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Quality Control: An Effective Tool for Efficient Facility Operations and Maintenance Management in a Multi Campus Setting

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Abstract: The study was an examination of quality control, an effective tool for Efficient Facility Operations and Maintenance Management in a Multi Campus Setting. The specific objectives were to determine if quality inspection, quality testing, quality repairs and quality replacement have significant impact on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting. The study adopted a survey design which involved the administration of questionnaire instrument. Four research questions and hypotheses guided the study. The population of the study consisted of 114 staff of the university of Uyo while a sample size of 89 staff were selected through the taro- yame formular. Descriptive statistics was used to answer the research questions while the hypotheses was tested using the r2 value of regression analysis. The study showed that quality inspection, quality testing, quality repairs and quality replacement all have significant impact on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting. Recommendation proffered include the need for policy on quality control, quality monitoring, quality inspection, quality replacement and quality repairs.

Keywords: Quality Control, Facility Operations, Facility, and Maintenance Management.

1.0 Introduction

In a multicampus setting, managing facilities can be challenging for a variety of reasons, including staffing shortages and other infrastructure issues. This could result in many facilities deteriorating and becoming less functional to fulfill their intended functions and satisfy users. Thus, it is imperative that quality control be implemented in order to improve the effectiveness of facility operations and maintenance management.

The operational and strategic management of an organization's infrastructure and physical assets is known as facility management. It includes a broad range of tasks and operations meant to guarantee a building's or facility's effective and efficient operation. The purpose of facility management is to maximize resource utilization and minimize expenses while providing occupants with a secure, comfortable, and productive work environment. Software for facility management can make facility management easier**.** Don Sapp,(2021)

The term "facilities operations and maintenance" refers to a wide range of services, skills, procedures, and equipment needed to guarantee that the built environment will fulfill the purposes for which it was created. The daily tasks required for the building or constructed structure, its systems and equipment, and its occupants or users to carry out their intended functions are generally included in operations and maintenance. Since a facility cannot run as

efficiently as it can without maintenance, the terms operations and maintenance (O&M) are combined to refer to both. Hub of Knowledge, (2022)

The daily duties and activities necessary to properly operate a facility are referred to as operations in facility management. It includes a broad range of duties, such as: Equipment Maintenance, Equipment must undergo routine maintenance in order to function at peak efficiency and have a longer lifespan. The proactive and preventative component of facility management is maintenance. Preserving asset condition and averting unplanned malfunctions are its main goals. Important components of upkeep consist of: Frequent Exams: Regular evaluations to spot possible problems early on; proactive actions to stop equipment malfunctions and failures. It also includes predictive maintenance, which forecasts maintenance needs and takes care of them ahead of time by using data and technology. Quality control measures serve as a mechanism to achieve their intended purposes and ensure that products and services meet standard and specification, thereby ensuring efficient facility operations and management.

An organization uses quality control as a procedure to make sure that product quality is either maintained or raised. (2023) American Society for Quality. The company must foster a culture of perfection among management and staff in order to implement quality control. This is accomplished through staff training, the development of product quality standards, and product testing to look for statistically significant differences. Testing units to see if they meet the requirements for the finished product is part of quality control. Quality control develops safeguards that can be used to ensure that defective or damaged goods are not delivered to clients. (2023) American Society for Quality.Testing units to see if they meet the requirements for the finished product is part of quality control. Finding out whether the process needs any corrective action is the aim of the testing. Good quality control enables businesses to satisfy customer expectations for higher-quality goods. Ensuring quality control and assurance is crucial. Organizations must track, record, inspect, and re-inspect every item and step of the building process in order to provide proof that everything is finished to extremely high standards. Parts that meet tolerances and specifications are the main focus of quality control. Engines and other mechanical components run smoothly, efficiently, safely, and according to plan thanks to quality control. Stress testing and the use of electrical flow meters are two common methods used in electronics quality testing. Quality control makes sure that goods fulfill all safety and quality standards. In this study four quality control measures is examined to determine their impact in ensuring Efficient Facility Operations And Maintenance Management In A Multi Campus Setting. Theses include quality inspection, quality testing, quality repairs and quality replacement. It is based on the above that the paper focuses on Quality Control: An Effective Tool For Efficient Facility Operations And Maintenance Management In A Multi Campus Setting

2.0 Literature Review

2.1 Conceptual framework

2.1.1 Concept of quality control

The process used by businesses to make sure a good or service satisfies customer needs or conforms to a predetermined set of quality standards is known as quality control, or QC. Typically, this means that the company must foster an atmosphere in which management and staff constantly aim for excellence. This entails intensive training, setting standards to gauge the quality of the goods or services, and testing to look for any notable discrepancies in quality. Yes, in 2023. Although the terms "quality assurance" and "quality control" are sometimes used synonymously and involve some related tasks, they have distinct meanings. Providing assurance that the good or service satisfies the organization's quality standards is the main goal of quality assurance, or QA. and it covers every action the business has taken to offer this level of assurance. However, quality control specifically refers to the methods and procedures utilized to meet the quality requirements. It is the inspection-related part of quality management.

A company uses quality control (QC) as a process to make sure that the quality of its products is either maintained or increased. The organization must foster a culture of perfection among management and staff in order to implement quality control. This is accomplished through staff training, setting standards for product quality, and testing goods to look for statistically significant differences. The creation of precise controls is a crucial component of quality control. These measures aid in standardizing output as well as responses to problems with quality. Reducing margin for error by clearly defining which production tasks are assigned to which personnel lowers the possibility that workers will perform tasks for which they are ill-prepared. Quality control develops safeguards that can be used to ensure that defective or damaged goods are not delivered to clients. Testing units to see if they meet the requirements for the finished product is part of quality control. Finding out whether the manufacturing process needs any corrective action is the aim of the testing. Effective quality control enables businesses to satisfy customer expectations for higher-quality goods.

Quality Control Methods

To coordinate and monitor inspections and problems, quality control employs a number of different techniques. A quality control chart, for example, is a visual representation that shows the extent to which sampled products or processes deviate from the intended specifications and, if they do, how much is the degree of deviation. A single chart is referred to as a univariate chart when it examines a single product attribute. A multivariate chart is one that shows variations in multiple product attributes. Businesses can see what kinds of defects are occurring and how many defects they produce per production unit by tracking variances. Here are a few illustrations of various techniques.

Taguchi Method

Another quality control method that highlights the importance of product design, development, and research and development in lowering the frequency of flaws and failures in products is the Taguchi Method. In quality control, the Taguchi Method prioritizes design over manufacturing procedures and works to prevent production variances before they happen.

100% Inspection Method

Examining and evaluating each component of the product is part of the quality control procedure known as the 100% inspection method. The purpose of this kind of quality control is to eliminate product defects. Valuing precious metals is one common application for this method. Software for inventory analysis and manufacturing process data are required for the 100% inspection method.

2.1.2 Concept of facility Management operations and maintenance

The operational and strategic management of an organization's infrastructure and physical assets is known as facility management. It includes a broad range of tasks and operations meant to guarantee a building's or facility's effective and efficient operation. The purpose of facility management is to maximize resource utilization and minimize expenses while providing occupants with a secure, comfortable, and productive work environment. Software for facility management can make facility management easier. Don Sapp (2021)

The term "facilities operations and maintenance" refers to a wide range of services, skills, procedures, and equipment needed to guarantee that the built environment will fulfill the purposes for which it was created. The daily tasks required for the building or constructed structure, its systems and equipment, and its occupants or users to carry out their intended functions are generally included in operations and maintenance. Since a facility cannot run as efficiently as it can without maintenance, the terms operations and maintenance (O&M) are combined to refer to both. Hub of Knowledge, (2022)

Understanding Operations and Maintenance

Operations Management

The daily duties and activities necessary to properly manage a facility are referred to as operations. It includes many different types of duties, such as:

Firstly, Equipment Maintenance: Equipment must undergo routine maintenance in order to function at peak efficiency and have a longer lifespan.

Moreover, Planning and Scheduling: arranging work in a planned manner and developing schedules to ensure efficiency.

Additionally, Health and Safety Compliance: Ensuring occupant safety necessitates following safety protocols, holding drills, and keeping a secure workplace.

Similarly, compliance and regulations: ensuring compliance with legal and industry standards.

Furthermore, Maintenance and Repairs: maintaining, repairing, and inspecting machinery on a regular basis to guarantee peak performance.

Lastly, Inventory Management: Supply management and replenishment to effectively meet operational needs.

Maintenance Management

The proactive and preventive part of facility management is maintenance. Preserving asset condition and averting unplanned malfunctions are its main goals. Important components of upkeep consist of:

Firstly, Regular Inspections: Performing routine evaluations to spot possible problems early.

Additionally, Preventive Maintenance: proactively preventing malfunctions and failures of the equipment.

Moreover, Predictive Maintenance: making use of technology and data to predict maintenance requirements and take care of them beforehand.

Furthermore, Scheduled Servicing: Putting in place a methodical plan for routine asset maintenance and servicing.

In addition, Equipment Calibration: making certain that apparatus is accurately calibrated in order to preserve precision and effectiveness.

In addition, spare parts management involves keeping an inventory of necessary spare parts in order to reduce downtime.

In addition, condition monitoring involves keeping an eye on an asset's performance over time to spot any deviations from standard operation.

In a similar vein, asset lifecycle management involves overseeing assets from acquisition to disposal.

Similarly, vendor management involves working together with suppliers and vendors to provide prompt maintenance support.

Last but not least, keeping thorough records of all maintenance operations for analysis and future reference.

Maximizing the overall performance of the facility, minimizing operational disruptions, and guaranteeing the longevity and dependability of assets all depend on effective maintenance management.

The Significance of Facility Maintenance Management

There are many advantages to a well-executed facility management strategy that includes both operations and maintenance, with a primary focus on maintenance. These advantages include:

First, higher effectiveness Resources are used more efficiently when processes are streamlined and maintenance is given more attention.

Furthermore, cost reductions Proactive maintenance prolongs the life of assets and lowers the need for expensive emergency repairs.

Additionally, improved safety Occupants are kept in a safer environment through adherence to safety protocols through regular inspections and maintenance focus.

Additionally, enhanced occupant experience Proper maintenance ensures that a well-maintained facility offers its occupants a pleasant and comfortable space.

Furthermore, increased productivity Productivity is boosted by maintenance-focused, optimal operations that cause few interruptions.

In addition, less downtime Good maintenance procedures cut down on unplanned malfunctions and downtime for the facility.

Moreover, regulatory compliance is guaranteed by the facility's emphasis on upkeep and adherence to industry standards.

Likewise, environmentally friendly methods Environmental sustainability is promoted by maintenance-focused, energy-efficient operations.

Similarly, improved asset administration Making better decisions is facilitated by keeping track of assets and their state of maintenance.

Finally, a favorable brand perception: Consistent maintenance results in a well-maintained facility, which enhances the organization's reputation by reflecting positively.

Any organization can benefit greatly from a comprehensive facility management strategy that prioritizes maintenance over operations by reaping numerous benefits that support the organization's expansion and success.

For businesses of all sizes, efficient facility management is essential because it maximizes operational effectiveness, lowers expenses, raises occupant satisfaction, and upholds regulatory compliance. In order to provide residents and guests with a clean, safe, and functional environment, facility management is essential. This is accomplished through:

Upkeep and Fixtures: Preventive maintenance, fixing repairs, and routine upkeep keep facilities in top shape. This covers the upkeep of plumbing, electrical, mechanical, and other systems. Space Planning and Allocation: By taking into account aspects like worker comfort, safety, and workflow, interior spaces are designed and arranged to be used to their fullest potential.

Implementing security and safety measures, such as access control, surveillance systems, emergency response plans, and adherence to safety regulations, is necessary to guarantee the safety of the building and its occupants.

Energy management is the process of keeping an eye on and regulating energy use in order to lower expenses and lessen the impact on the environment. Optimizing lighting, heating, cooling, and other energy-related systems falls under this category.

Environmental Sustainability: A smart facility management strategy must include the implementation of sustainable practices, such as waste management, recycling programs, and energy-efficient technologies, to lessen the facility's carbon footprint.

Vendor and Supplier Management: This includes managing contracts and relationships with outside vendors, service providers, and suppliers who help with facility upkeep and operations.

Financial and Budgetary Management: Organizing and overseeing spending plans for facility-related costs, such as upkeep, repairs, and enhancements, makes administration easier. Real estate management: Leases, purchases, sales, and negotiations for real estate can all be handled with the aid of facility management software.

To ensure the safety of occupants, emergency preparedness entails creating and executing plans for a variety of emergency scenarios, including fires, natural disasters, and other crises.

Technology Integration: Businesses can simplify facility management procedures by using technological solutions such as building automation systems (BAS), computerized maintenance management systems (CMMS), and other software.

Health and wellness: This involves planning spaces with elements like ergonomic furniture, natural lighting, and indoor air quality control in mind to enhance worker productivity and well-being.

2.1.4 Quality Control and Efficient Management Operations And Maintenance

Three levels can be used to summarize the effect of quality:

First: Performance of the Facility Enhance internal operations by focusing on raising productivity and profit while lowering losses and raising efficiency.

Prevent errors and lessen the likelihood of issues as much as you can.

Develop fresh approaches to take advantage of evolving labor market opportunities.

Accelerated growth is encouraged by enhancing reliability and bolstering reputation. Secondly, operational effectiveness simplifying internal processes and lowering the possibility of duplication and delay.

satisfying consumer demands while boosting productivity and efficiency.

Boost earnings and reduce unnecessary expenses in markets where competition is fierce.

Third: Contentment with clients Make sure you offer something more than just a consistently improved product or service.

satisfy clients' needs and go above and beyond their expectations.

Strive to build long-lasting relationships and boost patronage.

All of this is beneficial to sustainability and long-term success both inside and outside the facility, especially in the labor market.

2.1.5 How Efficient Facility Operations and Maintenance Management Enhance Students Performance

In order to keep colleges and universities operating efficiently and productively and ready to face the numerous challenges that will inevitably come up, good facilities management is essential. A university's reputation, employee and student satisfaction levels, performance, and even enrollment can all be strongly impacted by how well it manages its facilities.

Facilities management in schools is concerned with maintaining things like lesson plans, building and grounds maintenance, and instructional resource availability.

The Department of Education has budgeted funds specifically for the upkeep of school facilities because they are necessary to support high-quality instruction and provide an outstanding learning environment. Still, there's more work to be done in terms of school facility management.

Nine out of ten schools had significant flaws in at least one building component among the 20,000 buildings that were inspected. Don Sapp,(2021). The following are negatively impacted by poorly maintained school buildings:

- Student learning outcomes;

- Teacher and staff workload;
- Student health and safety; and

Availability of classrooms, supplies, and educational resources.

On the other hand, better student achievement is directly correlated with well-maintained facilities. An uninterrupted school building results in longer instructional days, a 25% lower teacher turnover rate, and improved academic achievement for students.

2.2 Theoretical framework

Quality control theory Joseph Juran (1954)

Juran's theory of quality control became a foundational principle in Japan after his trip there in 1954 when the Union of Japanese Scientists and Engineers invited Juran to teach the theories and practices he'd been developing in America.

1. Three essential phases are included in Juran's theory of quality: quality planning, quality control, and quality improvement. These phases are now referred to as the Quality Trilogy or the Juran Trilogy. They are employed to define best practices for quality control as well as to explain the quality management process.

The main goal of quality planning, also known as Design for Six Sigma, is to implement quality by design. In particular, it encourages the design of a good, service, concept, idea, or piece of knowledge along with the procedures that will result in the finished version. Using this creative approach, features and procedures are designed with the needs of the consumer in mind. After the planning stage, quality control evaluates work and monitors progress. But in order to carry out quality control effectively, a company needs to specify what needs to be measured in order to assess the goal's accomplishment. Furthermore, in the event that a discrepancy exists between the real-time state of the process and its intended state, the company ought to devise a quality improvement approach to address the gap and bridge the divide. If quality improvement is implemented consistently, it can bring about long-lasting changes for the process. One can encourage quality improvement through mending, honinging, remodeling, and inventing.

The foundation of Juran's management philosophy is ongoing quality improvement. Although it can be a laborious process for companies, long-lasting improvements are made possible by the dedication to continuous quality planning, control, and improvement and fosters innovation.

2. To create an all-encompassing quality management system within an organization, one must first identify its clientele, find out about their requirements and concerns, and work to address them. To satisfy these demands, it is essential to create quality metrics and standardized measurements in addition to creating procedures that function well in practical settings. Making plans requires decision makers to have a thorough understanding of the customer's mindset in order to predict or anticipate problems. As a result, the process is more efficient. By identifying the needs and wants of the customer and developing a plan to meet those needs, businesses can satisfy Juran's first step of quality planning. What is needed by the company to develop that solution? The participation of important stakeholders is a distinguishing feature of this planning process; it is multidisciplinary, rather than siloed.

3. Without a sincere commitment to quality from top-level management, all efforts would be in vain and Juran's quality theory would not work as intended. This idea, which is demonstrated in Juran's approach to quality improvement, supports a top-down mindset and a company-wide commitment to quality. In order to help them stay committed to quality planning, control, and improvement, leaders can refer to Juran's 10 steps to quality. The first step is to let their team know that there is a chance and a need for them to make improvements. After gaining support from the rest of the team, management needs to set objectives, give instruction, track advancement, and share outcomes.

The foundation of Juran's management theory is the Pareto principle, an idea that dates back to the late 1800s and states that 20% of causes account for 80% of effects. Throughout his career, Juran applied the Pareto principle to develop a theory of management that considers the root cause of problems in a process as well as creative, effective solutions.

Implication of the theory

Owners of orgnaisations can use Juran's management theory to find areas where their companies can be improved and to learn how to create a process that adapts to the changing needs of stakeholders.

3.0 Methodology

3.1 Introduction

This chapter provides the methodology used for the study. It consist of the research design, area of study, population of the study, Sample and Sampling Techniques, Instrument for Data Collection, Validation of the Instrument, Reliability of the Instrument, Method Of Data Collection and Method of Data Analysis

3.2 Design of the Study

The study used a survey design, which entailed creating and distributing questionnaires to gather the study's data. Survey design is a type of research design in which surveys are the main means of gathering data, according to Jessica G. Mills (2021). In this study, surveys are employed as a tool to help researchers better understand individual or group perspectives on a specific idea or topic of interest. Typically, a survey consists of a series of structured questions, each of which is intended to elicit a particular piece of data. The Instruments applied in this survey seeks to elicit information on Quality Control: An Effective Tool for efficient Facility Operations and Maintenance Management in a Multi Campus Setting

3.3 Area of the Study

The study focused on examining Quality Control: An Effective Tool for efficient Facility Operations and Maintenance Management in a Multi Campus Setting. The University of Uyo hosted the study.

3.4 Population of the Study

The study population was made of 114 staff drawn from the works department of the University of Uyo in Akawa Ibom state as shown in Table 1

Table 1: Population Distribution

S/N	Name of Schools	No of Staff
1	University of Uyo	114
	Total	114

Source: Field Survey, 2023,

3.5 Sampling and Sampling techniques

A total of 89 staff were selected as sample size for the study using the Taro Yamane formular.

Sample Size Determination

This formular is given as follows

$$n = \frac{N}{1+N(e)^2}$$

Where

N= Population

n=Sample size

e=Margin of error(0.05)

Hence we have

$$n = \frac{114}{1+114(0.05)^2}$$

$$n = \frac{114}{1+114(0.0025)}$$

$$n = \frac{114}{1.285}$$

n= 89

Table 2: Sample Distribution
Source: Field Survey, 2024
Table 2: Sample size Distribution

S/N	Name of Schools	No of Staff
1	University of Uyo	89
	Total	89

3.5 Instrument for Data Collection

Sections A, B, and C made up the instrument utilized for the investigation. The biographical information of the respondents was presented in Section A, while structured questionnaires with multiple-choice questions targeting information on Quality Control: An Effective Tool for efficient Facility Operations and Maintenance Management in a Multi Campus Setting were presented in Sections B and C.Respondents were asked to rate the questionnaire on a four-point scale by selecting one of the following options from the list.

1---------- Agree (A),

2----------Strongly Agree (SA),

3---------- Disagree (D),

4---------- Strongly Disagree (SD).

3.6 Validation of the Instrument

Researchers in the form of lecturers validated the instruments to ensure that the questions on the questionnaire were clear and valid.

3.7 Reliability of the Instrument

A test-retest reliability method was used to guarantee the instrument's dependability. Ten employees who were chosen from among those who had not previously participated in the study were given the test. The same test was given to the same staff members again after a two-week interval. By computing their variances, the scores acquired for the two administrations were statistically processed. The instrument's reliability was ascertained by calculating the ratio of the two variances. The internal consistency of the survey was assessed using a reliability coefficient ratio of 0.88.

3.8 Administration of the Instrument/Method Of Data Collection

The respondents were given the questionnaires by the researcher in person. The researcher benefits from this method because it lessens the chance of missing some of the instruments. The questionnaires were successfully administered and retrieved in 89 copies.

3.9 Method of Data Analysis

The descriptive statistics was used to answer the research questions while R^2 value Regression analysis was applied to test the hypotheses of the study at 0.05 level of significance

4.0 Result and Discussion

The result of the study showed that

1. There is significant impact of quality inspection on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting.
2. There is significant impact of quality testing on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting
3. There is significant impact of quality repairs on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting
4. There is significant impact of quality replacement on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting

The term "facilities operations and maintenance" refers to a wide range of services, skills, procedures, and equipment needed to guarantee that the built environment will fulfill the purposes for which it was created. The daily tasks required for the building or constructed structure, its systems and equipment, and its occupants or users to carry out their intended functions are generally included in operations and maintenance. An organization uses quality control (QC) as a process to make sure that the quality of its products is either maintained or increased. In order to implement quality control, an organization must foster a culture where management and staff are driven to achieve excellence. This is accomplished through staff training, setting standards for product quality, and testing goods to look for statistically significant differences. The creation of precise controls is a crucial component of quality control.

These measures aid in standardizing output as well as responses to problems with quality. Reducing margin for error by clearly defining which production tasks are assigned to which personnel lowers the possibility that workers will perform tasks for which they are ill-prepared. Quality control develops preventative measures that can be used to ensure that consumers are not exposed to defective or damaged products. Testing units to see if they meet the requirements for the finished product is part of quality control. Testing is done to see if any corrective action is necessary. Good quality control enables businesses to satisfy customer demands for higher-quality goods.

5.0 Conclusion

The study concludes that quality control is an effective tool for Efficient Facility Operations and Maintenance Management in a Multi Campus Setting. It specifically shows that

1. There is significant impact of quality inspection on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting.
2. There is significant impact of quality testing on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting
3. There is significant impact of quality repairs on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting
4. There is significant impact of quality replacement on Efficient Facility Operations and Maintenance Management in a Multi Campus Setting

6.0 Recommendation

Based on the findings , the following recommendations is proffered

1. Policy on Efficient Facility Operations and Maintenance Management should be properly articulated and implanted by the institution
2. There should be a quality monitoring and inspection of facilities to ensure deviations are detected early for appropriate repairs
3. Also quality testing should be conducted to ensure that facilities function according to specification.
4. The institution should have performance assessment of facilities to ensure that all parts are functioning according to specification otherwise quality replacement should be effected to maintain specified standards.

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