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# Comparative Analysis Of Six Sigma's Impact On Employee Performance In Higher Education Institutions: King Khalid University And Suez Canal University.

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## Abstract:

The primary objective of this study is to explore the feasibility of implementing Six Sigma standards to improve employee performance in higher education institutions, specifically focusing on King Khalid University and Suez Canal University. The study aims to assess the impact of Six Sigma standards on enhancing employee performance in both universities and propose recommendations to further enhance the role of Six Sigma in improving employee performance in the higher education sector.

To achieve these objectives, the study employs an analytical descriptive approach, which allows for a comprehensive understanding of the phenomenon under investigation, accurate description, and diagnosis of the study's objectives and statistical hypotheses. The primary data collection tool utilized in the study is a questionnaire. The study population comprises both male and female employees working at King Khalid University in the Kingdom of Saudi Arabia and Suez Canal University in the Arab Republic of Egypt. The specific faculties examined include the College of Arts and Sciences, the College of Applied Sciences, and the College of Nursing in Mahala at King Khalid University, as well as the College of Commerce, the College of Science, and the College of Engineering at Suez Canal University.

**Keywords:** Six Sigma, methodology, performance of workers, higher education institutions in the Kingdom of Saudi Arabia, King Khalid University.

## 1. Introduction

The administration of higher education in both Egypt and the Kingdom of Saudi Arabia faces a number of difficulties that limit its effectiveness. Perhaps the most important of these are centralization, the low percentage of qualified educational leaders, the deficiency in the use of modern administrative techniques, and the weakness of administrative research and development. This requires increased cooperation among all employees. In higher education institutions, higher education institutions require a supportive and innovative tool that helps improve the performance of employees so that they can face global competition and achieve competitive advantage. Six Sigma is one of the most important modern methods that guarantees the way to achieve it in an effective and less expensive manner, as well as a tool that helps in evaluating the performance of a process or product, achieving continuous improvement, and ensuring a high level of institutional performance of the colleges of King Khalid University, which involves planned and comprehensive activities, and strategies, plans and programs that are clear and specific in their objectives and priorities and which are carried out in accordance with its methods in a practical and humane manner aimed at achieving goals and meeting needs. It was necessary to move towards the (Six Sigma) approach, as Six Sigma is an entry point for continuous improvement and a scientific methodology. For change management, it is based on the desire to reduce defects, and focus on building quality in work, with the aim of reaching acceptable levels within the concept of zero defects. (Al-Sharif, 2015: 3)

### 1.1. The Study Problem:

Global changes pushed higher education institutions to shift in their vision and mission, because after they were responsible for graduating the workforce, they became the destination towards creativity and change, so their mission came to review the direct and indirect educational product, discover episodes of waste and its types, and develop education through evaluating the educational system, This necessitated moving towards quality in work and evaluating the performance of employees, the most important of which is Six Sigma. Accordingly, the problem of the study is determined in answering the following main question:

What is the role of applying the Six Sigma approach (top management support and commitment - continuous improvement) in improving the performance of employees in the universities under study? A group of the following questions branch out from it:

What is the role of senior management support and commitment in improving employee performance at the universities under study?

What is the role of continuous improvement in improving the performance of employees at the universities under study?

Are there statistical differences in the respondents' responses regarding the application of the Six Sigma approach in the universities under study according to demographic variables (academic qualification, years of experience, job grade)?

### 1.2. Study Objectives:

- To demonstrate the role of implementing the Six Sigma methodology, with its dimensions of support and commitment of top management, and continuous improvement, in improving the performance of employees in higher education institutions.
- To determine the impact of implementing the Six Sigma methodology on improving the performance of employees in higher education institutions.

### 1.3. The Study Significance

- The importance of the study appears in the lack of research and studies that dealt with the Six Sigma approach. Therefore, the researcher believes that this study will contribute to enriching the Arab library with more studies on the Six Sigma approach. This is due to the indicators and information the study provides that serve as a starting point for new studies.
- The practical significance of this study lies in the potential for obtaining results and recommendations that can contribute to enhancing performance in educational institutions. The administrators of King Khalid University and Suez Canal University can benefit from these findings and recommendations by directing their attention towards the importance of implementing modern management methodologies such as Six Sigma.
- The results of the study may also be beneficial to the Ministry of Education and Higher Education, considering the challenges faced by the higher education sector, including the widespread use of technology and its applications, increased competitiveness, and the repetition of preparation programs in universities. The evaluation of the actual implementation of the Six Sigma methodology in educational institutions can provide valuable insights in addressing these challenges.
- The objective importance emerges from the sensitivity of Six Sigma as one of the modern administrative approaches that aims to continuously improve the various processes within educational institutions, and achieve the satisfaction of its internal and external customers by focusing on their various needs, arranging the development priorities to be achieved, and improving the level of performance of its employees, which is What has been proven by many studies on different colleges and universities in many countries, such as the study (Assaf, 2018).

### 1.4. Study Limitations:

The current study is defined by the following limitations:

- A- Objective Limitations: The focus is on exploring the role of applying Six Sigma methodology in its various dimensions (support and commitment of top management, feedback, continuous improvement, applied processes and activities within the institution, human resources skills and experiences) in improving the performance of employees at King Khalid University in Saudi Arabia.
- B- Human Limitations: The study includes employees in the Mahalla complex (College of Science and Arts, College of Health Sciences, College of Applied Sciences) at King Khalid University, as well as the faculties of Commerce, Science, and Engineering at Suez Canal University.
- C- Spatial Limitations: The study is conducted at King Khalid University in Saudi Arabia and Suez Canal University in the Arab Republic of Egypt.
- D- Temporal Limitations: The study was conducted from November 1, 2023, to January 30, 2024.

### 1.5. Hypotheses:

achieve the objectives of the study, hypotheses were developed based on both the theoretical literature and the exploratory study, and the study model is as follows:

**The first main hypothesis:** (There is a statistically significant effect of applying the Six Sigma approach on job performance in Saudi educational institutions). A group of sub-hypotheses branch out from it:

- There is a statistically significant effect of implementing senior management support and commitment on job performance in higher education institutions
- There is a statistically significant impact of applying continuous improvement on job performance in higher education institutions
- There is a statistically significant effect of applying the applied processes and activities on job performance in higher education institutions
- There is a statistically significant effect of applying human resources skills and experiences on job performance in higher education institutions

**The second main hypothesis:** There is a statistically significant relationship at a significant level ( $\alpha=0.05$ ) in the respondents' responses regarding the Six Sigma approach due to demographic variables (academic qualification, years of experience, job grade) for employees at King Khalid University and Suez Canal University.

**The third main hypothesis:** There is a statistically significant relationship at a significant level ( $\alpha=0.05$ ) in the respondents' responses about job performance, which is due to demographic variables (academic qualification, years of experience, job grade) for employees at King Khalid University and Suez Canal University.

#### 1.6. Previous studies:

- Study (Abdul Sattar, 2024) aimed to measure the quality of library services by applying the Six Sigma methodology as one of the methods of total quality management, relying on the descriptive and analytical approach. It also aimed to determine the relationship between Six Sigma and total quality management through comparison between them. One of the most prominent results of the study is the comparison between the Deming wheel and the Demiac methodology. As well as reviewing applied models for applying Six Sigma in some libraries as a project to improve the existing situation, which resulted in solving their problems in a scientific way and improving existing services, and it reached the need to establish scientific foundations and standards for selecting participants in implementing the Six Sigma project in the library, based on specialization, skill, competence and experience. The study recommended the necessity of introducing A special department for monitoring quality in libraries (Quality Assurance Unit).
- Study (Reda, Howaida, 2023) The study aimed to identify the possibility of applying Six Sigma standards to improve the job performance of faculty members in higher education institutions at King Khalid University - Kingdom of Saudi Arabia. The study concluded that there is an important role and positive impact of the Six Sigma approach on improving The performance of employees in the researched colleges (Business and Applied Colleges in Mahalla) at King Khalid University, and it was determined which of the Six Sigma standards has the most impact on improving the performance of faculty members in the educational institutions of interest. The results showed that there were no statistically significant differences in the respondents' responses regarding both the Six Sigma approach and employee performance due to some demographic variables. The study also reached a set of recommendations, the most important of which is to improve the performance of employees in higher education institutions, the Six Sigma approach must be widely applied.
- Study (Heliyon, 2023), The study aimed to rely on the Six Sigma methodology by industry as a business management tool to improve operational capabilities and reduce defects in any process. This study aims to provide a case study on implementing the Six-Sigma DMAIC methodology for the purpose of reducing the rejection rate of rubber weather strips manufactured by As Sigma helped improve the level from 3.9 to 4.45 within three months, the company was very interested in reducing the high rejection rate of rubber weather strips and decided to deploy Six Sigma DMAIC as a quality improvement tool. This goal was achieved by applying the Six-Sigma DMAIC methodology.
- Study (Yanamandra & Alzoubi, 2022) The study aimed to develop a philosophical framework for the concept of Six Sigma, and how to employ it in measuring the quality of higher education as a relatively modern methodology for reducing error rates, specifically in this field targeting defects that have a negative impact on the quality of educational outcomes. The study presented the most important criteria for measuring the level of statistics on which the Six Sigma methodology was built.
- Study (Al-Otaibi and Al-Mutairi, et al., 2022), the study aimed to identify performance evaluation and its impact on the quality of health services in the Saudi health sector, the extent of the impact of performance evaluation on the quality of services in the Saudi government health sector, and the relationship between performance evaluation and the quality of health services. The study was based on the descriptive approach, and the study population consisted of all workers in government hospitals in the city of Riyadh, and they were selected using a random sampling method. The study reached a number of results, the most important of which is the existence of a direct (positive) relationship with statistical significance between the quality of pharmaceutical care service, performance evaluation, and the quality of health services. In the Saudi health sector.
- Study (Nassif, 2020), the study aimed to identify the role of using the Sigma Six model as a tool to improve performance in Saudi business organizations. Where the study focused on the role of using the Sigma Six model in improving performance by reducing errors, reducing costs, increasing customer satisfaction, and improving the quality of operations, the study population consists of all 180 employees in the senior and middle management categories. Where the number of questionnaires distributed reached 200 questionnaires and the percentage of questionnaires recovered was 90%. The study resulted in several results, the most important of which are: a strong relationship between the use of the Sigma Six model and improving the performance of business organizations in the Kingdom of Saudi Arabia by reducing errors, increasing customer satisfaction, reducing costs and improving the quality of operations in business organizations. A study recommended the need to adopt an information system linking Sigma Six operations with the dimensions of performance improvement so that they make optimal use of available information resources by the best means.
- Study (Juha, 2018). The study aimed to provide a conceptual framework that can be used to evaluate the quality of institutional performance of higher education. The study relied on the descriptive and analytical approach, and the sample of the study represented members of administration in higher education institutions. The results of the study led to the availability of quality concepts and strategic maps. It can be used to describe the system of both quality assurance and institutional performance to a high degree, and the quality of performance of higher education institutions can be evaluated by national agencies to ensure the quality of operations, and a group of stakeholders who have different goals and interests, so that the evaluation is based on subjective experiences to evaluate institutional performance.
- Study( Rashawn, 2017) The aim of the study is to identify the extent of commitment of industrial companies operating in the pharmaceutical sector to applying the determinants of the Six Sigma methodology, which are: supporting senior management, processes and systems, performance measurement, continuous improvement, training, incentive systems, and customer focus, and their impact on operational performance in companies in Strategic control systems remained as

an intermediary variable. To achieve this goal, eight hypotheses were developed, and reliance was placed on a survey list developed by the researcher to collect primary data that serves the purpose of the study. Through the Cronbach Alpha scale, the stability of the measures of the study variables was confirmed, and by using the multiple regression analysis method, the mediating or interactive regression analysis method, to test Study assignments, The study found that there is a positive effect of the determinants of applying the Six Sigma methodology on the operational performance in the companies under study, while there is an effect of the variable strategic control systems on the relationship between all the determinants of applying the Six Sigma methodology on evaluating the operational performance of employees.

- Study (Hassan's, 2015) aimed to use the (SIX SIGMA) approach to continuously improve electrical maintenance at the Sudanese Petroleum Pipeline Company at Atbara station. A questionnaire was designed that included (40) items to collect. The results of the study demonstrated a significant impact of the Six Sigma standards (commitment and support of senior leadership, feedback and measurement, continuous improvement, processes and systems, and human resources) on electrical maintenance at the Sudanese Petroleum Pipeline Company at the Atbara station. It also found that there is a statistically significant relationship between applying the Six Sigma methodology and preventing waste, reducing errors, and reducing the rework rate at a level of statistical significance, and the existence of a correlation between applying the Six Sigma methodology and increasing competitiveness and finding the best ways to carry out electrical maintenance work at a level of statistical significance. The study recommended paying attention to the concept of Six Sigma and emphasizing the possibility of using it in government service institutions because of its importance from a scientific standpoint, by reducing errors and improving the quality of services provided that are commensurate with the expectations of beneficiaries.
- The study examines a vital and contemporary aspect, which is the role of applying the Six Sigma approach in raising the level of employee performance, which would lead to the development of higher education institutions.
- B. The study examines the role of applying the Six Sigma approach in developing one of the most important vital institutions, namely King Khalid University and Suez Canal University.

#### **Scientific terminology and procedural concepts of the study:**

**Six Sigma:** The Six Sigma methodology refers to the method that enables organizations to continuously improve their basic processes and structure through the design and control of daily operations, so that waste and defects are reduced, and through the optimal exploitation of available resources, represented by time - human energies - material energies. (Sutton,2006,46-48)

Six Sigma is a data-driven methodology that aims to improve processes, reduce defects, and increase efficiency. By applying Six Sigma principles and tools, organizations can identify and eliminate variations and inefficiencies in their operations, ultimately leading to improved performance.

(Al-Meligy, 2011: 272) defines it as an organizational strategy to improve both the administrative and organizational processes of the institution, and it is used in order to improve the reputation of the institution, with the aim of eliminating defective outputs, and reducing failure rates in quality.

Researcher defines it procedurally as: "an evaluation approach to the level of quality of performance at work, and overcoming defects based on detailed knowledge of the beneficiaries' requirements, and based on data and information, and the precise application of statistical tools and techniques, and the effective participation of all employees in the organization and achieving the best outputs and results with transparency and achieving job satisfaction." And continuous improvement, which is determined by the rating scores on the questionnaire designed for the current study.

**Job performance:** The term performance refers to doing work and making an effort in order to achieve a specific goal. It is a quantity obtained by a person or a group of people after making a specific effort and is judged to be efficient and effective. The development of human resources is considered one of the factors that help... Developing organizations. Evaluating employee performance is one of the most important development factors.

Improving performance procedurally from the point of view of researcher: It is the degree to which employees accomplish the tasks that make up the job within the university, and the process through which all the material and human resources present in the educational institution are optimally used, and through which the latest means and modern technologies are used to improve all the processes practiced within King Khalid University. And provide high quality outputs.

**University** is a term: one of the social, cultural, and scientific institutions. These are complex and constantly changing organizations with the nature of the local and scientific community, or the so-called external environment (Alyoush, 1999).

## **2. The conceptual theoretical framework**

### **2.1. Job performance**

The term performance refers to making an effort to achieve a specific goal, which is "a quantity obtained by a person or a group of people after making a specific effort, and it is judged as efficient and effective." Human resources development is considered one of the factors that help develop organizations and evaluate performance. Employees are one of the most important factors in development (Mohammad, 2021: 311)

Job performance refers to the degree of achieving and completing the tasks that make up an individual's job, and it reflects the way in which performance is achieved, or by which the individual satisfies his job requirements. (Mohammad: 209)



### 2.1.1. Performance determinants:

The behavior and performance of individuals are influenced by three main factors, as identified by Sultan (p. 213). These factors can have either a positive or negative impact on performance and are categorized into internal determinants and external determinants (Al-Mahassneh, 2013;: 71-72)

#### A) Internal determinants, which include:

Effort exerted: It reflects the individual's commitment to performing their work.

Individual abilities and characteristics: Refers to the individual's capabilities and previous experience, which help determine the effectiveness of the exerted effort.

Job perceptions: Represents the individual's perceptions and impressions of their work activities and how they carry out their role in the organization.

#### B) External determinants, which are elements that affect employee performance and are beyond their control, including:

Job requirements: Encompass all the duties, tasks, and expected outcomes that an employee is responsible for.

Organizational environment: Refers to the work environment and climate in which the job is performed, including administrative systems, authority structures, work methods, and rewards and punishments.

External environment: Both the external environment and economic challenges can influence performance, either positively or negatively, ultimately affecting employee performance.

### 2.1.2. Conditions for job performance standards

Due to the difficulty of the performance evaluation process, it requires those responsible for implementing it to prepare a sound plan based on the evaluation criteria. These criteria have several conditions, which are:

- 1- Reliability: The criterion for the stability of the scale, which includes two aspects: stability and agreement, as stability implies that the measurements of the standard are taken at different times resulting in the same results, and consistency involves that the measurements of the standard are taken by different individuals, resulting in similar results from one person to another.
- 2- Excellence: Excellence criteria apply to individuals based on their performance. The main goal of evaluating employees' performance is to recognize their efforts and the resulting benefits in terms of promotion, wages, salaries, and training programs.
- 3- Validity: Valid performance criteria are those that are free from bias. The criteria should be comprehensive, taking into account all environmental variables that affect performance.
- 4- Acceptance: Acceptance criteria refer to fairness and reflect the actual performance of individuals. The criteria can be renewed based on the behaviors practiced by individuals, whether negative or positive, or based on the achievement of results by individuals. (Suhila, 2003: 264)
- 5- Accuracy: The accuracy standard indicates the stability and honesty of the results. There may be a set of consistent and honest performance standards, but they may be inaccurate due to the evaluator's leniency.

### 2.1.3. Objectives of the performance evaluation process:

The results and data achieved from the performance measurement process are used to achieve several primary and secondary goals as show in Table (1). Three main objectives were determined including:

- Administrative objectives.
- Guidance and Counseling Objectives.
- Scientific Research Objectives.

**Table: (1)** Objectives of the employee job performance evaluation process

Objectives of scientific research	Objectives of guidance and counseling	Administrative objectives
<ul style="list-style-type: none"> <li>• Verifying the validity and safety of recruitment and selection processes.</li> <li>• Evaluating training programs.</li> <li>• Evaluating procedures and systems for incentives and job satisfaction, such as salaries, wages, services, and career advancement.</li> </ul>	<ul style="list-style-type: none"> <li>• Highlighting the strengths and weaknesses in employees' performance</li> <li>• Guiding employees to training or rehabilitation programs.</li> <li>• Using data collected on performance in order for the organization to reconsider existing incentive programs and methods for improving satisfaction and motivation to work.</li> <li>• Use of data for career planning and preparation purposes.</li> </ul>	<ul style="list-style-type: none"> <li>• Promotion and transfer decisions And reducing salaries.</li> <li>• Contract renewal decisions And finish it.</li> <li>• Bonus disbursement decisions Encouragement.</li> <li>• Employee recruitment decisions With training and development programmes.</li> <li>• Reconsider recruitment and selection procedures.</li> </ul>

Source: Adnan Wali, 2011: 12

The *administrative objectives* of using Six-Sigma in the context of human resources management can include:

Promotion and transfer decisions: it can be applied to ensure fair and effective decision-making processes related to employee promotions and transfers. By using data-driven analysis and performance metrics, organizations can make informed decisions that align with their strategic objectives and reward deserving employees.

Contract renewal decisions: Six Sigma can assist in evaluating and assessing employee performance during contract renewal processes. By utilizing objective performance metrics and data analysis, organizations can make well-informed decisions regarding contract extensions or modifications.

Disbursing incentive rewards: Six Sigma methodologies can be employed to define clear and measurable performance indicators, allowing organizations to fairly distribute incentive rewards based on objective criteria. This ensures that rewards are allocated to employees who have achieved exceptional performance and contributed to organizational success.

Guidance and Counseling Objectives.

In the context of *guidance and counseling*, Six Sigma can contribute to achieving the following objectives:

Highlighting strengths and weaknesses in employees' performance: By applying Six Sigma principles, organizations can systematically identify and analyze the strengths and weaknesses in employees' performance. Through data-driven analysis, organizations can gain insights into areas where employees excel and areas that require improvement. This information can guide the guidance and counseling process by focusing on enhancing strengths and addressing weaknesses.

Guiding employees to training programs: Six Sigma can help guide employees towards appropriate training programs based on their performance gaps and development needs. By utilizing data analysis and performance metrics, organizations can identify the specific skills or knowledge areas that require improvement. This information can be used to guide employees towards targeted training programs that address their specific needs, enabling them to enhance their performance and contribute effectively to the organization.

By incorporating Six Sigma principles into *scientific research*, organizations can enhance the rigor and objectivity of their evaluations, leading to evidence-based decision-making in areas such as recruitment, training, and incentives. This can result in improved processes, increased efficiency, and better alignment between organizational objectives and outcomes.

The researcher believes that the objectives of evaluating the performance of employees at King Khalid University are as follows:

Performance evaluation is considered an indicator of the development and growth of university administration.

- Increasing the efficiency and effectiveness of administrative decisions at all administrative levels at the university

- Developing the approved standards and foundations that help evaluate the performance of the university administration and developing them in a manner that is appropriate with time for the various colleges and departments at the university.

Performance evaluation is necessary for reform processes in general to ensure the quality of employees' performance and maintain job satisfaction, which is reflected in the university's reputation.

## 2.2. Sigma Six

### 2.2.1. The Origin of the Six Sigma Methodology

The Six Sigma methodology emerged after significant efforts in inspection, development, and continuous improvement in the field of quality sciences, leading to the concept of total quality. The Six Sigma methodology is not a momentary creation but has its roots extending over decades of continuous research and improvement.

### 2.2.2. The Concept of Six Sigma ( $\sigma$ )

The term "Sigma  $\sigma$ " is a Greek letter used in statistics to refer to standard deviation, which is a statistical method and indicator used to describe the dispersion, variation, or inconsistency within a set of data, elements, or processes. The number "Six" signifies Six Sigma, which is the name of the methodology in quality and excellence.

At the Six Sigma level, we aim for a level of precision that reaches 99.997%, meaning that we are approaching a level of near defect-free or error-free performance. This is illustrated in the following figure (Figure 1).

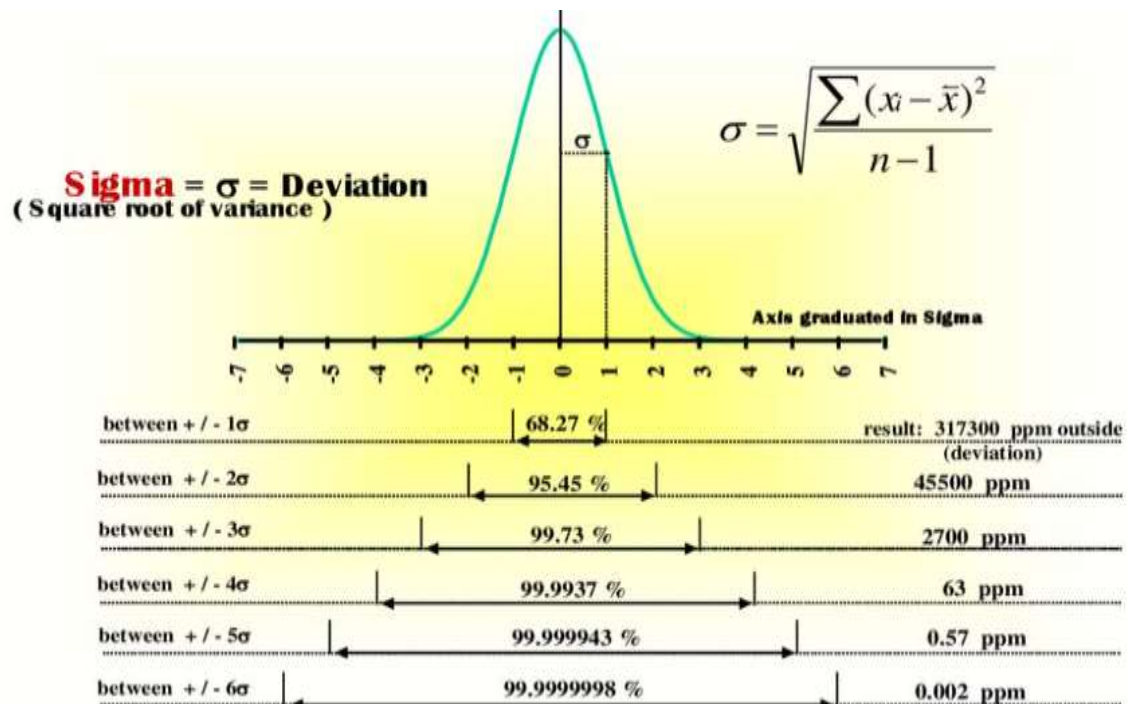


Figure 1: Deviation levels in Six Sigma (after, Al-Naimi et al., 2008).

Here are some of the key abbreviations used in Six Sigma:

- DMAIC: Define, Measure, Analyze, Improve, Control. This abbreviation represents the five phases of the Six Sigma methodology. These phases are the standard and fundamental steps for implementing Six Sigma, aiming to reduce defects and variations through proper understanding, measurement, analysis, improvement, and control.
- DMEDI: Define, Measure, Explore, Develop, Implement. DMEDI is an alternative abbreviation used in some variations of the Six Sigma methodology. It is primarily applied in design and innovation projects, focusing on developing new processes or products.
- DMADV: Define, Measure, Analyze, Design, Verify. DMADV is another abbreviation used in certain versions of Six Sigma, particularly in design and development projects. It emphasizes the importance of designing and verifying new processes or products to achieve desired performance levels.

These abbreviations have their own significance and are widely recognized in the Six Sigma community. They represent structured approaches to problem-solving and process improvement, contributing to the popularity and widespread adoption of the Six Sigma methodology [Source: Website].

### 2.2.3. The importance of Six Sigma methodology

the Six Sigma methodology provides a structured framework for identifying and solving problems, which can lead to significant improvements in efficiency, quality, and customer satisfaction. Organizations that successfully implement Six Sigma often see lasting benefits and a competitive advantage in their industry (Figure 2).

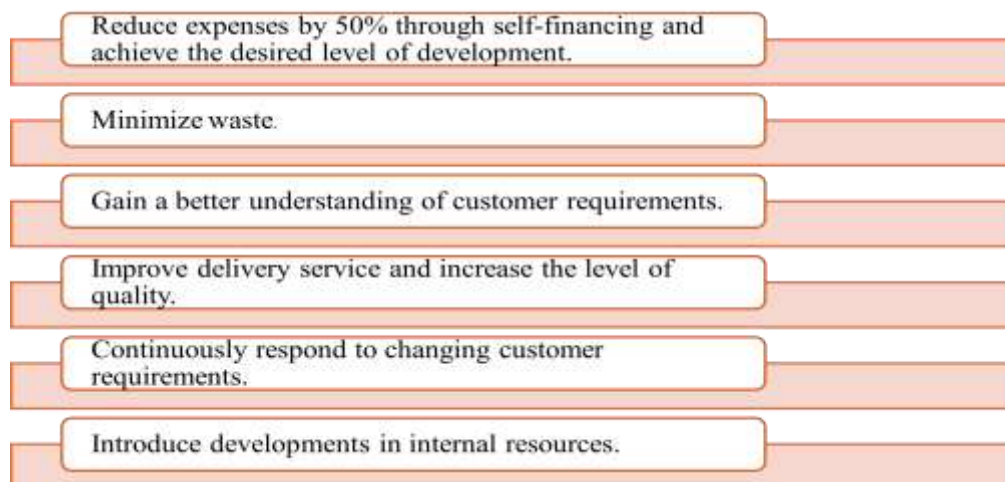


Figure 2: Benefits of utilizing six sigma in an organization (modified after Yassin & Nayf, 2012).

Applying the Six Sigma methodology in universities has many benefits, including: increasing effectiveness in addressing administrative problems, building work teams while enhancing self-learning, focusing on facts for decision-making, and on results as a measure of the extent of improvement (Cudney, et al., 2020)

#### 2.2.4. Principles of the Six Sigma Methodology

Six Sigma is built on several key principles that guide the methodology and its implementation in various industries. These principles help organizations improve processes, reduce variation, and achieve higher levels of quality and efficiency. The following is a brief discussion on the most common and applicable principles of Six Sigma methodology (Figure 3).



**Figure 3:** Cycle illustration shows the most applicable principles of six sigma methodology (source: The researcher).

- **Customer Focus:** Six Sigma prioritizes customer satisfaction by focusing on the needs and expectations of customers. This principle ensures that process improvements align with delivering value to the customer.
- **Data-Driven Decision Making:** Decisions in Six Sigma are based on data and statistical analysis rather than assumptions or guesswork. This approach helps organizations identify root causes and measure progress.
- **Process Improvement:** The methodology emphasizes the importance of analyzing and optimizing business processes. By streamlining and standardizing processes, organizations can reduce waste and improve quality.
- **Variation Reduction:** Six Sigma aims to minimize variability in processes, leading to more predictable and consistent outcomes. This principle helps organizations achieve higher levels of quality and efficiency.
- **Employee Involvement:** Six Sigma encourages employee involvement and empowerment. Workers are trained in Six Sigma tools and techniques, enabling them to contribute to process improvement initiatives.
- **Continuous Improvement:** The methodology promotes a culture of ongoing improvement. Organizations strive to consistently enhance processes and systems to achieve better outcomes over time.
- **DMAIC Framework:** Six Sigma follows a structured framework known as DMAIC (Define, Measure, Analyze, Improve, Control). This five-phase approach guides practitioners through the process improvement journey.

#### 2.2.5. Six Sigma standards

The word standards mean the legal regulations that must be adhered to and must be available in order to be able to determine its path, and the Six Sigma methodology in itself is a strategy with its own standards, as Al-Khudary 2017 defined them as follows:

- 1- Support senior management
- 2- Reverse feeding
- 3-Continuous improvement
- 4-Processes and systems
- 5- Human resources

#### 2.2.6. Stages of applying Six Sigma

The Six Sigma methodology is applied through the continuous improvement methodology known as (DMAIC), which is a set of steps aimed at reducing defects in the flow of existing processes. This methodology includes five stages, which are:

- 1- Define the problem
- 2- Measurement stage
- 3- Analyze stage
- 4- Improvement stage
- 5- Monitoring stage



Control is a summary of the beginning character of each stage of the application, and this form is referred to as DMAIC and the abbreviation (Figure 4).

Usually used in solving problems, it is considered the most widespread framework for applying the Six Sigma methodology and has many advantages, such as accurate measurement, focus on cost basis, risk management, and continuous improvement.

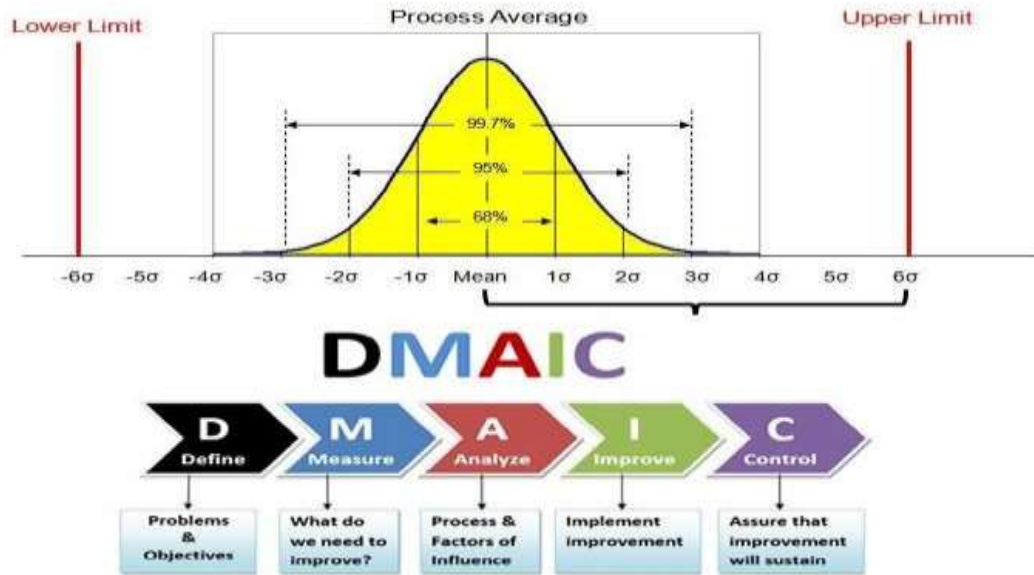


Figure 4: Diagram shows the meaning of DMAIC six sigma principle.

### 2.2.7. Six Sigma goals

Pointed out by: Thomas et al., (2017); Sony (2020); Gadd (2015) noted that Six Sigma seeks to achieve the following goals:

- Continuous improvement in the quality of educational processes and services, and in all quality elements of the institution.
- Changing and transforming the organizational culture from the mode of combating errors to the mode of preventing errors and performing the correct work.
- Six Sigma aims to provide quality products that meet customer expectations at the lowest cost and with the fewest defects.
- Follow a strategy to improve employees' ability and raise their skills to solve problems in the educational institution.
- Using data to make decisions, as the Six Sigma culture uses data as an important force for business, Which led to the emergence of what is called management by facts.

## 3. Methodology

The study analytically used a descriptive method considering the quantitative research design and collected secondary data from past research and study results.

### 3.1. Measurement Instrument & Data Collection

The study adopted a designed online questionnaire administered and developed to minimize missing responses in an online survey, as a convenient and feasible technique for collecting and managing data in the context of a targeted sample. Based on the various previous studies and literature related to the study issues, the study developed the questionnaire items constructs of a five-point Likert scale, which meanders from 1 (*totally disagree*) to 5 (*totally agree*). The personal data of the questionnaire were five items, including gender, job, and experience years. In addition, in this study, 5 items for each pivotal variable were top management support and commitment, Six Sigma, continuous improvement, and employees' performance.

### 3.2. Application and Field Framework:

The researcher reviewed the questionnaire to ensure its completeness and validity for data entry and statistical analysis. Questionnaires that did not meet the necessary conditions were excluded. The variables and data were then coded, unloaded, and the results were tabulated using Excel tables. Statistical analyses were then conducted using the Statistical Package for Social Sciences (SPSS) software. Several tests related to descriptive statistics were performed for the variables related to the characteristics of the research sample, followed by descriptive statistics for the research variables mentioned earlier. Descriptive statistics include frequencies, percentages, mean, standard deviation, and ranking based on the least dispersed or most homogeneous values.

## 4. Results and Discussion

### 4.1. Testing the Validity of the Study Hypotheses:

In this section, the researcher addresses the statistical analysis procedures and methods used to answer the research questions. The results of the statistical analysis of the data include four parts as follows:

4.1.1. Reliability and Validity Testing of Data Collection Tool

Reliability: It refers to the consistency and lack of contradiction in the measurement tool, meaning that it produces the same results when applied to the same sample. The reliability of the study tool can be assessed using Cronbach's Alpha, which ranges from 0 to 1. Where higher value of the coefficient indicates a higher level of reliability.

The study consisted of 6 main dimensions for both Six Sigma and Performance Improvement criteria:

Dimension 1: Performance Improvement, measured using a questionnaire with 10 statements.

Dimension 2: Top Management Support and Commitment, measured using a questionnaire with 10 statements.

Dimension 3: Continuous Improvement, measured using a questionnaire with 10 statements.

Dimension 4: Processes and Systems, measured using a questionnaire with 10 statements.

Dimension 5: Human Resources, measured using a questionnaire with 10 statements.

Validity: It refers to the extent to which the study tool measures what it intends to measure. Validity can be assessed in several ways, including calculating the Self-Validity Coefficient.

Self-Validity Coefficient = Square Root of the Reliability Coefficient

Using SPSS software, Cronbach's Alpha test was conducted to measure the reliability and validity of the study questionnaire.

The reliability test was performed for each dimension. The following is a summary of the program's outputs.

**Table 2:** The reliability and self-validity coefficients for the dimensions of the study

Dimensions	Self-validity Coefficient	Cronbach's Alpha Coefficient	No. of Statements
Performance Improvement	0.789	0.888	10
Support and commitment of top management	0.814	0.902	10
Feedback	0.945	0.972	10
Continuous Improvement	0.882	0.939	10
Processes and Systems	0.891	0.944	10
Human Resources	0.814	0.902	10
Overall questionnaire	0.962	0.981	60

Source: The Researcher from the survey study (2022).

The results presented in Table 2 indicate that the Cronbach's Alpha coefficients for each dimension of the study range from a minimum of 0.888 to a maximum of 0.972. The overall reliability coefficient for the questionnaire, encompassing all dimensions, was found to be 0.981. These values are considered high and satisfactory for the study's objectives, surpassing the minimum acceptable threshold of 0.6 for the Alpha coefficient. Consequently, it can be concluded that the study tool demonstrates internal consistency.

Furthermore, the calculation of the Self-Validity Coefficient for each dimension individually and for all dimensions collectively yielded a value of 0.962 for the entire questionnaire. These values are also notably high and deemed acceptable for the study's purposes.

4.1.2. Characteristics of the Study Sample

In this part, the characteristics of the study sample are presented, such as job position and years of experience. The study included two questions about demographic characteristics.

- Job Position: Employee/Supervisor/Department Head/Manager/Board Chairman
- Years of Experience: Less than 5 years/5 to less than 10 years/10 to less than 15 years/15 to less than 20 years/More than 20 years

Using SPSS software, the study samples were described and categorized based on the demographic variables (Table 3).

Table 3: Distribution of the study sample's characteristics based on demographic variables.

Variable	Class	No.	Percentage
Job Position	Department Head	12	11.32 %
	Supervisor	10	9.4 %
	Employee	78	73.6 %
	Manager	4	4 %
	Board Chairman	2	2 %
Years of Experience	Less than 5 years	17	16%
	5-10 years	28	26 %
	10-15 years	39	37 %
	15-20 years	30	28 %
	More than 20 years	30	28 %

Source: The Researcher from the survey study (2022).

From the table depicted above, one can discern that the preponderance of the respondents, amounting to 28 individuals or 73.6%, hailed from the cohort of employees. Subsequently, department heads trailed closely behind, comprising 12 individuals or 11.32%. Supervisors constituted a group of 10 individuals, whereas managers represented 4 individuals, both equating to 4% of the aggregate. The chairman of the board of directors exhibited the smallest percentage, with 2 individuals or 2%. These findings underscore the predominance of employees among the participants, underscoring the necessity of taking their viewpoints into account. Furthermore, there exists a diversity in the duration of experience among the cohort under examination. The majority share, amounting to 73.6%, pertained to individuals possessing 5 to 10 years of experience, while the minority represented those with less than 5 years of experience.

#### 4.1.3. Descriptive Statistics for Study Variables

This section presents some statistical measures (mean, standard deviation) for the items of each dimension of the study. The study included 6 dimensions, and each dimension was measured using a number of statements in the distributed survey. The following are the SPSS outputs displaying descriptive statistics for each dimension separately.

Dimension One: Improving employee performance, which is measured in the survey using 10 statements.

**Table 4:** Shows the mean and standard deviation of the paragraphs after "Performance Improvement."

Statements	Mean	Standard Deviation	Arrangement
University officials recognize the importance of implementing the Six Sigma methodology as a valuable tool for improving job performance.	3.2708	1.26726	10
Mechanisms are in place to monitor errors that occur in educational processes and correct them in a timely manner.	3.8542	.898930	8
All the necessary material and human resources are available to enhance the quality of operations within the university.	4.2500	.910930	4
The university provides its staff with controls to ensure that performance does not deteriorate after improvement, as well as clarifying the steps for implementing the Six Sigma approach.	4.0625	1.13749	6
The use of Six Sigma methodology helps eliminate unnecessary steps in university operations.	3.9375	.908730	7
Implementing the Six Sigma methodology assists the university in transitioning from an error reduction culture to an error prevention culture.	4.3542	.837670	2
The use of Six Sigma methodology helps in developing internal processes within the university.	4.1250	.605820	5
The university offers training courses to its staff to familiarize them with the Six Sigma methodology and enhance their performance.	3.4167	1.33422	9
Utilizing the Six Sigma methodology helps improve the quality of operations within the university.	4.3750	.788890	1
The Six Sigma methodology becomes an important element for the stability of universities that adopt and implement it.	4.2708	.916510	3

Source: The Researcher from the survey study (2022).

From the previous table, it is evident that most of the surveyed individuals agree with all the items of the first dimension "performance improvement" as indicated by the higher mean values exceeding 3.

Dimension 2: "Support and Commitment of Top Management" was measured in the survey questionnaire using 10 statements as shown in Table 5.

**Table [5]** displays the mean and standard deviation for the items of the "Support and Commitment of Top Management" dimension.

Statements	Mean	Standard Deviation	Arrangement
The university provides specific regulations and policies that outline the performance standards for its staff.	4.3333	0.99645	3
Top management at the university monitors and oversees the implementation of the pre-planned annual plan.	4.1250	0.76144	8
There is a clear strategic plan in place to obtain accreditation for the university's quality.	3.7083	0.98841	10
Top management is committed to delivering high-quality educational services.	4.5000	0.79894	1
Top management addresses employee issues and strives to prevent their recurrence.	4.1458	1.07168	7
Top management aims to reduce deviations in the educational environment.	4.2917	0.92157	5
Top management continuously seeks to develop its internal resources.	4.3125	0.82916	4
The university's management establishes an annual financial plan to expand educational services.	4.2708	0.86884	6
Top management sets educational objectives and strives to achieve them.	4.4583	0.68287	2
Top management possesses clear timelines for implementing continuous improvement processes.	4.0208	0.91068	9

Source: The Researcher from the survey study (2022).

From the previous table, it is evident that most of the sample agrees with all the items of the second dimension: Support and Commitment of Top Management. This is reflected in the higher mean values exceeding 3.  
Dimension 3: The third dimension, "Continuous Improvement," was measured in the survey questionnaire using 10 statements.

**Table [6]** displays the mean and standard deviation for the items of the "Continuous Improvement" dimension.

Statements	Mean	Standard Deviation	Arrangement
The university continuously strives for continuous improvement in job performance.	4.2708	.892990	2
The university identifies and defines the necessary activities for each service.	4.0625	.860630	7
The university streamlines the time required to perform the service.	4.0208	.811870	8
The university works on eliminating any activity that does not add value to the service provided to beneficiaries.	3.9583	.713350	9
Improving services leads to an increase in improving job performance.	4.4792	.743470	1
The university conducts continuous inspection and supervision of services to ensure efficiency and continuous improvement.	4.1875	.959970	5
The university adopts a continuous improvement system in all stages of service delivery.	4.1875	1.00332	4
The college develops a comprehensive plan to improve performance efficiency.	3.9167	1.19988	10
The university relies on continuous improvement as a component of strategic planning.	4.1250	1.16006	6
The university works on improving operational processes in all departments.	4.2292	.994440	3

Source: The Researcher from the survey study (2022).

From the previous table, it is evident that much of the sample agrees with all the items of the third dimension: Continuous Improvement. This is reflected in the higher mean values exceeding 3.  
Dimension -4 is "Processes and Systems," which was measured in the survey questionnaire using 10 statements as shown in Table 7.

**Table 7:** displays the mean and standard deviation for the items of the "Processes and Systems" dimension.

Statements	Mean	Standard Deviation	Arrangement
The university implements systems that contribute to improving job performance.	4.3125	.803090	1
The university works on optimizing time to accomplish tasks.	3.8125	.891000	8
The university studies and analyzes processes, comparing them to competing systems and their performance.	4.1875	1.04487	3
The university conducts continuous inspection and supervision of educational services to ensure educational quality.	4.1875	1.00332	4
The college meets the needs of male and female students through continuous modifications in the educational and administrative processes.	4.2292	.904820	2
The university has an alternative operational plan in case of any malfunction in one of the utilized systems.	4.0417	1.09074	7
The university introduces new methods to enhance its educational process.	4.0833	1.00707	6
The university seeks to obtain short-term and long-term funding sources for scientific research.	3.8125	1.23178	9
The university applies modern processes and systems in organizing its work.	4.1250	1.04423	5
The university aims to eliminate waste and inefficiency in processes within departments and administrations.	3.6458	.956270	10

Source: The Researcher from the survey study (2022).

Data from Table 4 indicates a significant level of agreement on all items related to the fourth dimension, "Processes and Systems." This is reflected in the high mean scores, with most exceeding 3.  
The fifth dimension is "Human Resources," which was measured in the survey questionnaire using 10 statements as shown in Table 8.



**Table 8:** displays the mean and standard deviation for the items of the "Human Resources" dimension.

Statements	Mean	Standard Deviation	Arrangement
The university has a qualified and trained human resource team.	4.5417	.713350	1
The university focuses on developing the capabilities of human resources and familiarizing them with statistical tools used in the Six Sigma methodology and how to utilize them.	3.0000	1.59787	8
The college trains employees on specialized programs in the Six Sigma methodology.	2.7917	1.50118	10
The college motivates employees to use the Six Sigma approach to improve job performance.	2.8333	1.56196	9
The college involves human resources in making appropriate decisions.	3.8333	1.07848	7
The college utilizes available human resources in various ways.	4.0833	.794480	5
The college monitors human resources through regular reports.	4.2500	.91093	2
The college enhances its competitiveness by involving human resources in the formulation of the annual plan.	4.1250	1.14157	3
The Human Resources Department seeks to innovate modern methods to enhance the value and efficiency of college employees.	4.1250	1.10367	4
The Human Resources Department focuses on leveraging their skills and expertise to improve job performance.	4.0000	.989300	6

Source: The Researcher from the survey study (2022).

The previous table shows that most respondents agree with all the statements related to the fifth dimension: Human Resources. This is evident in the higher mean values, all of which are above 3.

## 4.2. Hypothesis Tests of the Study

This section explores the testing of hypotheses established for this study. The analysis results will determine whether to accept or reject each hypothesis.

For examining the relationship between a single independent variable and a dependent variable, researcher employed the Simple Regression method. The significance level (p-value) obtained from the analysis is then compared to a pre-defined level of significance, typically set at 5% (corresponding to a 95% confidence level).

Beyond simple relationships, hypothesis testing gets more nuanced. When the independent variable has only two categories (e.g., gender: male/female), the T-Test is the preferred method. However, if the variable has more than two categories (e.g., job position with multiple levels or years of experience with different ranges), the Analysis of Variance (ANOVA) along with the F-Test becomes the appropriate statistical tool.

### 4.2.1. Main Hypothesis One:

(There is a statistically significant impact of applying the Six Sigma methodology on employee performance in educational institutions).

This main hypothesis branches into a series of sub-hypotheses:

*Sub-hypothesis One:* There is a statistically significant impact of applying the first standard on employee performance in Egyptian and Saudi educational institutions.

The regression model is considered significant and statistically meaningful (the computed significance level, Sig., is less than 0.05). Therefore, the first criterion, top management support and commitment in both educational sectors, has a significant impact on improving employee performance. There is a statistically significant relationship between top management support and commitment and the improvement of employee job performance. The coefficient of simple correlation, R, is 0.995, indicating a very strong relationship between the two variables. Additionally, the coefficient of determination, R<sup>2</sup>, is 0.990, meaning that the independent variable explains 99% of the variance in the dependent variable.

*Sub-hypothesis Two:* There is a statistically significant impact of applying the second standard on employee performance in Egyptian and Saudi educational institutions.

The regression model is found to be statistically significant (computed significance level Sig. < 0.05). This confirms that the second criterion, "feedback in higher education institutions," has a statistically significant impact on improving employee job performance. A strong positive correlation exists between feedback in higher education institutions and employee performance improvement, with a simple correlation coefficient R = 0.989. Additionally, the coefficient of determination R<sup>2</sup> = 0.978 indicates that the independent variable explains 97.8% of the variance in the dependent variable.

*Sub-hypothesis Three:* There is a statistically significant impact of applying the third standard on employee performance in Egyptian and Saudi educational institutions.

The regression model is found to be statistically significant (computed significance level Sig. < 0.05). This confirms that the third criterion, "performance improvement in higher education institutions," has a statistically significant impact on improving employee performance. A strong positive correlation exists between performance improvement in higher education institutions and employee performance improvement, with a simple correlation coefficient R = 0.989. Additionally, the coefficient of determination R<sup>2</sup> = 0.979 indicates that the independent variable explains 97.9% of the variance in the dependent variable.

*Sub-hypothesis Four:* There is a statistically significant impact of applying the fourth standard on employee performance in Egyptian and Saudi educational institutions.

The regression model is found to be statistically significant (computed significance level  $\text{Sig.} < 0.05$ ). This confirms that the fourth criterion, "processes and systems in higher education institutions," has a statistically significant impact on improving employee performance. A strong positive correlation exists between processes and systems in higher education institutions and employee performance improvement, with a simple correlation coefficient  $R = 0.986$ . Additionally, the coefficient of determination  $R^2 = 0.962$  indicates that the independent variable explains 96.2% of the variance in the dependent variable.

*Sub-hypothesis Five:* There is a statistically significant impact of applying the fifth standard on employee performance in Egyptian and Saudi educational institutions.

The regression model is significant and statistically meaningful (the computed significance level  $\text{Sig.}$  is less than 0.05). Therefore, the fifth standard, Human Resources, in higher education institutions has a significant impact on improving employee performance, and there is a statistically significant relationship between the fifth standard in the higher education institutions under study and improving employee performance. The value of the simple correlation coefficient  $R=0.981$  indicates a very strong correlation between them. The coefficient of determination  $R^2=0.962$  means that the independent variable explains 96.2% of the variance in the dependent variable.

#### 4.2.2. Main Hypothesis Two:

There is a statistically significant relationship at the significance level ( $\alpha=0.05$ ) in respondents' answers regarding the Six Sigma methodology due to demographic variables (gender, years of experience, educational degree) at Suez Canal University. However, the results showed that there is no relationship in respondents' answers regarding the Six Sigma methodology attributed to demographic variables (gender, years of experience, educational degree).

*Sub-hypothesis Six:* There is no statistically significant relationship at the significance level ( $\alpha=0.05$ ) in respondents' answers in both educational sectors regarding performance improvement and the Six Sigma methodology according to demographic variables (gender). The result from the T-test indicates this (as the computed significance level is greater than 0.05).

*Sub-hypothesis seven:* There is no statistically significant relationship at the significance level ( $\alpha=0.05$ ) in respondents' answers in both educational sectors regarding employee performance improvement and the first and fifth standards of the Six Sigma methodology according to demographic variables (years of experience). The F-test results indicate this (as the computed significance level is greater than 0.05).

#### 4.2.3. Main hypothesis Three

There is a statistically significant relationship, at a significance level of  $\alpha=0.05$ , in respondents' perceptions of job performance attributed to demographic variables (educational qualification, years of experience, job position) of employees at King Khalid University and Suez Canal University.

*Sub-hypothesis Eight:* There is no statistically significant relationship at the significance level ( $\alpha=0.05$ ) in respondents' answers regarding employee performance improvement and the Six Sigma methodology standards according to demographic variables (job rank), except for the first standard at Suez Canal University and the third standard at King University. The F-test results indicate this (as the computed significance level is greater than 0.05).

#### 4.3. Study Recommendations:

In light of the results, the study recommends that the education sector in universities prioritize the continuous performance evaluation process by implementing regular evaluation and monitoring programs, as well as using approved indicators and metrics in both Egypt and Saudi Arabia. This can be accompanied by enhancing the efficiency of educational services through the utilization of technology in all university systems and services.

Conduct a study on the impact of implementing the Six Sigma methodology in enhancing productivity and its reflection on the quality of educational and research services provided within academic departments.

It is essential to study the role of Six Sigma in achieving competitive advantage in the field of scientific research in universities.

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