

Improve Quality of Smart Universities through Information Technology Infrastructure Library Methodology

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Abstract— This paper focuses on educational institutions are increasingly seeking innovative ways to enhance the quality of their services. Smart universities, a product of this technological evolution, aim to provide students with cutting-edge educational experiences. One of the pivotal factors in achieving this goal is the effective management of Information Technology (IT) services. The Information Technology Infrastructure Library (ITIL) methodology is recognized worldwide as a robust framework for IT service management. Its principles and best practices have been successfully applied in various sectors to optimize processes, enhance service quality, and ensure efficient resource utilization. Given the ever-growing reliance on IT within educational institutions, implementing ITIL in smart universities has the potential to significantly elevate the quality of education. This paper explores the vital role that the ITIL methodology plays in improving the quality of smart universities. It delves into how the principles and practices of ITIL can be strategically integrated into the operational fabric of higher education institutions. By leveraging ITIL, universities can not only bolster their IT service management but also enrich the overall educational experience for students, ultimately contributing to the realization of truly smart and technologically advanced learning environments.

Keywords- Information Technology Infrastructure Library (ITIL), quality, Smart universities.

I. INTRODUCTION

The National Authority of Education Quality Assurance and Accreditation (NAQAAE) is Egypt's official body responsible for ensuring educational quality. NAQAAE sets quality criteria and standards, assesses institutions based on mission, and focuses on Institutional Capacity and Educational Effectiveness. Accreditation is voluntary but vital for government recognition and funding. NAQAAE also fosters quality assurance and accreditation systems in the Arab region through collaboration, promoting educational excellence and best practices in the field [1].

Quality standards measures in education are necessary to ensure that students receive a high-quality education that meets certain standards. Quality standards can vary depending on the educational institution and the assessment framework used. The

following are some common quality metrics and strategies used to measure the quality of education [1].

- ✓ Strategic Planning
- ✓ Leadership and Governance
- ✓ Quality management and development
- ✓ Faculty members and Assistants
- ✓ administrative body
- ✓ financial and physical resources
- ✓ Academic standards and educational programs
- ✓ Teaching and learning
- ✓ Students and Graduates
- ✓ Scientific research and scientific activities
- ✓ Postgraduate Studies
- ✓ Community participation and environmental development.

The Information Technology Infrastructure Library (ITIL) is the best practice framework for managing IT services and improving IT support and service levels. The main goal of ITIL is to ensure that IT services align with business objectives, even as those objectives change over time.

ITIL provides a set of guidelines and best practices for managing IT services, including service strategy, service design, service transition, service operation, and continuous service improvement. By following these guidelines, organizations can ensure that their IT services are delivered efficiently and effectively, and that they meet business needs. [2].

1.1 THE ITIL 4 FRAMEWORK:

- **The ITIL service value system**

The ITIL SVS (Service Value System) is a framework that represents the components and activities that work together within an organization to enable the creation of value through IT-enabled services. The ITIL SVS framework consists of several components that interact with each other in Fig. 1.

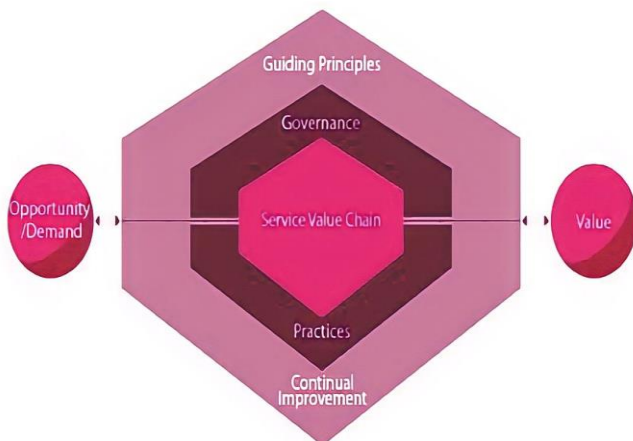


Fig .1 service value system

Service Value Chain (SVC): The SVC is a series of interconnected activities that are required to create and deliver a service. The activities are arranged into six stages: Plan, Improve, Engage, Design & Transition, Obtain & Build, and Deliver & Support.

- ✓ **Guiding Principles:** Guiding Principles are the core values and beliefs that guide an organization in all its decisions and actions. There are seven Guiding Principles in the ITIL framework: Focus on Value, Start Where You Are, Progress Iteratively with Feedback, Collaborate and Promote Visibility, Think and Work Holistically, Keep It Simple and Practical, and Optimize and Automate.
- ✓ **Governance:** Governance refers to the overall management framework that enables an organization to achieve its goals and objectives. It includes the policies, procedures, roles, and responsibilities that ensure that the organization operates in an effective, efficient, and ethical manner.

- ✓ **Service Management Practices:** Service Management Practices are specific practices that organizations can adopt to manage and deliver their services effectively. There are 34 Service Management Practices in the ITIL framework, grouped into three categories: General Management Practices, Service Management Practices, and Technical Management Practices.
- ✓ **Continual Improvement:** Continual Improvement is an ongoing process that organizations use to improve their services, processes, and systems. It involves identifying areas for improvement, analyzing and evaluating data, and implementing changes to drive improvement.
- ✓ **ITIL Service Value System Model:** The ITIL Service Value System Model is a visual representation of the ITIL SVS framework, showing how all the components fit together to enable value creation.

The ITIL SVS framework is a valuable tool for any organization that wants to optimize its service management capabilities and deliver value through IT-enabled services [2].

It demands to work as a framework. The ITIL SVS characterizes the inputs to this framework (opportunity and request), the essentials of this framework (organizational mastery, benefit administration, ceaseless upgrade, and the organization’s capacities and assets), and the yields (victory of organizational destinations and esteem for the organization, its clients, and other partners) “Mark Basham CEO , AXELOS” and et..al, [2].

1.2 THE CORE COMPONENTS OF THE ITIL SVS

ARE:

- **The ITIL guiding principles**
 - ✓ Attention on value.
 - ✓ Start where you are.
 - ✓ Movement iteratively with feedback.
 - ✓ Collaborate and stimulate visibility.
 - ✓ Think and effort holistically.
 - ✓ Keep it modest and practical.
 - ✓ Improve and automate.
 - ✓ Governance
 - ✓ Governing bodies and governance
 - ✓ Governance in the SVS
- **Service value chain**

As shown in Fig. 2 the components of service value chain are:

 - ✓ Plan
 - ✓ Improve
 - ✓ Engage
 - ✓ Design and transition
 - ✓ Obtain/build
 - ✓ Deliver and support

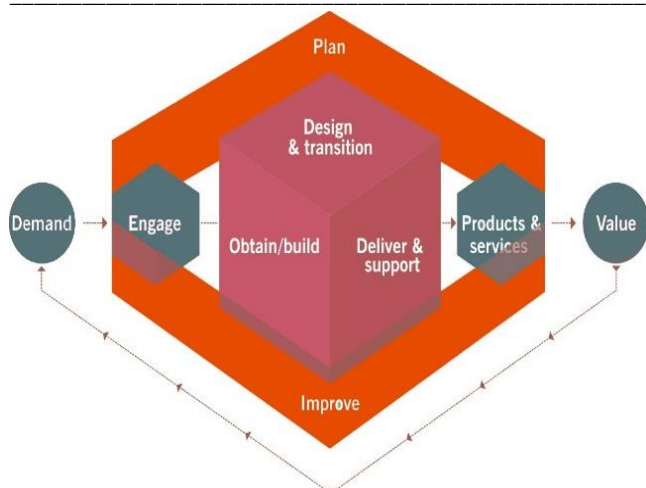


Fig .2 The ITIL service value chain

• **Opportunity, demand, and value**

Opportunity represents options or possibilities to add value for stakeholders or otherwise improve the organization.

• **Continual improvement**

Bring into line an organization’s practices and services with changing business needs through the ongoing identification and enhancement of all elements complicated in the effective management of products and services.

- ✓ Steps of the continual improvement model
- ✓ Continual improvement and the guiding principles
- ✓ Practices
- ✓ Summary

• **Practices**

Set of organizational resources designed for performing work or accomplishing an objective [3].

a) General management practices

- ✓ Strategy management
- ✓ Portfolio management
- ✓ Architecture management
- ✓ Service financial management
- ✓ Workforce and talent management
- ✓ Continual improvement
- ✓ Measurement and reporting
- ✓ Risk management
- ✓ Information security management
- ✓ Knowledge management
- ✓ Organizational change management
- ✓ Project management
- ✓ Relationship management
- ✓ Supplier management

b) Service management practices

- ✓ Business analysis

- ✓ Service catalogue management
- ✓ Service design
- ✓ Service level management
- ✓ Availability management
- ✓ Capacity and performance management
- ✓ Service continuity management
- ✓ Monitoring and event management
- ✓ Service desk
- ✓ Incident management
- ✓ Service request management
- ✓ Problem management
- ✓ Release management
- ✓ Change enablement
- ✓ Service validation and testing
- ✓ Service configuration management
- ✓ IT asset management
- c) Technical management practices

- ✓ Deployment management
- ✓ Infrastructure and platform management
- ✓ Software development and management

1.3 GENERAL MANAGEMENT PRACTICES

Your statement appears to discuss the ITIL framework's Benefit Methodology area, which focuses on managing IT services and identifying their value to the organization. Key processes in this area include Requirements Management, Service Portfolio Management, IT Financial Management, and Service Level Management. To ensure that IT services meet user requirements and provide value, you need to consider process creation, service portfolio management, financial management, and continuous service improvement. This entails evaluating service content, financial activities, and ongoing analysis and improvement [4].

1.4 SERVICE MANAGEMENT PRACTICES

The course focuses on aligning modern IT service design and management in the workplace, emphasizing essential processes for service planning. It also covers the organizational structure, roles, and considerations for cost reduction, quality enhancement, compliance, and ease of implementation. The processes that support service lifecycles in ITIL V3, including transition planning, change management, service asset management, release and application management, validation, testing, evaluation, and knowledge management, are discussed. Service operation, which is crucial for delivering and supporting services, is also explored, encompassing event management, order fulfillment, incident management, problem management, and access management. Various aspects such as event monitoring, response processes, incident handling, problem resolution, and access rights are examined to ensure optimal service operation [4].

1.5 THE FOUR DIMENSIONS MODEL

The four dimensions of service management The four perspectives that are critical to the effective and efficient facilitation of value for customers and other stakeholders in the form of products and services “Mark Basham CEO , AXELOS” and et..al, [2].

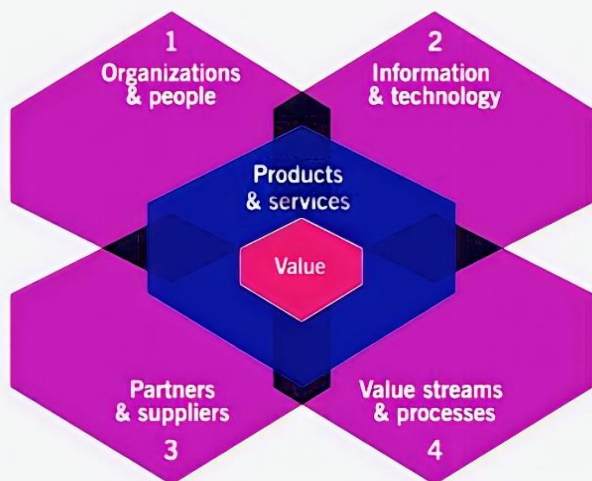


Fig .3 the four dimensions model

- ✓ Organizations and people
- ✓ Information and technology
- ✓ Partners and suppliers
- ✓ Value streams and processes

II. RELATED WORK

Hee-Wan Kim et, inferred the checklists of operation review by each space of benefit procedure, benefit plan, benefit move, benefit operation, and nonstop benefit change. This ponder shows up to have more than normal fulfillment the appropriateness comes about were [4].

Leandro Aparecida Antunes Steffen et, the paper is focused on analyzing the perspectives of IT Service Management at a government college, specifically looking at both the theoretical concepts and practical aspects of IT Service Management. The goal is to assess how well the college understands and applies the practical aspects of the ITIL (Information Technology Infrastructure Library) framework [5].

Yuyun Tri Wiranti addresses service quality enhancement for XYZ College academics through ITIL-based Service Level Management (SLM). It focuses on the ICT department's help desk services, involving service users (academics) and providers (ICT). The research aims to create three crucial SLM records: Service Level Requirements (SLR), Service Level Agreement (SLA), and Operational Level Agreement (OLA). These records outline expectations, responsibilities, and service levels, ensuring a comprehensive improvement approach[6].

Tining Haryanti et, based on what have been described, it sounds as if the research study focuses on measuring the

effectiveness and success of implementing a Benefit Plan at Unipart using an IT Balanced Scorecard (ITBSC). The ITBSC is a strategic management tool that helps organizations align their IT strategy with their overall business strategy and provides a framework for monitoring and measuring the performance of IT investments and initiatives colleges [7].

This research examines the suitability of objective measurement for ITBSC perspectives in e-commerce colleges, focusing on Unipart training evaluations based on ITIL v.3 service design assessments. The study found that the average value of these measurements was 2.69, indicating a repeatable level of development. Various aspects of the benefit plan space were assessed, with scores averaging 2.64 to 2.93, indicating an overall satisfactory level of effectiveness in e-commerce colleges at the University of X [7].

Wang Zhen's study explores the impact of green innovation, integrated smart systems, information technology audit management, and work behavior development on organizational commerce services and performance. Findings suggest that green innovation positively affects both service advancement and trade performance. Integrated smart systems also have a positive impact on service enhancement and trade transformation. Information technology audit management positively influences service transformation and trade performance. Work behavior development contributes to benefit enhancement and trade performance improvement. This study underscores the significance of these factors in enhancing organizational commerce services and performance [9].

Abílio Cardoso's research focuses on how processes can enhance individuals' information accessibility skills, particularly in the context of migrating to cloud computing. The study assesses the impact of this migration on individuals' knowledge and skills within the organization, pinpointing potential training and development opportunities. A case study involving real-world cloud migration is conducted, with interviews gathering stakeholder experiences and perceptions. Overall, the study aims to shed light on the use of the DIFL framework in cloud migration and its impact on individuals' skills and knowledge within the organization [10].

Agus Hermanto's study focuses on the outcome of service quality planning developed with ITIL. This outcome serves as a reference to enhance the role of information technology and systems in supporting organizational business processes at Polytechnic XYZ. The study involves the creation of documentation policy and an IT Service Management guide (ITSM) based on the service quality planning results. In the final stages, critical success factors are identified to ensure continuous IT service improvement, along with a plan for monitoring, evaluation, and key performance indicators (KPIs). Training and development opportunities for IT staff are also addressed to enhance their skills and knowledge in managing IT services and supporting business processes. The study

ultimately aims to guide the use of ITIL service quality planning for improving IT's role in supporting organizational processes and ensuring ongoing service improvement [11].

Wadie Berrahal et, appears to propose a model for effective implementation of an Information Technology Service Management (ITSM) system, with a focus on best practices for delivering and managing IT services, such as the Information Technology Infrastructure Library (ITIL). The study aims to bridge the gap between the research community and the practical world by reflecting on the implementation of IT Service Management standards.

The proposed model involves identifying the key components of IT Service Management and developing a framework for implementing best practices in IT service delivery and management. The study also involves reviewing existing IT Service Management standards and guidelines, such as ITIL and assessing their applicability to the organization.

The ultimate goal of the study is to improve the efficiency and effectiveness of IT service delivery and management by implementing best practices and standards for IT Service Management. This involves developing processes for incident management, problem management, change management, and other aspects of IT service delivery and management, and identifying metrics for monitoring and evaluating the effectiveness of these processes.

Overall, the study aims to propose a model for effective implementation of IT Service Management based on best practices and standards, and to reflect on the implementation of these standards in the practical world [12].

Mary Afi Mensahi's study delves into internal quality assurance practices within higher education, focusing on a university in Ghana. This descriptive survey assesses the adequacy and effectiveness of internal quality assurance (IQA) structures and practices at the university. It examines the university's establishment of internal institutional quality assurance arrangements, guidelines, and strategies to uphold educational quality. The study encompasses faculty members, senior students, and the Department of Academic Planning and Quality Assurance.

Quality assurance in higher education involves implementing mechanisms and procedures that demonstrate an institution's commitment to the right policies, supporting institutional effectiveness, and continually enhancing educational quality. The study concentrates on the university's internal quality assurance procedures aimed at improving the quality of teaching and learning. While the university's quality assurance efforts are in their early stages, they are already contributing to the enhancement of teaching and learning. The systems, mechanisms, and practices in place are deemed effective in ensuring quality and fostering a culture of quality [13].

Anas Ratib Alsoud's paper emphasizes the importance of quality assurance and accreditation for universities in a competitive global market, particularly in Jordan and Malaysia. The study identifies a strong relationship between quality and accreditation in universities in these regions. It investigates the impact of various institutional and educational activities on achieving quality assurance accreditation and suggests that effective infrastructure, learning tools, and faculty, as well as student support, contribute to this achievement. Effective organizational structure and administration are also highlighted as facilitators of quality assurance [14].

R. P. A. D. Thakshila's study focuses on the vital role nonacademic staff play in university operations and their awareness of quality assurance in Sri Lankan higher education, particularly at the University of Ruhuna's Faculty of Agriculture. The research collected data from 35 nonacademic staff, mostly male, with over 20 years of experience, revealing that 45% had moderate awareness of quality assurance, 34% had slight awareness, and none had adequate awareness. The study recommends workshops and training programs to enhance their quality assurance awareness. Improving nonacademic staff's awareness is crucial for university efficiency and overall educational quality [15].

O.Liuta and their colleagues conducted a study to gauge students' interest in internal quality assurance, particularly concerning course evaluations, teaching quality, and educators' pedagogical skills. They employed a questionnaire featuring both closed-end questions on teaching quality and open-end questions for student input. The study revealed an uptick in the number of students evaluating teachers and a positive trend in teachers exhibiting teaching excellence. More teachers received an "above-average" quality rating in the 2019-2020 academic year compared to the previous year. The research's uniqueness lies in surveying student opinions about teaching quality, allowing for student satisfaction monitoring and institutional oversight of mission fulfillment. It also indicates a growing student interest in participating in higher education's internal quality assurance endeavors. The study holds practical significance in shaping managerial decisions to enhance educational component content, elevate the competencies of teaching and research staff, and advance pedagogical best practices [16].

III. METHODOLOGY

The experimental method was used for the samples in the research, which included two groups:

- ✓ Subject to itil rating system
- ✓ Subject to quality

3.1 The methodology consists of three main steps:

- ✓ Data collection
- ✓ Data pre-processing
- ✓ Data analysis

3.1.1 Data collection

Data is collected from more than one educational institution through a survey. The sample includes seven educational institutes, 4 institutes of administrative sciences and 3 institutes of engineering.

The commercial institutes includes the following majors (computer science - information systems - business administration - accounting).

The engineering institutes included the following disciplines (civil engineering - architecture - electronics engineering).

3.1.2 Data pre-processing

The data is extracted from the opinion survey and classified according to each section to carry out the statistical treatment process.

3.1.3 Data analysis

The paired t-test is a statistical test used to determine whether there is a significant difference between the means of two related groups. Related groups can be pairs of measurements on the same subjects or identical pairs of subjects.

The paired t-test is parametric, which means that it assumes that the data are normally distributed and that the differences between the two groups are equal. It is also a one-sample test, which means that the null hypothesis or the mean difference between the two groups is zero. The alternative hypothesis or the mean difference is not zero. Accordingly, the differences between quality standards and ITIL standards are inferred, and the paired t-test is used to determine whether there is a significant difference between the means of two related groups.

IV. EXPERIMENTAL RESULTS

4.1 Data set and descriptive statistics:

I. Table 1: Statistical Analysis Commercial institutes sector

Statistical Analysis Commercial institutes sector								
Division	Dep. Information Systems		Dep. Computer Science		Dep. Management		Dep. Accounting	
standard	ITIL	QUALITY	ITIL	QUALITY	ITIL	QUALITY	ITIL	QUALITY
Average	124.75	113	130.25	120	125.25	129.5	127.75	132.75
Standard deviation	10.44	10.68	11.81	7.62	2.87	3.32	1.89	2.36
1 st quartile	116.5	104.75	121.5	114.5	122.25	126.75	125.75	131
Median	122	110	126.5	117.5	126.5	129	128.5	132
3 rd quartile	135.75	124.25	142.75	128	127	132.75	129	135.25
Minimum	116	104	121	114	121	126	125	131
Maximum	139	128	147	131	127	134	129	136
Range	23	24	26	17	6	8	4	5
Skewness	1.13	1.33	1.43	1.59	-1.85	0.88	-1.66	1.19
Kurtosis	0.32	1.5	1.69	2.55	3.41	1.93	2.62	0.44

4.2 Graphical representation of data set

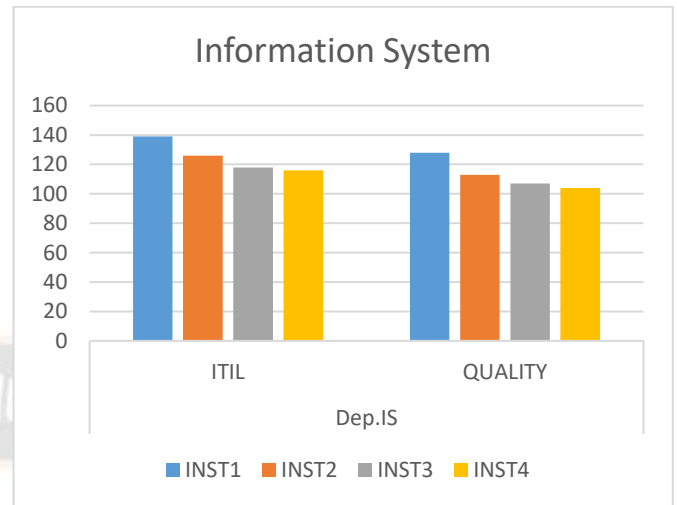


Figure. 4: The difference between ITIL and QUALITY for IS department

4.2.1 FOR INFORMATION SYSTEMS department:

There is a statistical significance difference between ITIL and QUALITY for IS department where P-value of the paired samples test is less than 0.001 and the difference is positive which means that the ITIL is greater than QULITY.

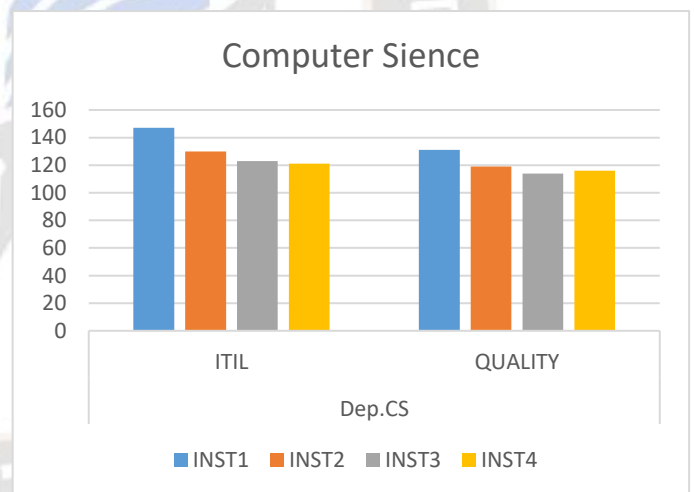


Figure. 5: The difference between ITIL and QUALITY for CS department

4.2.2 For COMPUTER SCIENCE department:

There is a statistical significance difference between ITIL and QUALITY for CS department where P-value of the paired samples test is equal to 0.021 and the difference is positive which means that the ITIL is greater than QULITY.

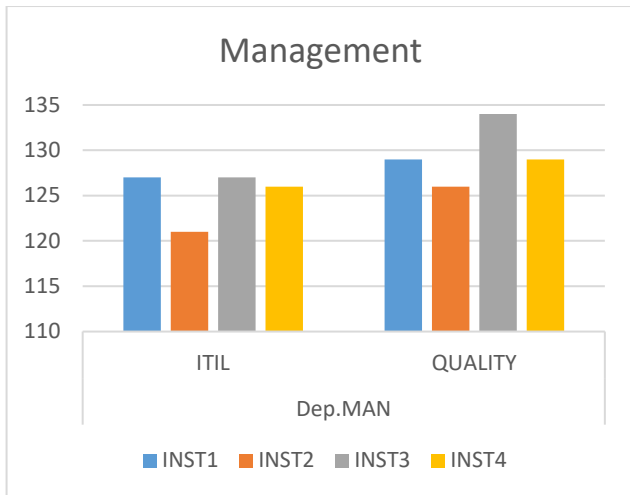


Figure. 6: The difference between ITIL and QUALITY for management department

4.2.3 For Management department:

There is a statistical significance difference between ITIL and QUALITY for management department where P-value of the paired samples test is equal to 0.031 and the difference is negative which means that the QULITY is greater than ITIL.

Table 2: Statistical Analysis Engineering institutes sector

Statistical Analysis Engineering institutes sector						
Division	Architectural Engineering		Electrical and electronics engineering		civil engineering	
standard	ITIL	QUALITY	ITIL	QUALITY	ITIL	QUALITY
Average	67	60	71	58.67	68	61.33
Standard deviation	1	5.29	2	6.03	4.58	5.13
1 st quartile	66	54	69	53	63	57
Median	67	62	71	58	69	60
3 rd quartile	---	---	---	---	---	--
Minimum	66	54	69	53	63	57
Maximum	68	64	73	65	72	67
Range	2	10	4	12	9	10
Skewness	0	-1.46	0	0.49	-0.94	1.09
Kurtosis	---	---	---	---	---	--

4.3 Graphical representation of dataset

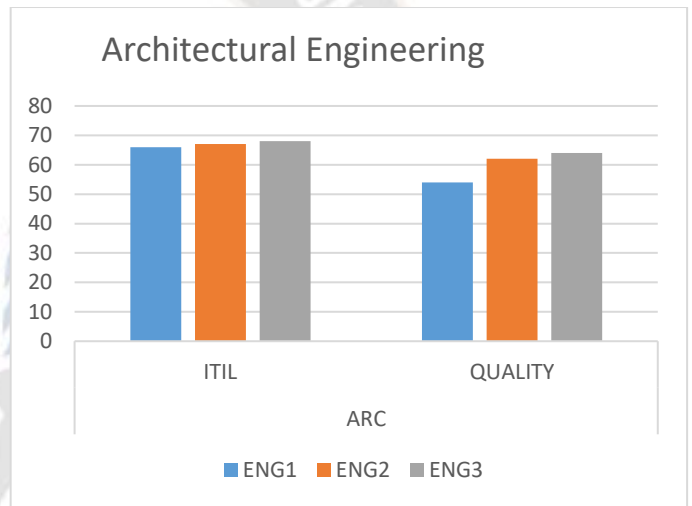


Figure. 8: The difference between ITIL and QUALITY for Architectural Engineering department

4.3.1 For Architectural Engineering:

There isn't a statistical significance difference between ITIL and QUALITY for Architectural Engineering department where P-value of the paired samples test is equal to 0.109.

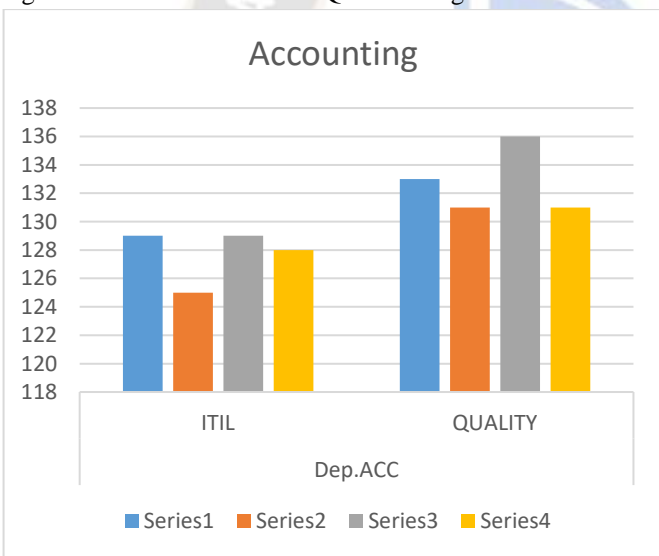


Figure. 7: The difference between ITIL and QUALITY for accounting department

4.2.4 For Accounting department:

There is a statistical significance difference between ITIL and QUALITY for accounting department where P-value of the paired samples test is equal to 0.012 and the difference is negative which means that the QULITY is greater than ITIL.

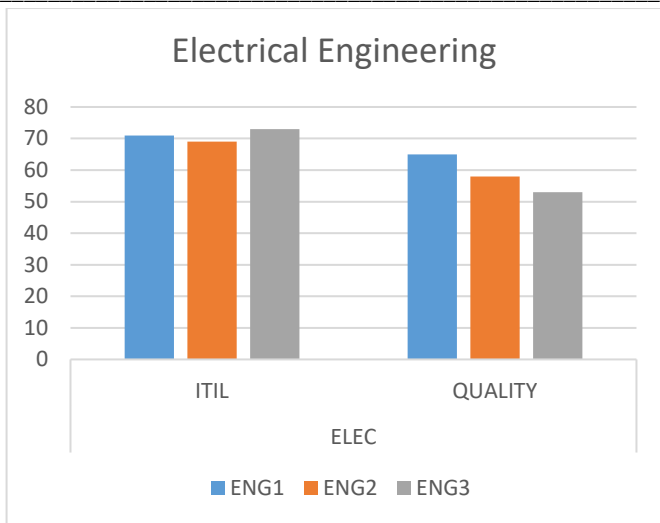


Figure. 9: The difference between ITIL and QUALITY for Electrical and electronics engineering department

4.3.2 For Electrical and electronics engineering:

There isn't a statistical significance difference between ITIL and QUALITY for Electrical and electronics engineering department where P-value of the paired samples test is equal to 0.95.

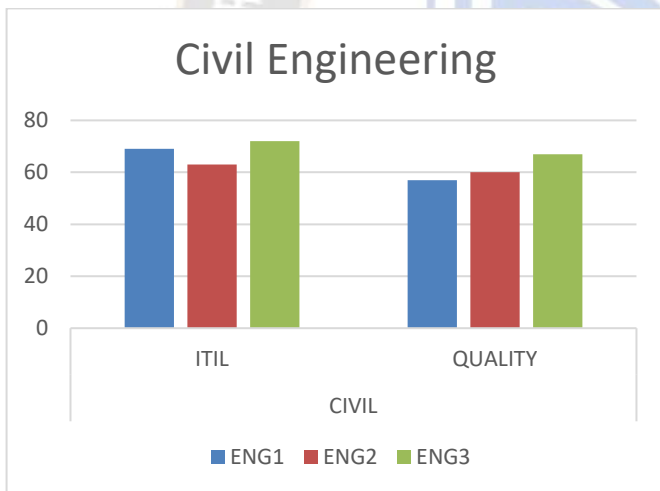


Figure. 9: The difference between ITIL and QUALITY for civil engineering department

4.3.3 For civil engineering:

There isn't a statistical significance difference between ITIL and QUALITY for civil engineering department where P-value of the paired samples test is equal to 0.135.

1. DISCUSSION

Using paired sample test to identify the significance relation between ITIL and QUALITY and to define the difference between them and to what criterion. The results shown in table (3) indicates that there is a statistically significant difference at the level (0.001) between the mean scores of the groups and the mean scores of the experimental

group in the post-measurement when applying the ITL system; In favor of the group, the academic departments related to computer science, information systems, electronics, and communications engineering compared to the traditional method, considered a good indicator, shows the importance of using the ITL model as one of the technological innovations that work to measure quality in Egyptian educational institutions.

Table 3: Paired Samples Test

Paired Samples Test							
ID	Difference	Mean	Std. Deviation	Std. Error	t	df	P-value
Dep. Information Systems	ITIL-QUALITY	11.75	0.957	0.479	24.545	3	0
Dep. Computer Science	ITIL-QUALITY	10.25	4.573	2.287	4.482	3	0.021
Dep. Management	ITIL-QUALITY	-4.25	2.217	1.109	-3.833	3	0.031
Dep. Accounting	ITIL-QUALITY	-5	1.826	0.913	-5.477	3	0.012
Architectural Engineering	ITIL-QUALITY	7	4.359	2.517	2.782	2	0.109
Electrical and electronics engineering	ITIL-QUALITY	12.333	7.095	4.096	3.011	2	0.095
civil engineering	ITIL-QUALITY	6.667	4.726	2.728	2.443	2	0.135

The integration of ITIL with quality assurance can help organizations improve the quality of their IT services and products. One way to integrate ITIL with QA is to use the ITIL framework as a basis for developing a quality management system . This involves defining processes, procedures, and policies based on the ITIL framework to ensure that the quality of IT services is consistently high. Another way to integrate ITIL with QA is to use ITIL as a guide for implementing quality management practices in IT service delivery. For example, ITIL provides guidance on incident management, problem management, change management, and other processes that are critical to the delivery of high-quality IT services.

2. CONCLUSION

ITIL (Information Technology Infrastructure Library) is a set of best practices for IT service management. It is widely used in organizations to improve the quality of their IT services and increase efficiency of their IT operations. The benefits of ITIL in education are as follows:

Standardization: ITIL provides a standardized approach to IT service management. This helps educational institutions to establish consistent and reliable IT services for their students, staff, and faculty.

Improved efficiency: Implementing ITIL practices helps educational institutions to streamline their IT processes, reduce downtime, and increase productivity. This allows institutions to focus on their core activities of teaching and research.

Cost savings: ITIL practices help educational institutions to reduce the costs associated with IT service delivery. By implementing best practices, institutions optimize their IT operations and reduce waste, leading to cost savings.

Better service quality: ITIL practices help educational institutions to deliver high-quality IT services that meet the needs of their users. This helps to enhance the reputation of the institution and improve student satisfaction.

Risk management: ITIL practices help educational institutions to identify and mitigate risks associated with IT service delivery. This helps to ensure the continuity of IT services and minimize the impact of any disruptions.

Collaboration: ITIL promotes collaboration and communication between different departments and stakeholders involved in IT service delivery. This helps to improve coordination and alignment of IT services with the overall goals of the institution.

Overall, ITIL helps educational institutions to improve their IT service delivery, reduce costs, and enhance students' experiences. By adopting ITIL best practices, institutions optimize their IT operations and focus on their core activities of teaching and research.

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