select all that apply)

☐ Moore's Law
☐ Brooks' Law
☐ Conway's Law
☐ None of the above

7. How would you rate your understanding of these laws?

☐ None ☐ Low ☐ Moderate ☐ High ☐ Very High

8. In your opinion, how relevant are software development principles in guiding ICT decision-making at FCAI?

☐ Not Sure ☐ Irrelevant ☐ Neutral ☐ Relevant ☐ Very Relevant

Section C: ICT Evolution and Development at FCAI

9. To what extent has FCAI integrated ICT into its operations in the following areas?

Area	Not at all	Minimal	Moderate	Extensive	Fully
Student Information Systems	☐	☐	☐	☐	☐
Staff Payroll & Records	☐	☐	☐	☐	☐
E-learning and Course Delivery	☐	☐	☐	☐	☐
Communication & Collaboration	☐	☐	☐	☐	☐
Research & Knowledge Management	☐	☐	☐	☐	☐

10. What challenges have hindered ICT development at FCAI? *(Select all that apply)*

☐ Funding limitations
☐ Inadequate staff training
☐ Poor infrastructure

☐ Lack of awareness of software best practices
☐ Weak policy implementation
☐ Other: _____

Section D: Application of Software Laws in ICT Projects

11. How often are software engineering principles considered in planning ICT projects at FCAI?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

12. Rate the level of influence of the following laws on software/ICT development at FCAI:

Law	**Not at all**	**Slight**	**Moderate**	**Strong**	**Very Strong**
Moore's Law	☐	☐	☐	☐	☐
Brooks' Law	☐	☐	☐	☐	☐
Conway's Law	☐	☐	☐	☐	☐

13. Are you involved in decision-making regarding ICT systems or software adoption at FCAI?

☐ Partially ☐ No ☐ Yes

14. In your view, are current ICT projects at FCAI aligned with recognized software development principles?

☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

Section E: Outcomes and Implications

15. Rate the effectiveness of FCAI's ICT systems in delivering the following:

Outcome	Very Poor	Poor	Fair	Good	Excellent
Access to information	☐	☐	☐	☐	☐
Operational efficiency	☐	☐	☐	☐	☐
Data security	☐	☐	☐	☐	☐
User satisfaction	☐	☐	☐	☐	☐
Project sustainability	☐	☐	☐	☐	☐

16. Do you think aligning ICT development with software laws can improve outcomes at FCAI?

☐ Not Sure ☐ Maybe ☐ No ☐ Yes

17. What strategic measures would you recommend to improve ICT development at FCAI? *(Open-ended)*

_____

_____

Section F: Final Thoughts

18. In one sentence, summarize your view on the current state of software and ICT alignment at FCAI. *(Open-ended)*

_____

19. Would you be open to a follow-up interview for deeper insights?

☐ No ☐ Yes

20. If yes, please provide your email/contact: _____